PARTICULATE EMISSION TESTING

NAZARETH PLANT

1977

Source category: Portland Cement
Plant name : Lone Star Industries, Inc.
Test date : 10/6 - 10/15/77
Process : dry

Date: 01/15/93
Location: Nazareth, PA
Ref. No.: 12
Basis for process rate : feed/production
Ratio: 1.73

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen ppm
rotary kiln	cylcone ESP	BASED ON FEED RATE							
		filt. PM	1	4.06	54.9	0.0370	0.0740		
		filt. PM	2	11.08	57.4	0.0965	0.1930		
		filt. PM	3	5.28	55.1	0.0479	0.0958		
					average	0.0605	0.121	Rating:	B
		con. inorg. PM	1	11.08	54.9	0.101	0.202		
		con. inorg. PM	2	8.23	57.4	0.0717	0.143		
		con. inorg. PM	3	6.29	55.1	0.0571	0.114		
					average	0.0766	0.153	Rating:	B
		BASED ON CLINKER PRODUCTION RATE							
		filt. PM	1	4.06	31.9	0.0636	0.127		
		filt. PM	2	11.08	33.2	0.167	0.334		
		filt. PM	3	5.28	31.9	0.0828	0.166		
					average	0.104	0.209	Rating:	B
		con. inorg. PM	1	11.08	31.9	0.174	0.347		
		con. inorg. PM	2	8.23	33.2	0.124	0.248		
		con. inorg. PM	3	6.29	31.9	0.0986	0.197		
					average	0.132	0.264	Rating:	B
		BASED ON FEED RATE							
		filt. PM	1	9.85	62.9	0.0783	0.157		
		filt. PM	2	31.77	59.8	0.266	0.531		
		filt. PM	3	8.68	62.6	0.0693	0.139		
					average	0.138	0.276	Rating:	B
		con. inorg. PM	1	25.71	62.9	0.204	0.409		
		con. inorg. PM	2	12.9	59.8	0.108	0.216		
		con. inorg. PM	3	50.04	62.6	0.400	0.799		
					average	0.237	0.475	Rating:	B
		BASED ON CLINKER PRODUCTION RATE							
		filt. PM	1	9.85	36.5	0.135	0.270		
		filt. PM	2	31.77	34.7	0.458	0.916		
		filt. PM	3	8.68	36.4	0.119	0.238		
					average	0.237	0.475	Rating:	B
		con. inorg. PM	1	25.71	36.5	0.352	0.704		
		con. inorg. PM	2	12.9	34.7	0.186	0.372		
		con. inorg. PM	3	50.04	36.4	0.687	1.37		
					average	0.408	0.817	Rating:	B

Lone Star Industries, Inc.

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen ppm
rotary kiln	cylcone ESP	BASED ON FEED RATE							
		SOx	1	1017.4	66.3	7.67	15.3		
		SOx	2	858.2	68	6.31	12.6		
		SOx	3	1010.5	67.4	7.50	15.0		
		SOx	4	1094.4	67.54	8.10	16.2		
		SOx	5	895.1	68.4	6.54	13.1		
		SOx	6	1080.9	62.9	8.59	17.2		
		SOx	7	1104.1	59.8	9.23	18.5		
		SOx	8	1118.3	62.6	8.93	17.9		
					average	7.86	15.7		
		SOx	1	1038.9	54.9	9.46	18.9		
		SOx	2	882.8	57.4	7.69	15.4		
		SOx	3	902.3	56	8.06	16.1		
		SOx	4	749.9	54.78	6.84	13.7		
					average	8.01	16.0		
		BASED ON CLINKER PRODUCTION RATE							
		SOx	1	1017.4	38.5	13.2	26.4		
		SOx	2	858.2	39.3	10.9	21.8		
		SOx	3	1010.5	39.1	12.9	25.8		
		SOx	4	1094.4	39.1	14.0	28.0		
		SOx	5	895.1	39.9	11.2	22.4		
		SOx	6	1080.9	36.5	14.8	29.6		
		SOx	7	1104.1	34.7	15.9	31.8		
		SOx	8	1118.3	36.4	15.4	30.7		
					average	13.5	27.1		
		SOx	1	1038.9	31.9	16.3	32.6		
		SOx	2	882.8	33.2	13.3	26.6		
		SOx	3	902.3	32.5	13.9	27.8		
		SOx	4	749.9	31.8	11.8	23.6		
					average	13.8	27.6		

COAL 2.84% S

SUMMARY

PLANT: LONE STAR - NAZARETH

LOCATION: NAZARETH PENNA

TEST/IDENTIFICATION CTR-PA-4973 DATE: OCTOBER-1977

TESTING BY: LONE STAR - MARTIN ENVIRONMENTAL TESTING LAB

KILN/COOLER NO. 2&3 COMBINED

			PERFORMANCE		ALLOWABLE
Kiln Production	Ton/Hr.	.....	359	@ 1.721 K.F. Factor	
Kiln Feed Rate	Ton/Hr.	.....	618		
Fuel Rate (Coal)	Ton/Hr.	.....	8.3	@ 12750 BTU/lb.	
" " (Oil)	Gal/Hr.	.....			
Fuel Ash	%	.....	13.3		
Fuel Sulphur	%	.....	2.80	@ 0.15 Kiln Feed S.	
KILN (Srack)					
Exhaust Gas Flow	DSCFM	.....	120,200		
Part. Concen.	lb/SCF	.....	0.00 0028		
Emissi			1.26 / 36		43/18.6
SOX (I					
(Conc			926		
Emiss			6.8 / 1038.2		0.5 / 18.5
Emiss					
NOX (					
(Conc					
Emiss					
COOLI					
Exha					
Part					
Emis					

Reference 25 * 10/77

(4) Coal-fired dry kilns w/ Multiclone + ESP

Method 5 tests +

SO_2 tests

No calib. data.

Rating: B

REMARKS:

SUMMARY

PLANT: LONE STAR - NAZARETH

LOCATION: NAZARETH PENNA

TEST/IDENTIFICATION CTR-PA-4973 DATE: OCTOBER-1977

TESTING BY: LONE STAR - MOBILE ENVIRONMENTAL TESTING LAB

KILN/COOLER NO. 4 & 5 COMBINED

			PERFORMANCE	
Kiln Production	Ton/Hr.	.....	324	@ 1.721 K.F. Factor
Kiln Feed Rate	Ton/Hr.	.....	558	
Fuel Rate (Coal)	Ton/Hr.	.....	6.5	@ 12,751 BTU/lb.
" " (Oil)	Gal/Hr.	.....		
Fuel Ash	%	.....	13.3	
Fuel Sulphur	%	.....	2.80	2.15 Kiln Feed S.
KILN (Stack)				ALLOWABLE
Exhaust Gas Flow	DSCFM	.....	94,450	
Part. Concen.	lb/SCF	.....	0.000001	
Emission Rate	lb/Ton/4	.....	0.1 / 16.8	0.3 / 16.7
SOX (Kiln) (Concentration)	PPM	.....	952	
Emission Rate	lb/Ton/4	.....	16.0 / 893.6	0.3 / 16.7
Emission Rate	lb/MMBTU	.....		
NOX (Kiln) (Concentration)	PPM	.....		
Emission Rate	lb/Ton	.....		
COOLER (Stack)				
Exhaust Gas Flow	DSCFM	.....		
Part. Concen.	lb/SCF	.....		
Emission Rate	lb/Ton	.....		

REMARKS:

PARTICULATE EMISSION TESTING

NAZARETH PLANT

1977

Interoffice Memo

LONE STAR INDUSTRIES, INC.

P. O. Box 2148, Houston, Texas 77001

Originating Office: Central Research Laboratory

Date: January 13, 1978

BUSINESS CONFIDENTIAL

TO: T. L. Mendez

FROM: W. W. Hurst

SUBJECT: Particulate Emission Testing - Nazareth, Penna. Plant

During the period of October 6 thru October 15, 1977 , particulate emission tests were conducted at the Nazareth, Penna. Plant. The survey included 3 runs on the North Stack serving Kiln Systems 2 and 3; and 3 runs on the South Stack serving Kiln Systems 4 and 5.

Tests were conducted in accordance with EPA Methods 1 - 5 for Stationary Sources as outlined in Fed. Register, Vol. 35, No. 247, dated December 23, 1971 or as amended June 8, 1976.

Objective:

To determine the normal level of stack particulate emissions.

Results showed:

1. Normal stack particulate emissions for the North Stack serving the Nos. 2 and 3 Kiln Systems averaged 46.3 lbs/hr., whereas the allowable per the Penna. Rule was 52.9 lbs/hr. at the production level during the testing program.

2. Normal stack particulate emissions for the South Stack serving the Nos. 4 and 5 Kiln Systems averaged 15.4 lbs/hr., whereas the allowable per the Penna. Rule was 50.5 lbs/hr. at the production level during the testing program.

3. On the basis of a total stack emission of 61.7 lbs/hr. this represents a value of less than 60 % of the allowable emission rate of 103.1 lbs/hr.

4. Prior to the stack emission program in-house precipitator efficiency tests were conducted during the period of August 27 and September 14, 1977. The results of the 16 tests showed the average precipitator collector efficiency @ 99.0 % $\pm$ 0.6 %.

Note: In 1956 the precipitators went into service with a specific guaranteed efficiency of 98.0 % with a residual grain loading of 0.05 grains/cu. ft. at a gas volume of 60,000 CFM @ 70 deg. F. Tests were then conducted and accepted according to the ASME Standard Method.

5. During the emission test program of October 6 thru October 15, 1977, the precipitator unit volume averaged 60,600 CFM @ 70 deg. F. with an exhaust grain loading of 0.03 grains/SCF.

Test procedures during this period were conducted by EPA Methods 1 - 5 and the total emission included the impinger catch.

Note: On the basis of the normal EPA requirement (without the impinger catch) the emission level showed 16.6 lbs/hr. instead of 46.3 lbs/hr. for the North Stack (Nos. 2 and 3 Kilns); and the emission level showed 6.8 lbs/hr. instead of 15.4 lbs/hr. for the South Stack (nos. 4 and 5 Kilns).

6. Isokinetic sampling during the emission test program averaged 92.6 % plus or minus 5 %.

7. The attached Tabulation outlines the salient data for the stack emission program.

Respectfully submitted

W. W. Hurst, P.E.

WWH/ssf

Encl.

NAZARETH, PENNA PLANT

CONSOLIDATED SUMMARY - PARTICULATE EMISSIONS
PERIOD OF OCTOBER 6 thru OCTOBER 15, 1977

TEST LOCATION	PARTICULATE EMISSION RATE lbs/Hr. Probe Catch	Impinger Catch	Total Catch	gr/SCF Total Catch	KILN FEED RATE T/H	COAL RATE T/H	VOLUME ACFM	TEMP Deg.F.	ISOKINETIC %
NORTH STACK Total / Avg	16.6	29.7	46.3	0.045	61.8	8.3	213,400	365	89.5
No. 2 Kiln					29.8	4.1			
No. 3 Kiln					32.0	4.2			
SOUTH STACK Total / Avg	6.8	8.6	15.4	0.019	55.8	6.5	165,300	373	95.8
No. 4 Kiln					28.6	3.3			
No. 5 Kiln					27.2	3.2			
PLANT TOTAL	23.4	38.3	61.7	0.032	117.6	14.8	378,700	369	92.6

W. W. Hurst 1/13/78

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I. INTRODUCTION

Stack emission tests were performed on the Nazareth Stacks during the period of October 6 thru 15, 1977.

Since 1972 measures have been taken to restrict the amount of infiltrated air and the cooling air blended with the combustion gases from the processing system. Two main approaches have been used. (1) Installation of air seals at the feed-end of the kiln where none had been positioned, and 2 (2) Introduction of water vapor in the kiln exhaust system so as to improve the conditioning of the gases for better electrostatic efficiency. These modifications were intended to reduce the total throughput of gases in the precipitator and thus lower the particulate emissions from the stack.

In order to evaluate the present status of the emissions, in the light of the process improvements the emission tests were conducted during the period noted above.

The purpose of this report is to present the test data and evaluate the results with regard to the present source standards as defined by the Commonwealth of Pennsylvania and/or the Environmental Protection Agency.

The report is divided into major sections as follows: (1) Current regulations are discussed, (2) Process parameters and operating equipment are established, (3) Test equipment and procedures are described, (4) Test program results are discussed and compared with allowable limits. and (5) Conclusions are stated.

II REGULATIONS

PA ALLOWABLE

Source standards for stack particulate emissions applicable to the Nazareth plant are covered by the Commonwealth of Pennsylvania Environmental Quality Board Regulation Title 25 - Rules and Regulations, Department of Environmental Resources, Chapter 123 - Standards for Contaminants, Particulate Matter Emissions.

In accordance with Pennsylvania, Regulation 123:13 covering "Processes", a formula is given to determine particulate emission allowable rates. In addition to the "Formula" allowable, the particulate concentration in the effluent gas can be calculated as a basis for allowable. The effluent gas concentration allowable is based on the gas volume whereas the emission rate is based on the dry solids feed to the process. The effluent gas concentration allowable is not to exceed 0.02 grains/dry std. cu. ft. We are allowed whichever is the greater amount of emissions as calculated by both methods.

(A) Formula Method

(a) Table 1 shows we are allowed a "process factor" of 150 lbs/ton of dry solid feed. (See Item 25 for Portland Cement Mfg - Clinker Production.)

(b) Rate of emission formula -

$$A = 0.76\ E^{0.42}$$

where A = Allowable Particulate Emissions in lbs/hr.

E = Emission Index = F x W in lbs/hr.

F = Process Factor in lbs/Ton

W = Dry Solid Feed Rate in Ton/Hr.

Since the Kilns Nos. 2 and 3 average 29.8 T/H and 32.0 T/H respectively and the Kilns Nos. 4 and 5 average 28.6 T/H and 27.2 T/H respectively, it follows:

Kiln 2 = 150 x 29.8 = 4470 lbs/hr. (Emission Index)
Kiln 3 = 150 x 32.0 = 4800 lbs/hr. " "
Kiln 4 = 150 x 28.6 = 4290 lbs/hr. " "
Kiln 5 = 150 x 27.0 = 4080 lbs/hr. " "

Therefore A (Allowable) = $0.76\ E^{0.42}$

Kiln 2 = $0.76 \times 4470^{0.42}$ = 25.9 lbs/hr.
Kiln 3 = $0.76 \times 4800^{0.42}$ = 26.7 lbs/hr.
Kiln 4 = $0.76 \times 4290^{0.42}$ = 25.5 lbs/hr.
Kiln 5 = $0.76 \times 4080^{0.42}$ = 25.0 lbs/hr.

Accordingly, a combination of exit emission levels from the No. 2 and 3 Kiln systems that enter the North Stack would be 52.6 lbs/hr.; and a combination of the exit emission levels from the No. 4 and 5 Kiln systems that enter the South Stack would be 50.5 lbs/hr . Therefore the allowable total emission level would be 103.1 lbs/hr.

B. Effluent Gas Concentration Method

$$\text{Allowable} = \frac{0.02 \times \text{CFH (std \& Dry)}}{7000} = \text{lbs/hr.}$$

$$= \frac{0.02 \times 6{,}4000{,}000}{7000} = 18.3 \text{ lbs/hr.}$$

Obviously, the "Process Method" gives the maximum allowable so that it should prevail.

III OPERATING EQUIPMENT and PROCESS PARAMETERS

The Commonwealth of Pennsylvania Regulations explicitly designates in Chapter 139, Sampling and Testing, rather extensive data concerning process parameters, testing equipment details and sampling procedures. Most state regulations do not require detailed data in these catagories. Accordingly, process parameters and operating equipment specifications along with testing equipment and procedures are detailed in this section of the report.

Four medium size, dry process Portland cement kilns are operated - each with its own flue transporting ducts, gas conditioning equipment and dust abatement equipment - with the cleaned and cooled flue gases fed to two concrete, brick lined stacks for waste gas dissemination. The Nos. 2 and 3 kilns discharge gases into the North Stack while the Nos. 4 and 5 kilns discharge gases into the South Stack. Actually there is no No. 1 kiln but space has been provided for installation of this addition if and when business conditions indicate this installation would be warrented.

Flue gases leave each of the kilns at 1100 - 1200 deg. F. with gas conditioning consisting of both water and ambient air in proper proportions to provide suitably tempered gas entering each of the respective precipitators at around 600 deg. F. with 10 - 15 % moisture vapor. The attached copies of the design drawings shows the general layout and some of the specific details of the installation.

The dust abatement equipment was installed in 1956 using facilities that were designed and supplied by the Research Cottrell, Inc. Each collector consists of 3 sections. The front or entrance section is a mechanical collector known as a "Cyclotrell" with a complement of 30 - 24" dia, cyclone type collectors. The intermediate and the larger last sections are electrostatic and referred to as "Opzel" plate sections. The plate area is 26,000 sq. ft. with 17,350 ft. of discharge electrode wires. The rated gas processing load is 120,000 CFM @ 600 deg. F. which results in a throughput velocity of 5.17 ft./sec. and a resident time period of 4.15 seconds. The unit guaranteed efficiency in 1956 was at least 98 % collection with no greater input load than 2.5 grains/ cu. ft. which has been calculated to be less than 0.05 grains/ cu. ft. for the processed exit gases.

Stack discharge location is 230 ft. above foundation @ 467 ft. above sea level. Test ports are located 111 ft. above the foundation at which point the internal stack diameter is 11'-0". Each stack has two - 4" dia, test ports placed at 90 deg. apart and in the same elevation plane. At the 111 ft. elevation the ports are 4.6 flue diameters above the inlet ducts of the system exhaust fans and 10.8 flue diameters between the test ports and the top of the stack. The attached sketch, Fig. 1 shows the basic details of this configuration. Accordingly the critical dimension with respect to duct disturbance is the 4.6 flue diameter factor between the gas inlet and the sampling port location.

Using EPA chart - flue diameters vs. test point at traverse - we estimate the stack traverse should have 48 test points with the locations shown per the attached Sketch, Fig. 2.

A complete listing of process conditions during each source test is tabulated. Table 2 shows the raw mix feed rate, fuel rate, clinker dust rate and precipitator dust rate. Also, flue gas characteristics including velocity, pressure, temperature, moisture density and chemical analysis (CO_2, O_2, CO, and N_2) are tabulated in Tables 3 - 6. Additionally, note chemical analyses of fuel, raw mix, clinker, clinker dust and precipitator dust (Table 7).

IV TEST EQUIPMENT and TESTING PROCEDURES

The Sampling Train used for source testing is basically a Model AP-5000 "Stac-O-Lator" manufactured by Scientific Glass and Instruments, Inc. of Houston and has been approved by EPA. The impinger type and charge is in accordance with EPA recommendations except we use somewhat more silica gel than EPA suggests so as to be sure of absorbing all of the water vapor generated during the process. The glass fiber filters are 4" Gelman, Type A, with a retention factor of 99.7 % @ 0.3 micron particle size.

We use the EPA sampling procedure as modified to meet the Commonwealth of Pennsylvania requirements. Each test was 2 to 3 hours long with sampling rate of approximately 0.5 CFM (dry gas basis). Each of the tests gathered well over 50 cu. ft. of the source gases. Some of the precipitator efficiency tests were performed using a modified EPA induct filter on the inlet side of the precipitator due to the heavy dust concentration. The sampling train was leak checked at the start and at the end of each run at about 17 " Hg. rather than at 15 " Hg. as required by EPA. Our control valves are at equilibrium with the pump at 17 " Hg. rather than at 15 " Hg.

Both stainless stell and stainless steel-teflon lined heated probes were used for the stack testing. Probes were thoroughly washed with Acetone following each test with the nozzle removed. Reassembled clean probes were leak checked @ 25 " Hg. vacumm with no noticable leaks tolerated. A shorter probe, used for the testing on the discharge side of the precipitator was glass lined. Probes have been modified for proper spacing of nozzle vs. pitot tube in accordance with EPA recent change (August, 1977).

We operate out of a 30 ft. mobile laboratory so that all sample recovery, such as weighing, evaporating and washing is done within the air-conditioned mobile laboratory.

Laboratory analyses are performed strictly in accordance with EPA recommendations. Our analytical balance for weighing filters and beakers is a Mettler H-6. Our impinger weighing balance is a Mettler P-1200. We use 4 large desiccators for storing and keeping filters and beakers at constant weight. We generally run blanks on each Acetone and distilled water lot but seldom find enough residue for significant modification of results. For the record, our current Acetone residue per 500 ml. is 0.4 mg. and our distilled water residue is 1.9 mg. per 500 ml.

We use two Thermo-Electric digital thermocouple indicators, Model ELPA with 1 deg. accuracy. The indicators are electrically connected through switching circuitry to a Thermo-Electric "Minimite" which is used to calibrate the temperature range of interest per test. The "Minimite" has an accuracy of $\pm$ 1/4 %. Calibration of thermocouple indicators occurs at the beginning of each plant run and more often if it seems necessary or a significant change occurs in the range of testing interest.

Four dry test Rockwell meters are calibrated at the start of each plant test. Part of the mobile laboratory equipment includes a Precision Wet Test Meter, Serial No. AA-9 which is used to standardize the dry test meters. The wet test meter is calibrated annually by equipment traceable to the Bureau of Standards.

The orifice used for "ΔH" readings is calibrated at random whenever the "ΔH" vs. CFM calibration charts show significant variation.

We use a L & N Analyzer for continuous monitoring of CO_2, O_2 and CO for each test run. Additionally, near the middle of each run we grab a sample for Orsat Analysis. Agreement of L & N with Orsat is good since we use the Orsat to calibrate the L & N with respect to CO_2 and O_2. However, CO is calibrated with "Span Gas" of approx. 0.15 % CO in Nitrogen.

V. DISCUSSION OF TEST RESULTS

The stacks at Nazareth are about average size (diameter) at the test ports but complicated to test since they possess only 2 test ports @ 90 deg. spacing. Technically, this met all of the requirements for the proper transverses but practically this also meant the probe length had to be 15 feet long. If the usual 4 ports had been available, the work could have been done with the 6 feet probes. The longest probe that we had immediately available was 10 feet long so we improvised and added a 5 foot extension. This modification, though difficult to handle, to our knowledge was legitimate; and seemed to do the job in an acceptable manner.

The State of Pennsylvania is one of the few states that require the impinger catch as part of the total particulate emissions. (EPA excludes the impinger catch). This being the case, every effort was extended to minimize the accumulations of impinger solids after the water was evaporated. Sometimes, the impinger catch represented a substantial portion of the total catch. The Nazareth impinger catch showed some carbon residue and this condition has also been shown in other test programs.

A question may develop as to why we did not use a glass liner in the probe. With the 15 foot probe we found that bending was so great so that glass liners would break as fast as they could be installed.

Since the stack temperature was under 500 deg. F., other options became available. We were able to obtain a new probe - 15 feet in length - with a teflon liner.

In order to satisfy ourselves the teflon liner would give us acceptable results we conducted a separate investigation to determine the filter catch under two conditions of the teflon liner versus the stainless steel pipe and found values of 0.0431 to 0.1426 grams for the teflon liner versus values of 0.0413 to 0.1867 grams for the stainless steel pipe. Since these values were within the limits of experimental error - depending on the kiln condition at the time of test we concluded the teflon liner would do an acceptable job.

The question of using the teflon probe had been presented to the EPA in their request for Public Comment of June 8, 1976 covering Proposed Revisions to Reference Methods 1 - 8 in Appendix A of Standards of Performance for New Stationary Sources. A reponse to that question was presented by EPA to the effect that " --- Teflon may be an acceptable material but must be evaluated on a case-by case basis --- ". In view of that investigation as noted by the results outlined above we believe the test results are entirely valid based on the use of the teflon lined probe in this study.

VI. CONCLUSIONS

Particulate emission levels from each stack were well within the limits permitted by Pennsylvania Enivironmental Quality Board Regulations.

All Electrostatic precipitators and mechanical dust abatement equipment associated with each kiln exhaust system were performing effectively at about 99.0 % efficiency which meets , if not exceeds, the performance guarantee for the equipment purchased in 1956.

TABLE 1

NAZARETH STACK EMISSION SURVEY

PARTICULATE EMISSION RATE

1977

Run No.	Date	Exhaust Gas Temp. °F	Exhaust Gas Volume ACFM	Particulate Emission Rate Grains/ SCF Dry	Particulate Emission Rate Lbs/SCF Dryx10^{-6}	Particulate Emission Rate Lbs/Hr
@ South Stack :						
PA-77-10-6	10-6	366	160,700	0.0189	2.70	15.14
PA-77-10-7	10-7	380	166,900	0.0246	3.51	19.41
PA-77-10-15	10-15	372	168,200	0.0148	2.12	11.57
Ave.		373	165,300	0.0194	2.78	15.37
@ North Stack :						
PA-77-10-10	10-10	363	211,200	0.0352	5.03	35.56
PA-77-10-11	10-11	370	219,100	0.0424	6.05	44.67
PA-77-10-12	10-12	361	209,900	0.0575	8.22	58.72
Ave.		365	213,400	0.0450	6.43	46.32

TABLE 2

NAZARETH STACK EMISSION SURVEY

PROCESS RATES, CONSUMPTION AND PRODUCTION

1977

Run No.	Date	Kiln No.	Coal * Fuel Rate T/Hr	Kiln Feed T/Hr	Clinker Produced T/Hr	Clinker Dust T/Hr	Precip.& Multiclone Dust T/Hr
PA/6	10-6	4	3.1	27.6	16.0	---	---
		5	3.1	27.3	15.9	---	---
PA/7	10-7	4	3.3	29.9	17.3	0.2	0.2
		5	3.3	27.5	15.9	0.2	0.2
PA/15	10-15	4	3.4	28.3	16.4	---	---
		5	3.2	26.8	15.5	---	---
Ave. Kiln # 4			3.3	28.6	16.6		
Ave. Kiln # 5			3.2	27.2	15.8		
PA/10	10-10	2	4.2	30.0	17.4	0.1	---
		3	4.6	32.9	19.1	0.2	---
PA/11	10-11	2	4.1	29.3	17.0	0.1	2.0
		3	4.0	30.5	17.7	0.2	1.0
PA/12	10-12	2	4.0	30.1	17.5	0.1	2.2
		3	3.9	32.5	18.9	0.2	1.1
Ave. Kiln # 2			4.1	29.8	17.3		
Ave. Kiln # 3			4.2	32.0	18.6		

*Coal Mill Feed Moisture (Ave.) for PA/6,7,15 was 5.0%
" " " " " for PA/10,11,12 was 7.0%

TABLE 3

NAZARETH STACK EMISSION SURVEY

EXHAUST GAS CHARACTERISTICS

1977

Run No.	Pitot Tube Factor	Temp. ^{o}R T_s	% Water in Gas	Wet Gas Density Lbs/Lb-Mole	Stack Gas Press. "Hg	Stack Static Press. "H_2O
PA/6	0.84	826	8.2	28.99	29.58	-0.64
PA/7	"	840	12.0	28.50	29.80	-0.64
PA/15	"	832	13.0	28.36	29.19	-0.68
PA/10	"	823	12.1	28.34	29.49	-0.68
PA/11	"	830	11.2	28.48	29.65	-0.60
PA/12	"	821	11.2	28.48	29.63	-0.64

TABLE 4

NAZARETH STACK EMISSION SURVEY

EXHAUST GAS FLOW RATE

1977

Run No.	Stack Area Sq.Ft.	$\sqrt{\Delta P}$ "H_2O	Velocity Ft/Sec	Volume ACFM	Volume CFH (Dry) @ Stand. Cond. x 10^6
PA/6	95.0	0.40	28.19	160,700	5.608
PA/7	"	0.41	29.28	166,900	5.532
PA/15	"	0.41	29.52	168,200	5.452
PA/10	"	0.52	37.06	211,200	7.064
PA/11	"	0.54	38.44	219,100	7.379
PA/12	"	0.52	36.83	209,900	7.143
					7.15

TABLE 5

NAZARETH STACK EMISSION SURVEY

GAS SAMPLING AND TESTING PARAMETERS

1977

Run No.	Nozzle Size Sq.Ft.	Test Duration Min.	Δ H Meter Press. "H_2O	Sample Volume @ Meter Cond. Cu.Ft.Dry	Sample Volume @ Stand. Cond. Cu.Ft.Dry	% Isokinetic
PA/6	.000325	192	0.21	58.01	57.35	93.4
PA/7	"	"	0.21	58.37	58.13	96.0
PA/15	"	"	0.22	59.70	58.37	98.0
PA/10	"	"	0.29	68.85	68.01	88.0
PA/11	"	"	0.33	73.39	72.86	90.2
PA/12	"	"	0.32	71.30	70.63	90.3

TABLE 6

NAZARETH STACK EMISSION SURVEY

GAS ANALYSIS

1977

Run No.	Date	Gas Composition - % @ Sampling Ports		
		CO_2	O_2	N_2
PA/6	10-6	8.6	15.0	76.4
PA/7	10-7	8.4	14.6	77.0
PA/15	10-15	8.2	15.0	76.8
PA/10	10-10	7.2	15.2	77.6
PA/11	10-11	7.6	14.6	77.8
PA/12	10-12	7.5	15.1	77.4

TABLE 7

NAZARETH STACK EMISSION SURVEY

CHEMICAL ANALYSIS

1977

Composite Analyses	Kiln Feed	Clinker	Clinker Dust	Precipitator Dust	Multiclone Dust
SiO_2	13.81	21.36	21.91	15.69	17.20
Al_2O_3	3.24	5.08	3.88	6.80	6.75
Fe_2O_3	1.52	2.86	2.45	3.77	4.38
CaO	43.76	66.82	67.98	42.55	48.47
MgO	1.86	2.79	2.52	1.16	1.65
SO_3	0.31	0.33	0.31	13.41	7.66
Na_2O	0.06	0.10	0.10	0.35	0.30
K_2O	0.52	0.51	0.40	7.52	3.94
Loss	34.92	0.15	0.45	8.75	9.65
Total	100	100	100	100	100

TABLE 8

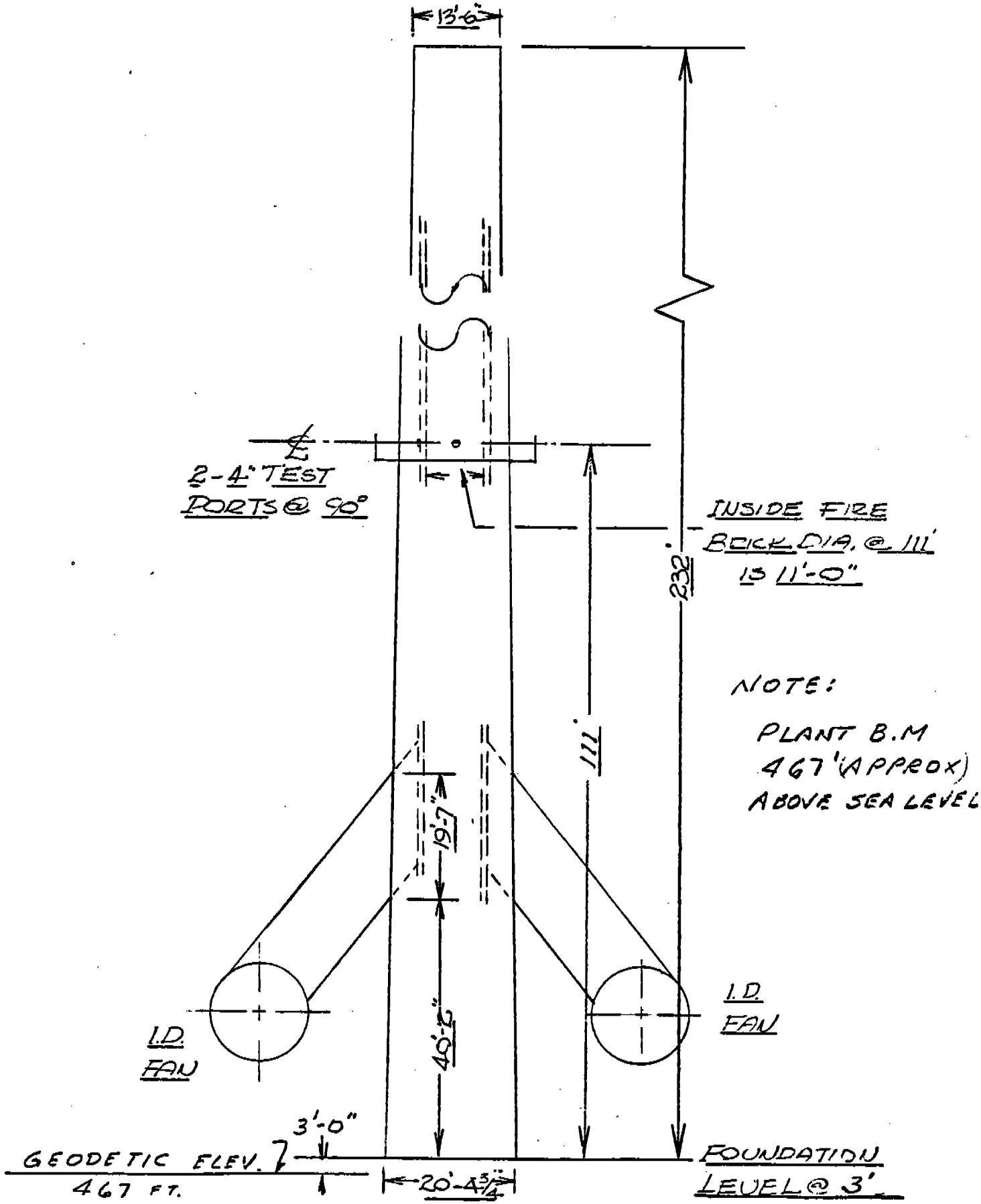
NAZARETH STACK EMISSION SURVEY

METEOROLOGICAL CONDITIONS

1977

Run No.	Relative Humidity	Ambient Temp. ^{o}F	Barometric Pressure, "Hg
PA/6	80	61	29.63
PA/7	65	48	29.85
PA/15	80	47	29.24
PA/10	74	56	29.54
PA/11	75	47	29.69
PA/12	56	50	29.68

FIG. 1

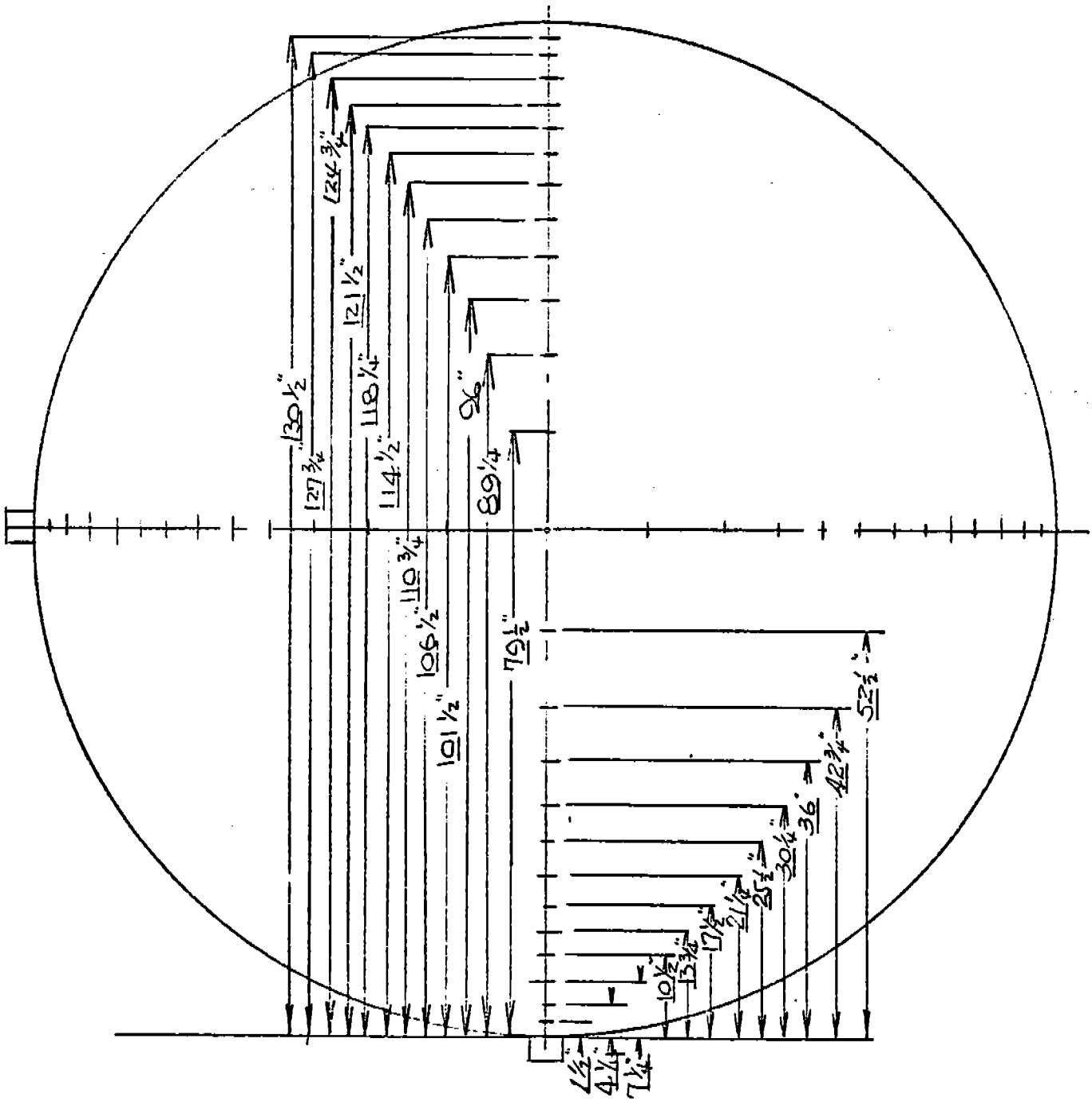


NAZARETH STACKS

FIG. 2

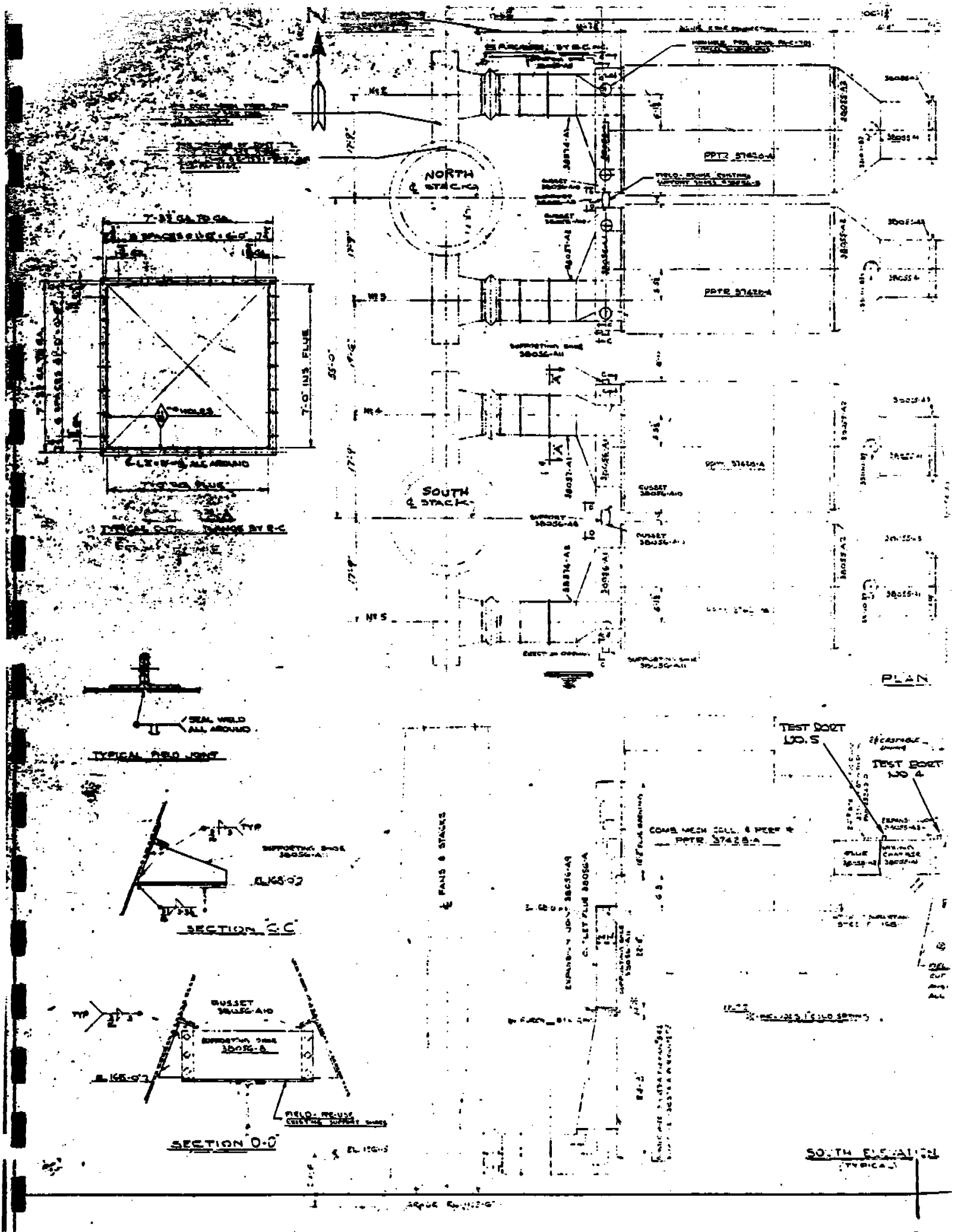
NAZARETH EMISSION SURVEY

STACK SAMPLING TRAVERSE POINTS



PLAN VIEW

SAMPLING LOCATIONS
CROSS SECTIONAL AREA - 95 SQ.FT.


NORTH
STACK
SOUTH
STACK
PLAN
SEAL WELD
ALL AROUND
TYPICAL PIPE JOINT
SECTION C-C
SECTION D-D
TEST DOOR
NO. 5
TEST DOOR
NO. 4
FANS & STACKS
SOUTH ELEVATION
(TYPICAL)

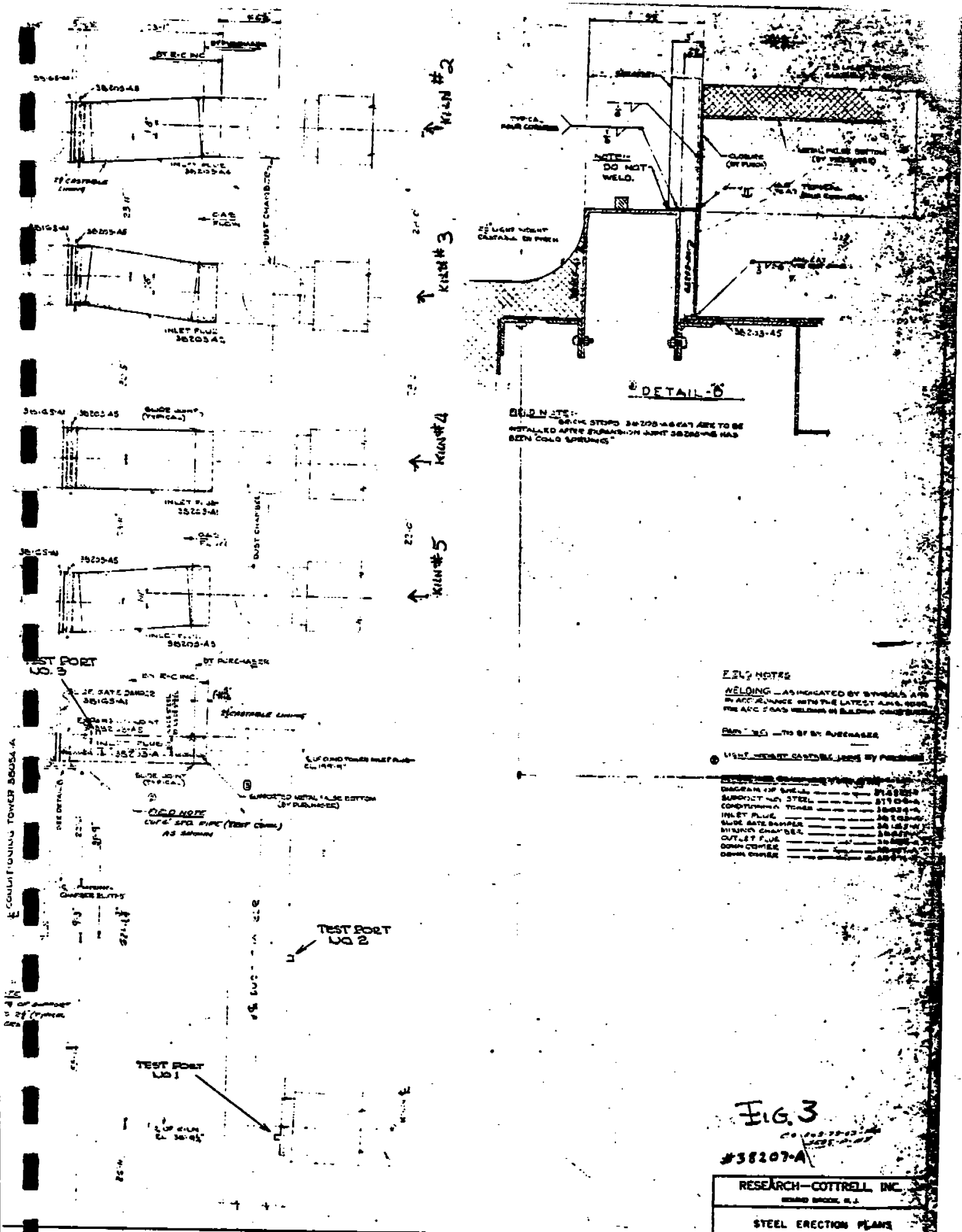


FIG. 3

#38207-A

RESEARCH—COTTRELL INC.

STEEL ERECTION PLANS

PERFORATED PLATE PRECIPITATOR - CONDITIONING TOWER ARRANGEMENT

APPENDIX

SAMPLE CALCULATION FOR STACK RUN PA/6

NOMENCLATURE

A_n	-	Cross-sectional area of sample nozzle, sq. ft.
A	-	Cross-sectional area of stack, $ft.^3$
B_{wo}	-	Proportion by volume of water vapor in the gas stream, dimensionless
C_p	-	Pitot tube coefficient, dimensionless
$C_{p\ std.}$	-	Pitot tube coef. of standard type tube @ .99
$C_{p\ test}$	-	Pitot tube coefficient of type "S" pitot tube
c'_s	-	Concentration of particulate matter in stack gas, gr./s.c.f. dry basis
c_s	-	Concentration of particulate matter in stack gas, lb/s.c.f.
D_s	-	Inside diameter of stack at sample port, Ft.
E	-	Particulate emission rate
ΔH	-	Average pressure drop across the orifice meter, inches H_2O
I	-	Percent of Iso-Kinetic sampling. Test acceptable between 90% - I - 110%
K_p	-	$85.48 \frac{ft.}{sec.} \frac{lbs.}{lb\text{-}mole\ ^\circ R}$
M_d	-	Dry molecular weight of stack gas
M_{H_2O}	-	Molecular weight of water, 18 lb/lb-mole
M_s	-	Molecular weight of stack gas (wet basis) lbs/lb-mole $M_d\ (1-B_{wo}) + 18\ B_{wo}$
M_n	-	Total amount of particule matter collected, mg.
P_{bar}	-	Barometric pressure at the orifice meter, inches Hg.
$P_{std.}$	-	Absolute pressure at standard conditions, 29.92 inches Hg.
P_s	-	Absolute stack gas pressure, inches Hg.

$\Delta P_{std.}$	-	Velocity head measured by standard type pitot tube
ΔP_{test}	-	Velocity head measured by type "S" pitot tube
$\sqrt{\Delta p}_{ave.}$	-	Ave. velocity head of stack gas, inches H_2O
Q_s	-	Volumetric flow rate, dry basis, standard conditions, $ft.^3/hr.$
R	-	Ideal gas constant
°R	-	Degrees of temperature, Rankin (F+460)
ρH_2O	-	Density of water, 1 gm./ml.
$(T_s)_{ave}$	-	Average absolute stack gas temperature, °R
$T_{std.}$	-	Absolute temperature at standard conditions, 530°R
T_m	-	Average dry gas meter temperature, °R
Θ	-	Total sampling time, min.
$V_{m\ std.}$	-	Volume of gas sample through the dry gas meter (standard conditions), cu. ft.
$V_{s\ (ave)}$	-	Stack gas velocity, feet per second (f.p.s.)
V_m	-	Volume of gas sample through the dry gas meter (meter conditions) cu. ft.
V_{ic}	-	Total volume of liquid collected in impingers and silica gel
17.71	-	°R per inch. Hg @ std. cond. of 530 & 29.92
24.1	-	Liters water per gram-mole
28.3	-	Liters dry air per cu. ft.
1.667	-	100/60 min/sec
13.6	-	Specific gravity of mercury
$2.205X10^{-6}$	-	mg/lb.
0.0154	-	Grains per mg.

1. Velocity of Stack Gas

$$V_{s\ ave.} = K_p C_p \sqrt{\Delta P_{ave.}} \sqrt{\frac{T_{s\ ave.}}{P_s X M_s}}$$

$$V_{s\ ave.} = 85.49 \times 0.84 \times 0.40 \times \sqrt{\frac{(826)}{(29.58)(28.99)}}$$

$$V_{s\ ave.} = \underline{28.19} \text{ ft/sec.}$$

2. Volume of Gas (Actual) from Stack

$$\text{Volume} = (V_{s\ ave.})\ (A)\ (60)$$

$$\text{Volume} = (28.19)(95)(60)$$

$$\text{Volume} = \underline{160,700} \text{ ACFM}$$

3. Volume of Dry Gas @ Standard Conditions

$$Q_s = 3600(1 - B_{wo})(V_{s\ ave.})(A)\left(\frac{T_{std.}}{T_{s\ ave.}} \times \frac{P_s}{P_{std.}}\right)$$

$$Q_s = 3600(1 - .082)(28.19)(95)\left(\frac{530}{826} \times \frac{29.58}{29.92}\right)$$

$$Q_s = \underline{5.61 \times 10^6} \text{ SCFH}$$

4. Sample Gas Volume @ Standard Conditions

$$V_{m\ std.} = 17.71 \times V_m \times \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right)$$

$$V_{m\ std.} = 17.71 \times 58.01 \times \left(\frac{29.63 + \frac{0.21}{13.6}}{531} \right)$$

$$V_{m\ std.} = \underline{57.35} \text{ cu.ft.}$$

5. Percent of Isokinetic Sampling

$$I = \frac{(1.667 \times T_s) \times \left[(.00267 \cdot V_{ic}) + \left(\frac{V_{m\ std.}}{17.71} \right) \right]}{(\Theta)(V_{s\ ave.})(P_s)(A_n)}$$

$$I = \frac{(1.667 \times 826) \left[(.00267 \times 109) + \frac{57.35}{17.71} \right]}{(192)(28.19)(29.58)(.000325)}$$

$$I = \underline{93.4\%}$$

6. Particulate Concentration

Dust catched by Filter + Impinger and Probe wash was 70.4 mg, or:

$$\frac{70.4}{V_{m\ std.}} = \frac{70.4}{57.35} = \underline{1.227} \text{ mg/SCF}$$

$$= (1.227) \times (.0154)$$

$$= \underline{0.0189} \text{ Grains/SCF}$$

$$= \frac{0.0189}{7000}$$

$$= 2.70 \times 10^{-6} \text{ lbs/SCF}$$

$$= (2.70 \times 10^{-6}) \times Q_s$$

$$= (2.70 \times 10^{-6})(5.61 \times 10^{6})$$

$$= \underline{15.14} \text{ Lbs/Hr.}$$

FORM 407 REV. PG

PITTSBURGH TESTING LABORATORY

ESTABLISHED 1881
850 POPLAR STREET, PITTSBURGH, PA. 15220

PLEASE REPLY TO:
P. O. BOX 1646
PITTSBURGH, PA. 15230

AREA CODE 412 TELEPHONE 922-4000

LABORATORY No. 779871

ORDER No. PG-6218

CLIENT'S No. P. O. 8999-R

REPORT

October 26, 1977

Analysis of: C O A L

Submitted by: Lone Star - Nazareth Plant

Reported to: Lone Star Industries, Inc.
P. O. Box 2148
Houston, Texas 77001

	As Received	Dry Basis
Carbon	----	71.54%
Hydrogen	----	4.72%
Oxygen	----	5.92%
Nitrogen	----	1.37%
Sulfur	----	2.84%
Ash	----	13.61%
BTU Per Pound	12,751	12,929
Moisture	1.38%	

PITTSBURGH TESTING LABORATORY

Robert J. King
Manager, Chemical Department

3-Client
Attn: Clyde W. Moore

pd

Monongahela City, New Eagle Borough, North Charleroi Borough, Roscoe Borough, Stockdale Borough, Twilight Borough, Union Township, West Brownsville Borough, and the following political subdivisions in Westmoreland County: Monessen City, North Belle Vernon Borough, Rostraver Township and West Newton Borough.

(25) *Non-specific particulate matter* - Particulate matter which is non-odorous and non-irritating, including but not limited to alundum, calcium carbonate, cellulose, portland cement, graphite, gypsum, limestone, magnesite, starch, tin oxide and glycerine mist.

(26) *Opacity* - The degree to which emissions reduce the transmission of light and obscure the view of an object in the background.

(27) *Open burning* - Any fire, the air contaminants from which are emitted directly into the outdoor atmosphere and not directed thereto through a flue.

(28) *Particulate matter* - Any material, except uncombined water, that is or has been airborne and exists as a solid or liquid at 70° F and 14.7 pounds per square inch absolute pressure.

(29) *Potential emission rate* - The total weight rate at which a particular air contaminant, in the absence of any air cleaning devices, would be emitted per unit of time from an air contamination source when such source in operated at its rated capacity.

(30) *Process* - Any method, reaction, or operation wherein materials are handled or whereby materials undergo physical change (i.e. the size, shape, appearance, temperature, state or other physical property of the material is altered) or chemical change (i.e. a substance or substances with different chemical composition or properties are formed or created). A process includes all of the equipment and facilities necessary for the completion of the transformation of the materials to produce a physical or chemical change. There may be several processes in series or in parallel necessary to the manufacture of a product.

(31) *Rating* - The operating limit of a source as stated by the manufacturer of the source or as determined by good engineering judgement.

(32) *Reading air basin* - The following political subdivisions in Berks County: Bern Township, Cumru Township, Kenhorst Borough, Laureldale Borough, Leesport Borough, Lower Alsace Township, Mohnton Borough, Mt. Penn Borough, Muhlenberg Township, City of Reading, Shillington Borough, Sinking Spring Borough, Spring Township, St. Lawrence Borough, Temple Borough, West Lawn Borough, West Reading Borough, Wyomissing Borough, and Wyomissing Hills Borough.

(33) *Scranton, Wilkes-Barre air basin* - The following political subdivisions in Lackawanna County: Archbald Borough, Blakely Borough, Dickson City Borough, Dunmore Borough, Jessup Borough, Moosic Borough, Old Forge Borough, Olyphant Borough, City of Scranton, Taylor Borough, Throop Borough, and the following political subdivisions in Luzerne County: Ashley Borough, Avoca Borough, Courtdale Borough, Dupont Borough, Duryea Borough, Edwardsville Borough, Exeter Borough, Forty Fort Borough, Hanover Township, Hughestown Borough, Jenkins Township, Kingston Borough, Laflin Borough, Larksville Borough, Laurel Run Borough, Luzerne Borough, City of Nanticoke, City of Pittston, Pittston Township, Plains Township, Plymouth Borough, Plymouth Township, Pringle Borough, Sugar Notch Borough, Swoyersville Borough, Warrior Run Borough, West Pittston Borough, West Wyoming Borough, City of Wilkes-Barre, Wilkes-Barre Township, Wyoming Borough and Yatesville Borough.

(34) *Source* - Air contamination source.

(35) *Southeast Pennsylvania air basin* - The following counties: Bucks, Chester, Delaware, Montgomery and Philadelphia.

(36) *Standard conditions* - 70° F and 14.7 pounds per square inch absolute pressure.

(37) *Volatile organic compound* - Any compound containing carbon and hydrogen or containing carbon and hydrogen in combination with any other element and which has a vapor pressure of at least 1.5 pounds per square inch absolute under actual storage conditions.

(38) *York air basin* - The following political subdivisions in York County: Manchester Township, North York Borough, Spring Garden Township, Springettsbury Township, West Manchester Township, West York Borough and City of York.

PARTICULATE MATTER EMISSIONS

§ 123.11. Combustion units.

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

(1) The rate of 0.4 lbs. per million BTU of heat input, when the heat input to the combustion 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 emissions 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 combustion unit in millions of BTUs per hour is equal to or greater than 600.

(b) Allowable emissions under subsection (a) of this section are graphically indicated in Figure 1 appended to this Chapter.

§ 123.12. Incinerators.

No person shall cause, suffer, or permit the emission to the outdoor atmosphere of particulate matter from any incinerator, at any time, in such a manner that the particulate matter concentration in the effluent gas exceeds 0.1 grains per dry standard cubic foot, corrected to 12% CO_2.

§ 123.13. Processes.

(a) Subsections (b) and (c) of this section shall apply to all processes except combustion units and incinerators.

(b) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of particulate matter from any process listed in Table 1, at any time, either in excess of the rate calculated by the following formula or in such a manner that the concentration of particulate matter in the effluent gas exceeds 0.02 grains per dry standard cubic foot whichever is greater:

$A = 0.76E^{0.42}$, where:
A = Allowable emissions in lbs./hr
E = Emission index = F x W lbs./hr
F = Process factor in lbs./unit, and
W = Production or charging rate in units/hr.

The factor F shall be obtained from Table 1. The units for F and W shall be compatible.

Allowable emissions under this subsection are graphically indicated in Figure 2 appended to this Chapter.

(c) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of particulate matter from any process not listed in Table 1 in such a manner that the concentration of particulate matter in the effluent gas, at any time, exceeds:

(1) 0.04 grains per dry standard cubic foot, when the effluent gas volume is less than 150,000 dry standard cubic feet per minute.

(2) The rate determined by the formula:

$A = 6000E^{-1}$, where:
A = Allowable emissions in grains per dry standard cubic foot, and
E = Effluent gas volume in dry standard subic feet per minute,

when E is equal to or greater than 150,000 but less than 300,000.

(3) 0.02 grains per dry standard cubic foot, when the effluent gas volume is greater than 300,000 dry standard cubic feet per minute.

Allowable emissions under this subsection are graphically indicated in Figure 3 appended to this Chapter.

TABLE 1

Process	Process Factor, F
1. Carbon black mfg.	500 lbs./ton of product
2. Charcoal mfg.	400 lbs./ton of product
3. Crushers or grinders or screens	20 lbs./ton of feed
4. Paint mfg.	0.05 lbs./ton of pigment handled
5. Phosphoric acid mfg.	6 lbs./ton of phosphorous burned
6. Detergent drying	30 lbs./ton of product
7. Alfalfa dehydration	30 lbs./ton of product
8. Grain elevators:	
Loading or unloading	90 lbs./ton of grain
9. Grain screening and cleaning	300 lbs./ton of grain
10. Grain drying	200 lbs./ton of product
11. Meat smoking	0.01 lbs./ton of meat
12. Ammonium nitrate mfg.:	
Granulator	0.1 lbs./ton of product
13. Ferroalloy production furnace	0.3 lbs./ton of product
14. Primary iron and/or steel making:	
Iron production	100 lbs./ton of product
Sintering: windbox	20 lbs./ton of dry solids feed
Steel production	40 lbs./ton of product
Scarfing	20 lbs./ton of product
15. Primary lead production:	
Roasting	0.004 lbs./ton of ore feed
Sintering: windbox	0.2 lbs./ton of sinter
Lead reduction	0.5 lbs./ton of product
16. Primary zinc production:	
Roasting	3 lbs./ton of ore feed
Sintering: windbox	2 lbs./ton of product
Zinc reduction	10 lbs./ton of product
17. Secondary aluminum production:	
Sweating	50 lbs./ton of aluminum product
Melting and refining	10 lbs./ton of aluminum feed
18. Brass and bronze production:	
Melting and refining	20 lbs./ton of product

TABLE 1

Process	Process Factor, F
19. Iron foundry:	
Melting:	
5T./hr and less	150 lbs./ton of iron
More than 5T./hr	50 lbs./ton of iron
Sand handling	20 lbs./ton of sand
Shake-out	20 lbs./ton of sand
20. Secondary lead smelting	0.5 lbs./ton of product
21. Secondary magnesium smelting	0.2 lbs./ton of product
22. Secondary zinc smelting:	
Sweating	0.01 lbs./ton of product
Refining	0.3 lbs./ton of product
23. Asphaltic concrete production	6 lbs./ton of aggregate feed
24. Asphalt roofing mfg:	
Felt saturation	0.6 lbs./ton of asphalt used
25. Portland cement mfg:	
Clinker production	150 lbs./ton of dry solids feed
Clinker cooling	50 lbs./ton of product
26. Coal drying	2 lbs./ton of product
27. Coal dry-cleaning	2 lbs./ton of product
28. Lime calcining	200 lbs./ton of product
29. Petroleum refining:	
Catalytic cracking	40 lbs./ton of liquid feed

RUN DATA SHEETS

PARTICULATE FIELD DATA

57 (WB) P_H = 80%

250 ±25°

Run No. PA-77-10-6 | Amb. Temp. °F 61 (DB) | Probe Tip Dia., In 1/4" | Heater Box Setting √

Location SOUTH STACK | Bar. Press. "Hg. 29.63 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/6/77 | Assumed Moist 10% | Inp. Nos. 97 → 100 | READ & RECORD AT THE START OF EACH TEST POINT

Operator D.V.K. | Test Periods 192 MIN | Sample Box No. PART. | 7 = .76

48 PTS. @ 4 MIN EACH

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	12:51	409.00	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
A-24	:55	410.14	.12	.34	.15	.18	72	73	1.0	170	56	137	330	
23	:59	411.30	.15	.39	.18	.18	71	72	1.0	185	57	132	360	
22	13:03	412.61	.18	.42	.23	.24	70	72	2.0	198	58	131	375	
21	:07	413.80	.15	.39	.18	.20	69	70	1.0	214	58	263	360	0
20	:11	415.08	.18	.42	.23	.22	69	71	2.0	222	59	122	366	
19	:15	416.37	.18	.42	.23	.23	68	71	2.0	276	59	235	361	
18	:19	417.68	.18	.42	.23	.24	68	71	2.0	182	59	246	370	.64
17	:23	418.83	.15	.39	.18	.18	68	71	1.0	190	61	116	374	
16	:27	420.11	.18	.42	.23	.23	68	71	2.0	213	61	111	370	0
15	:31	421.43	.18	.42	.23	.24	68	71	2.0	240	61	108	375	
14	:35	422.76	.18	.42	.23	.24	67	71	2.0	259	61	194	372	
13	:39	424.05	.18	.42	.23	.24	68	72	2.0	262	63	210	373	
12	:43	425.25	.16	.40	.20	.20	68	72	1.5	145	63	107	372	
11	:47	426.41	.16	.40	.20	.18	68	72	1.5	187	63	107	370	
10	:51	427.62	.16	.40	.20	.20	68	73	1.8	215	63	113	374	
9	:55	428.87	.18	.42	.23	.21	68	73	2.0	221	64	116	376	
8	:59	430.11	.18	.42	.23	.21	69	73	2.0	243	64	106	374	
7	14:03	431.40	.15	.39	.18	.22	69	73	1.5	262	64	102	372	STATIC PRESSURE =
6	:07	432.45	.15	.39	.18	.15	69	73	1.0	248	64	104	371	
5	:11	433.61	.15	.39	.18	.19	69	73	1.0	213	65	106	371	
4	:15	434.80	.16	.40	.20	.20	69	73	1.5	189	65	106	374	
3	:19	435.98	.15	.39	.18	.19	69	73	1.5	199	63	103	371	
2	:23	437.04	.10	.31	.13	.15	69	73	1.0	211	60	105	360	
1	:27	438.07	.10	.31	.13	.15	69	73	1.0	273	59	107	362	
TOTAL										[redacted]				
AVERAGE														

STATIC PRESSURE = −0.64" H_2O

Meter Volume

Dry Meter Calibration Factor

P.T.O.

PARTICULATE FIELD DATA

(CONT.)

57 (WB)

250±25°F

Run No. PA-77-10-6 | Amb. Temp. °F. 61 (DB) | Probe Tip Dia., In. 1/4" | Heater Box Setting √

Location SOUTH STACK | Bar. Press. "Hg. 29.63 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/6/77 | Assumed Moist 10% | Inp. Nos. 97 → 100 | READ & RECORD ALL DATA

Operator DVV. | Test Periods 192 MIN | Sample Box No. PART. | START OF EACH TEST POINT

48 PTS. @ 4 MIN EACH | F = .76

Point	Clock Time 15:18	Dry Gas Meter C.F. 438.07	Pitot In.. H_2O ΔP	Pitot In.. H_2O √ΔP	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
B- 1	:22	439.10	.10	.31	.13	.15	68	70	1.0	153	50	86	332	
2	:26	440.18	.13	.36	.16	.16	68	70	1.0	197	52	98	351	
3	:30	441.31	.13	.36	.16	.17	68	70	1.0	213	52	99	356	
4	:34	442.46	.15	.39	.18	.18	68	70	1.0	256	52	120	357	
5	:38	443.62	.15	.39	.18	.18	69	72	1.0	277	52	109	366	
6	:42	444.83	.16	.40	.20	.20	69	72	1.0	262	55	98	366	
7	:46	446.06	.16	.40	.20	.21	70	73	1.0	248	55	121	366	
8	:50	447.32	.18	.42	.23	.22	71	74	1.5	198	56	138	365	
9	:54	448.63	.18	.42	.23	.24	71	74	1.8	212	56	125	366	
10	:58	449.95	.18	.42	.23	.24	71	74	1.8	199	56	115	366	
11	16:02	451.31	.18	.42	.23	.25	71	73	1.8	240	57	128	367	
12	:06	452.57	.18	.42	.23	.22	71	74	1.8	259	58	123	367	
13	:10	453.88	.18	.42	.23	.24	71	74	1.8	219	58	116	369	
14	:14	455.19	.18	.42	.23	.24	71	74	2.0	218	58	124	368	
15	:18	456.40	.15	.39	.18	.20	72	74	1.5	229	58	128	366	
16	:22	457.72	.18	.42	.23	.24	71	74	2.0	198	57	159	362	
17	:26	459.04	.18	.42	.23	.24	72	74	2.0	245	58	150	365	
18	:30	460.37	.18	.42	.23	.24	72	74	2.0	263	59	162	369	
19	:34	461.69	.18	.42	.23	.24	71	73	2.0	274	58	155	368	
20	:38	463.02	.18	.42	.23	.24	72	74	2.0	257	59	158	373	
21	:42	464.33	.18	.42	.23	.24	72	74	2.0	266	59	159	371	
22	:46	465.55	.15	.39	.18	.20	72	74	1.5	198	58	168	371	
23	:50	466.74	.15	.39	.18	.20	73	75	1.0	197	59	162	373	
24	:54	467.89	.15	.39	.18	.18	73	75	1.0	210	59	158	374	
TOTAL				19.12		9.99	3367	3485					17587	
AVERAGE				0.40		0.21	70	73					366	

(531) Meter Volume

(826) Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME: 58.89 Ft³

SOUTH STACK

RUN NO. PA-77_10-6

PARTICULATE & WATER CATCH

IMPINGER NO. 97	Final Weight 645.18 Initial Weight 552.06 Increase	WATER WEIGHT GAIN	IMPINGER 1 93.12
IMPINGER NO. 98	Final Weight 552.51 Initial Weight 550.84 Increase		IMPINGER 2 1.67
IMPINGER NO. 99	Final Weight 454.34 Initial Weight 453.91 Increase		IMPINGER 3 0.43
IMPINGER NO. 100	Final Weight 817.35 Initial Weight 803.77 Increase		IMPINGER 4 13.58
FILTER NO. 25	Final Weight .7268 Initial Weight .7059 Part. Catch .0189		TOTAL 108.80

$M_S = 28.99$

ORSAT

CO_2 8.6

O_2 15.0

CO —

N_2 76.4

SOLID WEIGHT GAIN

Filter → .0185

BEAKER NO. 1 (IMPINGER)	Final Weight 112.9030 Initial Weight 112.7888 Increase .0142	BEAKER 1 .0142
BEAKER NO. 24 (PROBE WASH)	Final Weight 148.4642 Initial Weight 148.4269 Increase .0373	BEAKER 24 .0373
BEAKER NO. ____	Final Weight ____ Initial Weight ____ Increase ____	~~BEAKER 3~~ ____
BEAKER NO. ____	Final Weight ____ Initial Weight ____ Increase ____	~~BEAKER 4~~ ____
		TOTAL .0704

Moisture Content: Sample Vol. 58.01 ft.^{3} x $\frac{460 + 70\ (530)}{460 + \text{Meter}\ (531)\ \text{temp}}$ x 28.3 L/ft.^{3} = 1638 L Dry Gas

Water Vapor: $\frac{108.8 \text{ gm.}}{18 \frac{\text{gm.}}{\text{mol.}}} \times 24.1 \frac{\text{L}}{\text{mol.}}$ = 146 L H_2O Vapor

Total = 1784

$\frac{H_2O \text{ Vol.}}{\text{Total}}$ $\frac{146 \text{ L}}{1784 \text{ L}} \times 100$ = 8.2%

(GARCO)

PARTICULATE FIELD DATA

44 (WB) RH = 65%

250 ± 25 °F

Run No. PA-77-10-7 | Amb. Temp. °F 48 (DB) | Probe Tip Dia., In. 1/4" | Heater Box Setting

Location SOUTH STACK | Bar. Press. "Hg. 29.85 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/7/77 | Assumed Moist 10% | Inp. Nos. 1→4 | READ & RECORD AT THE

Operator D.V.V. | Test Periods 1½ MIN | Sample Box No. PART. | START OF EACH TEST

48 PTS. @ 4 MIN EACH | $\bar{f}$ = .76 | POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:31	468.19	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
A-2x	:25	469.43	.21	.46	.27	.21	69	71	3.5	164	59	126	397	
23	:29	470.85	.20	.45	.26	.28	69	72	3.5	179	59	114	394	0
22	:33	472.13	.20	.45	.26	.23	69	71	3.5	271	58	118	394	
21	:37	473.49	.18	.42	.23	.26	68	71	3.5	285	58	122	389	1" H_2O
20	:41	474.81	.20	.45	.26	.24	68	71	3.5	194	57	123	392	
19	:45	476.15	.20	.45	.26	.25	68	71	3.5	181	57	126	388	0.6
18	:49	477.41	.18	.42	.23	.22	67	71	3.2	191	57	132	389	0.
17	:53	478.63	.18	.42	.23	.20	68	71	3.0	195	57	129	385	1
16	:57	479.87	.18	.42	.23	.22	68	71	3.0	227	58	134	385	1
15	10:01	481.08	.18	.42	.23	.20	68	72	3.0	239	59	137	385	
14	:05	482.32	.18	.42	.23	.21	68	72	3.0	244	60	135	384	
13	:09	483.57	.18	.42	.23	.21	68	73	3.2	256	61	139	383	
12	:13	484.82	.16	.40	.20	.21	70	73	3.2	254	61	135	383	
11	:17	486.07	.16	.40	.20	.21	69	73	3.2	259	62	139	382	
10	:21	487.36	.16	.40	.20	.23	69	73	3.2	249	61	138	384	
9	:25	488.56	.18	.42	.23	.20	69	73	3.2	228	62	139	383	
8	:29	489.75	.16	.40	.20	.20	69	73	3.0	236	62	138	379	
7	:33	490.97	.18	.42	.23	.20	69	73	3.2	268	63	140	381	
6	:37	492.20	.18	.42	.23	.21	69	73	3.2	264	64	142	384	
5	:41	493.44	.16	.40	.20	.21	70	73	3.2	243	65	140	380	
4	:45	494.71	.18	.42	.23	.23	70	73	3.2	287	64	141	382	
3	:49	495.89	.15	.39	.19	.19	70	74	3.0	280	63	134	376	
2	:53	497.08	.15	.39	.19	.17	70	74	3.0	251	62	145	376	
1	:57	497.95	.10	.31	.12	.12	70	74	2.0	220	61	138	308	
TOTAL														
AVERAGE														

STACK PRESSURE

P.T.O.

STATIC PRESSURE = −0.64 " H_2O

Meter Volume

Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME =

Ft 3 v

(BRAD)

PARTICULATE FIELD DATA

(CONT.)

Run No. PA-77-10-7
Location SOUTH STACK
Date 10/7/77
Operator D.V.V.

Amb. Temp. °F. 44 (WB) 48 (DB)
Bar. Press. "Hg. 29.85
Assumed Moist 10%
Test Periods 192 MIN
48 PTS. @ 4 MIN EACH

Probe Tip Dia., In. 1/4"
Probe Length 15 ft
Inp. Nos. 1 → 4
Sample Box No. PART.
f = .76

250±25°F
Heater Box Setting

FILL IN ALL BLANKS
READ & RECORD ALL DATA
START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	11:24	497.95	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
B-24	:28	499.15	.18	.42	.23	.20	67	68	3.5	161	52	104	378	
23	:32	500.43	.18	.42	.23	.23	69	71	3.2	187	55	102	379	
22	:36	501.67	.18	.42	.23	.21	69	71	3.5	197	56	104	381	
21	:40	502.95	.14	.43	.24	.23	69	71	3.5	216	57	102	381	
20	:44	504.23	.18	.42	.23	.23	69	72	3.5	248	58	95	382	
19	:48	505.50	.18	.42	.23	.22	69	72	3.5	259	58	94	381	
18	:52	506.78	.18	.42	.23	.23	69	72	3.5	269	59	89	383	
17	:56	508.05	.18	.42	.23	.22	70	73	3.5	234	59	106	381	
16	12:00	509.31	.17	.41	.21	.22	70	73	3.5	243	58	115	382	
15	:04	510.57	.17	.41	.21	.21	70	74	3.5	204	57	120	378	
14	:08	511.83	.17	.41	.21	.22	70	74	3.5	190	57	122	381	
13	:12	513.10	.17	.41	.21	.22	70	74	3.5	212	57	126	381	
12	:16	514.37	.17	.41	.21	.22	70	74	3.5	240	58	125	381	
11	:20	515.57	.15	.39	.20	.20	70	74	3.2	255	58	99	380	
10	:24	516.75	.15	.39	.20	.19	71	74	3.2	265	58	98	377	
9	:28	518.00	.16	.40	.20	.21	71	74	3.5	245	57	99	377	
8	:32	519.24	.18	.42	.23	.21	71	74	3.5	214	56	97	379	
7	:36	520.49	.18	.42	.23	.21	71	74	3.5	246	56	99	378	
6	:40	521.76	.16	.40	.20	.23	71	74	3.5	277	56	107	378	
5	:44	522.92	.15	.39	.19	.18	71	74	3.0	210	56	106	378	
4	:48	524.10	.16	.40	.20	.19	71	74	3.2	197	56	99	378	
3	:52	525.29	.15	.39	.19	.20	71	74	3.2	193	56	88	377	
2	:56	526.37	.12	.34	.15	.16	72	75	3.0	205	57	89	371	
1	13:00	527.45	.10	.31	.12	.16	71	74	3.0	195	56	89	356	
TOTAL				19.64		10.11	3334	3490					18241	
AVERAGE				0.41		0.21	69	73					(380)	

(531) Meter Volume

840 °R

Dry Meter Calibration Factor 995

CORRECTED SAMPLE VOLUME = 59.26 Ft 3 v

South Stack

RUN NO. PA-77-10-7

PARTICULATE & WATER CATCH

IMPINGER NO. 1	Final Weight 684.92 Initial Weight 549.17 Increase	WATER WEIGHT GAIN	IMPINGER 1 135.75
IMPINGER NO. 2	Final Weight 553.77 Initial Weight 540.35 Increase		IMPINGER 2 13.42
IMPINGER NO. 3	Final Weight 458.93 Initial Weight 456.71 Increase		IMPINGER 3 2.22
IMPINGER NO. 4	Final Weight 802.65 Initial Weight 785.89 Increase		IMPINGER 4 16.76
			TOTAL 168.15
			ORSAT
		$M_s = 28.50$	CO_2 8.4
			O_2 14.6
			CO —
			N_2 77.0
FILTER NO. 26	Final Weight .7294 Initial Weight .6760 Part. Catch .0534		

SOLID WEIGHT GAIN

BEAKER NO. 37 (IMPINGER)	Final Weight 139.2483 Initial Weight 139.2209 Increase .0274	Filter → .0534 ~~BEAKER 1~~ —— BEAKER 37 .0274
BEAKER NO. ———	Final Weight ——— Initial Weight ——— Increase ———	BEAKER 36 .0119 ~~BEAKER 4~~ —— TOTAL .0927
BEAKER NO. ———	Final Weight ——— Initial Weight ——— Increase ———	
BEAKER NO. 36 (PROBE WASH)	Final Weight 146.6492 Initial Weight 146.6373 Increase .0119	

Moisture Content: Sample Vol. 58.37 ft.^{3} x $\frac{460 + (530)}{460 + \text{Meter}\ (531)}$ x 28.3 L/ft.^{3} = 1649 L

Water Weight $\frac{168.15}{18}$ gm. x 24.1 L = 225 L H_2O Vapor

Total = 1874

$\frac{225}{1874}$ x 100 = 12.0%

[redacted] PARTICULATE FIELD DATA [redacted] (GRAY)

44 (WB) RH = 80%

250125°F

Run No. PA-77-10-15 | Amb. Temp. °F 47 (DB) | Probe Tip Dia., In. 1/4 | Heater Box Setting V

Location SOUTH STACK | Bar. Press. "Hg. 29.24 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/15/77 | Assumed Moist 12% | Inp. Nos. ~~53→56~~ 49→52 | READ & RECORD AT THE

Operator DVV | Test Periods 192 MIN | Sample Box No. PART. | START OF EACH TEST POINT

48 PTS. @ 4 MIN EACH | γ = .76

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O ΔP	Pitot In.. H_2O √ΔP	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:58	866.91												
A-1	10:02	867.93	.10	.31	.13	.14	66	68	2.8	207	57	159	354	
2	:06	868.99	.12	.34	.15	.15	66	68	2.8	217	58	161	356	
3	:10	870.08	.14	.37	.17	.16	66	68	2.8	228	58	161	369	
4	:14	871.25	.15	.39	.18	.18	67	69	3.0	229	59	159	373	
5	:18	872.44	.15	.39	.18	.18	67	69	3.0	208	59	158	374	
6	:22	873.74	.18	.42	.23	.23	67	70	3.2	231	60	158	376	
7	:26	875.06	.18	.42	.23	.24	67	70	3.2	243	60	158	372	
8	:30	876.39	.18	.42	.23	.24	67	70	3.3	254	60	158	375	
9	:34	877.73	.18	.42	.23	.25	67	71	3.3	267	60	158	373	
10	:38	879.03	.18	.42	.23	.23	67	71	3.2	248	60	157	373	
11	:42	880.34	.18	.42	.23	.24	67	71	3.2	276	60	157	374	
12	:46	881.64	.18	.42	.23	.23	68	72	3.2	285	60	157	371	
13	:50	882.95	.19	.43	.24	.24	68	72	3.2	213	59	157	374	
14	:54	884.24	.19	.43	.24	.23	67	72	3.2	253	59	157	372	
15	:58	885.30	.19	.43	.24	.15	68	72	3.2	286	60	161	371	
16	11:02	886.56	.18	.42	.23	.22	68	72	3.0	268	59	169	369	
17	:06	887.88	.18	.42	.23	.24	68	72	3.0	266	59	165	372	
18	:10	889.24	.18	.42	.23	.25	68	72	3.0	218	59	163	371	
19	:14	890.61	.18	.42	.23	.25	68	72	3.1	259	59	162	371	
20	:18	891.97	.18	.42	.23	.25	69	73	3.1	248	59	163	370	
21	:22	893.32	.18	.42	.23	.25	68	73	3.1	228	59	164	371	
22	:26	894.69	.19	.43	.24	.25	69	73	3.1	271	59	168	369	
23	:30	896.05	.19	.43	.24	.25	69	73	3.0	254	59	168	372	
24	:34	897.41	.19	.42	.23	.25	69	73	3.0	248	59	168	375	
TOTAL														
AVERAGE														

STATIC PRESSURE = −0.68"

(LEAK CHECK AFTER CHANGING PORTS)

Meter Volume

Dry Meter Calibration Factor

P.T.O.

CORRECTED SAMPLE VOLUME =

Pr. 3 v

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] PARTICULATE FIELD DATA (GARY) [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

(CONT.)

44 (WB)

250 ± 25°F

Run No. PA-77-10-15 | Amb. Temp. °F 47 (DB) | Probe Tip Dia., In. 1/4 | Heater Box Setting V

Location SOUTH STACK | Bar. Press. "Hg. 29.24 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/15/77 | Assumed Moist 12% | Inp. Nos. 49 → 52 | READ & RECORD ALL DATA

Operator DVV | Test Periods 192 MIN | Sample Box No. PART | AT START OF EACH TEST POINT

48 PTS. @ 4 MIN EACH | f = .76

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	12:10	897.70	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
B-1	:14	898.76	.09	.30	.12	.15	69	70	2.2	159	55	146	343	
2	:18	899.77	.10	.31	.13	.14	69	70	2.5	198	56	147	349	
3	:22	900.94	.14	.37	.17	.18	69	70	2.9	213	57	148	359	
4	:26	902.24	.16	.40	.20	.23	69	70	3.2	219	57	148	367	
5	:30	903.54	.18	.42	.23	.22	69	71	3.2	221	57	147	371	
6	:34	904.85	.18	.42	.23	.24	69	71	3.2	227	58	147	370	
7	:38	906.15	.18	.42	.23	.23	69	71	3.2	220	58	147	371	
8	:42	907.46	.17	.41	.21	.24	69	72	3.3	245	58	148	374	
9	:46	908.68	.17	.41	.21	.20	69	72	3.0	223	57	146	372	
10	:50	910.05	.18	.42	.23	.25	69	72	3.2	220	57	145	369	
11	:54	911.24	.18	.42	.23	.20	69	72	3.2	213	57	145	369	
12	:58	912.57	.18	.42	.23	.24	69	72	3.2	215	58	145	368	
13	13:02	913.78	.18	.42	.23	.20	69	72	3.2	219	58	146	369	
14	:06	915.04	.18	.42	.23	.21	70	73	3.3	214	58	147	369	
15	:10	916.32	.18	.42	.23	.23	70	73	3.5	228	58	148	370	
16	:14	917.61	.19	.43	.24	.23	70	73	3.7	265	59	159	386	
17	:18	918.94	.19	.43	.24	.24	70	73	3.8	271	58	165	397	
18	:22	920.29	.18	.42	.23	.25	70	73	3.9	233	60	154	376	
19	:26	921.60	.18	.42	.23	.24	70	73	3.9	255	59	166	383	
20	:30	922.84	.17	.41	.21	.21	70	73	3.5	258	60	161	384	
21	:34	924.07	.18	.42	.23	.21	70	73	3.8	253	59	160	385	
22	:38	925.30	.17	.41	.21	.21	70	74	3.5	248	59	168	378	
23	:42	926.56	.18	.42	.23	.22	71	73	3.8	269	60	160	385	
24	:46	927.84	.18	.42	.23	.22	70	73	3.8	266	61	161	380	
TOTAL				19.59		10.49	3289	3435					17841	
AVERAGE				0.41		0.22	68	72					(372)	

(530) Meter Volume — (832) Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME - 60.61 FT 3 ~ 0.905 ~ 53.7 [illegible]

SOUTH STACK

RUN NO. PA-77-10-15

PARTICULATE & WATER CATCH

IMPINGER NO. 49	Final Weight 733.31 Initial Weight 574.91 Increase	WATER WEIGHT GAIN	IMPINGER 1 158.4
IMPINGER NO. 50	Final Weight 578.45 Initial Weight 566.65 Increase		IMPINGER 2 11.80 IMPINGER 3 0.92
IMPINGER NO. 51	Final Weight 451.89 Initial Weight 450.97 Increase		IMPINGER 4 12.80 TOTAL 188.5
IMPINGER NO. 52	Final Weight 747.80 Initial Weight 729.20 Increase		ORSAT CO_2 8.2
FILTER NO. #32	Final Weight .7311 Initial Weight .7054 Part. Catch .0257		$M_S = 28.36$ O_2 15.0 CO — N_2 76.8

SOLID WEIGHT GAIN

BEAKER NO. 33 (IMPINGER)	Final Weight 146.0900 Initial Weight 146.0835 Increase .0065		FILTER .0257 BEAKER 1 — BEAKER 33 .0065
BEAKER NO. —	Final Weight — Initial Weight Increase —		BEAKER 36 .0241 BEAKER 4 — TOTAL .0563
BEAKER NO. —	Final Weight — Initial Weight Increase —		
BEAKER NO. 36 (PROBE WASH)	Final Weight 146.6610 Initial Weight 146.6369 Increase .0241		

Moisture Content: Sample Vol. 59.70 ft.^{3} x $\frac{(530)}{460 + 70}$ x 28.3 L/ft.^{3} = 1689 L Dry Gas

$\frac{460 + \text{Meter}}{(530)\ \text{Temp.}}$

Water Weight $\frac{188.92}{18}$ gm. x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 253 L H_2O Vapor

Total = 1942 L

$\frac{H_2O\ \text{Vol.}}{\text{Total}}$ $\frac{253\ \text{L}}{1942\ \text{L}}$ x 100 = 13.0%

PARTICULATE FIELD DATA (SHARON)

51 (WB) RH = 74%

250±25°F

Run No. PA-77-10-10 | Amb. Temp. °F 56 (DB) | Probe Tip Dia., In 1/4" | Heater Box Setting √

Location NORTH STACK | Bar. Press. "Hg. 29.54" | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/10/77 | Assumed Moist 15% | Inp. Nos. 9 → 12 | READ Δ P AT THE START OF EACH TEST POINT

Operator D.V.V. | Test Periods 192 MIN | Sample Box No. PART.

48 PTS. @ 4 MIN EACH | f = (.72)

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O ΔP	Pitot In.. H_2O √ΔP	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	10:45	528.91												
A-24	:49	530.61	.38	.61	.43	.39	65	66	3.5	196	61	81	392	
23	:53	532.22	.35	.59	.39	.35	66	68	3.0	261	59	143	394	
22	:57	533.80	.35	.59	.39	.35	66	69	3.0	257	59	154	389	
21	11:01	535.56	.38	.61	.43	.43	66	69	3.5	261	61	150	392	
20	:05	537.38	.38	.61	.43	.46	68	70	3.5	248	60	153	392	
19	:09	539.05	.38	.61	.43	.39	66	71	3.5	269	60	155	389	
18	:13	540.67	.34	.58	.39	.36	67	71	3.2	269	61	149	392	
17	:17	542.25	.32	.56	.37	.34	67	72	3.2	244	61	151	387	
16	:21	543.83	.30	.55	.34	.34	68	72	3.0	266	61	152	385	
15	:25	545.43	.30	.55	.34	.35	68	72	3.0	269	61	154	380	
14	:29	546.94	.28	.53	.32	.32	68	72	3.0	220	61	155	375	
13	:33	548.36	.25	.50	.28	.28	68	72	2.8	247	62	157	371	
12	:37	549.77	.25	.50	.28	.27	68	72	2.8	259	61	142	364	
11	:41	551.20	.23	.48	.26	.28	68	72	2.8	289	62	155	369	
10	:45	552.57	.25	.50	.28	.26	68	72	2.8	273	63	149	362	
9	:49	554.00	.25	.50	.28	.28	69	73	3.0	194	62	103	369	
8	:53	555.44	.25	.50	.28	.28	69	72	3.0	212	62	145	341	
7	:57	556.93	.25	.50	.28	.30	69	73	3.0	240	62	145	340	
6	12:01	558.24	.25	.50	.28	.24	69	73	2.5	272	61	132	333	
5	:05	559.59	.23	.48	.26	.26	68	72	2.8	268	62	139	331	
4	:09	560.88	.20	.45	.23	.23	69	73	2.5	253	61	133	329	
3	:13	562.14	.20	.45	.23	.22	69	72	2.5	287	61	141	327	
2	:17	563.25	.18	.42	.20	.19	69	72	2.2	252	61	127	329	
1	:21	564.32	.15	.39	.19	.18	69	72	2.2	253	60	130	323	
TOTAL														
AVERAGE														

STATIC PRESSURE = -0.68 "H_2O

STATIC PRESSURE = -0.68 "H_2O

P.T.O.

Meter Volume

Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME = Ft.3 y

(GA)

PARTICULATE FIELD DATA

(CONT.) 51 (WB) 250±25°F

Run No. PA-77-10-10 | Amb. Temp. °F 56 (DB) | Probe Tip Dia., In 1/4" | Heater Box Setting

Location NORTH STACK | Bar. Press. "Hg. 29.54 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/10/77 | Assumed Moist 15% | Inp. Nos. 9→12 | READ & RECORD AT THE

Operator DVV | Test Periods 192 MIN | Sample Box No. PART. | START OF EACH TEST

48 PTS @ 4 MIN EACH | f = .72 | POINT

Point	Clock Time 12:5A	Dry Gas Meter C.F. 564.32	Pitot In. H_2O ΔP	Pitot In. H_2O $\sqrt{\Delta P}$	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
3-24	:56	565.68	.30	.55	.34	.26	68	69	3.5	179	57	154	371	
23	13:00	567.28	.30	.55	.34	.35	68	70	3.5	185	59	155	370	
22	:04	568.78	.28	.53	.32	.31	68	70	3.2	228	60	158	378	
21	:08	570.26	.30	.55	.34	.30	68	70	3.2	270	60	163	368	
20	:12	571.81	.32	.56	.37	.34	68	71	3.5	272	60	168	366	
19	:16	573.35	.30	.55	.34	.33	68	72	3.0	248	59	193	361	
18	:20	574.74	.30	.55	.34	.27	69	72	3.0	256	59	158	369	
17	:24	576.20	.28	.53	.32	.30	69	72	3.2	272	60	161	369	
16	:28	577.68	.28	.53	.32	.30	69	72	3.0	254	60	156	370	
15	:32	579.16	.28	.53	.32	.30	68	72	3.0	255	60	155	361	
14	:36	580.62	.28	.53	.32	.30	68	72	3.0	261	61	154	360	
13	:40	582.10	.30	.55	.34	.30	69	74	3.0	236	60	152	359	
12	:44	583.57	.28	.53	.32	.30	70	74	3.0	209	60	149	359	
11	:48	584.99	.28	.53	.32	.28	69	73	3.0	262	59	150	365	
10	:52	586.43	.25	.50	.28	.29	69	73	2.8	249	59	149	354	
9	:56	587.86	.28	.53	.32	.29	69	73	2.8	227	60	149	355	
8	14:00	589.25	.25	.50	.28	.27	69	73	2.8	249	60	150	356	
7	:04	590.74	.25	.50	.28	.30	69	74	2.5	255	60	148	356	
6	:08	591.96	.25	.50	.28	.21	69	74	2.5	207	61	147	355	
5	:12	593.34	.25	.50	.28	.26	69	74	2.8	237	61	148	357	
4	:16	594.73	.25	.50	.28	.27	70	74	2.8	254	61	147	365	
3	:20	596.07	.25	.50	.28	.24	70	74	2.8	252	60	147	352	
2	:24	597.43	.20	.45	.23	.25	70	74	2.8	226	60	146	358	
1	:28	598.81	.20	.45	.23	.26	69	74	2.8	273	59	145	361	
TOTAL				25.06		14.23	3277	3458					17455	
AVERAGE				0.52		0.29	68	72					363	

(530) Meter Volume — Dry Meter Calibration Factor (823)

CORRECTED SAMPLE VOLUME = 69.9 Ft³ × .805 = 56.25

RUN NO. PA-77-10-10 NORTH STACK

PARTICULATE & WATER CATCH

IMPINGER NO. 9	Final Weight 754.34	WATER WEIGHT GAIN	IMPINGER 1 190.81
	Initial Weight 563.53		IMPINGER 2 -72.65
IMPINGER NO. 10	Final Weight 568.67		IMPINGER 3 10.64
	Initial Weight 581.32		IMPINGER 4 11.18
IMPINGER NO. 11	Final Weight 462.70		TOTAL 199.98
	Initial Weight 456.06		ORSAT —
IMPINGER NO. 12	Final Weight 809.59		CO_2 7.2
	Initial Weight 798.41		$M_s = 28.34$ O_2 15.2
FILTER NO. #27	Final Weight .7514		CO —
	Initial Weight .7083		N_2 77.6
	Part. Catch .0431		

SOLID WEIGHT GAIN

Filter → .0431

BEAKER NO. 1 (IMPINGER)	Final Weight 112.8534	BEAKER 1 .0663
	Initial Weight 112.7871	~~BEAKER 2~~ —
	Increase .0663	BEAKER 28 .0462
BEAKER NO. —	Final Weight —	~~BEAKER 4~~ —
	Initial Weight —	TOTAL .1556
	Increase —	
BEAKER NO. —	Final Weight —	
	Initial Weight —	
	Increase —	
BEAKER NO. 28 (PROBE WASH)	Final Weight 140.9185	
	Initial Weight 140.8723	
	Increase .0462	

Moisture Content: Sample Vol. 68.85 ft.^{3} x $\frac{(530)}{460 + \text{Meter Temp}}$ x 28.3 L/ft.^{3} = 1948 L Dry Gas

Water Weight 199.98 gm. x 24.1 L/mol. / 18 gm./mol. = 268 L H_2O Vapor

Total = 2216

H_2O Vol. / Total = 268 L / 2216 L x 100 = 12.1%

[redacted] PARTICULATE FIELD DATA [redacted]

45 (WB) RH = 75%

Run No. PA-77-10-11 | Amb. Temp. °F. 47 (DB) | Probe Tip Dia., In. 1/4" | Heater Box Setting 250±25°F

Location NORTH STACK | Bar. Press. "Hg. 29.69 | Probe Length 15 ft

Date 10/11/77 | Assumed Moist 12% | Inp. Nos. 17 → 20

Operator DVV | Test Periods 192 MIN | Sample Box No. PART.

48 PTS. @ 4 MIN EACH | f = (74)

FILL IN ALL BLANKS. READ & RECORD AT THE START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:47	599.11	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
A-1	:51	600.40	.20	.45	.24	.23	70	71	3.0	175	66	103	335	
2	:55	601.68	.20	.45	.24	.23	69	71	2.8	193	66	102	335	
3	:54	603.16	.25	.50	.30	.30	68	70	3.2	212	65	103	338	
4	10:03	604.69	.28	.53	.33	.32	68	70	3.2	270	65	131	347	
5	:07	606.19	.28	.53	.33	.31	67	70	3.0	271	65	133	348	
6	:11	607.84	.32	.56	.39	.37	67	71	3.5	269	65	167	354	
7	:15	609.40	.30	.55	.35	.34	66	71	3.2	228	65	161	353	
8	:19	610.98	.30	.55	.35	.34	66	71	3.2	279	65	160	352	
9	:23	612.56	.30	.55	.35	.34	66	71	3.2	260	66	159	353	
10	:27	614.22	.32	.56	.39	.38	67	72	3.5	234	66	159	357	
11	:31	615.74	.30	.55	.35	.34	66	72	3.2	247	67	158	360	
12	:35	617.33	.30	.55	.35	.33	67	72	3.2	267	67	159	362	
13	:39	618.87	.28	.53	.33	.33	67	73	3.2	238	67	162	371	
14	:43	620.42	.28	.53	.33	.33	67	73	3.0	248	67	158	374	
15	:47	621.97	.30	.55	.35	.34	68	73	3.2	266	67	155	378	
16	:51	623.52	.32	.56	.39	.33	67	73	3.5	258	67	155	385	
17	:55	625.10	.32	.56	.39	.35	67	73	4.0	203	67	157	385	
18	:59	626.88	.32	.56	.39	.43	66	72	4.0	256	65	155	386	
19	11:03	628.28	.35	.59	.43	.27	67	73	4.5	249	66	157	356	
20	:07	629.89	.35	.59	.43	.36	67	73	4.8	232	65	154	355	
21	:11	631.51	.35	.59	.43	.36	68	73	4.8	218	64	153	388	
22	:15	633.18	.35	.59	.43	.39	67	73	5.0	221	64	153	383	
23	:19	634.85	.32	.56	.39	.37	67	73	5.0	248	65	154	383	
24	:23	636.61	.30	.55	.35	.43	68	73	4.8	215	65	152	383	
TOTAL														
AVERAGE														

STATIC PRESSURE = − 0.60" H_2O

STATIC PRESSURE = − 0.60 "H_2O

P.T.O.

Meter Volume | Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME = Ft.3 X

(CONT.)

(CARB)

PARTICULATE FIELD DATA

Run No. PA-77-10-11 | Amb. Temp. °F. 45 (WB) 47 (DB) | Probe Tip Dia., In. 1/4" | Heater Box Setting 250±25°F

Location NORTH STACK | Bar. Press. "Hg. 29.69 | Probe Length 15 ft | FILL IN ALL BLANKS READ & RECORD AT THE START OF EACH TEST POINT

Date 10/11/77 | Assumed Moist 12% | Inp. Nos. 17 → 20

Operator DVV | Test Periods 192 MIN 48 PTS. @ 4 MIN EACH | Sample Box No. PART. # = (74)

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	11:48	636.61	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
B-1	:52	638.25	.28	.53	.33	.37	68	70	4.0	224	65	171	356	
2	:56	639.85	.28	.53	.33	.35	68	70	4.0	244	66	176	356	
3	12:00	641.46	.30	.55	.35	.35	68	70	3.5	217	66	175	382	
4	:04	643.08	.30	.55	.35	.35	68	70	3.5	244	66	173	381	
5	:08	644.76	.33	.57	.39	.39	67	70	3.8	245	66	172	386	
6	:12	646.45	.33	.57	.39	.39	67	71	3.8	259	66	172	379	
7	:16	648.07	.30	.55	.35	.36	67	71	3.5	262	66	171	381	
8	:20	649.63	.30	.55	.35	.33	67	71	3.2	243	65	172	382	
9	:24	651.19	.30	.55	.35	.34	68	72	3.2	219	66	172	378	
10	:28	652.76	.30	.55	.35	.34	68	72	3.2	240	65	173	378	
11	:32	654.32	.28	.53	.33	.33	68	73	3.2	247	65	174	376	
12	:36	655.88	.28	.53	.33	.33	68	73	3.2	265	66	172	375	
13	:40	657.56	.28	.53	.33	.34	68	73	3.0	272	65	170	371	
14	:44	658.99	.28	.53	.33	.28	68	73	3.0	259	64	172	367	
15	:48	660.53	.28	.53	.33	.33	69	74	3.0	262	64	169	369	
16	:52	662.04	.28	.53	.33	.32	69	74	3.0	248	61	174	365	
17	:56	663.44	.26	.51	.32	.27	69	74	5.0	251	61	173	365	
18	13:00	664.93	.28	.53	.33	.30	69	74	5.0	253	61	174	368	
19	:04	666.42	.29	.53	.33	.30	69	74	5.0	243	63	171	370	
20	:08	667.90	.28	.53	.33	.30	69	73	5.5	254	63	197	371	
21	:12	669.38	.28	.53	.33	.30	69	73	5.5	261	63	188	373	
22	:16	670.79	.28	.53	.33	.27	69	74	5.8	229	62	189	371	
23	:20	672.16	.20	.45	.24	.26	69	74	5.8	243	61	198	374	
24	:24	673.62	.20	.45	.24	.30	68	73	5.8	261	61	192	362	
TOTAL				25.83		15.97	3250	3465					17781	
AVERAGE				0.54		0.33	68	72					370	

(530) Meter Volume | Dry Meter Calibration Factor | (830)

CORRECTED SAMPLE VOLUME = 74.51 Ft.3 × .98 = 73.02

RUN NO. PA-77-10-11 Vath

PARTICULATE & WATER CATCH Stack

IMPINGER NO. 17	Final Weight 698.85	WATER WEIGHT GAIN	IMPINGER 1 145.31
	Initial Weight 553.54		IMPINGER 2 15.34
IMPINGER NO. 18	Final Weight 582.77		IMPINGER 3 15.12
	Initial Weight 567.43		IMPINGER 4 20.01
IMPINGER NO. 19	Final Weight 468.14		TOTAL 195.78
	Initial Weight 453.02		
IMPINGER NO. 20	Final Weight 798.57		ORSAT
	Initial Weight 778.56		CO_2 7.6
FILTER NO. #28	Final Weight .8413	$M_S = 28.48$	O_2 14.6
	Initial Weight		CO —
	Part. Catch .6587		N_2 77.8
	.1426		

SOLID WEIGHT GAIN

			Filter .1426
BEAKER NO. 33 (IMPINGER)	Final Weight 146.1325		BEAKER 33 .0464
	Initial Weight 146.0865		BEAKER 25 .0115
	Increase .0464		~~BEAKER 3~~
BEAKER NO.	Final Weight		~~BEAKER 4~~
	Initial Weight		TOTAL .2005
	Increase		
BEAKER NO.	Final Weight		
	Initial Weight		
	Increase		
BEAKER NO. 25 (PROBE WASH)	Final Weight 148.6402		
	Initial Weight 148.6287		
	Increase .0115		

Moisture Content: Sample Vol 73.39 ft.^{3} x $\frac{(530)}{460 + 70}$ x 28.3 L/ft.^{3} = 2077 L Dry Gas

(530)°R

Water Weight $\frac{195.78}{18}$ gm. x $\frac{24.1 \text{ L}}{\text{mol.}}$ = 262 L H_2O Vapor

Total 2339

H_2O Vol. $\frac{262 \text{ L}}{2339 \text{ L}}$ x 100 = 11.2%
Total

PARTICULATE FIELD DATA (SHARON)

43 (WB) RH = 56%

250 ± 25°F

Run No. PA-78-10-12 | Amb. Temp. °F 50 (DB) | Probe Tip Dia., In 1/4 | Heater Box Setting √

Location NORTH STACK | Bar. Press. "Hg. 29.68 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/12/77 | Assumed Moist 12% | Inp. Nos. 25 → 28 | READ & RECORD AT THE

Operator DVV | Test Periods 192 MIN | Sample Box No. PART. | START OF EACH TEST POINT

48 PTS. @ 4 MIN EACH $f = .74$

Point	Clock Time	Dry Gas Meter C.F.	Pitot In., H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
			ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
	9:26	673.92												
24	:30	675.44	.28	.53	.34	.32	70	71	3.5	168	57	157	369	
23	:34	676.88	.28	.53	.34	.33	69	71	3.2	220	57	164	362	
22	:38	678.50	.28	.53	.34	.32	68	70	3.2	249	55	168	363	
21	:42	680.04	.25	.50	.30	.33	68	71	3.2	262	55	168	359	
20	:46	681.56	.28	.53	.34	.32	68	71	3.2	254	56	184	357	
19	:50	683.10	.25	.50	.30	.33	67	70	3.2	247	55	170	356	
18	:54	684.54	.26	.50	.30	.29	68	71	3.0	262	56	169	348	
17	:58	686.05	.27	.50	.32	.31	68	72	3.2	237	55	168	354	
16	10:02	687.62	.25	.50	.30	.29	68	72	3.2	218	55	171	356	
15	:06	688.94	.28	.53	.34	.24	68	72	3.8	209	55	172	357	
14	:10	690.09	.28	.53	.34	.19	68	70	3.8	214	54	154	357	
13	:14	691.36	.25	.50	.34	.23	68	70	3.8	234	56	160	357	
12	:18	692.68	.27	.52	.32	.24	68	70	3.8	261	56	161	361	
11	:22	693.71	.27	.52	.32	.15	68	70	3.8	217	55	157	363	
10	:26	694.63	.27	.52	.32	.12	68	71	3.8	217	54	155	358	
9	:30	695.90	.27	.52	.32	.23	69	71	3.8	235	55	157	362	
8	:34	697.52	.28	.53	.34	.35	68	72	3.8	227	56	159	366	
7	:38	699.88	.28	.53	.34	.80	68	72	4.0	211	57	154	364	
6	:42	700.84	.27	.52	.32	.13	69	73	4.0	219	57	155	369	
5	:46	702.39	.27	.52	.32	.34	69	73	4.2	213	56	155	366	
4	:50	703.93	.25	.50	.30	.33	69	74	4.2	225	57	158	372	
3	:54	705.45	.22	.47	.26	.32	69	74	4.2	242	57	158	375	
2	:58	707.16	.20	.45	.24	.41	69	74	4.2	233	56	159	374	
1	11:02	708.82	.18	.42	.21	.37	69	74	4.8	241	56	152	364	
TOTAL														
AVERAGE														

STATIC PRESSURE = -2.64 "H

Meter Volume

Dry Meter Calibration Factor

P.T.O

CORRECTED SAMPLE VOLUME =

Pg 3

[redacted] PARTICULATE FIELD DATA (GAS)

(CONT.)

Run No. PA-77-10-12
Location NORTH STACK
Date 10/12/77
Operator D.V.K.

Amb. Temp. °F. 43 (WB) 50 (DB)
Bar. Press. "Hg. 29.68
Assumed Moist 12%
Test Periods 192 MIN
48 PTS @ 4MIN EACH

Probe Tip Dia., In. 1/4
Probe Length 15 ft
Inp. Nos. 25 → 28
Sample Box No. PART.
f = 1.74

250 ± 25°F
Heater Box Setting
[redacted] ALL BLANKS
[redacted] READ & RECORD AT
[redacted] START OF EACH TEST
POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	12:12	708.82	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
B-24	:16	710.19	.32	.56	.39	.26	68	69	5.0	208	54	164	378	
23	:20	711.45	.30	.55	.35	.21	68	69	5.0	219	55	163	378	
22	:24	713.38	.32	.56	.39	.52	69	71	5.0	255	57	160	376	
21	:28	715.34	.32	.56	.39	.54	69	72	5.0	295	57	144	377	
20	:32	717.25	.35	.59	.43	.52	69	73	4.5	267	57	146	380	
19	:36	718.94	.35	.59	.43	.39	69	73	4.0	269	57	146	384	
18	:40	720.67	.30	.55	.35	.41	69	73	3.8	260	57	148	378	
17	:44	722.34	.30	.55	.35	.39	69	74	3.8	297	57	149	379	
16	98	723.89	.30	.55	.35	.33	69	74	3.8	268	57	151	377	
15	12:52	725.43	.28	.53	.34	.33	69	74	3.8	274	57	151	377	
14	:56	726.94	.28	.53	.34	.32	69	74	3.2	252	57	150	370	
13	13:00	728.48	.28	.53	.34	.33	69	74	3.5	283	58	150	367	
12	:04	730.00	.28	.53	.34	.32	69	74	3.5	247	58	150	358	
11	:08	731.51	.26	.51	.32	.32	69	74	3.5	261	58	182	351	
10	:12	732.97	.26	.51	.32	.30	70	75	3.5	269	57	149	354	
9	:16	734.55	.28	.53	.34	.34	70	75	3.8	251	56	148	353	
8	:20	736.17	.28	.53	.34	.35	70	75	3.8	269	55	146	353	
7	:24	737.67	.26	.51	.32	.31	71	75	3.5	274	55	147	346	
6	:28	739.18	.26	.51	.32	.32	71	75	3.5	249	54	144	343	
5	:32	740.68	.26	.51	.32	.30	70	75	3.5	264	54	144	331	
4	:36	742.18	.25	.50	.30	.31	70	75	3.5	244	54	145	334	
3	:40	743.63	.23	.48	.27	.28	70	74	3.2	268	53	145	327	
2	:44	745.07	.23	.48	.27	.28	70	74	3.2	236	54	147	327	
1	13:48	746.31	.15	.39	.17	.21	70	74	2.8	231	54	147	325	
TOTAL				24.89		15.53	3307	3484					17328	
AVERAGE				0.52		0.32	69	73					361	

(531) Meter Volume

(821) Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME = 72.39 Ft.3 × 0.985 = 71.31 ft.3

RUN NO. PA-7710_12 Nos 1 & 5 Stack

PARTICULATE & WATER CATCH

IMPINGER NO. 25	Final Weight 693.65	WATER WEIGHT GAIN	IMPINGER 1 146.55
	Initial Weight 547.10		IMPINGER 2 11.55
IMPINGER NO. 26	Final Weight 568.76		IMPINGER 3 2.08
	Initial Weight 557.41		IMPINGER 4 30.16
IMPINGER NO. 27	Final Weight 457.75		TOTAL 190.3
	Initial Weight 455.67		
IMPINGER NO. 28	Final Weight 785.11		ORSAT
	Initial Weight 754.93		CO_2 7.5
		$M_S = 28.48$	O_2 15.1
FILTER NO. 25	Final Weight .7459		CO —
	Initial Weight		N_2 77.4
	Part. Catch .7065		
	.0390		

SOLID WEIGHT GAIN

			Filter .0390
BEAKER NO. 31 (IMPINGER)	Final Weight 145.2600		~~BEAKER 1~~
	Initial Weight 145.1265		BEAKER 31 .1335
	Increase .1335		BEAKER 32 .0914
BEAKER NO. ____	Final Weight ____		~~BEAKER 4~~
	Initial Weight		TOTAL .2639
	Increase ____		
BEAKER NO. 32 (PROBE WASH)	Final Weight 145.2144		
	Initial Weight 145.1230		
	Increase .0914		
BEAKER NO. PROBE WASH	Final Weight ____		
	Initial Weight		
	Increase ____		

Moisture Content: Sample Vol. 71.30 ft.^{3} x $\frac{530}{460 + 70}$ / $\frac{460 + \text{Meter}}{53/\text{Temp.}}$ X 28.3 L/ft.^{3} = 20 14 L Dry Gas

Water Weight 192.36 gm. / 18 gm. mol. x 24.1 L / mol. = 257 L H_2O Vapor

Total = 2269 L

H_2O Vol. $\frac{257 \text{ L}}{\text{Total}}$ x 100 = 11.2%

Interoffice Memo

LONE STAR INDUSTRIES, INC.

Originating Office: Nazareth, Pa.

Date: June 21, 1977

COPY

M. Messinger

TO: W. Hurst

FROM: T. L. Mendez

SUBJECT: Precipitator & Stack Testing
Nazareth Plant - 1977

cc: Messrs. M.Reid, C.Moore, Hurley, Boyer, Newman, G.F.Messinger

This is to confirm our telephone conversation of June 21, on the above subject. It was agreed that you will be at the Nazareth Plant on August 1 of this year ready to begin testing of all four of our precipitators and their respective stacks. The main scope of work is to determine the precipitator efficiencies as well as the emission rates from each of the stacks. The latter work is the one in which the local DER will be very much interested in.

We would also like to state again that unfortunately the water spray system which we were trying out on our #2 kiln with hopes of installing in the other kilns has not been successful. Therefore the tests to be made will be done without any additional water spray cooling of our kiln gases. We have installed the kiln feed end seals in all the kilns. They are operating very satisfactorily in all kilns except in #2. Shortly after installing this one we found that the kiln after expanding was rubbing the springs and holders very hard; therefore, we had to pull out the springs, holders, and carbon blocks. In this kiln, although it does not have the new seal per se, we do feel presently it infiltrates less amounts of air than before doing this work.

If you feel there is any work that we can do prior to your arrival, please advise.

We are looking forward to your visit!

Tomas L. Mendez

TLM:CHI

Interoffice Memo

LONE STAR INDUSTRIES, INC.

P. O. Box 2148, Houston, Texas 77001

Originating Office: Central Research Laboratory

Date: June 30, 1977

75

PERSONAL & BUSINESS CONFIDENTIAL

TO: ~~P. L. Mendez~~

FROM: W. W. Hurst

SUBJECT: Emission Testing at Nazareth - 1977 Scope of Work

CC: C. D. Fehnel
S. S. Fritts
C. W. Moore
F. Newman

Your request for work activity in the field of Emission Testing is herein acknowledged and the following program is offered for your consideration and approval.

1. Testing objective is to furnish Nazareth group, as well as, the Corporate group, source emission data generated by procedures, testing equipment, and methods acceptable to the Pennsylvania Air Pollution Emission Control Authority.

2. Plans are to leave Houston July 27, so as to transfer mobile lab from Greencastle to Nazareth and be ready for testing on August 1. We will consider this period for starting firm unless we hear from you or you hear from us that rescheduling is necessary. This time of the year, we should not experience abnormal delays due to weather problems.

3. At each stack, we plan to conduct three individual tests for both sulfur and particulate emissions with test occurring at different periods and so that the test for sulfur and for particulates will occur simultaneously. During the particulate and SOX runs by EPA Methods, we will monitor stack for SOX and NOX with our Envirometric equipment. A comparison with our Envirometric results and EPA results can be developed.

4. A precipitator efficiency evaluation will be made by simultaneously testing the precipitator input and stack for particulate emissions. Each kiln operation will be tested three (3) times per usual.

5. Additional tests over and above as outlined in (3 & 4) will not be made unless preliminary findings indicate erroneous final results or specific requests are made by management.

6. Testing time will consume a minimum of 24 - eight hour - shifts. To set-up, move to new location and gather equipment will require an additional 8 shifts. In the event we have breakdowns or breakdowns occur effecting the operation, more time will be required. We can count on some inclement weather causing lost time.

We plan to work one shift per day on a 2 week cycle so as to work 8 days, travel 2 and off 4. This plan necessarily means we work every other weekend which we trust will not create undue hardship from a scheduling point of view. The tour will likely consume the better part of two months overall. Reporting will be within a week after we receive all results of supporting data.

7. We will need the full time help of 2 plant people. They do not need to be technical people but willing to learn and climb stack.

8. We do not need power accessible to test ports since we work via an umbilical cord connected to the Mobile Laboratory. However, we do need a source of 440 volts A.C. within 100' of Mobile Lab, as it would logically be located with respect to testing locations, so as to power our whole system. The power facility should be readily available or require minimum modification after we are on location.

9. If there have been no modifications since our last tour, test ports exist with only some of the support outriggers to handle the gear. Main locations requiring outriggers remaining are the stack ports. Since stack ports are available only at 90° spacing, we have to span the complete stack diameter in order to develop a traverse. Accordingly, we have to use a 12' probe due to lost annular space, liner brick and stack wall. The 12' probe plus 2' for impinger box means we need an outrigger 15' long extending beyond each port for each stack. Due to the excessive length of these outriggers, it might be well to use a double section of unistrut channel spot welded "back to back" to give greater support and prevent buckling under load. In any event, the important detail is the spacing of outrigger with respect to port center. I am enclosing 3 copies of sketch showing the "outrigger vs. port center" spacing with a proposed method for supporting outriggers, etc. Contact me if all is not clear.

10. As back-up data and to extend our understanding of product sulfurization and particulate abatement, we plan to collect samples for analysis and gather rate data concurrently with testing.

(a) Generally, we will need individual 2 hr. samples of coal fuel, raw mix kiln feed, clinker and discarded kiln dust along with rate data of these parameters. As in the past, we will have coal analyzed by an outside laboratory. Our testing program will provide similar information on kiln exit gases.

(b) We would like to start sampling at the time we begin testing and continue until we complete our test.

(c) Needless to say, we need the best possible rate data. Therefore, if any preliminary adjustment can be made to improve the accuracy of measuring quantities of materials involved, we should make these adjustments before starting the test. We especially need a good handle on the quantity of kiln dust discarded from system under test.

(d) Chemically, we will need a sulfur determination on each day's composites of clinker, raw mix, and dust - along with alkali. A complete analysis on each weekly composite of clinker, raw mix, and dust should suffice. A single composite of coal will be sufficient for "ultimate analysis" (Carbon, Hydrogen, Oxygen, and Sulfur).

All individual samples should be clearly marked with date and time and saved for possible re-check if final results indicate discrepancy.

(e) Rate data should be recorded on a 2 hr. basis unless the data is recorded on a chart that can be transcribed at the end of test period.

(f) Manpower needed to sample and record usage rates will be over and above the people needed for assisting with the emission gas testing.

If there are any questions and/or modifications to the program that are considered advisable and/or necessary, all concerned are asked to contact me so that we can finalize the program.

Bill

WWH/po

& 08 77

Interoffice Memo

LONE STAR INDUSTRIES, INC.

One Greenwich Plaza, Greenwich, Connecticut 06830

Originating Office: Nazareth, Pa.

Date: August 4, 1977

Responded in letter dated August 9, 1977 GFM

TO: G. F. Messinger

FROM: W. W. Hurst

SUBJECT: Pennsylvania Environmental Quality Board Regulations

CC: T. L. Mendez
C. D. Fehnel
C. W. Moore

You will recall testing is about to get under way at Nazareth with respect to stacks and precipitators per my letter on this subject to T. Mendez dated June 30.

Testing is proceeding in accordance with current EPA Methods modified per Pennsylvania Rules which were given to me during 1974 testing tour by Penn. Regulatory people.

They are:

Title 25. Rules and Regulations
Part I. Department of Environmental Resources
Sub-Part C. Protection of Natural Resources
Article III - Air Resources
Chapter 121 - General Provisions
Chapter 123 - Standards For Contaminants
Chapter 129 - Standards For Sources
Chapter 135 - Reporting of Sources
Chapter 139 - Sampling and Testing

It has occurred to me there might be a later directive modifying methods cited above.

Do you have a later and revised version of any of these chapters? If so, please forward copies to me.

If you are not sure you have the latest test methods, will you contact Penn. people for same or do you want me to contact them?

Would you prefer to drop the whole matter and assume the regulations are applicable and/or sufficiently correct at this time?

We will proceed with the rules at hand until we hear from you with instructions.

WWH/aks

Thanks-
Bill

Interoffice Memo

LONE STAR INDUSTRIES, INC.

Originating Office: C&CM Group - Technical

Date: August 8, 1977

TO: W. W. Hurst

FROM: G. F. Messinger

SUBJECT: Pennsylvania Environmental Quality Board Regulations

Replying to your letter dated August 4, 1977 it is the responsibility of the field operations to maintain an "up-to-date" file on local and state regulations, and they should be able to respond to your request for the latest regulations.

I do have access to the B.N.A. Environmental Reporter and from such attempt to maintain an up date of those regulations for States wherein we have operations for our departmental reference requirements.

According to my accounting, the following tabulation indicates the latest effective date for each of the chapters referenced in your letter:

Chapter 121	-	October 31, 1973
Chapter 123	-	August 9, 1976
Chapter 129	-	August 9, 1976
Chapter 135	-	March 20, 1972
Chapter 139	-	March 20, 1972

Apparently Chapters 123 and 129 have been revised since you obtained your copies. Therefore, in order not to delay your work, I am enclosing copies herewith of those two chapters.

G. F. Messinger

GFM/jml

cc: T. M. Mendez
C. D. Fehnel
C. W. Moore

Interoffice Memo

LONE STAR INDUSTRIES, INC.

One Greenwich Plaza, Greenwich, Connecticut 06830

Originating Office: Nazareth, Pa.

Date: September 13, 1977

W. Messinger

PERSONAL & BUSINESS CONFIDENTIAL

TO: T. L. Mendez

FROM: W. W. Hurst

SUBJECT: Extended Testing at Nazareth - 1977 Scope of Work - Revision 1

CC: C. D. Fehnel
C. F. Messinger
C. W. Moore
F. J. Newman

Recently, we discussed problems associated with the Fuller Water Spray System as applied to kiln operation with end result seemingly giving rise to additional precipitator load resulting in presumably greater stack emissions and lost production as wasted increased dust load.

You have requested expanded testing to, in fact, validate current impressions and quantitate Emission, Dust Load, etc. levels that might be attributed to Spray System Operation.

Depending on data that might be generated by proposed Spray System Operation, consider additional test toward optomizing overall operation utilizing Spray System technique.

Since all kiln systems are different, any development work would be restricted to a single system, where practical, in the interest of economy and minimize interruption of plant operation.

Each mode of Kiln System operation would be tested 3 times to obtain an average of reasonable creditability.

Proposed work would be in addition to - not in place of - work proposed and agreed upon in the original "Scope Work" outlined in letter dated, June 30, 1977.

9-16-77
Talked to Tommy on this today and told him to arrange to get whatever testing they can by Nov. 1.

Accordingly, the Nazareth tour would likely be extended a month or so depending on results obtained during testing, etc.

Some talk about work at Roanoke this year exist following the completion of Nazareth project scheduled around October 1. (Original Project) Therefore, any additional work at Nazareth, as herein outlined, is predicated on priority level of Roanoke work.

We concur further testing is needed at Nazareth and offer services to the limit of our authority; however, interested parties in Greenwich will make the final decision as to our availability for proposed extended work.

Yours very truly,

Bill

W. W. Hurst

WWH/aks

Interoffice Memo

LONE STAR INDUSTRIES, INC.

Originating Office: C&CM Group - Technical

Date: September 20, 1977

TO: T. L. Mendez

FROM: G. F. Messinger

SUBJECT: Extended Testing at Nazareth -
1977 Scope of Work - Revision 1

This is to confirm our telephone conversation of September 16, relating to Bill Hurst's letter of September 13.

It was advised that it was agreeable to expand the testing program at the Nazareth plant so long as the work could be completed by November 1, 1977.

You and Bill are to work out a schedule for the program and advise accordingly.

G. F. Messinger

GFM/jml

cc: C. D. Fehnel
W. W. Hurst/D. Vu
C. W. Moore
F. J. Newman

SULFUR DIOXIDE EMISSION TESTING

NAZARETH PLANT

1977

Interoffice Memo

LONE STAR INDUSTRIES, INC.

P. O. Box 2148, Houston, Texas 77001

Originating Office: Central Research Laboratory

Date: November 8, 1977

PERSONAL & BUSINESS CONFIDENTIAL

TO: T. L. Mendez

FROM: W. W. Hurst

SUBJECT: Sulfur Dioxide Emission Testing at Nazareth Plant

CC: G. F. Messinger
C. D. Fehnel
C. W. Moore

Stack Sulfur Dioxide emissions were tested on working days between August 12 and October 15. Survey included 12 runs on stacks. Testing was conducted in accordance with EPA Methods 1-4 and 8 for Stationary Sources as given in Fed. Register, Vol. 35, No. 247, dated December 23, 1971 and amended June 8, 1976.

Objective was to determine normal level of stack sulfur dioxide emissions.

Results showed: Normal stack sulfur dioxide emissions for North Stack serving Kilns 2 and 3 averaged 1038.2 lbs/hr. or 926 ppm (dry basis), whereas, the allowable for Pennsylvania Rule was 500 ppm (dry basis) at the production level during testing. Normal stack sulfur dioxide emissions for South Stack serving Kilns 4 and 5 averaged 893.5 lbs/hr. or 952 ppm (dry basis) whereas the allowable was 500 ppm (dry basis).

Respectfully submitted,

W. W. Hurst, P.E.

WWH/po

Encl.

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1. Introduction

In order to evaluate the present status of emissions from Nazareth stacks, Mr. Mendez requested source test for stack emissions in his letter on this subject dated June 21, 1977. The objectives, as stated, were to determine the sulfur dioxide emission rates from each of the stacks. The testing program was conducted on selected days between August 12 and October 15.

The purpose of this report is to present test data and evaluate the results with regard to present source standards for the state of Pennsylvania and Environmental Protection Agency.

The test program consisted of 12 runs. Eight tests were made on the North Stack and four on the South Stack. All results obtained are considered to be representative of the true conditions, though the first five runs were made with a stainless steel probe liner and the last seven were made with a teflon liner.

The report is divided into six major sections: (1) Current regulations are discussed, (2) Process parameters and operating equipment are established, (3) test equipment and procedures are described, (4) the test program results are discussed and compared to allowable limits, (5) conclusions are stated, (6) recommendations are offered.

II. Regulations

Source standards for stack sulfur dioxide emissions applicable to the Nazareth plant are covered by Pennsylvania State Environmental Quality Board Regulation Title 25 - Rules and Regulations, Department of Environmental Resources, Chapter 123 - Standards for Contaminants, Sulfur Compound Emissions.

In accordance with Pennsylvania rules, Regulation 123.21 general, subsection (b) - "No person shall cause, suffer, or permit the emission into the outdoor atmosphere of sulfur oxide from any source, in such a manner that the concentration, at any time, of sulfur oxides, expressed as SO_2, in the effluent exceeds 500 ppm by volume (dry basis)."

This rule clearly applies to our operation at Nazareth since there were no subsections that applies to "Portland Cement Production" with a specific formula for calculating the allowable sulfur emissions.

Apparently, the lack of an "Allowable Formula" for a particular operation type has not been an oversight since subsection 123.22 deals specifically with "Combustion Units" and defines in detail sulfur emission allowables for a combustion unit.

It might be argued that the kiln or clinkering process was a particular application of the general class of combustion unit operations and, therefore, the "Combustion Unit Rule" applies to our operation. This interpretation, however, was probably not the intent of the regulatory people. This credence was based on the fact that under "Particulate Matter Emissions", which has been given much more detailed and specific guidelines, the separate types of operations - 123.11 Combustion Unit and 123.13 Processes - have been assigned distinctly separate allowable formula.

Pennsylvania State Regulations explicitly designates in Chapter 139, Sampling and Testing, rather extensive data concerning process parameters, testing equipment details and sampling procedures. Most state regulations do not require detailed data in these catagories. Accordingly, process parameters and operating equipment specifications along with testing equipment and procedures are detailed in the following sections of the report.

III. Operating Equipment and Process Parameters

Two medium size, dry process clinker kilns are operated - each with its own flue gas transporting ducts, gas conditioning equipment and dust abatement equipment - with the cleaned and cooled flue gas fed to a single stack for waste gas dissemination. Flue gases leave the kilns at 1100-1200°F with conditioning consisting of both water and ambient air in proper proportions to provide gas entering the precipitators at around 600°F and 10-15% water. In all, there are 4 kilns with 2 stacks. Each stack (North and South) is supplied gas by the same configuration as described above. See Fig. 3 which shows the general equipment arrangement.

Stack discharge location was 230 ft. above foundation (foundation 3 ft. above plant base*). Test ports were located 111 ft. above foundation where the stack diameter was 11'-0". Each stack had two - 4" test ports placed at 90° apart and in the same elevation plane. At the 111 ft. elevation, ports were 4.6 flue diameters from the stack input ducts in the upwind direction and 10.8 flue diameters from discharge on the downwind side of ports. See Sketch, Fig. 1 for details. Accordingly, the upwind direction becomes the most critical with respect to duct disturbance. Using EPA chart - flue diameters vs. test points on traverse - we estimate stack traverse should have 48 test points with locations as shown in Sketch, Fig. 2.

A complete listing of process conditions during each source test is tabulated. Note Table 3 shows raw mix feed rate, fuel rate, clinker production rate, clinker dust rate, precipitator dust rate. Also, flue gas characteristics including velocity, pressure, temperature, moisture, density and chemical analyses (CO_2, O_2) are tabulated in Tables 4-7. Additionally, note composite chemical analyses of coal fuel, raw mix, clinker, clinker dust and precipitator dust (Table 8).

* Plant base 550 ft. (approx.) above sea level.

IV. Test Equipment and Testing Procedures

The Sampling Train used for source testing was basically a Model AP-5000 "Stac-O-Lator" manufactured by Scientific Glass and Instruments, Inc. of Houston and has been EPA approved. The impinger type and charge was in accordance with EPA recommendation. The glass fiber filters were 3" Gelman, Type A.

We used the EPA sampling procedure as modified by Penn. State requirements. Each test was 2-3 hours long generally sampling at 0.5 CFM dry gas. Each of the stack test gathered well over 50 cu.ft. The train was leak checked at the start and end of each run at about 17" Hg. rather than 15" Hg. as required by EPA. Our control valves are at equilibrium with pump at 17" Hg. rather than 15" Hg.

Both stainless steel and stainless steel, teflon lined heated probe liners were used for stack testing. Probes were thoroughly washed with alcohol following each test with nozzle removed. Reassembled clean probes were leak checked @ 25" Hg. vacuum with no noticable leaks tolerated. Probes have been modified for proper spacing of nozzle vs. pitot tube in accordance with EPA's recent change (August, 1977).

We operate out of a 30' mobile laboratory so that all sample recovery, such as titrating and washing is done within the air-conditioned mobile laboratory.

Laboratory analysis are performed strictly in accordance with EPA. We generally run blanks on each alcohol and distilled water lot.

We use two Thermo Electric digital thermocouple indicators, Model ELPA with a 1° accuracy. The indicators are elétrically connected through switching to a Thermo Electric "Minimite" which is used to calibrate the temperature range of interest per test. The "Minimite" has an accuracy of $\pm$ 1/4%. Calibration of thermocouple indicators occurs at the beginning of each plant run and more often if it seems necessary or a significant change occurs in the range of testing interest.

Four dry test Rockwell meters are calibrated at the start of each plant test. Part of the mobile laboratory equipment is a Precision Wet Test Meter, Serial No. AA-9 which is used to standardize the dry test meters. The wet meter is calibrated annually by equipment traceable to the Bureau of Standards.

The orifice used for " Δ H" readings is calibrated at random periods whenever the " Δ H" vs. CFM calibration charts show significant variation.

We use a L & N Analyzer for continuous monitoring of CO_2, CO and O_2 that records during each run. Additionally, near the middle of each run we grab a sample for Orsat Analysis. Agreement in L & N vs. Orsat is good since we use Orsat to calibrate L & N with respect to CO_2 and O_2. CO is calibrated with a span gas of approx. 0.15% CO in nitrogen.

V. Discussion of Results

A. Stack Testing

Stacks at Nazareth were about average in size (diameter) at the test ports but complicated to test since they possessed only 2 test ports at 90° spacing. Technically, this met all requirements for proper traversing but practically meant the probe length must be a long 15'. Operating with a 15' probe is like the "tail wagging the dog". If the usual 4 ports had been available, the work could have been done with 6' probes which could be easily handled. The longest probe we had at the outset was 10' so that we improvised and added to the 10' probe a 5' nozzle, (normal nozzles are 5"-6"). This modification, though difficult to handle, to our knowledge was perfectly legitimate and seemed to do the job in an acceptable manner (see Runs 2-10, Table 1).

There seemed to develop in the impinger solutions a faint blue-green tint that heretofore had not been noticed in other Method 8 tests. Concentrating some of the impinger solution and evaporating to dryness produced a blue-green gunk that was assumed to be chronium-nickel compounds. This fact was later confirmed by laboratory analysis. Apparently, the sulfiric acid mist contained in the stack gas was at such a level that it dissolved some of the stainless steel probe liner at a perceptible rate. A reaction between the stainless steel probe liner and stack gases has not heretofore been detected.

The question might develop as to why there was not a glass liner in the probe. There was too much bending in a 15' probe so that glass liners would break about as fast as they could be installed. (Only one of the several disadvantages of a long probe).

Since the stack temperature was under 500°F., other options were available. We were able to obtain a new probe - 15' in length - with a teflon liner. The teflon lined probes were used for Runs 50-62. The data generated indicates relatively clear impinger catches free from the blue-green gunk.

Results from Method 8 seem consistent and accurately tell the story. It was obvious that the SO_2 content of flue gases at Nazareth was higher than any previously encountered due to the intense odor of SO_2 in samples that escaped in the mobile lab. (Most of the sample gas was vented to the outside).

Also, note the coal analysis with almost 3% sulfur (2.84). This compared to less than 2% sulfur in coal at Greencastle and around 1% at Roanoke. Theory says that clinker operation will do a good job of absorbing sulfur until the "threshold" is reached but beyond this point, sulfur in the system is almost quantitatively converted to sulfur emissions.

Under present conditions, sulfur emissions at Nazareth were hopelessly beyond allowable limits. To alleviate this problem would require major changes, such as, a new fuel supply of low sulfur coal and/or large expenditure for scrubbing equipment.

Probably, all 20 some old cement plants in the Lehigh Valley have a similar problem - a fact that is undoubtedly known by local regulatory people. With the present status of both the energy and economic climate, it would seem the regulatory people have a temporary "hold" on discussing and enforcing sulfur allowable.

SOX and NOX results were recorded almost daily with the Environmetric Detector. Note Xerox copies included for your consideration.

During almost 3 months of consideration, it was felt the Nazareth stack gases have been at a comparatively consistent 1000 $\pm$ 200 ppm concentration of SO_2. This opinion was backed up by Method 8 results and our sense of smell. Nothing has changed - reasonably good kiln operation and uniformly high sulfur coal - which were the primary factors controlling SOX emissions. Yet, during this period, SOX recordings on several occasions varied from near zero to 1000+ ppm. For a period and

until we ran out of calibration gas, the equipment was calibrated each day. At each calibration, some adjustment was made which indicates poor equipment longterm stability. In view of Method 8 results and supporting facts, it is hard to reconcile the variations in SOX recordings indicated by Environmetric Analyzer.

The NOX results were also somewhat inconsistent, though NOX results were possibly better than SOX, there was a noticably large lag period to reach equilibrium. Conceivably, the high level of SOX adversely influenced the NOX readings since these two parameters are interrelated in the Environmetric technique. Depending on the strip charts selected, one might conclude NOX at the Nazareth plant also range from near zero to 1000 ppm plus.

Considering individual results, please note Run 54 was out of line with an exceptionally high value for acid and correspondingly low value for SO_2. Recall, the impinger train was arranged to absorb acid in alcohol solution first with an isolation filter followed by a hydrogen peroxide solution for absorbing SO_2. When Run 54 was processed, it was noted most of the H_2O_2 solution in the #2 impinger had been inadvertently sucked into #1, alcohol impinger, due to a back pressure development. This, of course, meant not only the acid but also SO_2 would be absorbed in the #1 impinger labeled for acid absorption only - thus, the reason for abnormal results. These results have been included in the report since the total sulfur value was valid though the proportion of acid vs. SO_2 was incorrect.

VI. Conclusions

Sulfur Dioxide emissions from each stack was well above the limits allowed by Pennsylvania Environmental Quality Board Regulations.

The nature and corrosive influence of Nazareth gases required teflon lined probes so that the stack gases will not react with conventional stainless steel probe liner.

Results obtained using stainless steel probe liners seem valid even though there was a reaction between the stack gases and probe liner.

Environmentric SOX and NOX recorder failed to consistently show high level sulfur emission levels which were believed to be, in fact, the prevailing true condition.

VII. Recommendations

It is recommended the stack sulfur dioxide emissions be monitored every 18 mo. to 2 yrs. so as to keep all interested parties informed of current conditions. Thus, maintain an up-to-date case history of sulfur emissions at Nazareth.

TABLE I

NAZARETH STACK EMISSION SURVEY

SO_2 EMISSION RATE

1977

Run No.	Date	Exhaust Gas Temp. °F	Exhaust Gas Press. "Hg	Exhaust Gas Volume ACFM	Vol. Gas Sampled @ Std.Cond. Dry, Cu.Ft.	SO_2 Emission Rate Lbs/Hr* (Dry)	SO_2 Emission Rate ppm** (Dry)
A - Stainless Steel Line Probe							
North Stack :							
2	8-12	363	29.51	183,000	65.08	1017.4	968.4
4	8-14	359	29.50	185,000	61.46	858.2	811.5
6	8-15	358	29.73	185,000	61.97	1010.5	973.9
8	8-16	366	29.65	190,000	68.34	1094.4	1038.7
10	8-17	359	29.34	186,500	66.50	895.1	869.2
Ave.					64.67	975.1	932.3
B - Teflon Line Probe							
North Stack :							
54	10-10	362	29.49	219,000	69.57	1080.9	886.5
56	10-11	368	29.65	219,200	74.45	1104.1	909.3
58	10-12	360	29.63	210,700	73.20	1118.9	963.6
Ave.					72.41	1101.3	919.8
South Stack :							
50	10-6	362	29.58	177,600	60.01	1038.9	1048.8
52	10-7	366	29.80	169,800	59.51	882.8	939.1
60	10-13	384	29.67	168,100	59.20	902.3	1000.4
62	10-14	391	29.39	173,800	59.45	749.9	819.8
Ave.					59.54	893.5	952.0

* Total SO_2 (Lbs/Hr) = SO_2(Lbs/Hr, Table 2A) + $\left(H_2SO_4\text{(Lbs/Hr, Table 2B)} \cdot \frac{64}{98}\right)$

** ppm (dry basis) = $\left[SO_2 \frac{\text{Lbs}}{\text{SCF} \times 10^{-6}} + \left(H_2SO_4 \frac{\text{Lbs}}{\text{SCF} \times 10^{-6}} \times 64/98\right)\right] \times 387/64$

TABLE 2A

NAZARETH EMISSION SURVEY

SULFUR DIOXIDE EMISSION - EPA METHOD 8

1977

(a) Normality of Std. H_2SO_4 - 0.010
(b) Mls. Std. H_2SO_4 used - 20.00
(c) Mls. Barium Perchlorate Soln. Req'd - 20.30
(d) Normality of $Ba(ClO_4).3H_2O$ Soln. - 0.0095
(d) = (a)(b)/(c)

Run No.	Location	(e) Tot.Vol. Peroxide/ SO_2, Mls.	(f) Aliquot Titrated Mls.	(g) Quantity Factor (e)/(f)	(h) Vol. Gas Sampled @ Std.Cond. Dry,Cu.Ft.	(i) $Ba(ClO_4)$ Soln. Titrant Mls.
2	N.Stack	590	1	590	65.08	23.95
4	"	640	"	640	61.46	18.45
6	"	670	"	670	61.97	20.38
8	"	710	"	710	68.34	23.20
10	"	680	"	680	66.50	19.70
54	"	370	"	370	69.57	4.00
56	"	585	"	585	74.45	27.72
58	"	710	"	710	73.20	24.07
50	S.Stack	605	1	605	60.01	25.55
52	"	600	"	600	59.51	22.65
60	"	645	"	645	59.20	22.47
62	"	610	"	610	59.45	19.45

TABLE 2A

(Continued)

(j) Blank Corr. Mls.	(k) Net Titrant Mls. (i)-(j)	(l) Run Constant (7.05×10^{-5}) x(d)x10^{-7}	(m) Conc. SO_2 Lbs/Std. C.F. Dry $\frac{(l)(k)(s)}{(n)} \times 10^{-6}$	(n) Conc. as Sulfur Lbs/Std. C.F. Dry (0.5)x(m) x10^{-6}	SO_2 Lbs/Hr @ Std.Cond. Dry (m)x(CFH)	
0.05	23.90	6.70	145.17	72.58	922.3	2
"	18.40	"	128.37	64.19	820.9	4
"	20.33	"	147.27	73.63	924.0	6
"	23.15	"	161.14	80.57	1026.6	8
"	19.65	"	134.62	67.31	838.3	10
"	3.95	"	14.08	7.04	103.8	54
"	27.67	"	145.67	72.83	1069.5	56
"	24.02	"	156.10	78.05	1096.1	58
0.05	25.50	6.70	172.24	86.12	1031.7	60
"	22.60	"	152.67	76.33	867.8	62
"	22.42	"	163.66	81.83	892.6	64
"	19.40	"	133.37	66.68	737.7	66

TABLE 2B

NAZARETH EMISSION SURVEY

SULFURIC ACID & SULFUR TRIOXIDE EMISSION - EPA METHOD 8

1977

(a) Normality of Std. H_2SO_4 - 0.010
(b) Mls. Std. H_2SO_4 used - 20.00
(c) Mls. Barium Perchlorate Soln. Req'd - 20.30
(d) Normality of $Ba(ClO_4).H_2O$ Soln. - 0.0095

Run No.	Location	(e) Tot.Vol. Alcohol/ H_2SO_4 Mls.	(f) Aliquot Titrated Mls.	(g) Quantity Factor (e)/(f)	(h) Vol.Gas Sampled @ Std.Cond. Dry,Cu.Ft.	(i) $Ba(ClO_4)$ Soln. Titrant Mls.
2	N.Stack	480	1	480	65.08	3.07
4	"	550	"	550	61.46	1.02
6	"	605	"	605	61.97	2.15
8	"	510	"	510	68.34	2.17
10	"	590	"	590	66.50	1.58
54	"	610	"	610	69.57	22.52
56	"	745	"	745	74.45	0.75
58	"	590	"	590	73.20	0.65
50	S.Stack	360	1	360	60.01	0.35
52	"	450	"	450	59.51	0.57
60	"	450	"	450	59.20	0.40
62	"	435	"	435	59.45	0.50

TABLE 2B

(Continued)

(j) Blank Corr. Mls.	(k) Net Titrant Mls. (i)-(j)	(l) Run Constant (1.08×10^{-4}) x(d)$\times 10^{-6}$	(m) H_2SO_4 Lbs/Std. C.F. Dry $\frac{(l)(k)(g)}{(n)} \times 10^{-6}$	(n) Conc.as Sulfur Lbs/Std. C.F. Dry (.327)x(m) $\times 10^{-6}$	H_2SO_4 Lbs/Hr @ Std.Cond. Dry (m)x(CFH)	
0.05	3.02	1.03	22.94	7.05	145.7	2
"	0.97	"	8.94	2.92	57.2	4
"	2.10	"	21.12	6.90	132.5	5
"	2.12	"	16.29	5.33	103.8	4
"	1.53	"	13.96	4.57	87.0	3
"	22.47	"	202.93	66.36	1496.2	57
"	0.70	"	7.21	2.36	52.9	56
"	0.60	"	4.98	1.63	35.0	58
0.05	0.30	1.03	1.85	0.60	11.1	59
"	0.52	"	4.05	1.32	23.0	57
"	0.35	"	2.74	0.89	14.9	60
"	0.45	"	3.39	1.11	18.7	60

TABLE 3

NAZARETH EMISSION SURVEY

PROCESS RATES, CONSUMPTION AND PRODUCTION

1977

Run No.	Date	Kiln No.	Coal* Fuel Rate T/Hr	Kiln Feed T/Hr	Clinker Produced T/Hr	Clinker Dust T/Hr	Precip.& Multiclone Dust T/Hr
2	8-12	2	4.2	33.3	19.3	---	---
		3	4.1	33.0	19.2	---	---
4	8-14	2	4.2	33.8	19.5	---	---
		3	4.5	34.2	19.8	---	---
6	8-15	2	4.1	34.1	19.8	0.1	1.3
		3	4.0	33.3	19.3	0.1	---
8	8-16	2	4.2	33.5	19.4	0.1	1.2
		3	3.8	34.0	19.7	0.1	---
10	8-17	2	3.9	34.2	19.9	0.1	1.2
		3	4.0	34.4	20.0	0.1	---
Ave.(North Stack)			8.2	67.6	39.2	0.2	2.4
54	10-10	2	4.2	30.0	17.4	0.1	---
		3	4.6	32.9	19.1	0.2	---
56	10-11	2	4.1	29.3	17.0	0.1	2.0
		3	4.0	30.5	17.7	0.2	1.0
58	10-12	2	4.0	30.1	17.5	0.1	2.2
		3	3.9	32.5	18.9	0.2	1.1
Ave.(North Stack)			8.3	61.8	35.9	0.3	3.1

*Coal Mill Feed Moisture (Ave.) for Runs 2-10 was 6.6%
" " " " " for Runs 54-58 was 7.0%

TABLE 3

(Continued)

Run No.	Date	Kiln No.	Coal* Fuel Rate T/Hr	Kiln Feed T/Hr	Clinker Produced T/Hr	Clinker Dust T/Hr	Precip.& Multiclone Dust T/Hr
50	10-6	4	3.1	27.6	16.0	---	---
		5	3.1	27.3	15.9	---	---
52	10-7	4	3.3	29.9	17.3	0.2	1.2
		5	3.3	27.5	15.9	0.2	1.2
60	10-13	4	3.5	29.1	16.9	0.3	1.1
		5	3.2	26.9	15.6	0.1	1.0
62	10-14	4	3.4	28.7	16.7	0.1	1.1
		5	3.2	26.0	15.1	0.1	1.1
Ave.(South Stack)			6.5	55.7	32.3	0.3	2.2

*Coal Mill Feed Moisture (Ave.) for Runs 50-62 was 5.0%

TABLE 4

NAZARETH EMISSION SURVEY

EXHAUST GAS CHARACTERISTICS

1977

Run No.	Pitot Tube Factor	Temp. ^{o}R T_s	% Water in Gas	Gas Density Lbs/Lb-Mole	Stack Gas Press. "Hg	Stack Gas Press. "H_2O
2	0.80	823	8.8	29.13	29.51	-0.40
4	"	819	9.6	28.40	29.50	-0.45
6	"	813	12.1	28.12	29.73	-0.43
8	"	826	12.0	28.11	29.65	-0.44
10	"	819	12.2	28.10	29.34	-0.45
54	0.84	822	11.6	28.40	29.49	-0.65
56	"	828	11.9	28.40	29.65	-0.55
58	"	820	13.1	28.26	29.63	-0.68
50	0.84	822	11.7	28.57	29.58	-0.72
52	"	826	12.6	28.42	29.80	-0.65
60	"	844	13.1	28.32	29.67	-0.70
62	"	851	13.2	28.31	29.39	-0.64

TABLE 5

NAZARETH EMISSION SURVEY

EXHAUST GAS FLOW RATE

1977

Run No.	Barometric Press. "Hg	Stack Area Sq. Ft.	ΔP "H_2O	Velocity Ft/Sec	Volume ACFM	Volume CFH (Dry) @ Stand. Cond. x10^6
2	29.54	95.0	0.48	32.10	183,000	6.353
4	29.54	"	0.48	32.46	185,000	6.395
6	29.76	"	0.48	32.46	185,000	6.274
8	29.68	"	0.49	33.34	190,000	6.371
10	29.37	"	0.48	32.72	186,500	6.227
54	29.54	"	0.54	38.42	219,000	7.373
56	29.69	"	0.54	38.46	219,200	7.342
58	29.68	"	0.52	36.96	210,700	7.022
50	29.63	95.0	0.44	31.15	177,600	5.990
52	29.85	"	0.42	29.79	169,800	5.684
60	29.72	"	0.41	29.50	168,100	5.454
62	29.44	"	0.42	30.49	173,800	5.531

TABLE 6

NAZARETH EMISSION SURVEY

GAS SAMPLING AND TESTING PARAMETERS

1977

Run No.	Test Nozzle Size Sq.Ft.	Test Duration Min.	Meter Temp. ^{o}R	Meter Vol. @ Meter Cond. Cu.Ft.	Meter Vol. @ Stand. Cond. Cu.Ft.Dry	Meter Press. "Hg	Meter Press. ΔH "H_2O	% Isokinetic
2	.000327	192	531	65.99	65.08	29.57	0.44	93.0
4	"	"	534	62.67	61.46	29.57	0.39	87.3
6	"	"	532	62.49	61.97	29.79	0.39	89.6
8	"	"	531	68.97	68.34	29.71	0.48	97.3
10	"	"	532	67.95	66.50	29.40	0.47	97.3
54	"	"	529	70.25	69.57	29.58	0.50	85.7
56	"	"	530	74.94	74.45	29.73	0.57	92.0
58	"	"	529	73.57	73.20	29.72	0.55	94.7
50	"	"	530	60.57	60.01	29.65	0.36	90.9
52	"	"	530	59.62	59.51	29.87	0.35	95.0
60	"	"	529	59.47	59.20	29.74	0.35	98.5
62	"	"	530	60.39	59.45	29.46	0.35	97.8

TABLE 7

NAZARETH EMISSION SURVEY

GAS ANALYSIS

1977

Run No.	Date	Gas Composition - % @ Sampling Ports CO_2	O_2	N_2
@ Stacks :				
2	8-12	10.0	15.0	75.0
4	8-14	5.0	17.5	77.5
6	8-15	5.0	17.5	77.5
8	8-16	4.7	18.5	76.8
10	8-17	5.0	17.5	77.5
54	10-10	7.2	15.2	77.6
56	10-11	7.6	14.6	77.8
58	10-12	7.5	15.1	77.4
Ave.(North Stack)		6.5	16.4	77.1
50	10-6	8.6	15.0	76.4
52	10-7	8.4	14.6	77.0
60	10-13	8.0	15.0	77.0
62	10-14	8.0	15.0	77.0
Ave.(South Stack)		8.3	14.9	76.8

TABLE 8

NAZARETH EMISSION SURVEY

CHEMICAL ANALYSIS

1977

Composite Analyses	Kiln Feed	Clinker	Clinker Dust	Precipitator Dust	Multiclone Dust
SiO_2	13.81	21.36	21.91	15.69	17.20
Al_2O_3	3.24	5.08	3.88	6.80	6.75
Fe_2O_3	1.52	2.86	2.45	3.77	4.38
CaO	43.76	66.82	67.98	42.55	48.47
MgO	1.86	2.79	2.52	1.16	1.65
SO_3	0.31	0.33	0.31	13.41	7.66
Na_2O	0.06	0.10	0.10	0.35	0.30
K_2O	0.52	0.51	0.40	7.52	3.94
Loss	34.92	0.15	0.45	8.75	9.65
Total	100.0	100.0	100.0	100.0	100.0

TABLE 9

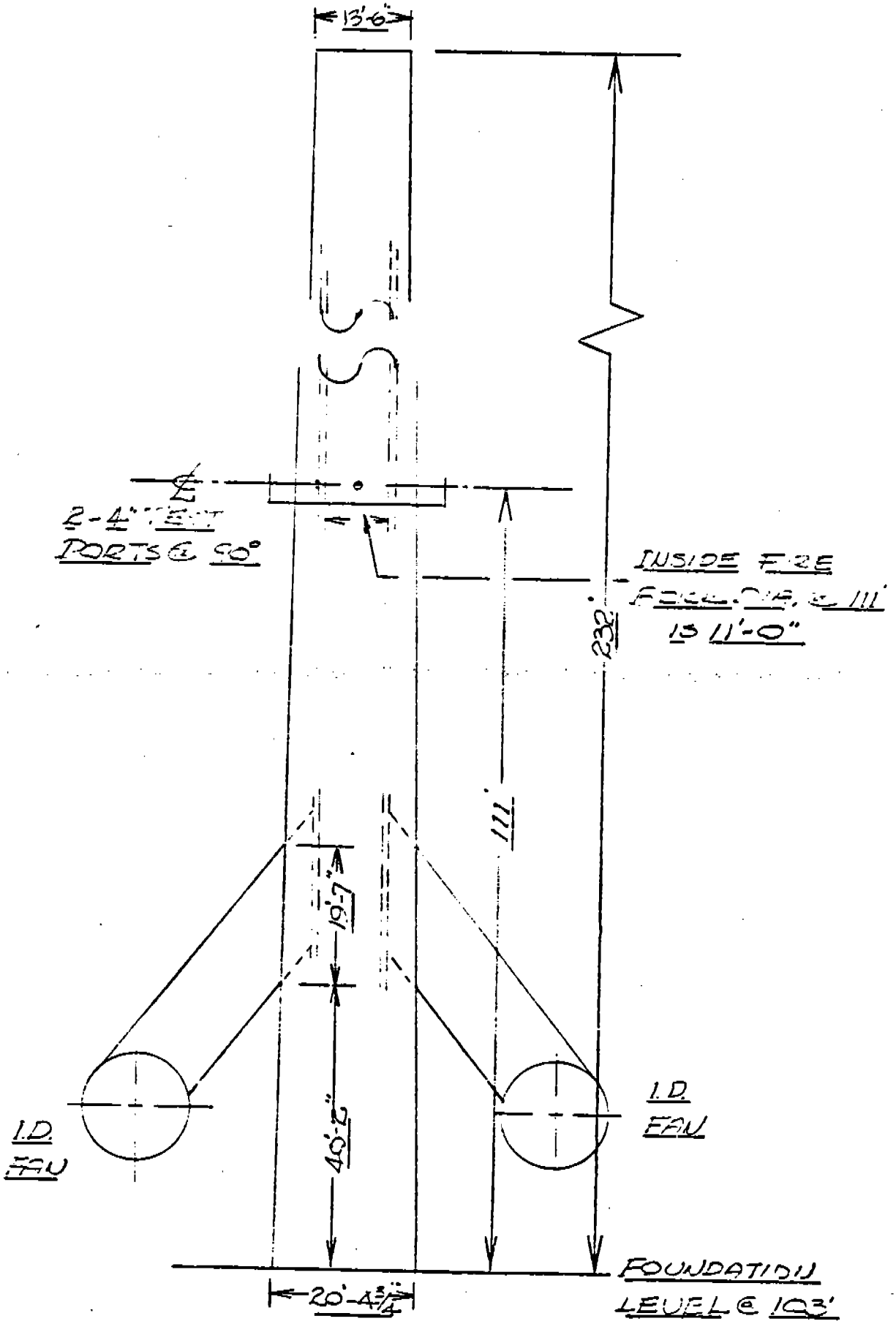
NAZARETH EMISSION SURVEY

METEOROLOGICAL CONDITIONS

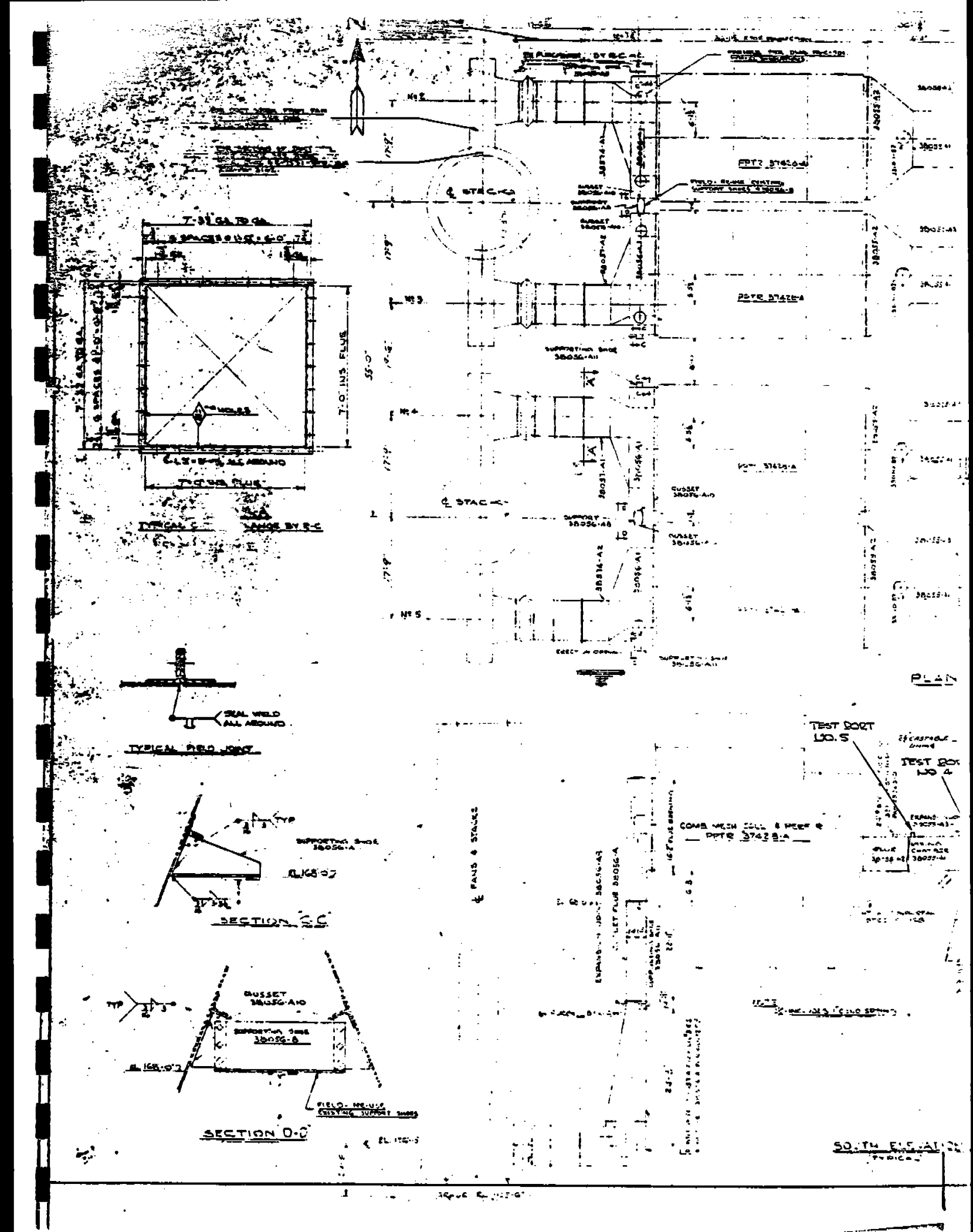
1977

Run No.	Relative Humidity	Ambient Temp. °F	Barometric Pressure, "Hg
2	74	79	29.54
4	89	74	29.54
6	60	73	29.76
8	84	73	29.68
10	99	76	29.37
54	74	56	29.54
56	75	47	29.69
58	56	50	29.68
60	72	47	29.72
62	80	53	29.44
50	80	61	29.63
52	65	48	29.85

FIG. 1



NAZARETH STACK


PLAN
SECTION C-C
SECTION D-D
TYPICAL PIPE JOINT
SOUTH ELEVATION
TEST PORT NO. 5
TEST PORT NO. 4
FANS & STACKS
SUPPORTING SHOE 38056-A
GUSSET 38056-A10
SUPPORTING SHOE 38056-B
SEAL WELD ALL AROUND
7'-0 INS FLUE
STACK

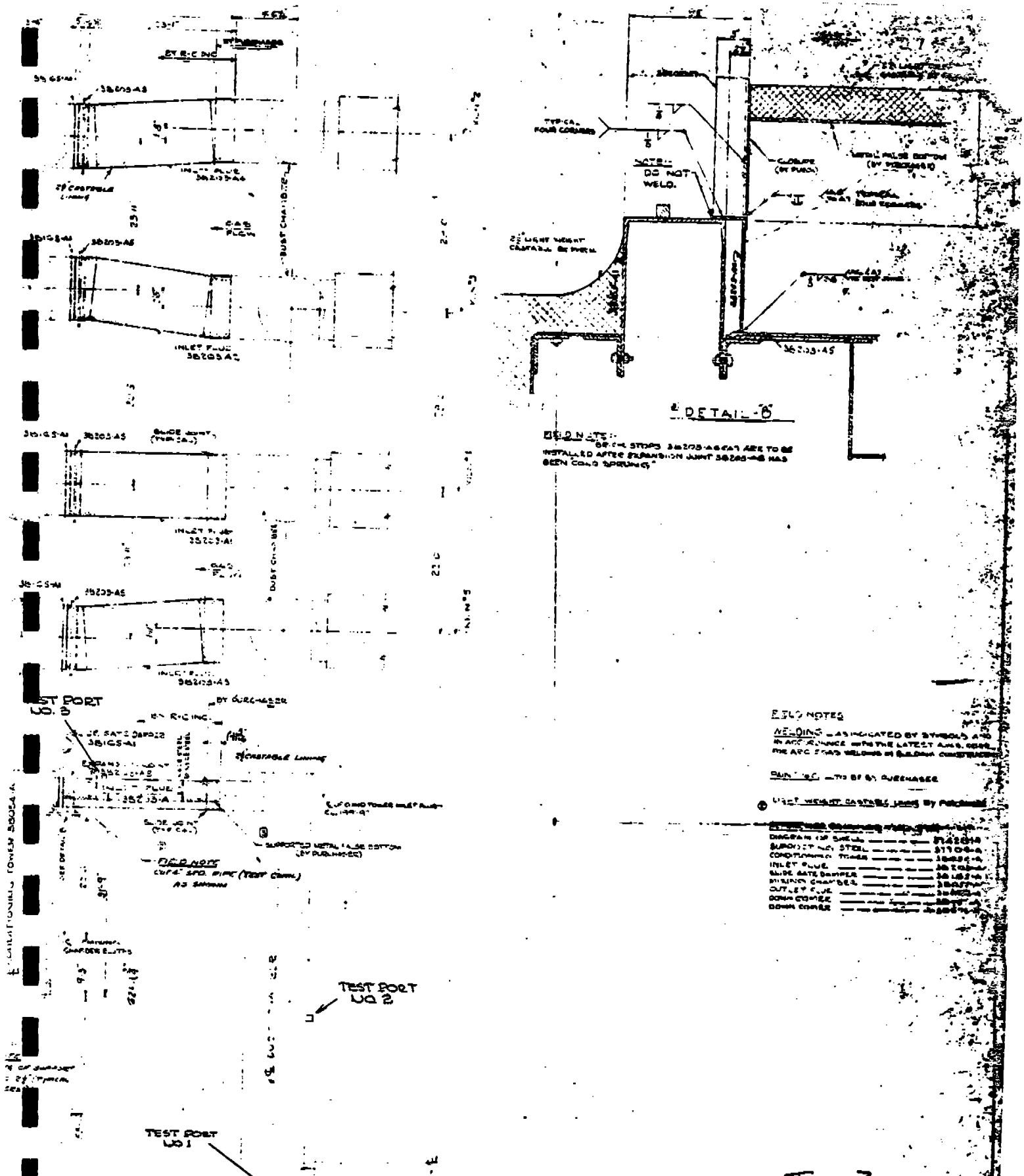

DETAIL "B"
TEST PORT NO. 3
TEST PORT NO. 2
TEST PORT NO. 1
DO NOT WELD.
RESEARCH-COTTRELL, INC.
STEEL ERECTION PLANS
PERFORATED PLATE PRECIPITATOR CONDITIONING TOWER ARRANGEMENT

FIG 3

#38207-A

Appendix 1

Material Balance Calculations

(Sample Calculation for Runs 54, 56 and 58)

I. Fuel Consumption Calculation - Molal Basis

A. Coal Analysis

See Appendix 3 for the copy of letter enclosed from Pittsburgh Testing Laboratory showing ultimate analysis of average sample gathered during testing, on the dry basis. Accordingly, ultimate coal analysis corrected for moisture of 7.0% is:

% Component	Dry Basis	Coal Mill Feed "As Used"
Carbon	71.54	66.53
Hydrogen	4.72	4.39
Nitrogen	1.37	1.27
Oxygen	5.92	5.51
Sulfur	2.84	2.64
Water	None	7.00
Ash	13.61	12.66
Total	100	100

Btu per Pound: 12,751

B. Distribution of Combustable and Products

Line	Constituent	Fuel, Oxygen & Air per 100 Lbs. Coal: Lbs. per 100 Lbs. Coal	Mol. Wt. Divisor	Moles Fuel Constituent	O_2 Multiplier	O_2 Moles Theo. Req'd.	Moles/100 Lbs. Coal As Used: CO_2	SO_2	O_2	N_2	H_2O
1	C to CO_2	66.53	12	5.54	1	5.54	5.54	--	--	--	--
2	H_2 to H_2O	4.39	2	2.19	0.5	1.10	--	--	--	--	2.19
3	S to SO_2	2.64	32	0.08	1	0.08	--	0.08	--	--	--
4	O_2 (Deduct)	5.51	32	0.17	---	-0.17	--	--	--	--	--
5	N_2	1.27	28	0.04	---	0	--	--	--	0.04	--
6	Water	7.00	18	0.39	---	0	--	--	--	--	0.39
7	Ash	12.66	--	--	---	0					
8	Total	100	--	8.41	---	6.55					
9	Therfore, O_2 required, Line 8 -					6.55					
10	Recall, Mole Ratio of N_2 to O_2 in Air is 3.76										
11	Then, N_2 with Air -					24.63				24.63	
12	Dry Air supplied (Line 9+11) -					31.18					
13	H_2O in Air - (0.0086)* x (31.18)					0.27					0.27
14	Wet Air supplied (Line 12+13) -					31.45					
15	Flue Gas Constituents (Line 1 to 14) Total						5.14	0.08		24.67	2.85

Total Moles Dry Flue Gas / 100 Lbs. Coal As Used - 29.89

Total Moles Wet Flue Gas / 100 Lbs. Coal As Used - 32.74

*Molal Humidity For Ambient Air @ 51 °F & 68% Relative Humidity

II. Theoretical Combustion Gas Quantities - (No Excess Air)

1. The average fuel coal used by kilns during testing for Runs 54, 56, 58 (North Stack with kilns 2 and 3) was 8.3 ton/hr, or:

$$\frac{(8.3)(2000)}{(60)} = 276.7 \text{ lbs/min.}$$

Accordingly, 100 lbs. coal supplies fuel for:

$$\frac{100}{276.7} = 0.36 \text{ min. of kilns operation}$$

2. Therefore, referring to I-B:

(a) Theoretical Dry Air supplied for total combustion:

$$\frac{(31.18)(387)}{(0.36)} = 33,518.5 \text{ SCFM}$$

$$\text{Wet Air Supplied} = \frac{(31.43)(387)}{(0.36)} = 33,808.7 \text{ SCFM}$$

$$H_2O \text{ in Air} = 33,808.7 - 33,518.5 = 290.2 \text{ SCFM}$$

(b) Flue Gas Components:

$$CO_2 = \frac{(5.54)(44)}{(0.36)} = 677.1 \text{ lbs/min.}$$

$$H_2O = \frac{(285)(18)}{(0.36)} = 142.5 \text{ lbs/min.}$$

$$N_2 = \frac{(24.67)(28)}{(0.36)} = 1918.8 \text{ lbs/min.}$$

$$SO_2 = \frac{(0.08)(64)}{(0.36)} = 14.2 \text{ lbs/min.}$$

3. Breakdown of Water Source

(a) Combustion Water:

$$\frac{(2.19)(18)}{(0.36)} = 109.5 \text{ lbs/min.}$$

(b) Water in Coal as ued:

$$\frac{(0.39)(18)}{(0.36)} = 19.5 \text{ lbs/min.}$$

(c) Water in Combustion Air:

$$\frac{(0.27)(18)}{(0.36)} = 13.5 \text{ lbs/min.}$$

III. (a) Liberation of CO_2 from Raw Mix

Average Raw Mix feed rate during test was 61.8 ton/hr. or 2060.0 lbs/min. dry solids.

Raw Mix chemical analysis (Table 8) was used to determine the available CO_2 liberated from $CaCO_3$ and $MgCO_3$:

$$(\%\ CaO) \times \frac{(100)}{(56)} = (\%\ CaCO_3)$$

$$= (43.76)\frac{(100)}{(56)} = 78.14\%$$

$$(\%\ MgO) \times \frac{(84)}{(40)} = (\%\ MgCO_3)$$

$$= (1.86)\frac{(84)}{(40)} = 3.91\%$$

From $CaCO_3$, $CO_2 = \frac{(78.14)(44)}{(100)} = 34.38$ lbs/100 lbs. of raw mix

From $MgCO_3$, $CO_2 = \frac{(3.91)(44)}{(84)} = 2.05$ lbs/100 lbs. of raw mix

Total CO_2 = 36.43 lbs/100 lbs. of raw mix

or,

$$CO_2 = \frac{(36.43)(2060)}{(100)} = \underline{750.5}\ \text{lbs/min.}$$

(b) Water from Cooling Process

During normal operation conditions, Nazareth Plant used approx. 30 gal/min. of water per kiln to cool kiln exit gases. However, the plant used, in addition, another 30 gal/min. (approx.) of water for kiln No. 2 (only) in Fuller Spray System. Therefore, total cooling water used for kilns 2 and 3 was: $[(2)(30) + 30] \times (8.33) = \underline{749.7}$ lbs/min.

IV. Theoretical Kiln Exist Gas - (No Excess Air)

1. Total Exit Gas Quantities (per min. of kilns operation)

Source	CO_2(lbs)	H_2O(lbs)	N_2(lbs)
(a) Combustion Process	677.1	109.5	1918.8
(b) Raw Mix Liberation	750.5	--	--
(c) Cooling Process	--	749.7	--
TOTAL	1427.6	859.2	1918.8

2. Exit Gas Analysis - Wet Basis

$$CO_2 \text{ (Moles)} = \frac{1427.6}{44} = 32.4$$

$$H_2O \text{ (Moles)} = \frac{859.2}{18} = 47.4$$

$$N_2 \text{ (Moles)} = \frac{1918.8}{18} = 68.5$$

TOTAL 148.6 moles/min.

Hence:

$$CO_2 = \frac{32.4}{148.6} \times 100 = 21.8\%$$

$$H_2O = \frac{47.7}{148.6} \times 100 = 32.1\%$$

$$N_2 = \frac{68.5}{148.6} \times 100 = 46.1\%$$

3. Exit Gas Analysis - Dry Basis

$$CO_2 = \frac{(21.8)}{(1 - 0.321)} = 32.1\%$$

$$N_2 = \frac{(46.1)}{(1 - 0.321)} = 67.9\%$$

4. Theoretical Exit Gas Volume

At Standard Conditions (70°F and 29.92" Hg),

Volume = (148.6)(387) = 57,508 SCFM (Wet)

or = (57,508)(1 - 0.321) = 39,048 SCFM (Dry)

V. Actual Stack Gas at Sampling Ports

1. Exhaust Gas included not only Theoretical Combustion Flue Gas and Excess Air but also Infiltrated Air at kiln exit, precipitator, etc. From here forward, the term Excess Air will be used instead of Excess and Infiltrated Air.

2. Average Orsat Analysis taken from Exhaust Gas are showing along with Theoretical Gas Analysis:

Orsat Analysis (Dry)	Theo. Analysis (Dry)
CO_2 - 7.4	CO_2 - 32.1
O_2 - 15.0	O_2 - 0
N_2 - 77.6	N_2 - 67.9

3. Excess Air Calculation - CO_2 Balance (Using Above Analyses)

(Vol. Comb. Gas)(% CO_2) + (Vol. Excess Air)(% CO_2) = (Vol. Actual Gas)(% CO_2)

Let X = Vol. Comb. Gas (relative)
100-X = Vol. Excess Air (relative)
100 = Vol. Actual Gas (relative)

then,

$$(X)(32.1) + (100-X)(0) = (100)(7.4)$$
$$32.1\ X = 740$$
$$X = 23.0\% \text{ (Comb. Gas)}$$
$$(100-X) = 77.0\% \text{ (Excess Air)}$$

From IV-4 above, the theoretical dry Exit Gas was 39,048 SCFM, therefore, Actual Kiln Exit Gas (Dry) was:

$$\frac{39,048}{0.23} = 169,774 \text{ SCFM - Dry}$$

Excess Air: 169,774 - 39,048

= 130,726 SCFM - Dry

4. Oxygen Balance (Using above analyses)

(Vol. Comb. Gas)(% O_2) + (Vol. Excess Air)(% O_2) = (Vol. Actual Gas)(% O_2)

Using the same symbol X as above,

$$(X)(0) + (100-X)(21) = (100)(15.0)$$

$$X = \frac{2100 - 1500}{21} = 28.6\% \text{ (Comb. Gas)}$$

$$(100-X) = 71.4\% \text{ (Excess Air)}$$

Hence,

$$\text{Actual Kiln Exit Gas} = \frac{39,048}{0.286} = 136,531 \text{ SCFM (Dry)}$$

$$\text{Excess Air} = 136,531 - 39,048 = \underline{97,483} \text{ SCFM (Dry)}$$

5. Reconciliation of Balance

The CO_2 and O_2 balances should give the same quantity of excess air for a given location. They did not agree exactly due to experimental error, but the average of the balances may represent the true condition.

$$\text{(Average) Excess Air} = \frac{130,726 + 97,483}{2}$$

$$= \underline{114,104} \text{ SCFM - (Dry)}$$

6. Excess Air Components

Lbs/min. of kilns operation:

$$O_2 = \frac{(114,104)(.21)(32)}{(387)} = \underline{1981.3} \text{ lbs/min.}$$

$$N_2 = \frac{(114,104)(.79)(28)}{(387)} = \underline{6521.9} \text{ lbs/min.}$$

$$H_2O = \frac{(114,104)(.0086)(18)}{(387)} = \underline{45.6} \text{ lbs/min.}$$

or (114,104)(.0086) = 981 SCFM

(Recall 0.0086 was the molal humidity of air @ testing period)

7. Actual Stack Exit Gas Volume

(a) Theoretical Kiln Exit Gas (IV-4) = 57,508 SCFM (Wet)

(b) Excess Air (V-5 and V-6) = 114,104 + 981

= 115,085 SCFM (Wet)

(c) Actual Stack Exit Gas @ Std. Cond. = 172,593 SCFM (Wet)

(d) @ Stack Conditions (365°F. and 29.59" Hg) = $\frac{(172,593)(825)(29.92)}{(530)(29.59)}$

= 271.655 ACFM (Wet)

VI. Stack Gas

1. Gas Volume (Measured)

Average volume of gas measured was 216,300 ACFM (wet) @ average stack conditions of 363 °F (or 823°R) and 29.59" Hg. Therefore, @ std. cond. (70°F. and 29.92" Hg), stack gas volume:

$$\frac{(216,300)(530)(29.59)}{(823)(29.92)} = 137,758 \text{ SCFM (wet)}$$

2. Gas Components

(a) On the average, 12.2% of stack gas was water vapor based on condensate collected during test. This was 12.2 % by volume since we compared moisture content of stack gas while water was in vapor state. Therefore, stack gas contained:

$$(137,758)(0.122) = 16,806 \text{ SCFM Vapor}$$

or,

$$\frac{(16806)(18)}{(387)} = \underline{781.7} \text{ lb/min. } H_2O$$

(b) Orsat Analysis shows 7.4% CO_2, 15.0% O_2 and 77.6% N_2 on the dry basis. With 12.2% H_2O, the analysis can be reported on the wet basis as follows:

CO_2	-	(7.4)(1-0.122)	= 6.5
O_2	-	(15.0)(1-0.122)	= 13.2
N_2	-	(77.6)(1-0.122)	= 68.1
H_2O	-		= 12.2
		TOTAL	100

(c) From VI-1 above, the total volume of stack gas was measured as 137,758 SCFM (wet). The rate of each gaseous component emitted from the stack can be calculated as follows:

$$CO_2 = \frac{(137758)(0.065)(44)}{(387)} = \underline{1018.1} \text{ lbs/min.}$$

$$O_2 = \frac{(137758)(0.13)(32)}{(387)} = \underline{1503.6} \text{ lbs/min.}$$

$$N_2 = \frac{(137758)(0.68)(28)}{(387)} = \underline{6787.5} \text{ lbs/min.}$$

H_2O = 781.7 lbs/min (from VI-2-a)

VII. Gas Balance

(1) CO_2

CO_2 Input = 1427.6 Lbs/min. (from IV-1)

CO_2 Output = 1018.1 lbs/min. (from VI-2-c)

Measuring Efficiency = 71.3%

(2) O_2

O_2 Input = 1981.3 lbs/min. (from V-6)

O_2 Output = 1503.6 lbs/min. (from VI-2-c)

Measuring Efficiency = 75.9%

(3) N_2

N_2 Input = 8440.7 lbs/min. (from IV-1 and V-6)

N_2 Output = 6787.5 lbs/min. (from VI-2-c)

Measuring Efficiency = 80.4%

(4) H_2O

H_2O Input = 904.8 lbs/min. (from IV-1 and V-6)

H_2O Output = 781.7 lbs/min. (from VI-2-c)

Measuring Efficiency = 86.4%

Total Gas Volume

Calculated Gas Volume = 271,600 ACFM (Wet)(from V-7)

Measured Gas Volume = 216,300 ACFM (wet)(from VI-1)

Measuring Efficiency = 79.6%

VIII. Sulfur Balance

1. Sulfur Input:

(a) SO_2 produced by burning coal was 14.2 lbs/min (from II-2), then sulfur input from fuel coal was:

$$(14.2) \times \frac{(32)}{(64)} = 7.10 \text{ lbs/min.}$$

(b) SO_3 content in raw mix was 0.31% (from Table 8). The average feed rate was 2060 lb/min. Then sulfur added to process from raw mix was:

$$(2060)(0.0031)\frac{(32)}{(80)} = 2.55 \text{ lbs/min.}$$

(c) Total Sulfur Input = 9.65 lbs/min.

2. Sulfur Output:

(a) SO_3 content in clinker was 0.33% (from Table 8). The average clinker produced rate was 35.9 T/Hr. or 1196.7 lbs/min. Sulfur removed from the process in clinker was:

$$(1196.7)(0.0033) \times \frac{(32)}{(80)} = 1.58 \text{ lbs/min.}$$

(b) SO_3 content in clinker dust was 0.31% (From Table 8). The average clinker dust removed was 0.3 T/Hr. or 10 lbs/min., therefore, sulfur in clinker dust was:

$$(10)(0.0031) \times \frac{(32)}{(80)} = 0.01 \text{ lbs/min.}$$

(c) Precipitator dust contained 13.41% SO_3 and Multiclone dust contained 7.66% SO_3, from Table 8. The average Precipitator and Multiclone dust disposed rate was 3.1 T/Hr. or 103.3 lbs/min. (combined).

The weight ratio between Precipitator Dust and Multiclone Dust was 45/55, hence sulfur removed with discarded dust was:

$$\left[(103.3)(.45) \times \frac{(0.1341)(32)}{(80)}\right] + \left[(103.3)(.55) \times \frac{(0.0766)(32)}{(80)}\right]$$

$$= 2.49 + 1.74$$

$$= 4.23 \text{ lbs/min.}$$

(d) Table I shows the average SO_2 emission via North Stack was 1101.3 lbs/hr. or 18.35 lbs/min., the Sulfur leaving stack was:

$$(18.35) \times \frac{(32)}{(64)} = 9.17 \text{ lbs/min.}$$

(e) Total Sulfur Output = 14.99 lbs/min.

3. Sulfur Measuring Efficiency = $(O/I) = \frac{14.99}{9.65} = 155.3\%$

MATERIAL BALANCE CALCULATIONS FOR KILN OPERATED WITH COAL AS FUEL

EMISSION TESTING AT NAZARETH PLANT, AUGUST - OCTOBER / 1977

RUNS 54,56&58 (NORTH STACK WITH KILNS 2 & 3)

DATA INPUT

CARBON WEIGHT% IN COAL= 66.53
HYDROGEN WEIGHT% IN COAL= 4.39
NITROGEN WEIGHT% IN COAL= 1.27
OXYGEN WEIGHT% IN COAL= 5.51
SULFUR WEIGHT% IN COAL= 2.64
WATER WEIGHT% IN COAL= 7
CAO WEIGHT% IN RAW MIX = 43.76
MGO WEIGHT% IN RAW MIX = 1.86
H2O RATE FOR COOLING PROCESS, GAL/MIN = 90
SO3 WEIGHT% IN RAW MIX = .31
SO3 WEIGHT% IN CLINKER = .33
SO3 WEIGHT% IN CLINKER DUST = .31
SO3 WEIGHT% IN PRECIPITATOR DUST = 13.41
SO3 WEIGHT% IN MULTICLONE DUST = 7.66
TOTAL SO2 EMISSION FROM STACK, LB/MIN = 18.35
CO2 VOL.%, ORSAT ANALYSIS = 7.4
OXY VOL.%, ORSAT ANALYSIS = 15
N2 VOL.%, ORSAT ANALYSIS = 77.6
AVE.RAW FEED, TON/HR = 61.8
AVE.CLINKER PRODUCED, TON/HR = 35.9
AVE.CLINKER DUST REMOVED, TON/HR = .3
AVE.PRECIP.& MULTICLONE DUST REMOVED, TON/HR = 3.1
WEIGHT% OF PRECIP.DUST IN TOTAL DUST REMOVED = 45
AVE.FUEL COAL RATE, TON/HR= 8.3
MOLAL HUMIDITY OF AMBIENT AIR = 8.60000000E-03
AVE.VOL.OF STACK GAS (WET), ACFM = 216300
AVE.VOL.% OF H2O IN STACK GAS = 12.2
AVE.TEMP.OF STACK GAS, DEG.R = 823
AVE.PRES.OF STACK GAS, IN.HG.= 29.59

RESULTS

BASIS 100 LB FUEL COAL (AS USED)

THEORETICAL AIR REQUIRED :
DRY AIR = 33405.73 SCFM
WET AIR = 33693.02 SCFM

EXCESS AIR CALCULATED :
BASED ON CO2 BALANCE, DRY = 130437.21 SCFM
BASED ON OXY BALANCE, DRY = 97439.11 SCFM
AVERAGE, DRY = 113938.16 SCFM
AVERAGE, WET = 114918.03 SCFM

CARBON DIOXIDE BALANCE :

CO2 FROM COMBUSTION PROCESS	=	674.90 LB/MIN
CO2 LIBERATED FROM RAW MIX	=	750.43 LB/MIN
TOTAL INPUT	=	1425.34 LB/MIN
CO2 MEASURED FROM STACK	=	1017.61 LB/MIN
TOTAL OUTPUT	=	1017.61 LB/MIN
MEASURING EFFICIENCY (O/I)	=	71.39 %

OXYGEN BALANCE :

O2 IN EXCESS AIR	=	1978.46 LB/MIN
TOTAL INPUT	=	1978.46 LB/MIN
O2 MEASURED FROM STACK	=	1500.17 LB/MIN
TOTAL OUTPUT	=	1500.17 LB/MIN
MEAS. EFFICIENCY (O/I)	=	75.82 %

NITROGEN BALANCE :

N2 IN COMBUSTION AIR	=	1912.90 LB/MIN
N2 IN EXCESS AIR	=	6512.43 LB/MIN
TOTAL INPUT	=	8425.34 LB/MIN
N2 MEASURED FROM STACK	=	6790.77 LB/MIN
TOTAL OUTPUT	=	6790.77 LB/MIN
MEAS. EFFICIENCY (O/I)	=	80.59 %

WATER BALANCE :

H2O FROM COMBUSTION PROCESS	=	109.31 LB/MIN
H2O IN COMBUSTION AIR	=	13.36 LB/MIN
H2O IN EXCESS AIR	=	45.57 LB/MIN
H2O FROM COOLING PROCESS	=	749.70 LB/MIN
H2O IN FUEL COAL	=	19.36 LB/MIN
TOTAL INPUT	=	937.31 LB/MIN
H2O MEASURED FROM STACK	=	781.69 LB/MIN
TOTAL OUTPUT	=	781.69 LB/MIN
MEASURING EFFICIENCY (O/I)	=	83.39 %

SULFUR BALANCE :

SULFUR IN FUEL COAL	=	7.30 LB/MIN
SULFUR IN RAW MIX	=	2.55 LB/MIN
TOTAL INPUT	=	9.85 LB/MIN
SULFUR IN CLINKER	=	1.57 LB/MIN
SULFUR IN WASTE DUST	=	4.23 LB/MIN
SULFUR IN CLINKER DUST	=	0.01 LB/MIN
SULFUR EMITTED FROM STACK	=	9.17 LB/MIN
TOTAL OUTPUT	=	15.00 LB/MIN
MEASURING EFFICIENCY (O/I)	=	152.18 %

TOTAL THEO. VOLUME OF STACK GAS (WET) = 173066.08 SCFM
TOTAL MEAS. VOLUME OF STACK GAS (WET) = 137757.71 SCFM
TOTAL GAS MEAS. EFFICIENCY = 79.59 %

MATERIAL BALANCE CALCULATIONS FOR KILN OPERATED WITH COAL AS FUEL

EMISSION TESTING AT NAZARETH PLANT, AUGUST - OCTOBER / 1977

RUNS 50,52,60&62 (SOUTH STACK WITH KILNS 4 & 5)

DATA INPUT

CARBON WEIGHT% IN COAL= 67.96
HYDROGEN WEIGHT% IN COAL= 4.48
NITROGEN WEIGHT% IN COAL= 1.3
OXYGEN WEIGHT% IN COAL= 5.62
SULFUR WEIGHT% IN COAL= 2.7
WATER WEIGHT% IN COAL= 5
CAO WEIGHT% IN RAW MIX = 43.76
MGO WEIGHT% IN RAW MIX = 1.06
H2O RATE FOR COOLING PROCESS, GAL/MIN = 60
SO3 WEIGHT% IN RAW MIX = .31
SO3 WEIGHT% IN CLINKER = .33
SO3 WEIGHT% IN CLINKER DUST = .31
SO3 WEIGHT% IN PRECIPITATOR DUST = 13.41
SO3 WEIGHT% IN MULTICLONE DUST = 7.66
TOTAL SO2 EMISSION FROM STACK, LB/MIN = 14.89
CO2 VOL.%, ORSAT ANALYSIS = 8.3
OXY VOL.%, ORSAT ANALYSIS = 14.9
N2 VOL.%, ORSAT ANALYSIS = 76.8
AVE.RAW FEED, TON/HR = 55.7
AVE.CLINKER PRODUCED, TON/HR = 32.3
AVE.CLINKER DUST REMOVED, TON/HR = .3
AVE.PRECIP.& MULTICLONE DUST REMOVED, TON/HR = 2.2
WEIGHT% OF PRECIP.DUST IN TOTAL DUST REMOVED = 45
AVE.FUEL COAL RATE, TON/HR= 6.5
MOLAL HUMIDITY OF AMBIENT AIR = 1.00000000E-02
AVE.VOL.OF STACK GAS (WET), ACFM = 172300
AVE.VOL.% OF H2O IN STACK GAS = 12.6
AVE.TEMP.OF STACK GAS, DEG.R = 836
AVE.PRES.OF STACK GAS, IN.HG.= 29.61

RESULTS

BASIS 100 LB FUEL COAL (AS USED)

THEORETICAL AIR REQUIRED :
DRY AIR = 26720.53 SCFM
WET AIR = 26087.73 SCFM

EXCESS AIR CALCULATED :
BASED ON CO2 BALANCE, DRY = 97041.21 SCFM
BASED ON OXY BALANCE, DRY = 77787.21 SCFM
AVERAGE, DRY = 87414.21 SCFM
AVERAGE, WET = 86288.35 SCFM

CARBON DIOXIDE BALANCE :

CO2 FROM COMBUSTION PROCESS	=	539.90 LB/MIN
CO2 LIBERATED FROM RAW MIX	=	676.36 LB/MIN
TOTAL INPUT	=	1216.26 LB/MIN
CO2 MEASURED FROM STACK	=	891.58 LB/MIN
TOTAL OUTPUT	=	891.58 LB/MIN
MEASURING EFFICIENCY (O/I)	=	73.30 %

OXYGEN BALANCE :

O2 IN EXCESS AIR	=	1517.89 LB/MIN
TOTAL INPUT	=	1517.89 LB/MIN
O2 MEASURED FROM STACK	=	1164.04 LB/MIN
TOTAL OUTPUT	=	1164.04 LB/MIN
MEAS. EFFICIENCY (O/I)	=	76.68 %

NITROGEN BALANCE :

N2 IN COMBUSTION AIR	=	1530.09 LB/MIN
N2 IN EXCESS AIR	=	4996.38 LB/MIN
TOTAL INPUT	=	6526.48 LB/MIN
N2 MEASURED FROM STACK	=	5249.90 LB/MIN
TOTAL OUTPUT	=	5249.90 LB/MIN
MEAS. EFFICIENCY (O/I)	=	80.43 %

WATER BALANCE :

H2O FROM COMBUSTION PROCESS	=	87.36 LB/MIN
H2O IN COMBUSTION AIR	=	12.42 LB/MIN
H2O IN EXCESS AIR	=	40.65 LB/MIN
H2O FROM COOLING PROCESS	=	499.80 LB/MIN
H2O IN FUEL COAL	=	10.83 LB/MIN
TOTAL INPUT	=	651.07 LB/MIN
H2O MEASURED FROM STACK	=	633.52 LB/MIN
TOTAL OUTPUT	=	633.52 LB/MIN
MEASURING EFFICIENCY (O/I)	=	97.30 %

SULFUR BALANCE :

SULFUR IN FUEL COAL	=	5.85 LB/MIN
SULFUR IN RAW MIX	=	2.30 LB/MIN
TOTAL INPUT	=	8.15 LB/MIN
SULFUR IN CLINKER	=	1.42 LB/MIN
SULFUR IN WASTE DUST	=	3.00 LB/MIN
SULFUR IN CLINKER DUST	=	0.01 LB/MIN
SULFUR EMITTED FROM STACK	=	7.44 LB/MIN
TOTAL OUTPUT	=	11.88 LB/MIN
MEASURING EFFICIENCY (O/I)	=	145.78 %

TOTAL THEO. VOLUME OF STACK GAS (WET) = 133258.19 SCFM
TOTAL MEAS. VOLUME OF STACK GAS (WET) = 108101.49 SCFM
TOTAL GAS MEAS. EFFICIENCY = 81.12 %

MATERIAL BALANCE CALCULATIONS FOR KILN OPERATED WITH COAL AS FUEL

EMISSION TESTING AT NAZARETH PLANT, AUGUST - OCTOBER / 1977

RUNS 2,4,6,8&10 (NORTH STACK WITH KILNS 2 & 3)

DATA INPUT

CARBON WEIGHT% IN COAL= 66.82
HYDROGEN WEIGHT% IN COAL= 4.41
NITROGEN WEIGHT% IN COAL= 1.28
OXYGEN WEIGHT% IN COAL= 5.53
SULFUR WEIGHT% IN COAL= 2.65
WATER WEIGHT% IN COAL= 6.6
CAO WEIGHT% IN RAW MIX = 43.76
MGO WEIGHT% IN RAW MIX = 1.86
H2O RATE FOR COOLING PROCESS, GAL/MIN = 60
SO3 WEIGHT% IN RAW MIX = .31
SO3 WEIGHT% IN CLINKER = .33
SO3 WEIGHT% IN CLINKER DUST = .31
SO3 WEIGHT% IN PRECIPITATOR DUST = 13.41
SO3 WEIGHT% IN MULTICLONE DUST = 7.66
TOTAL SO2 EMISSION FROM STACK, LB/MIN = 16.25
CO2 VOL.%, ORSAT ANALYSIS = 5.9
OXY VOL.%, ORSAT ANALYSIS = 17.2
N2 VOL.%, ORSAT ANALYSIS = 76.9
AVE.RAW FEED, TON/HR = 67.6
AVE.CLINKER PRODUCED, TON/HR = 39.2
AVE.CLINKER DUST REMOVED, TON/HR = .2
AVE.PRECIP.& MULTICLONE DUST REMOVED, TON/HR = 2.4
WEIGHT% OF PRECIP.DUST IN TOTAL DUST REMOVED = 45
AVE.FUEL COAL RATE, TON/HR= 8.2
MOLAL HUMIDITY OF AMBIENT AIR = 2.42000000E-02
AVE.VOL.OF STACK GAS (WET), ACFM = 185900
AVE.VOL.% OF H2O IN STACK GAS = 10.9
AVE.TEMP.OF STACK GAS, DEG.R = 821
AVE.PRES.OF STACK GAS, IN.HG.= 29.55

RESULTS

BASIS 100 LB FUEL COAL (AS USED)

THEORETICAL AIR REQUIRED :
DRY AIR = 33148.59 SCFM
WET AIR = 33950.79 SCFM

EXCESS AIR CALCULATED :
BASED ON CO2 BALANCE, DRY = 182858.45 SCFM
BASED ON OXY BALANCE, DRY = 178091.51 SCFM
AVERAGE, DRY = 180474.98 SCFM
AVERAGE, WET = 184842.48 SCFM

CARBON DIOXIDE BALANCE :

CO2 FROM COMBUSTION PROCESS	=	669.68 LB/MIN
CO2 LIBERATED FROM RAW MIX	=	820.86 LB/MIN
TOTAL INPUT	=	1490.54 LB/MIN
CO2 MEASURED FROM STACK	=	708.40 LB/MIN
TOTAL OUTPUT	=	708.40 LB/MIN
MEASURING EFFICIENCY (O/I)	=	47.52 %

OXYGEN BALANCE :

O2 IN EXCESS AIR	=	3133.82 LB/MIN
TOTAL INPUT	=	3133.82 LB/MIN
O2 MEASURED FROM STACK	=	1501.94 LB/MIN
TOTAL OUTPUT	=	1501.94 LB/MIN
MEAS. EFFICIENCY (O/I)	=	47.92 %

NITROGEN BALANCE :

N2 IN COMBUSTION AIR	=	1898.19 LB/MIN
N2 IN EXCESS AIR	=	10315.52 LB/MIN
TOTAL INPUT	=	12213.71 LB/MIN
N2 MEASURED FROM STACK	=	5875.69 LB/MIN
TOTAL OUTPUT	=	5875.69 LB/MIN
MEAS. EFFICIENCY (O/I)	=	48.10 %

WATER BALANCE :

H2O FROM COMBUSTION PROCESS	=	108.48 LB/MIN
H2O IN COMBUSTION AIR	=	37.31 LB/MIN
H2O IN EXCESS AIR	=	203.13 LB/MIN
H2O FROM COOLING PROCESS	=	499.80 LB/MIN
H2O IN FUEL COAL	=	18.04 LB/MIN
TOTAL INPUT	=	866.77 LB /MIN
H2O MEASURED FROM STACK	=	600.89 LB/MIN
TOTAL OUTPUT	=	600.89 LB/MIN
MEASURING EFFICIENCY (O/I)	=	69.32 %

SULFUR BALANCE :

SULFUR IN FUEL COAL	=	7.24 LB/MIN
SULFUR IN RAW MIX	=	2.79 LB/MIN
TOTAL INPUT	=	10.03 LB/MIN
SULFUR IN CLINKER	=	1.72 LB/MIN
SULFUR IN WASTE DUST	=	3.27 LB/MIN
SULFUR IN CLINKER DUST	=	0.00 LB/MIN
SULFUR EMITTED FROM STACK	=	8.12 LB/MIN
TOTAL OUTPUT	=	13.13 LB/MIN
MEASURING EFFICIENCY (O/I)	=	130.88 %

TOTAL THEO. VOLUME OF STACK GAS (WET) = 238456.48 SCFM
TOTAL MEAS. VOLUME OF STACK GAS (WET) = 118524.46 SCFM
TOTAL GAS MEAS. EFFICIENCY = 49.70 %

APPENDIX 2

SAMPLE CALCULATION FOR STACK RUN 2

NOMENCLATURE

A_n	-	Cross-sectional area of sample nozzle, sq. ft.
A	-	Cross-sectional area of stack, $ft.^3$
B_{wo}	-	Proportion by volume of water vapor in the gas stream, dimensionless
C_p	-	Pitot tube coefficient, dimensionless
$C_{p\ std.}$	-	Pitot tube coef. of standard type tube @ .99
$C_{p\ test}$	-	Pitot tube coefficient of type "S" pitot tube
c'_s	-	Concentration of particulate matter in stack gas, gr./s.c.f. dry basis
c_s	-	Concentration of particulate matter in stack gas, lb/s.c.f.
D_s	-	Inside diameter of stack at sample port, Ft.
E	-	Particulate emission rate
ΔH	-	Average pressure drop across the orifice meter, inches H_2O
I	-	Percent of Iso Kinetic sampling. Test acceptable between 90% - I - 110%
K_p	-	$85.48 \frac{ft.}{sec.} \frac{lbs.}{lb\text{-}mole\ ^\circ R}$
M_d	-	Dry molecular weight of stack gas
M_{H_2O}	-	Molecular weight of water, 18 lb/lb-mole
M_s	-	Molecular weight of stack gas (wet basis) lbs/lb-mole $M_d\ (1-B_{wo}) + 18\ B_{wo}$
M_n	-	Total amount of particule matter collected, mg.
P_{bar}	-	Barometric pressure at the orifice meter, inches Hg.
$P_{std.}$	-	Absolute pressure at standard conditions, 29.92 inches Hg.
P_s	-	Absolute stack gas pressure, inches Hg.

$\Delta P_{std.}$	-	Velocity head measured by standard type pitot tube
ΔP_{test}	-	Velocity head measured by type "S" pitot tube
$\sqrt{\Delta p}_{ave.}$	-	Ave. velocity head of stack gas, inches H_2O
Q_s	-	Volumetric flow rate, dry basis, standard conditions, $ft.^3/hr.$
R	-	Ideal gas constant
°R	-	Degrees of temperature, Rankin (F+460)
ρH_2O	-	Density of water, 1 gm./ml.
$(T_s)_{ave}$	-	Average absolute stack gas temperature, °R
$T_{std.}$	-	Absolute temperature at standard conditions, 530°R
T_m	-	Average dry gas meter temperature, °R
Θ	-	Total sampling time, min.
$V_{m\ std.}$	-	Volume of gas sample through the dry gas meter (standard conditions), cu. ft.
$V_{s\ (ave)}$	-	Stack gas velocity, feet per second (f.p.s.)
V_m	-	Volume of gas sample through the dry gas meter (meter conditions) cu. ft.
V_{ic}	-	Total volume of liquid collected in impingers and silica gel
17.71	-	°R per inch. Hg @ std. cond. of 530 & 29.92
24.1	-	Liters water per gram-mole
28.3	-	Liters dry air per cu. ft.
1.667	-	100/60 min/sec
13.6	-	Specific gravity of mercury
$2.205X10^{-6}$	-	mg/lb.
0.0154	-	Grains per mg.
32	-	Molecular weight of oxygen

1. Pitot Tube Calibration

Using "S" type, Tube "b" 4' length calibrated April , 1977.

$$Cp\ test = Cp\ std. \sqrt{\frac{P_{std}}{P_{test}}}$$

Forward

$$Cp\ test = (.99) \sqrt{\frac{.58}{.88}}$$

$$Cp = .80$$

Reverse

$$Cp\ test = (.99) \sqrt{\frac{.56}{.87}}$$

$$= .80$$

$$Cp\ ave. = .80$$

2. Velocity of Stack Gas

$$V_s\ ave. = K_p C_p \sqrt{P_{ave}} \sqrt{\frac{T_{s\ ave.}}{P_s M_s}}$$

$$V_s\ ave. = (85.48)(0.80)(0.48) \sqrt{\frac{(823)}{(29.51)(29.13)}}$$

$$V_s\ ave. = 32.12 \text{ ft/sec}$$

3. Volume of Gas (Actual) from Stack

$$Volume = (V_s\ ave.)(A)(60)$$

$$Volume = (32.12)(95)(60) = 183{,}000 \text{ ACFM}$$

4. Volume Dry Gas @ Standard Conditions

$$Q_s = 3600\ (1-B_{wo})\ (V_s)\ (A)\left(\frac{T_{std.}}{T_{s\ ave}}\right)\left(\frac{P_s}{P_{std.}}\right)$$

$$Q_s = 3600\ (1 - .088)(32.12)(95)\left(\frac{530}{823}\right)\left(\frac{29.51}{29.92}\right)$$

$$Q_s = 6.3 \times 10^6 \text{ SCFH}$$

5. Sample Gas Volume @ Standard Conditions

$$V_{m\ std.} = 17.71\ V_m \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{Tm} \right)$$

$$V_{m\ std.} = (17.71)(65.99) \left(\frac{29.54 + \frac{.44}{13.6}}{531} \right)$$

$$V_{m\ std.} = 65.08 \quad \text{cu.ft.}$$

6. Percent of Isokinetic - EPA Method

$$I = \frac{(1.667\ Ts) \left[(.00267)\ (Vic) + \left(\frac{Vm}{Tm} \quad (P\ bar + \frac{\Delta H}{13.6}) \right) \right]}{(\Theta)\ (Vs)\ (Ps)\ (A_n)}$$

$$I = \frac{(1.667)(823)(0.358 + 3.675\ )}{(192)(\quad)(29.31)(.000527)}$$

$$I = \underline{93.0\%}$$

% Isokinetic for all runs (from Run No. 2 to Run No. 62) were calculated using the same method as above, and are presented in Table 6 .

FORM 407 REV. 3-6

PITTSBURGH TESTING LABORATORY

ESTABLISHED 1881
850 POPLAR STREET, PITTSBURGH, PA. 15220

PLEASE REPLY TO:
P. O. BOX 1546
PITTSBURGH, PA. 15230

AREA CODE 412 TELEPHONE 922-4000

LABORATORY No. 779871

CLIENT'S No. P. O. 8999-R

ORDER No. PG-6218

REPORT

October 26, 1977

Analysis of: C O A L

Submitted by: Lone Star - Nazareth Plant

Reported to: Lone Star Industries, Inc.
P. O. Box 2148
Houston, Texas 77001

	As Received	Dry Basis
Carbon	----	71.54%
Hydrogen	----	4.72%
Oxygen	----	5.92%
Nitrogen	----	1.37%
Sulfur	----	2.84%
Ash	----	13.61%
BTU Per Pound	12,751	12,929
Moisture	1.38%	

PITTSBURGH TESTING LABORATORY

Robert J. King
Manager, Chemical Department

3-Client
Attn: Clyde W. Moore

rd

TABLE 1

Process	Process Factor, F
19. Iron foundry:	
Melting:	
5T./hr and less	150 lbs./ton of iron
More than 5T./hr	50 lbs./ton of iron
Sand handling	20 lbs./ton of sand
Shake-out	20 lbs./ton of sand
20. Secondary lead smelting	0.5 lbs./ton of product
21. Secondary magnesium smelting	0.2 lbs./ton of product
22. Secondary zinc smelting:	
Sweating	0.01 lbs./ton of product
Refining	0.3 lbs./ton of product
23. Asphaltic concrete production	6 lbs./ton of aggregate feed
24. Asphalt roofing mfg:	
Felt saturation	0.6 lbs./ton of asphalt used
25. Portland cement mfg:	
Clinker production	150 lbs./ton of dry solids feed
Clinker cooling	50 lbs./ton of product
26. Coal drying	2 lbs./ton of product
27. Coal dry-cleaning	2 lbs./ton of product
28. Lime calcining	200 lbs./ton of product
29. Petroleum refining:	
Catalytic cracking	40 lbs./ton of liquid feed

SULFUR COMPOUND EMISSIONS

§ 123.21. General.

(a) Subsection (b) of this section shall apply to all sources except those subject to the provisions of other sections of this Article, with respect to the control of sulfur compound emissions.

(b) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of sulfur oxides, from any source, in such a manner that the concentration, at any time, of the sulfur oxides, expressed as SO_2, in the effluent gas exceeds 500 parts per million, by volume (dry basis).

§ 123.22. Combustion units.

(a) (1) Clause (2) of this subsection shall apply to all combustion units in all the air basins except those units subject to the provisions of subsection (b) of this section.

(2) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of sulfur oxides, expressed as SO_2, from any combustion unit, at any time, in excess of:

(i) The rate of 3.0 lbs. per million BTU of heat input when the heat input to the combustion unit in millions of BTUs per hour is greater than 2.5 but less than 50.

(ii) The rate determined by the formula:

$A = 5.1E^{-0.14}$, where:

A = Allowable emissions 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 2,000.

(iii) The rate of 1.8 lbs. per million BTU of heat input when the heat input to the combustion unit in millions of BTUs per hour is equal to or greater than 2,000.

(b) (1) Clause (2) of this subsection shall apply to all combustion units in the Allegheny County, Beaver Valley, Monongahela Valley and Southeast Pennsylvania air basins.

(2) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of sulfur oxides, expressed as SO_2, from any combustion unit, at any time, in excess of:

(i) The rate of 1.0 lb. per million BTU of heat input, when the heat input to the combustion unit in millions of BTUs per hour is greater than 2.5 but less than 50.

(ii) The rate determined by the formula:

$A = 1.7E^{-0.14}$, where:
A = Allowable emissions 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 2,000.

(iii) The rate of 0.6 lbs. per million BTU of heat input when the heat input to the combustion unit in millions of BTUs per hour is equal to or greater than 2,000.

(c) (1) Clause (2) of this subsection shall apply to all combustion units not subject to the provisions of subsections (a) and (b) of this section.

(2) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of sulfur oxides, expressed as SO_2, from any combustion unit, at any time, in excess of the rate of 4.0 lbs. per million BTU of heat input.

(d) Allowable emissions under this section are graphically indicated in Figure 4 appended to this Chapter.

§ 123.23. By-product coke oven gas.

(a) No person shall cause, suffer or permit the emission of by-product coke oven gas into the outdoor atmosphere unless such gas is first burned.

(b) No person shall cause, suffer or permit the flaring or combustion of any coke oven by-product gas that contains sulfur compounds, measured as hydrogen sulfide, in concentrations greater than 50 grains per 100 dry standard cubic feet.

ODOR EMISSIONS

§ 123.31. Limitations.

(a) (1) No person shall cause, suffer or permit, at any time, any emissions from the following processes unless the emissions have been incinerated at at least 1200° F for at least 0.3 seconds prior to their emission into the outdoor atmosphere: Chip dryers, animal blood dryers, asphalt oxidation, asphalt roofing manufacture, brake shoe debonding operations, core ovens, rendering cookers, varnish cookers, paint-baking ovens, meat smokehouses other than those in single family farms, plastic curing ovens, fabric-backing and fabric-coating baking ovens, ovens for curing of binders in mineral wool production, meat processing other than in single family farms, tear gas manufacture and sources of hydrogen sulfide or mercaptans.

(2) Techniques other than incineration may be used to comply with the provisions of Clause (1) of this subsection if it is shown to the satisfaction of the Department that such techniques are equivalent to or better than the required incineration in terms of control of the odor emissions.

Borough, Wayne Township and all of Beaver County except for the following political subdivisions: Darlington Borough, Darlington Township, Economy Borough, Frankfort Springs Borough, Franklin Township, Hanover Township, Independence Township, Marion Township, New Sewickley Township and South Beaver Township.

(10) *Best available technology* - Equipment, devices, methods or techniques which will prevent, reduce or control emissions of air contaminants to the maximum degree possible and which are available or can be made available.

(11) *Board* - The Environmental Hearing Board established by The Administrative Code of 1929, the act of April 9, 1929, P.L. 177, as amended December 3, 1970, Act No. 275 (71 P.S. § 51 *et seq.*).

(12) *Clean Air Act* - The Federal Clean Air Act, as amended by Public Law 91-604, 84 Stat. 1676 (42 U.S.C. 1857 *et seq.*), and the rules and regulations promulgated thereunder.

(13) *Combustion unit* - Any stationary equipment used to burn fuel primarily for the purpose of producing power or producing heat by indirect heat transfer.

(14) *Emissions* - Air contaminants emitted into the outdoor atmosphere.

(15) *Erie air basin* - The following political subdivisions in Erie County: City of Erie, Harborcreek Township, Lawrence Park Township, Millcreek Township and Wesleyville Borough.

(16) *Flue* - Any duct, pipe, stack, chimney or conduit permitting air contaminants to be emitted into the outdoor atmosphere. In order to be classified as a flue, such duct, pipe, stack, chimney or conduit shall be of such a nature as to permit the performance of the test methods and procedures specified in Chapter 139 of this Title (relating to sampling and testing).

(17) *Fugitive air contaminant* - Any air contaminant emitted into the outdoor atmosphere in any manner other than through a flue.

(18) *Harrisburg air basin* - The following political subdivisions in Cumberland County: Camp Hill Borough, East Pennsboro Township, Lemoyne Borough, New Cumberland Borough, West Fairview Borough, Wormleysburg Borough, and the following political subdivisions in Dauphin County: City of Harrisburg, Highspire Borough, Lower Swatara Township, Middletown Borough, Paxtang Borough, Penbrook Borough, Royalton Borough, Steelton Borough, Susquehanna Township and Swatara Township.

(19) *Johnstown air basin* - The following political subdivisions in Cambria County: Brownstown Borough, Conemaugh Township, Daisytown Borough, Dale Borough, East Conemaugh Borough, East Taylor Township, Ferndale Borough, Franklin Borough, Geistown Borough, City of Johnstown, Lorain Borough, Lower Yoder Township, Middle Taylor Township, Southmont Borough, Stoneycreek Township, Upper Yoder Township, West Taylor Township and Westmont Borough.

(20) *Lancaster air basin* - The following political subdivisions in Lancaster County: East Petersburg Borough, City of Lancaster, Lancaster Township, Manheim Township and Millersville Borough.

(21) *Malodor* - Any odor which causes annoyance or discomfort to the public and which the Department determines to be objectionable to the public.

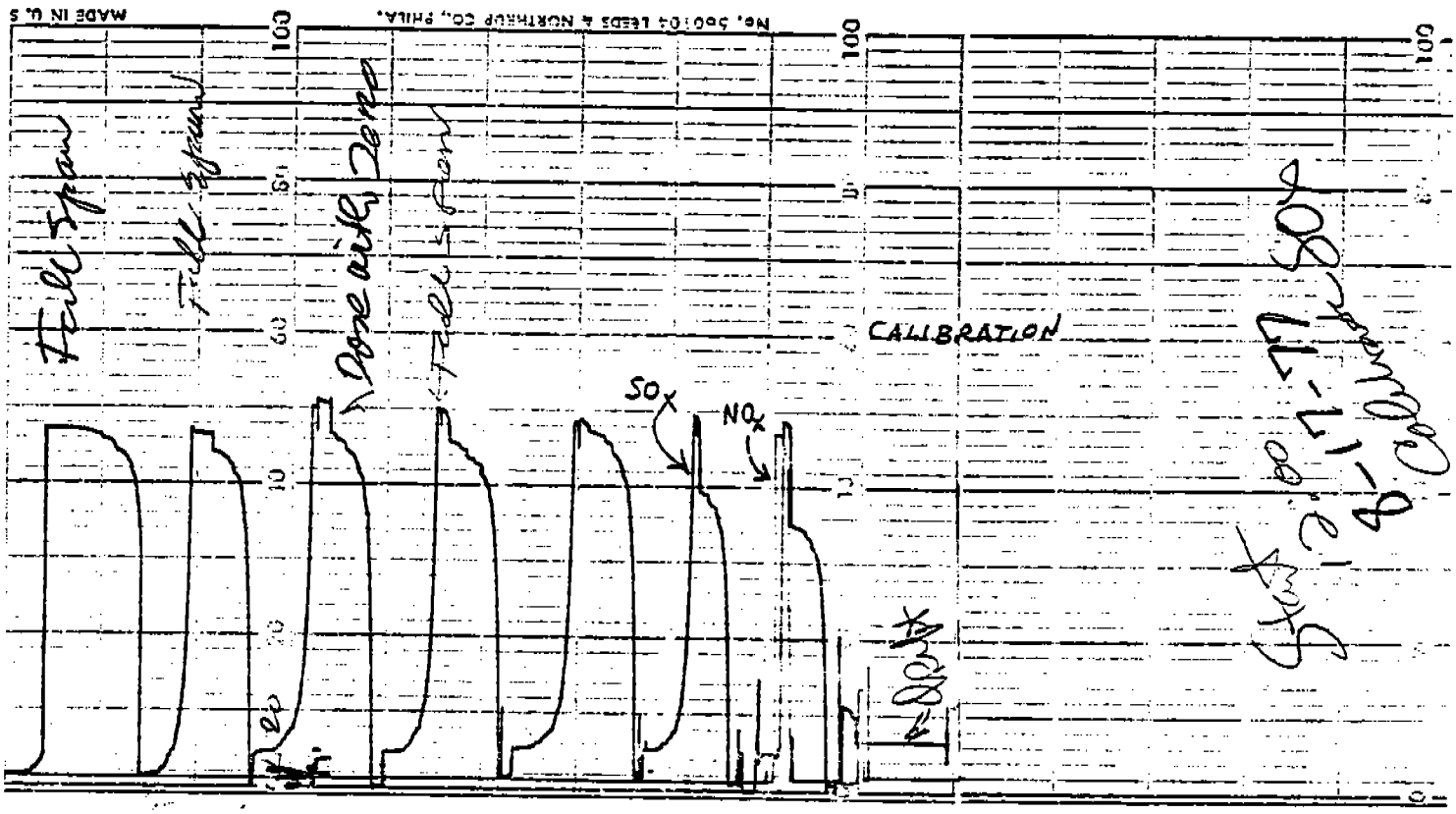
(22) *Mobil air contamination source* - Any vehicular air contamination source, including but not limited to automobiles, trucks, tractors, buses and other motor vehicles, railroad locomotives, ships, boats and other water-borne craft, but not including any source mounted on a vehicle whether such mounting is permanent or temporary, which source is not used to supply power to the vehicle.

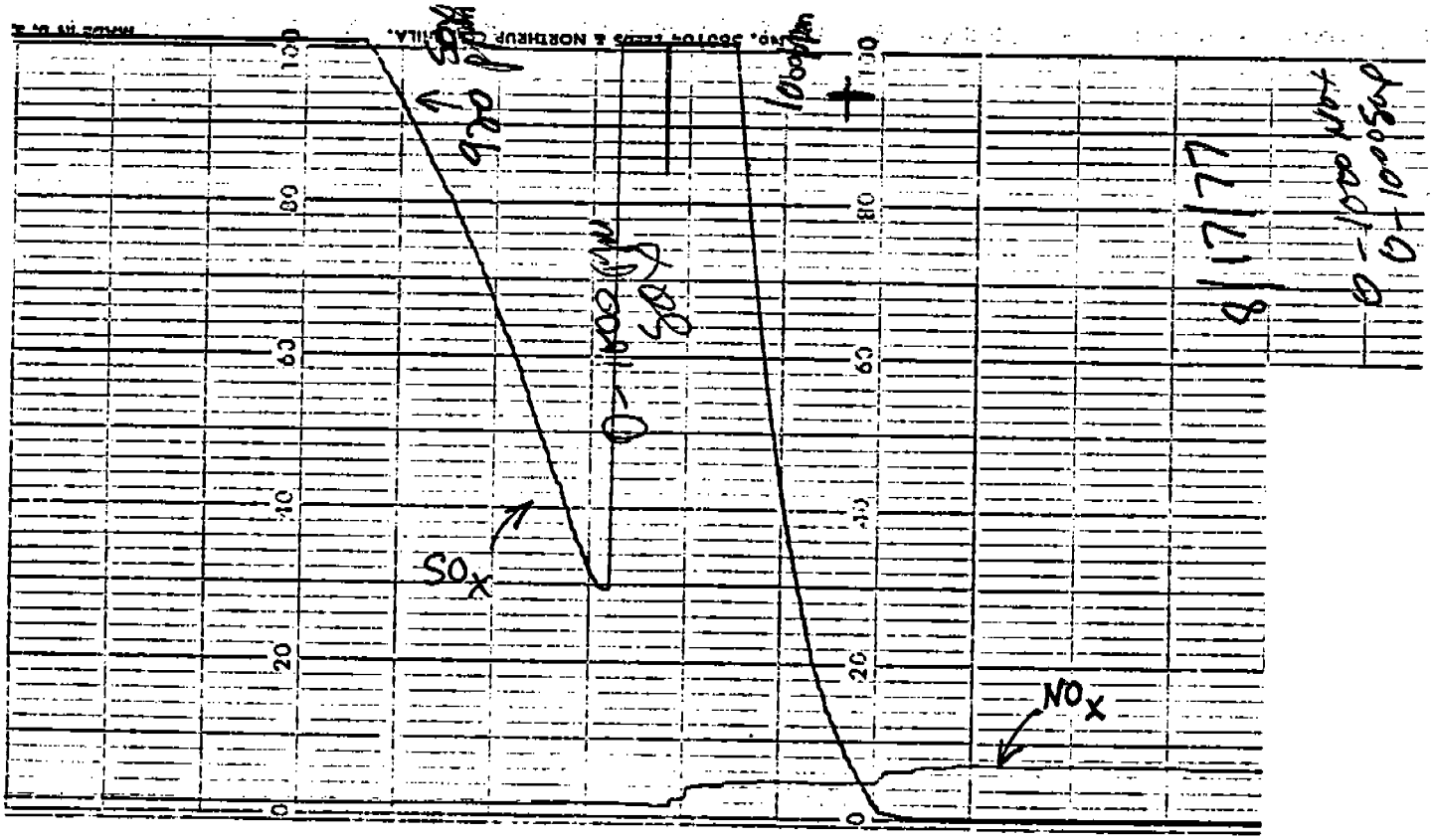
(23) *Modification* - Any physical change in a source or any change in the method of operation of a source which would increase the amount of any air contaminant emitted by such source or which would result in the emission of any air contaminant not previously emitted, except that routine maintenance, repair, and replacement shall not be considered physical changes.

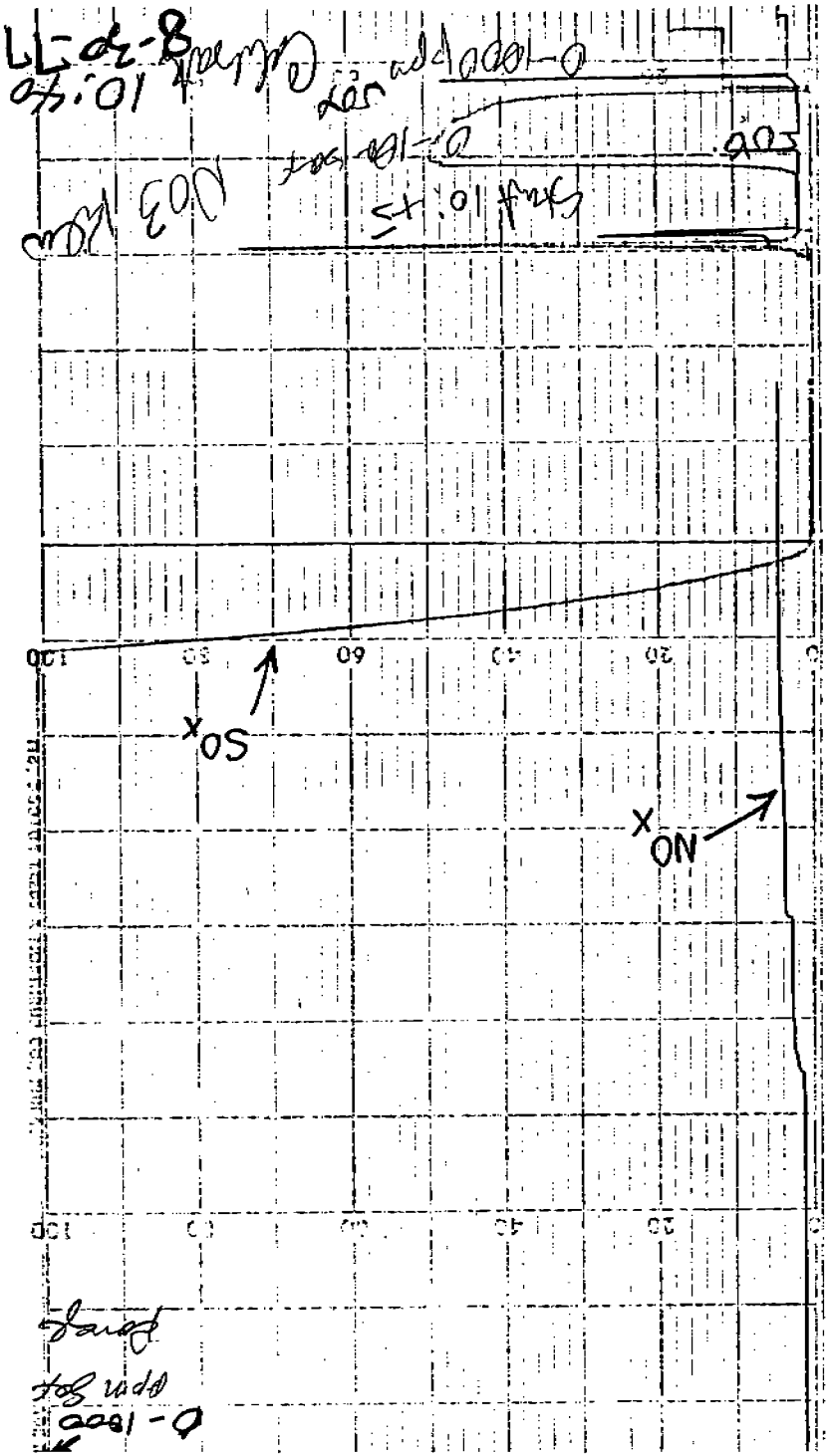
(24) *Monongahela Valley air basin* - The following political subdivisions in Fayette County: Belle Vernon Borough, Brownsville Borough, Brownsville Township, Fayette City Borough, Jefferson Township, Newell Borough, Washington Township, and the following political subdivisions in Washington County: Allenport Borough, California Borough, Carroll Township, Charleroi Borough, Coal Center Borough, Donora Borough, Dunlevy Borough, Fallowfield Township, Finleyville Borough, Long Branch Borough,

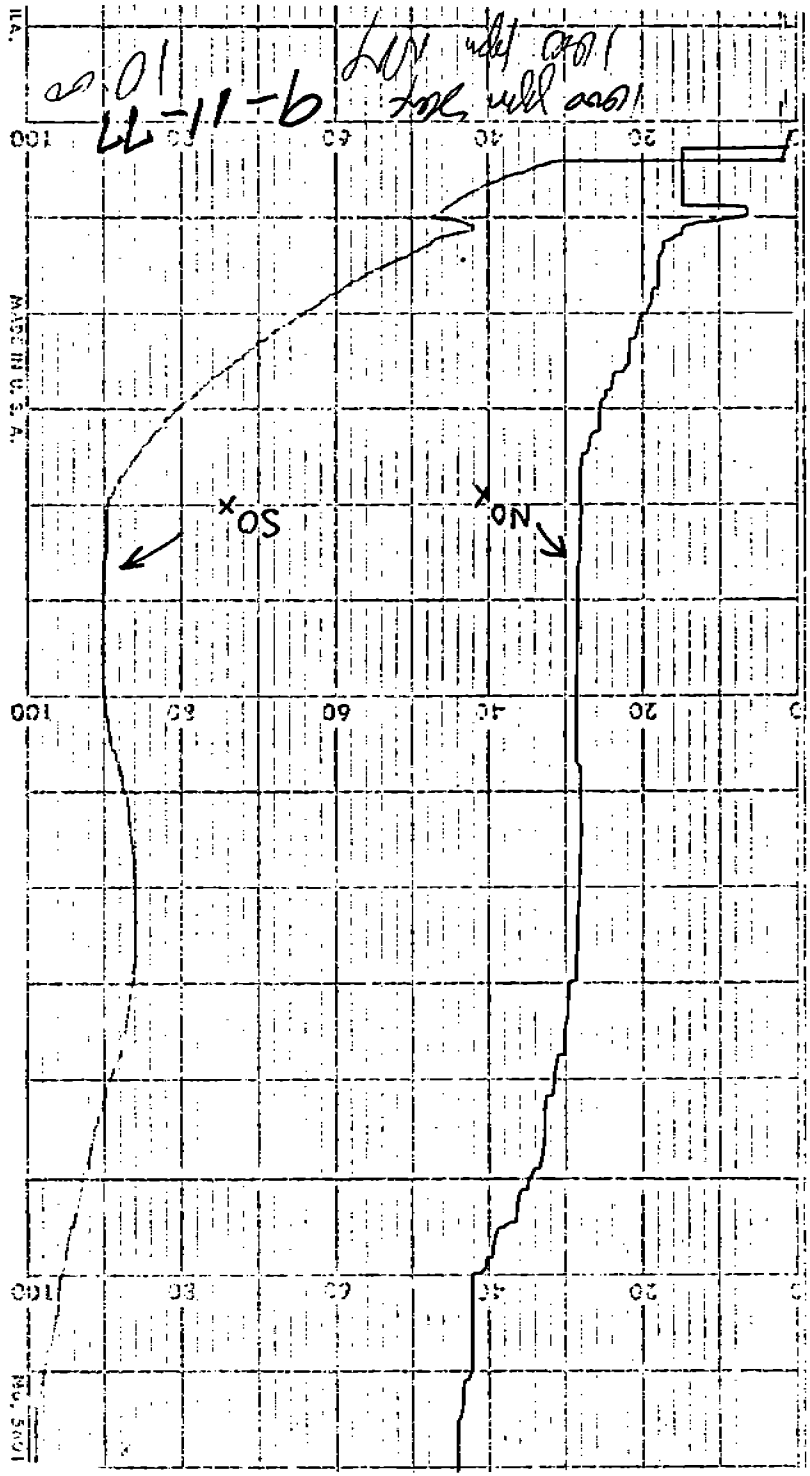
APPENDIX 5

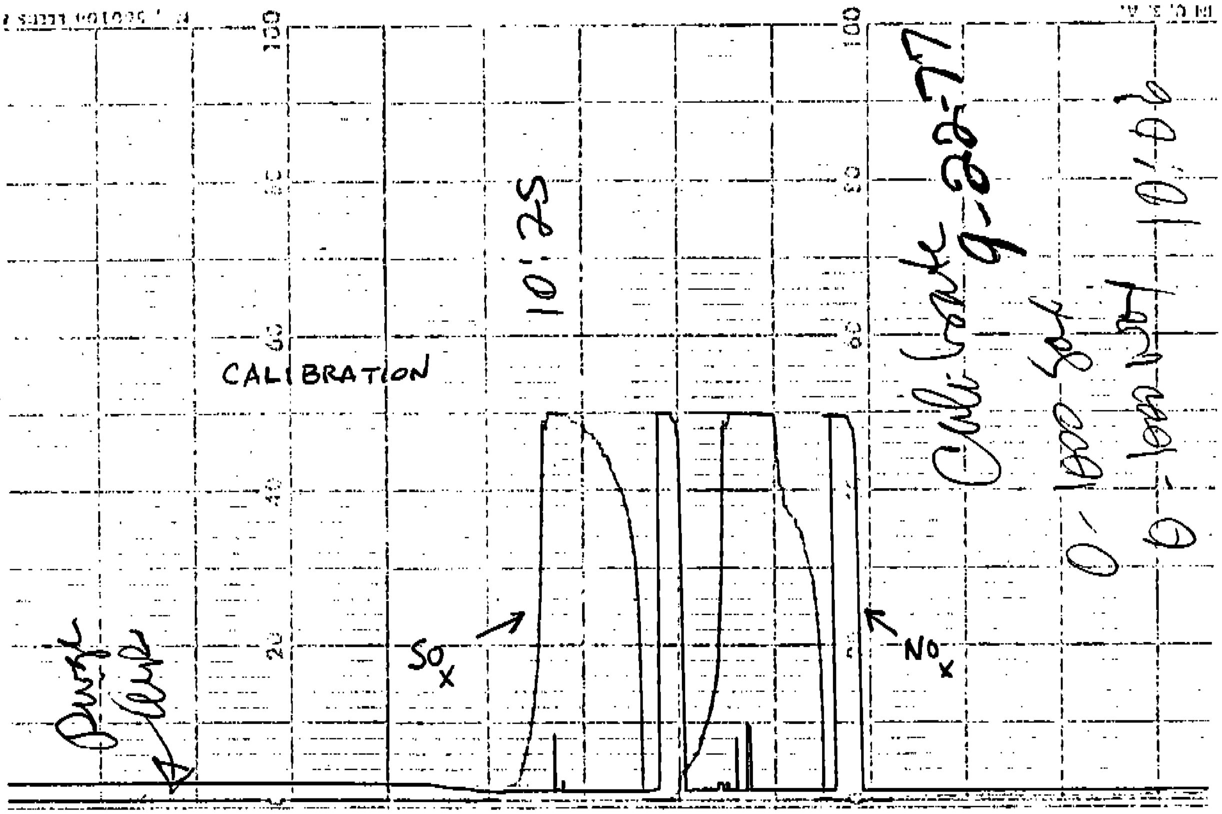
ENVIRONMENTRIC ANALYZER CHARTS

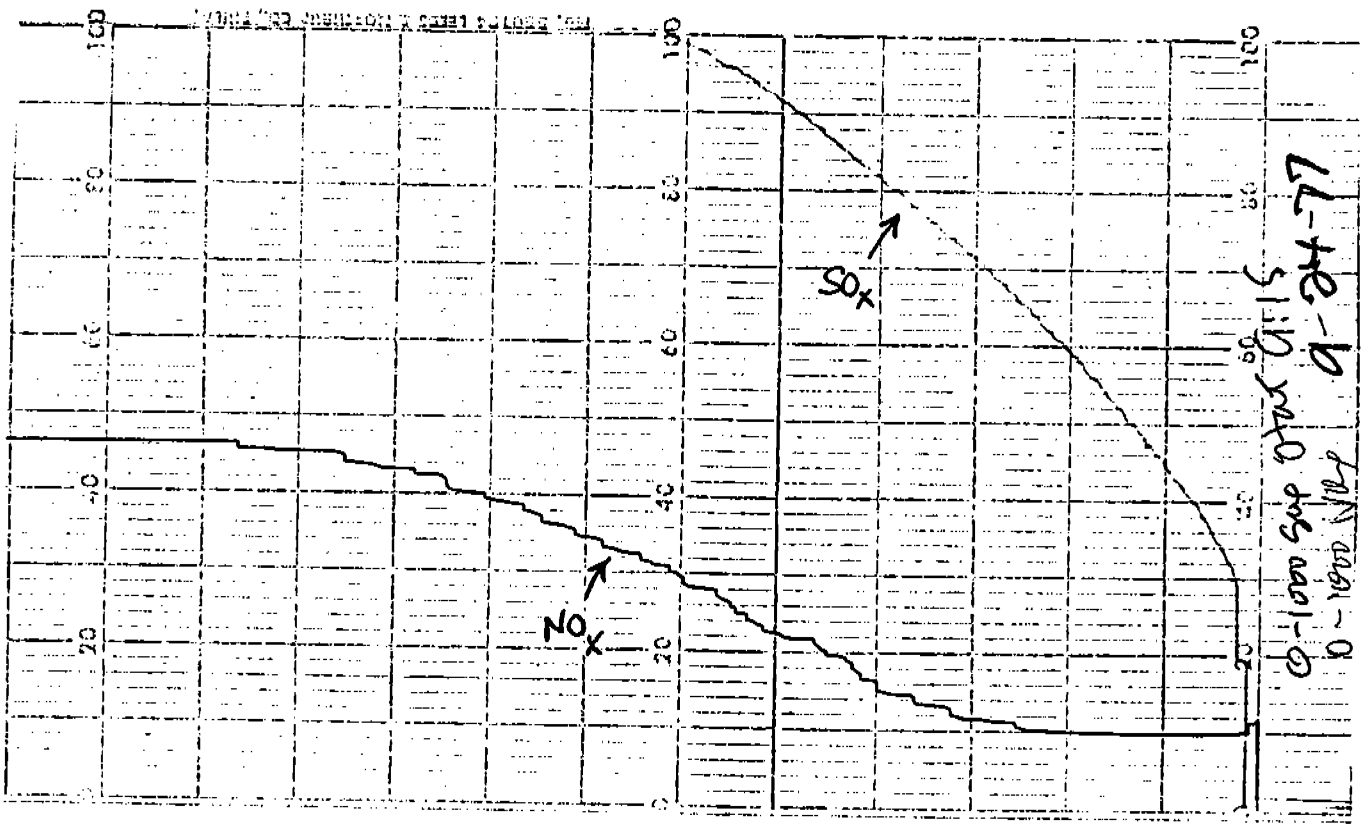


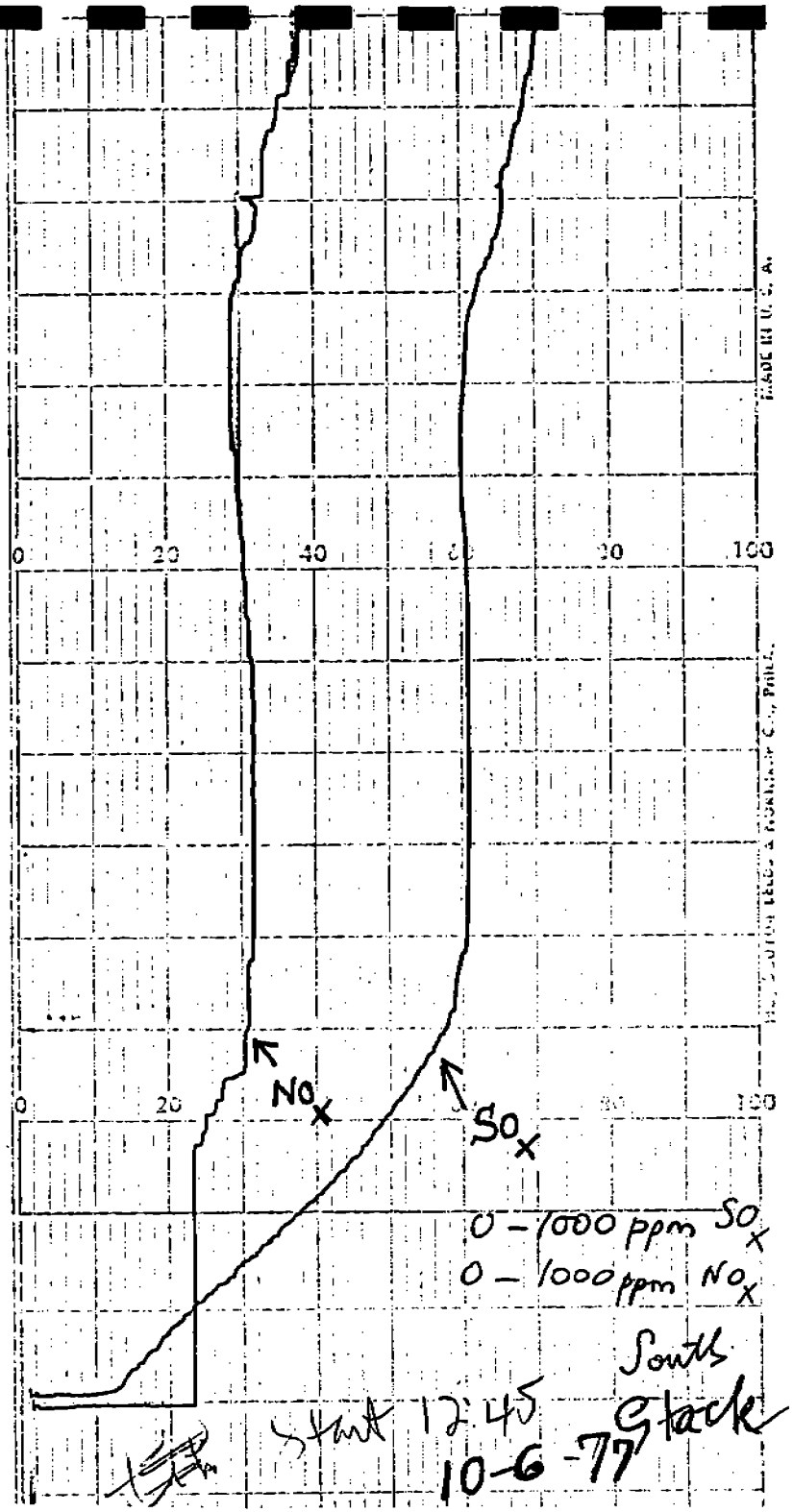


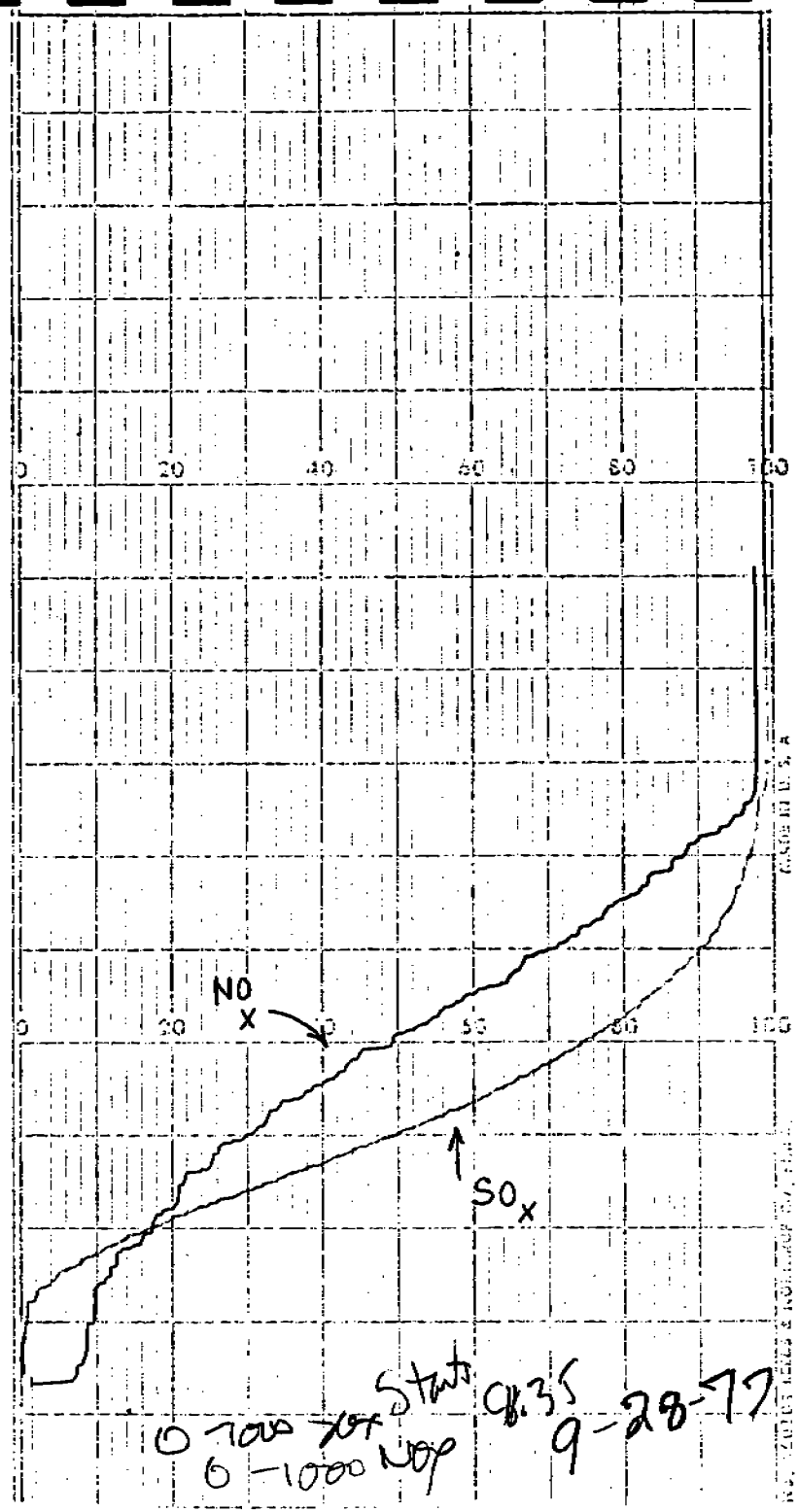

x_{OS}
x_{ON}

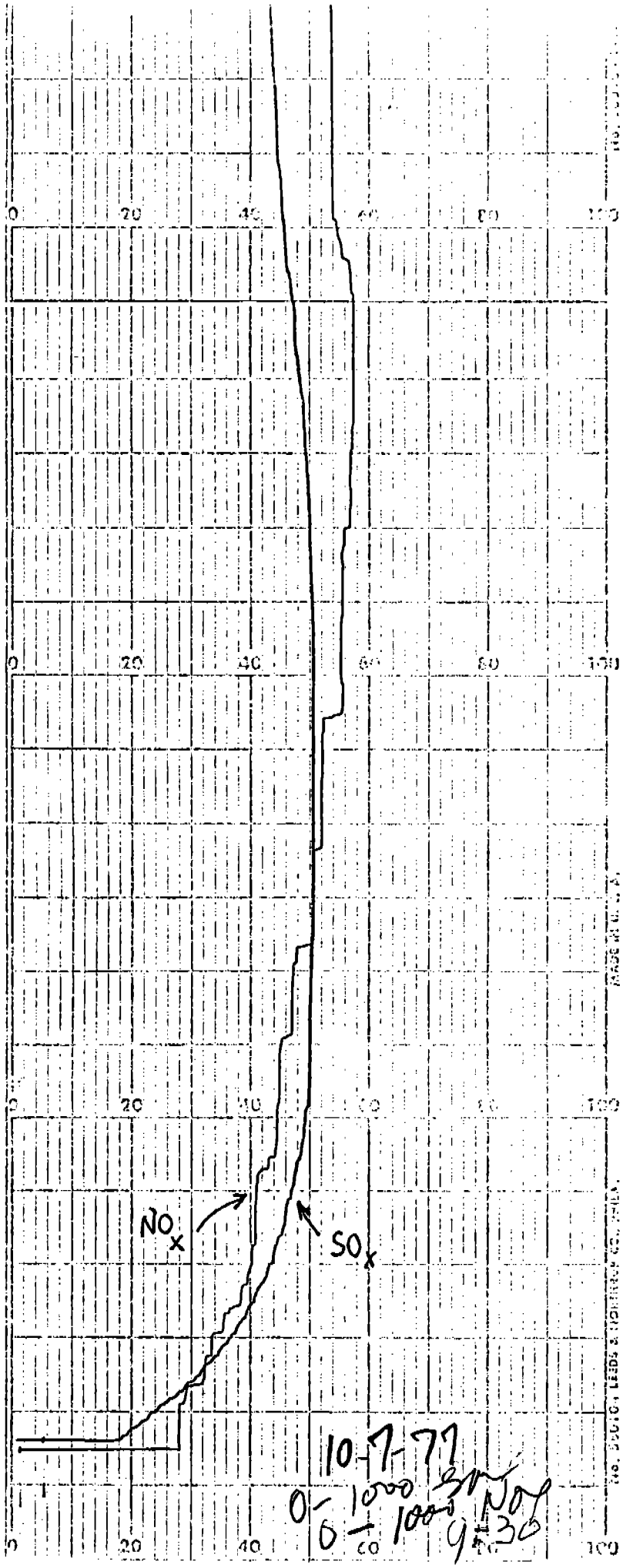

x_{OS}
x_{ON}

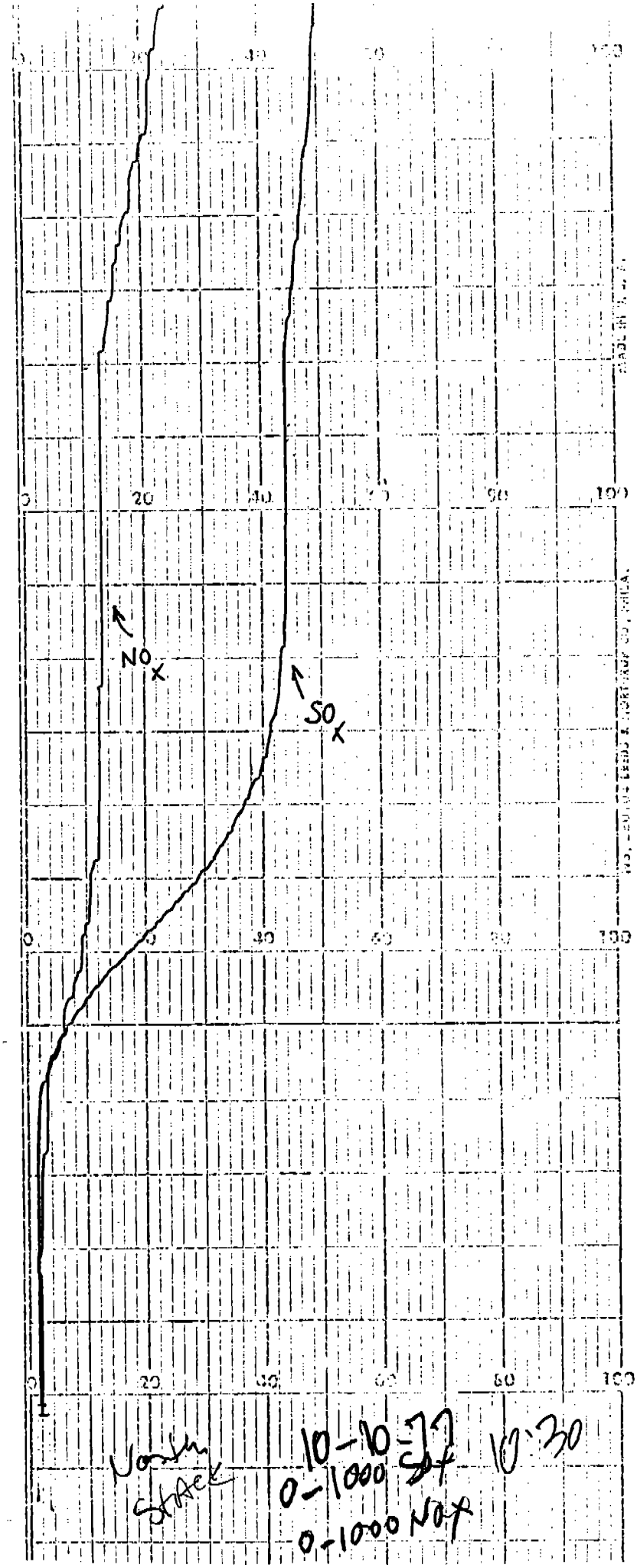

CALIBRATION
10:25
Calibrate 9-22-77
SOx
NOx

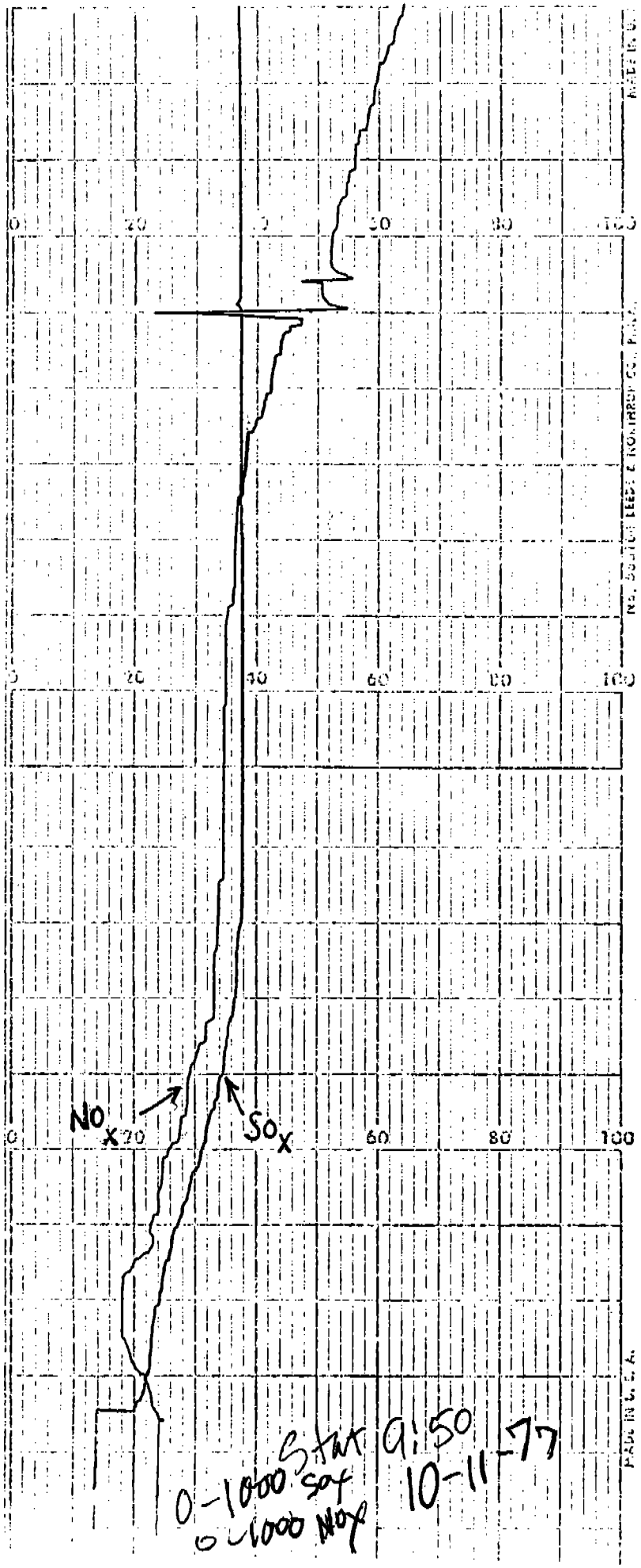

9-27-77
SOx
NOx

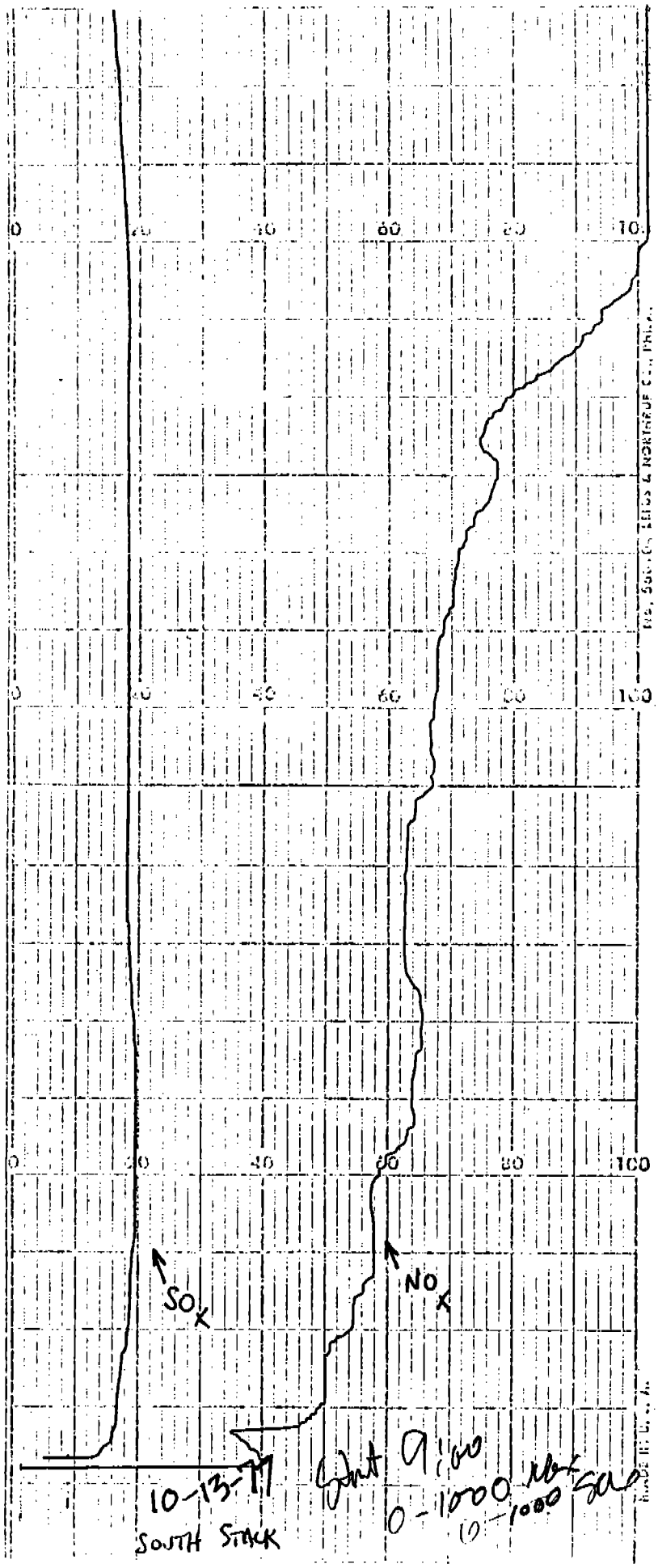

0
20
40
60
80
100
NO x
SO x
0 – 1000 ppm SO x
0 – 1000 ppm NO x
South Stack
Start 12:45
10-6-77

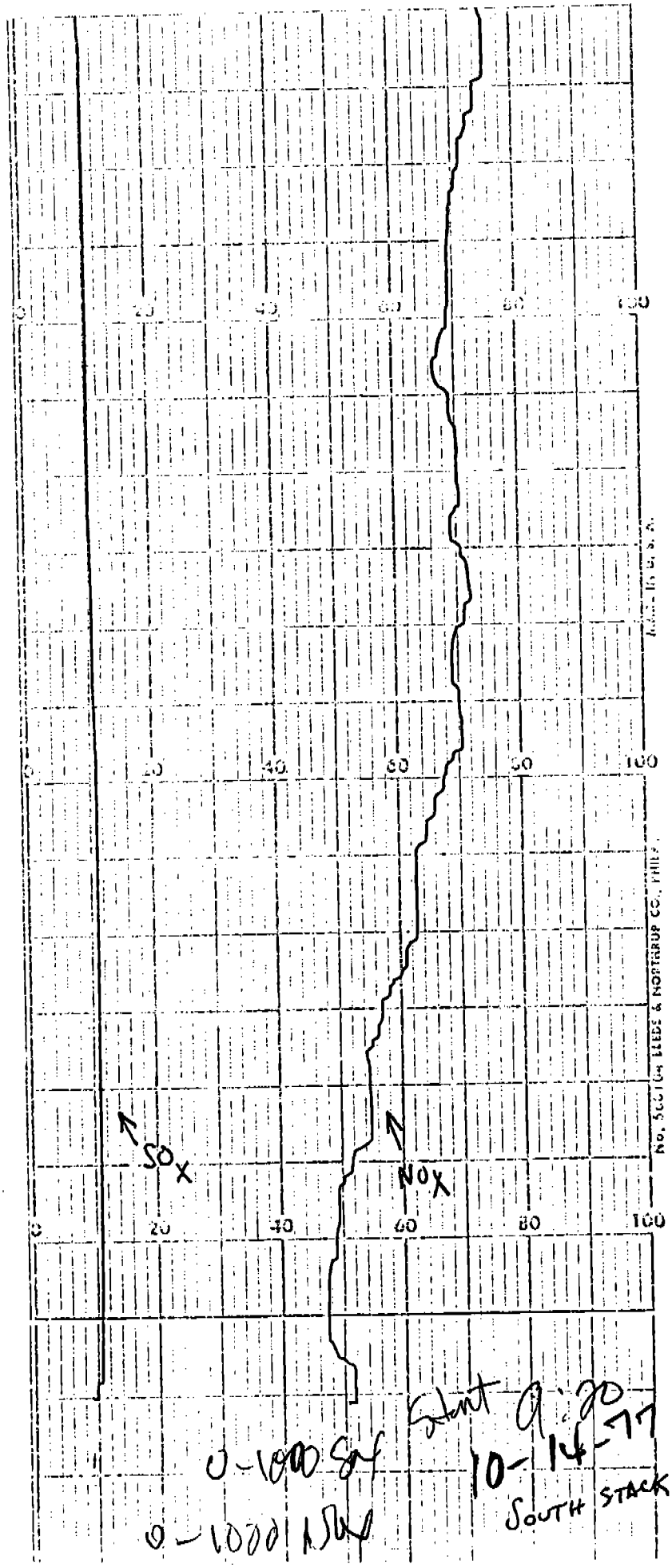

0
20
40
60
80
100
NO x
SO x
0 – 1000 ppm SO x
0 – 1000 ppm NO x
Start 08:35
9-28-77


0
20
40
60
80
100
NO$_x$
SO$_x$
10-7-77
0-1000 ppm NO
0-100 ppm CO
9:30


0
20
40
60
80
100
NOx
SOx
Nomo
Stack
10-10
0-1000 SO2
0-1000 NOx
10:30


0
20
40
60
80
100
NO_x
SO_x
0-1000 Stack
0-1000 SO2
0-1000 NOx
9:50
10-11-77


0
40
60
80
100
SOx
NOx
10-13-77
SOUTH STACK
Unit 9 1600
0-1000 Mk
0-1000 Sca


0
20
40
60
80
100
SOx
NOx
No. 5001-M LEEDS & NORTHRUP CO., PHILA.
0-1000 SCF
0-1000 lbs/hr
Start 9:20
10-14-77
South Stack

APPENDIX 6

RUN DATA SHEETS

SOx (ED)

~~PARTICULATE~~ FIELD DATA

RH = 74%

Run No. 2 | Amb. Temp. °F 79°F DB & 73°F WB | Probe Tip Dia., In 1/4" | Heater Box Setting

Location NORTH KILN STACK | Bar. Press. "Hg. 29.54 "Hg | Probe Length 15 ft

Date 8/12/77 | Assumed Moist 15% | Inp. Nos. 5 → 8

Operator DVV | Test Periods 192 MIN | Sample Box No. SOx

48 PTS @ 4 MIN EACH | ∮ = .73

FILL IN ALL BLANKS READ & RECORD AT THE START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	10:38	700.15	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
A - 1	:42	701.30	.15	.39	.28	.28	69	70	1.0	168	67	69	89	
2	:46	702.40	.15	.39	.28	.26	68	69	1.0	167	67	82	101	
3	:50	703.71	.20	.45	.36	.39	67	69	1.0	168	67	92	109	
4	:54	705.09	.25	.50	.48	.43	67	70	2.0	169	68	93	119	
5	:58	706.54	.25	.50	.48	.47	67	70	2.0	171	68	83	〃	
6	11:02	708.00	.25	.50	.48	.49	67	71	2.0	170	68	86	〃	
7	:06	709.46	.20	.45	.36	.48	67	71	2.5	170	69	83	〃	
8	:10	710.80	.20	.45	.36	.39	68	72	2.0	170	68	90	〃	
9	:14	712.10	.20	.45	.36	.38	67	72	2.0	171	69	88	332	←
10	:18	713.38	.20	.45	.36	.36	67	72	2.0	172	67	98	345	↓
11	:22	714.70	.20	.45	.36	.39	68	73	2.5	212	67	109	373	
12	:26	715.98	.20	.45	.36	.37	68	73	2.5	224	66	216	371	
13	:30	717.28	.20	.45	.36	.37	68	73	2.5	229	66	241	370	
14	:34	718.69	.25	.50	.48	.45	69	74	2.5	195	66	223	368	
15	:38	720.02	.20	.45	.36	.39	69	74	2.5	192	66	225	367	
16	:42	721.36	.25	.50	.48	.40	69	74	2.5	198	66	303	364	
17	:46	722.66	.20	.45	.36	.37	69	74	2.5	189	67	335	365	
18	:50	724.00	.25	.50	.48	.40	69	75	2.5	169	69	357	363	
19	:54	725.54	.30	.55	.60	.55	69	75	3.0	145	69	362	368	
20	:58	727.17	.30	.55	.60	.62	69	76	3.0	139	68	366	361	
21	12:02	728.64	.25	.50	.48	.53	69	76	3.0	105	68	365	367	
22	:06	730.18	.25	.50	.48	.50	69	76	3.0	108	68	354	368	
23	:10	731.75	.25	.50	.48	.50	69	76	3.0	105	68	365	365	
24	:14	733.00	.20	.45	.36	.34	69	76	3.0	101	68	365	363	
TOTAL														
AVERAGE														

CORRECTED SAMPLE VOLUME = _____ Ft.^{3} (Meter Volume) X _____ (Dry Meter Calibration Factor) = _____ Ft.^{3}

(CONT.)

SOX

~~PARTICULATE~~ FIELD DATA (SHARON)

D.B. W.B.

Run No. 2 | Amb. Temp. °F 79°F & 73°F | Probe Tip Dia., In 1/4" | Heater Box Setting ____

Location NORTH KILN STACK | Bar. Press. "Hg. 29.54" Hg | Probe Length 15 ft | FILL IN ALL BLANKS READ & RECORD AT THE START OF EACH TEST POINT

Date 8/12/77 | Assumed Moist 15% | Inp. Nos. 5 → 8

Operator DVV | Test Periods 192 MIN | Sample Box No. 50x

48 PTS @ 4 MIN EACH | f = .73

Point	Clock Time 13:17	Dry Gas Meter C.F. 733.00	Pitot In. H_2O ΔP	Pitot In. H_2O $\sqrt{\Delta P}$	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
B-1	:21	734.10	.15	.39	.27	.26	69	70	2.0	179	71	93		
2	:25	735.22	.15	.39	.27	.27	69	70	2.0	178	71	79		
3	:29	736.33	.15	.39	.27	.27	69	70	2.0	178	72	79		
4	:33	737.43	.25	.50	.48	.25	69	70	2.0	180	72	89		
5	:37	738.95	.25	.50	.48	.53	69	71	3.0	182	71	77		
6	:41	740.54	.25	.50	.48	.54	69	72	3.0	191	71	80		
7	:45	741.98	.25	.50	.48	.47	68	73	3.0	192	70	82		
8	:49	743.44	.25	.50	.48	.47	68	73	3.0	198	72	97		
9	:53	744.92	.25	.50	.48	.50	68	73	3.0	102	70	83	316	
10	:57	746.40	.25	.50	.48	.50	68	74	3.0	212	71	90	323	
11	:01	747.77	.20	.45	.36	.42	68	74	3.0	216	73	118	341	
12	:05	749.18	.25	.50	.48	.45	68	73	2.5	215	71	194	344	
13	:09	750.62	.25	.50	.48	.47	68	74	3.0	124	71	282	354	
14	:13	752.01	.25	.50	.48	.45	68	74	3.0	202	72	322	362	
15	:17	753.00	.25	.50	.48	.21	68	74	3.0	177	72	340	364	
16	:21	754.98	.25	.50	.48	.88	69	75	3.0	185	74	348	367	
17	:25	756.61	.28	.53	.53	.62	69	75	3.0	198	75	351	371	
18	:29	757.97	.28	.53	.53	.42	69	76	3.0	182	76	357	372	
19	:33	759.54	.30	.55	.60	.56	70	77	3.0	103	76	360	379	
20	:37	761.19	.30	.55	.60	.62	70	77	3.0	109	77	362	382	
21	:41	762.84	.30	.55	.60	.62	70	77	3.0	125	78	365	382	
22	:45	764.50	.30	.55	.60	.62	70	77	3.5	138	78	367	382	
23	:49	765.73	.15	.39	.27	.34	71	76	2.5	238	76	368	383	
24	:53	766.81	.15	.39	.27	.25	70	76	2.5	240	75	370	386	
TOTAL				22.99		21.10	3291	3522					11618	
AVERAGE				0.48		0.44	68	73					363	

(531) Meter Volume | Dry Meter Calibration Factor (823)

STATIC PRESSURE = −0.40 "H_2O CORRECTED SAMPLE VOLUME = 66.66 Ft.3 X 0.990 = 65.99 Ft.3

~~Sep~~ RUN NO. 2

~~PARTICULATE~~ & WATER CATCH

IMPINGER NO. 5	Final Weight 678.9C Initial Weight 658.52 Increase	WATER WEIGHT GAIN	IMPINGER 1 20.4x
IMPINGER NO. 6	Final Weight ~~722.55~~ 735.43 Initial Weight 701.41 Increase		IMPINGER 2 34.0v IMPINGER 3 57.2x IMPINGER 4 22.6/
IMPINGER NO. 7	Final Weight ~~735.43~~ 722.55 Initial Weight 665.31 Increase		TOTAL 134.31
IMPINGER NO. 8	Final Weight 815.4C Initial Weight 792.85 Increase		ORSAT CO_2 10.0 O_2 15.0
FILTER NO. [redacted]	Final Weight Initial Weight Part. Catch	$M_S = 29.13$	CO — N_2 75.0

SOLID WEIGHT GAIN

BEAKER NO.	Final Weight Initial Weight Increase	BEAKER 1 BEAKER 2
BEAKER NO.	Final Weight Initial Weight Increase	BEAKER 3 BEAKER 4
BEAKER NO.	Final Weight Initial Weight Increase	TOTAL
BEAKER NO. PROBE WASH	Final Weight Initial Weight Increase	

Moisture Content: Sample Vol. 65.99 ft.^{3} x $\frac{530}{460 + 70}$ / $\frac{460 + \text{Meter}}{531 \text{ Temp.}}$ X 28.3 L/ft.^{3} = 186x L Dry Gas

Water Weight $\frac{134.3/ \text{gm.}}{18 \frac{\text{gm.}}{\text{mol.}}}$ x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 179.8L H_2O Vapor

Total = 2044

$\frac{H_2O \text{ Vol.}}{\text{Total}}$ $\frac{179.8}{2044}$ x 100 = 8.8 %

SOx (ED)

~~PARTICULATE~~ FIELD DATA

D.B. W.B. R.H = 89%

Run No. 4 | Amb. Temp. °F 74°F & 72°F | Probe Tip Dia., In ~~.500~~ ¼" | Heater Box Setting

Location NORTH STACK | Bar. Press. "Hg. 29.54 "Hg | Probe Length 15 ft

Date 8 | Assumed Moist 10% | Inp. Nos.

Operator DVV | Test Periods 192 MIN | Sample Box No.

48 PTS @ 4 MIN EACH | f = 0.76

FILL IN ALL BLANKS
READ & RECORD AT THE START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:10	767.16	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
A-1	:14	768.41	.17	.41	.34	.34	76	77	1.5	167	58	98	?	
2	:18	769.72	.20	.45	.42	.39	75	76	1.5	168	58	89		
3	:22	771.05	.20	.45	.42	.39	74	75	1.5	167	59	89		
4	:26	772.39	.20	.45	.42	.40	73	75	1.5	125	66	90		
5	:30	773.76	.22	.47	.44	.42	73	75	2.0	101	65	90		
6	:34	775.20	.24	.50	.50	.47	72	76	2.0	103	64	92		
7	:38	776.69	.25	.50	.50	.50	72	76	2.0	124	63	94		
8	:42	778.18	.25	.50	.50	.50	72	76	2.0	131	63	97		
9	:46	779.67	.25	.50	.50	.50	72	77	2.0	135	63	99		
10	:50	781.13	.25	.50	.50	.49	72	77	2.0	99	62	104	366	←
11	:54	782.63	.25	.50	.50	.50	73	78	2.0	198	62	109	370	↓
12	:58	784.11	.24	.50	.50	.50	73	78	2.0	199	62	178	365	
13	10:02	785.50	.20	.45	.42	.44	73	78	2.0	104	63	215	360	
14	:06	786.86	.20	.45	.42	.42	73	78	2.0	198	63	221	360	
15	:10	788.21	.22	.47	.44	.42	73	78	2.0	99	63	246	358	
16	:14	789.57	.22	.47	.44	.42	73	78	2.0	205	64	292	351	
17	:18	790.92	.22	.47	.44	.42	73	78	2.0	218	64	326	348	
18	:22	792.37	.25	.50	.50	.47	74	79	2.5	221	64	345	355	
19	:26	793.84	.25	.50	.50	.49	74	79	2.5	198	65	354	354	
20	:30	795.33	.25	.50	.50	.50	74	79	2.5	199	64	358	359	
21	:34	796.70	.25	.50	.50	.42	74	79	4.5	208	64	358	357	
22	:38	798.20	.25	.50	.50	.50	74	79	5.5	220	65	359	359	
23	:42	799.55	.20	.45	.42	.42	74	79	5.0	198	64	361	355	
24	:46	800.90	.20	.45	.42	.42	74	79	5.0	195	64	361	357	
TOTAL				(11.44)		(10.74)	(1760)	(1859)					(5380)	
AVERAGE														

CORRECTED SAMPLE VOLUME = _____ Ft.^{3} (Meter Volume) X _____ (Dry Meter Calibration Factor) = _____ Ft.^{3}

(CONT.)

SOx (SHARON)

~~PARTICULATE~~ FIELD DATA

Run No. 4 | Amb. Temp. °F D.B. 74°F & W.B. 72°F | Probe Tip Dia., In 1/4" | Heater Box Setting

Location NORTH STACK | Bar. Press. "Hg. 29.54" Hg | Probe Length 15 ft | FILL IN ALL BLANKS

Date 8/14/77 | Assumed Moist 10% | Inp. Nos. | READ & RECORD AT THE START OF EACH TEST POINT

Operator DVV | Test Periods 192 MIN | Sample Box No.

48 PTS @ 4 MIN EACH | $I = .76$

Point	Clock Time 11:48	Dry Gas Meter C.F. 800.90	Pitot In. H_2O Δp	Pitot In. H_2O $\sqrt{\Delta p}$	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
B-1	:52	802.01	.17	.41	.34	.27	69	72	14.0	170	62	93	?	
2	:56	803.16	.18	.42	.36	.30	69	72	14.0	175	62	90		
3	12:00	804.33	.20	.45	.42	.30	69	72	14.0	182	62	78		
4	:04	805.55	.22	.47	.44	.33	69	72	14.0	191	62	76		
5	:08	806.65	.20	.45	.42	.26	69	72	14.0	192	61	77		
6	:12	807.80	.22	.47	.44	.30	69	73	14.0	195	60	78		
7	:16	809.96	.20	.45	.42	.30	69	73	14.0	190	60	80		
8	:20	810.12	.20	.45	.42	.30	69	74	14.0	185	60	87		
9	:24	811.30	.22	.47	.44	.31	69	74	14.0	184	59	86		
10	:28	812.49	.22	.47	.44	.32	69	74	14.5	182	59	89	347	←
11	:32	813.68	.22	.47	.44	.32	70	75	14.5	185	59	92	349	↓
12	:36	814.86	.20	.45	.42	.32	70	76	14.5	186	60	141	349	
13	:40	816.04	.20	.45	.42	.32	71	76	14.5	185	60	238	341	
14	:44	817.23	.22	.47	.44	.32	71	76	14.5	181	59	282	347	
15	:48	818.41	.25	.50	.50	.32	71	76	14.5	188	59	318	355	
16	:52	819.59	.22	.47	.44	.32	72	76	14.5	189	60	257	354	
17	:56	820.80	.25	.50	.50	.32	72	76	14.5	185	60	256	359	
18	13:00	822.04	.28	.53	.60	.34	72	76	14.5	188	60	309	362	
19	:04	823.35	.30	.55	.62	.39	72	77	14.0	187	60	335	361	
20	:08	824.74	.33	.57	.68	.45	73	77	13.5	188	60	350	368	
21	:12	826.20	.33	.57	.68	.49	73	77	13.5	179	61	360	374	
22	:16	827.58	.30	.55	.62	.42	73	77	13.5	177	61	364	377	
23	:20	828.94	.25	.50	.50	.42	73	78	13.5	177	60	367	380	
24	:24	830.47	.25	.50	.50	.53	74	78	13.5	178	61	369	380	(5403)
TOTAL				23.03		19.01	3457	3658					10,783	
AVERAGE				0.48		0.39	(72)	(76)					359	

(534) Meter Volume

(819) Dry Meter Calibration Factor

STATIC PRESSURE = -0.45 " H_2O

CORRECTED SAMPLE VOLUME = 63.31 Ft.^{3} X 0.990 = 62.67 Ft.^{3}

RUN NO. 4

Soap ~~PARTICULATE~~ & WATER CATCH

IMPINGER NO. 13	Final Weight 699.27 Initial Weight 661.65 Increase	WATER WEIGHT GAIN	IMPINGER 1 37.62
			IMPINGER 2 56.97
IMPINGER NO. 14	Final Weight 721.18 Initial Weight 714.21 Increase		IMPINGER 3 18.76
			IMPINGER 4 26.23
IMPINGER NO. 15	Final Weight 768.55 Initial Weight 749.79 Increase		TOTAL 139.58
			ORSAT
IMPINGER NO. 16	Final Weight 822.06 Initial Weight 796.43 Increase	$M_S = 28.40$	CO_2 5.0
			O_2 17.5
FILTER NO. _____	Final Weight _____ Initial Weight Part. Catch _____		CO .07
			N_2 77.5

SOLID WEIGHT GAIN

BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 1 _____
		BEAKER 2 _____
BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 3 _____
		BEAKER 4 _____
		TOTAL _____
BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	
BEAKER NO. _____ PROBE WASH	Final Weight _____ Initial Weight Increase _____	

Moisture Content: Sample Vol. 62.67 ft.^{3} x $\frac{(530)}{460 + 70}$ X 28.3 L/ft.^{3} = 1760 L Dry Gas
$\frac{}{460 + \text{Meter}}$ (534) Temp.

Water Weight $\frac{139.58 \text{ gm.}}{18 \frac{\text{gm.}}{\text{mol.}}}$ x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 187 L H_2O Vapor

Total = 1947 L

$\frac{H_2O \text{ Vol.}}{\text{Total}}$ $\frac{187 \text{ L}}{1947 \text{ L}}$ x 100 = 9.6 %

SOx (FD)

FIELD DATA

DB WB RH = 60%

Run No. 6 | Amb. Temp. °F 73 °F & 63 °F | Probe Tip Dia., In 1/4" | Heater Box Setting

Location NORTH STACK | Bar. Press. "Hg. 29.76 "Hg | Probe Length 15 ft | FILL IN ALL BLANKS

Date 8/15/77 | Assumed Moist 10 % | Inp. Nos. 25 → 28 | READ & RECORD AT THE

Operator DVV | Test Periods 192 MIN | Sample Box No. SOx | START OF EACH TEST

48 PTS @ 4 MIN EACH | f = .76 | POINT

Point	Clock Time 9:17	Dry Gas Meter C.F. 830.74	Pitot In. H_2O ΔP	Pitot In. H_2O $\sqrt{\Delta P}$	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
A-1	:21	832.03	.20	.45	.42	.37	71	73	3.5	195	66	295		
2	:25	833.41	.22	.47	.44	.43	69	72	3.5	192	65	207		
3	:29	834.85	.25	.50	.53	.47	69	72	3.0	194	64	150		
4	:33	836.28	.25	.50	.53	.47	68	72	3.0	197	63	113		
5	:37	837.75	.25	.50	.53	.50	68	72	3.0	198	62	97		
6	:41	839.28	.27	.52	.56	.53	68	73	3.5	121	61	89		
7	:45	840.71	.22	.47	.44	.47	68	73	3.0	197	68	89		
8	:49	842.10	.22	.47	.44	.44	68	73	3.0	198	69	95		
9	:53	843.59	.25	.50	.53	.50	68	74	3.0	143	68	91		
10	:57	845.10	.25	.50	.53	.54	68	74	3.0	125	68	92	378	
11	10:01	846.53	.22	.47	.44	.47	68	75	3.0	148	68	101	375	
12	:05	848.00	.25	.50	.53	.50	68	75	3.0	108	69	191	375	
13	:09	849.42	.22	.47	.44	.45	68	75	3.0	197	68	246	366	
14	:13	850.80	.20	.45	.42	.42	69	75	3.0	198	68	250	362	
15	:17	852.19	.22	.47	.44	.44	69	76	3.0	174	69	296	360	
16	:21	853.60	.22	.47	.44	.45	69	76	3.0	109	68	337	345	
17	:25	855.00	.22	.47	.44	.45	70	76	3.0	99	69	355	360	
18	:29	856.41	.22	.47	.44	.45	70	76	3.0	197	69	360	357	
19	:33	857.89	.25	.50	.53	.50	71	76	3.5	198	68	362	359	
20	:37	859.38	.25	.50	.53	.50	71	76	3.5	195	68	361	356	
21	:41	860.80	.22	.47	.44	.45	71	76	3.5	198	68	360	354	
22	:45	862.17	.25	.50	.53	.42	71	76	3.5	185	62	357	348	
23	:49	863.50	.22	.47	.44	.40	71	76	4.0	112	62	356	348	
24	10:53	864.83	.20	.45	.42	.40	72	76	4.5	109	63	357	352	
TOTAL				(11.54)		(11.02)	(1663)	(1788)					(5395)	
AVERAGE														

CORRECTED SAMPLE VOLUME = _____ Ft.^{3} (Meter Volume) X _____ (Dry Meter Calibration Factor) = _____ Ft.^{3}

(SHARON)

SOx

[redacted] FIELD DATA

(CONT.)

Run No. 6 | Amb. Temp. °F DB 73°F & WB 63°F | Probe Tip Dia., In 1/4" | Heater Box Setting

Location NORTH STACK | Bar. Press. "Hg. 29.76" Hg | Probe Length 15 ft

Date 8/15/77 | Assumed Moist 10% | Inp. Nos. 25 → 28

Operator DVV | Test Periods 192 MIN | Sample Box No. SO,

48 PTS @ 4 MIN EACH | Y = .76

FILL IN ALL BLANKS
READ & RECORD AT THE START OF EACH TEST POINT

Point	Clock Time 11:38	Dry Gas Meter C.F. 864.83	Pitot In. H_2O ΔP	Pitot In. H_2O $\sqrt{\Delta P}$	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
B-1	:42	865.93	.15	.39	.30	.25	69	70	13.0	98	61	138		
2	:46	867.09	.15	.39	.30	.30	69	70	13.5	98	62	104		
3	:50	868.25	.18	.42	.37	.30	69	70	13.5	97	62	87		
4	:54	869.43	.20	.45	.42	.31	70	71	14.0	101	61	81		
5	:58	870.62	.22	.47	.44	.32	69	71	14.0	105	61	80		
6	12:02	871.81	.22	.47	.44	.31	70	72	14.0	103	61	81		
7	:06	873.00	.25	.50	.53	.31	69	72	14.0	109	60	83		
8	:10	874.19	.25	.50	.53	.32	69	72	14.0	99	60	86		
9	:14	875.37	.24	.49	.50	.31	69	72	14.0	198	60	88		
10	:18	876.57	.24	.49	.50	.32	69	73	14.0	197	59	89	345	
11	:22	877.74	.24	.49	.50	.31	70	73	14.0	199	60	92	342	
12	:26	878.96	.24	.49	.50	.33	69	73	14.0	98	60	137	344	
13	:30	880.20	.22	.47	.44	.34	69	74	14.0	104	60	226	351	
14	:34	881.44	.22	.47	.44	.34	69	74	14.0	109	59	297	353	
15	:38	882.70	.22	.47	.44	.36	69	74	14.0	97	59	329	357	
16	:42	883.90	.24	.49	.50	.32	70	74	14.0	98	59	345	362	
17	:46	885.16	.27	.52	.56	.36	70	74	14.0	199	59	350	366	
18	:50	886.39	.25	.50	.53	.34	70	74	14.0	197	59	353	361	
19	:54	887.62	.28	.53	.60	.34	70	74	14.0	185	59	355	365	
20	:58	888.84	.28	.53	.60	.33	70	74	14.0	198	59	357	367	
21	13:02	890.07	.28	.53	.60	.34	70	74	14.0	196	60	360	356	
22	:06	891.31	.28	.53	.60	.34	71	75	14.0	99	60	362	353	
23	:10	892.70	.25	.50	.53	.44	71	75	14.0	98	60	364	357	
24	:14	893.86	.25	.50	.53	.30	71	75	14.5	99	61	365	362	
TOTAL				23.13		18.86	3334	3538					10,746	
AVERAGE				0.48		0.39	69	74					358	

(532) Meter Volume | Dry Meter Calibration Factor (818)

STATIC PRESSURE = −0.43" H_2O CORRECTED SAMPLE VOLUME = 63.12 Ft.^{3} X 0.990 = 62.49 Ft.^{3}

SOx RUN NO. 6

PARTICULATE & WATER CATCH

IMPINGER NO. 25	Final Weight 713.70 Initial Weight 676.75 Increase	WATER WEIGHT GAIN	IMPINGER 1 36.95
			IMPINGER 2 79.23
IMPINGER NO. 26	Final Weight 760.31 Initial Weight Increase 680.58		IMPINGER 3 33.35
			IMPINGER 4 31.85
IMPINGER NO. 27	Final Weight 752.85 Initial Weight Increase 719.47		TOTAL 181.88
			ORSAT
IMPINGER NO. 28	Final Weight 807.20 Initial Weight Increase 775.85		CO_2 5.0
		M_s = 28.12	O_2 17.5
FILTER NO. None	Final Weight Initial Weight Part. Catch		CO —
			N_2 77.5

SOLID WEIGHT GAIN

BEAKER NO.	Final Weight Initial Weight Increase	BEAKER 1
		BEAKER 2
BEAKER NO.	Final Weight Initial Weight Increase	BEAKER 3
		BEAKER 4
		TOTAL
BEAKER NO.	Final Weight Initial Weight Increase	
BEAKER NO. PROBE WASH	Final Weight Initial Weight Increase	

Moisture Content: Sample Vol 62.45 ft.^{3} x $\frac{530}{460 + 70}$ / $\frac{460 + \text{Meter}}{532 \text{ Temp.}}$ X 28.3 L/ft.^{3} = 1762 L Dry Gas

Water Weight $\frac{181.88 \text{ gm.}}{18 \frac{\text{gm.}}{\text{mol.}}}$ x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 243 L H_2O Vapor

Total = 2005 L

$\frac{H_2O \text{ Vol.}}{\text{Total}}$ $\frac{243 \text{ L}}{2005 \text{ L}}$ x 100 = 12.1%

SOx FIELD DATA (SHARON)

R.H. = 84%

Run No. 8
Location NORTH STACK
Date 8/16/77
Operator D.V.V.

Amb. Temp. °F 73°F & 69°F
Bar. Press. "Hg. 29.68 "Hg
Assumed Moist 10%
Test Periods 192 MIN
48 PTS @ 4 MIN EACH

Probe Tip Dia., In 1/4"
Probe Length 15 ft
Inp. Nos. 33 → 36
Sample Box No. SOx
F = .76

Heater Box Setting

FILL IN ALL BLANKS
READ & RECORD AT THE START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:31	894.58	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
A-1	:35	895.78	.18	.42	.37	.32	68	64	2.5	163	58	166		
2	:39	897.03	.18	.42	.37	.34	68	69	2.5	174	58	107		
3	:43	898.39	.18	.42	.37	.42	68	70	2.5	144	59	79		
4	:47	899.75	.20	.45	.42	.42	67	70	2.5	193	59	70		
5	:51	901.19	.24	.49	.50	.47	67	71	2.5	202	60	69		
6	:55	902.64	.24	.49	.50	.47	67	72	3.0	144	60	70		
7	:59	904.14	.25	.50	.53	.52	67	73	3.0	124	61	61		
8	10:03	905.59	.23	.48	.47	.47	68	73	2.5	215	63	69		
9	:07	907.11	.25	.50	.53	.53	68	74	3.0	183	63	64		
10	:11	908.64	.25	.50	.53	.53	68	74	3.0	180	64	66	358	
11	:15	910.19	.25	.50	.53	.56	69	75	3.0	219	65	90	359	
12	:19	911.65	.24	.49	.50	.49	64	75	3.0	210	66	176	365	
13	:23	913.25	.28	.53	.60	.60	69	75	3.0	146	67	283	352	
14	:27	914.67	.23	.48	.47	.45	69	75	3.0	197	67	324	357	
15	:31	916.17	.25	.50	.53	.52	69	75	3.0	190	67	336	360	
16	:35	917.60	.23	.48	.47	.46	70	75	3.0	112	68	346	363	
17	:34	919.08	.25	.50	.53	.50	70	75	3.0	184	67	354	366	
18	:43	920.65	.27	.52	.56	.56	70	75	3.5	180	67	358	366	
19	:47	922.19	.28	.53	.60	.56	70	75	3.5	148	68	355	365	
20	:51	923.79	.28	.53	.60	.60	70	76	3.5	119	71	355	372	
21	:55	925.39	.28	.53	.60	.60	70	76	3.5	205	70	354	372	
22	:59	926.99	.28	.53	.60	.60	70	76	3.5	214	73	362	373	
23	11:03	928.54	.27	.52	.56	.56	70	76	3.5	181	72	352	375	
24	:07	930.10	.25	.50	.53	.56	70	76	3.5	185	72	353	376	
TOTAL				(11.81)			(1651)	(1770)					(5479)	
AVERAGE														

CORRECTED SAMPLE VOLUME = _____ Ft.^{3} (Meter Volume) X _____ (Dry Meter Calibration Factor) = _____ Ft.^{3}

(CONT.)

SOx (ED)

~~EMISSIONS~~ FIELD DATA

Run No. 8
Location NORTH STACK
Date 8/16/77
Operator DVV

Amb. Temp. °F D.B. 73°F & W.B. 69°F
Bar. Press. "Hg. 29.68" Hg
Assumed Moist 10%
Test Periods 192 MIN

Probe Tip Dia., In 1/4"
Probe Length 15ft
Inp. Nos. 33 → 36
Sample Box No. SOx
F = .76

Heater Box Setting

FILL IN ALL BLANKS
READ & RECORD AT THE START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	11:55	930.10	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
B-1	:59	931.26	.18	.42	.36	.29	68	69	2.5	114	69	95		
2	12:03	932.61	.20	.45	.42	.42	68	69	3.0	140	70	86		
3	:07	934.09	.25	.50	.53	.50	68	69	3.0	169	70	82		
4	:11	935.52	.25	.50	.53	.48	68	70	3.0	167	71	86		
5	:15	937.00	.25	.50	.53	.50	68	71	3.0	149	71	85		
6	:19	938.47	.25	.50	.53	.49	68	72	3.0	124	71	89		
7	:23	939.94	.23	.48	.47	.50	68	72	3.0	135	72	92		
8	:27	941.37	.23	.48	.47	.48	68	73	3.0	152	71	93		
9	:31	942.78	.23	.48	.47	.45	68	73	3.0	145	72	98		
10	:35	944.11	.20	.45	.42	.39	68	73	3.0	136	72	116	355	
11	:39	945.50	.24	.49	.50	.45	69	74	3.0	125	72	183	372	
12	:43	946.94	.24	.49	.50	.48	69	74	3.0	116	71	261	374	
13	:47	948.38	.23	.48	.47	.47	69	74	3.0	112	70	334	369	
14	:51	949.81	.23	.48	.47	.47	69	74	3.0	199	68	219	371	
15	:55	951.21	.22	.47	.44	.44	69	74	3.5	126	68	286	369	
16	:59	952.67	.22	.47	.44	.47	68	74	3.5	141	69	329	367	
17	13:03	953.94	.22	.47	.44	.37	68	74	3.0	139	71	350	367	
18	:07	955.33	.23	.48	.47	.45	69	74	3.5	143	72	363	364	
19	:11	956.75	.25	.50	.53	.46	69	74	3.5	107	72	365	364	
20	:15	958.25	.25	.50	.53	.51	68	74	3.5	114	72	366	364	
21	:19	959.75	.25	.50	.53	.52	68	74	3.5	108	73	366	363	
22	:23	961.25	.27	.52	.56	.52	68	74	3.5	110	74	365	367	
23	:27	962.74	.25	.50	.53	.50	68	74	3.5	145	74	365	364	
24	:31	964.25	.25	.50	.53	.53	68	74	3.5	188	74	366	363	
TOTAL				23.42		23.25	3290	3517					10972	
AVERAGE				0.49		0.48	68	73					365	

STATIC PRESSURE = -0.44 " H_2O CORRECTED SAMPLE VOLUME = (531) Meter Volume 69.67 Ft.^{3} X Dry Meter Calibration Factor (826) 0.990 = 68.97 Ft.^{3}

RUN NO. 8

Sep

~~PARTICULATE~~ & WATER CATCH

IMPINGER NO. 33	Final Weight 655.44 (93.42)	WATER WEIGHT GAIN	IMPINGER 1 38.82
	Initial Weight 654.60		IMPINGER 2 88.31
IMPINGER NO. 34	Final Weight 784.61		IMPINGER 3 38.12
	Initial Weight 696.30		IMPINGER 4 33.90
IMPINGER NO. 35	Final Weight 792.52		TOTAL 199.15
	Initial Weight 754.40		
IMPINGER NO. 36	Final Weight 768.60		ORSAT
	Initial Weight 734.70		CO_2 4.7
FILTER NO. _____	Final Weight _____		O_2 18.5
	Initial Weight _____		CO 0.06
	Part. Catch _____		N_2 76.8

$M_S = 28.11$

SOLID WEIGHT GAIN

BEAKER NO. _____	Final Weight _____	BEAKER 1 _____
	Initial Weight _____	BEAKER 2 _____
	Increase _____	BEAKER 3 _____
BEAKER NO. _____	Final Weight _____	BEAKER 4 _____
	Initial Weight _____	TOTAL _____
	Increase _____	
BEAKER NO. _____	Final Weight _____	
	Initial Weight _____	
	Increase _____	
BEAKER NO. _____ PROBE WASH	Final Weight _____	
	Initial Weight _____	
	Increase _____	

Moisture Content: Sample Vol. 68.47 ft.^{3} x $\frac{(530)}{460 + 70}$ / $\frac{460 + \text{Meter}}{(531)\ \text{Temp.}}$ X 28.3 L/ft.^{3} = 1948 L Dry Gas

Water Weight $\frac{199.15 \text{ gm.}}{18 \text{ gm./mol.}}$ x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 266 L H_2O Vapor

Total = 2214 L

$\frac{H_2O \text{ Vol.}}{\text{Total}}$ $\frac{266 \text{ L}}{2214 \text{ L}}$ x 100 = 12.0%

SOx (ED)

FIELD DATA

DB W.B. RH = 99%

Run No. 10
Location NORTH STACK
Date 8/17/77
Operator D.V.V

Amb. Temp. °F 76°F & 75°F
Bar. Press. "Hg. 29.37"Hg
Assumed Moist 10%
Test Periods 192 MIN
48 PTS @ 4 MIN EACH

Probe Tip Dia., In 1/4"
Probe Length 15 ft
Inp. Nos. 37 → 40
Sample Box No. SOx
$\neq$ = .76

Heater Box Setting

FILL IN ALL BLANKS
READ & RECORD AT THE START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:01	964.60	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
A-1	:05	965.82	.17	.41	.34	.33	68	70	2.5	146	70	127		
2	:09	967.08	.18	.42	.36	.35	67	70	2.5	171	70	98		
3	:13	968.37	.21	.46	.44	.37	67	70	2.5	174	70	87		
4	:17	969.72	.21	.46	.44	.42	67	71	2.5	188	69	86		
5	:21	971.14	.23	.48	.47	.46	67	72	3.0	184	68	90		
6	:25	972.57	.23	.48	.47	.47	67	72	3.0	190	68	91		
7	:29	974.05	.22	.47	.46	.50	67	73	3.0	202	68	94		
8	:33	975.44	.23	.48	.47	.44	67	74	3.0	200	69	94		
9	:37	976.88	.24	.49	.50	.46	68	74	3.0	212	69	96		
10	:41	978.33	.22	.47	.46	.48	68	75	3.0	186	70	102	322	
11	:45	979.76	.23	.48	.47	.47	68	75	3.0	177	70	132	333	
12	:49	981.20	.23	.48	.47	.47	69	76	3.0	177	70	207	341	
13	:53	982.63	.23	.48	.47	.47	69	76	3.0	136	70	287	352	
14	:57	984.07	.23	.48	.47	.47	70	76	3.0	132	69	332	359	
15	10:01	985.52	.24	.49	.50	.47	70	77	3.0	121	68	349	364	
16	:05	986.94	.24	.49	.50	.45	70	77	3.0	109	67	355	365	
17	:09	988.57	.26	.51	.56	.62	70	77	3.5	101	66	359	368	
18	:13	990.03	.26	.51	.56	.49	71	77	3.5	193	66	362	369	
19	:17	991.68	.28	.53	.60	.62	71	78	3.5	141	66	365	370	
20	:21	993.17	.28	.53	.60	.50	71	78	3.5	188	66	368	374	
21	:25	994.74	.28	.53	.60	.56	71	78	3.5	185	66	369	378	
22	:29	996.35	.28	.53	.60	.60	71	78	3.5	182	65	368	375	
23	:33	997.85	.25	.50	.53	.52	71	78	3.5	178	65	355	375	
24	:37	999.36	.25	.50	.53	.53	71	78	3.5	177	65	355	378	
TOTAL				(11.66)		(11.62)	(1656)	(1800)					(5423)	
AVERAGE														

CORRECTED SAMPLE VOLUME = _____ Ft.^{3} (Meter Volume) X _____ (Dry Meter Calibration Factor) = _____ Ft.^{3}

SOX

~~PARTICULATE~~ FIELD DATA (SHARON)

(CONT.)

D.B. WB.

Run No. 10 — Amb. Temp. °F 76 & 75 (°F) — Probe Tip Dia., In. 1/4" — Heater Box Setting

Location NORTH STACK — Bar. Press. "Hg. 29.37 "Hg — Probe Length 15 ft — FILL IN ALL BLANKS

Date 8/17/77 — Assumed Moist 10% — Inp. Nos. 37 → 40 — READ & RECORD AT THE START OF EACH TEST POINT

Operator D.V.V. — Test Periods 192 MIN — Sample Box No. SOx

48 PTS @ 4 MIN EACH — $\frac{1}{4}$ = .76

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	11:22	999.36	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
B-1	:26	0.64	.20	.45	.42	.36	70	71	3.0	121	64	220		
2	:30	2.05	.22	.47	.46	.45	70	71	3.0	145	64	132		
3	:34	3.56	.22	.47	.46	.53	70	72	3.0	98	64	99		
4	:38	4.87	.23	.48	.47	.40	70	72	3.0	128	64	90		
5	:42	6.26	.23	.48	.47	.45	70	73	3.0	141	64	92		
6	:46	7.71	.24	.49	.50	.47	69	73	3.0	172	63	91		
7	:50	9.17	.24	.49	.50	.49	69	74	3.5	185	64	92		
8	:54	10.55	.20	.45	.42	.43	69	75	3.0	198	64	94		
9	:58	11.90	.20	.45	.42	.42	69	75	3.0	224	64	95		
10	12:02	13.27	.22	.47	.46	.42	70	75	3.0	177	64	102	332	
11	:06	14.63	.22	.47	.46	.42	69	75	3.0	179	64	142	364	
12	:10	15.99	.24	.49	.50	.42	69	76	3.0	168	64	224	367	
13	:14	17.35	.22	.47	.46	.42	69	76	3.0	173	63	205	358	
14	:18	18.71	.22	.47	.46	.42	69	76	3.0	124	63	217	359	
15	:22	20.06	.20	.45	.42	.42	70	76	3.5	121	64	207	358	
16	:26	21.42	.20	.45	.42	.42	70	76	3.5	199	64	284	358	
17	:30	22.83	.23	.48	.47	.45	69	75	3.5	256	62	325	360	
18	:34	24.27	.23	.48	.47	.47	69	76	3.5	244	62	344	358	
19	:38	25.75	.25	.50	.53	.50	70	76	3.5	234	63	353	357	
20	:42	27.27	.25	.50	.53	.53	70	76	3.8	219	61	356	358	
21	:46	28.79	.25	.50	.53	.53	70	77	3.8	208	61	359	358	
22	:50	30.35	.25	.50	.53	.56	70	77	3.5	182	64	343	355	
23	:54	31.80	.25	.50	.53	.48	71	77	3.5	177	64	355	353	
24	12:58	33.24	.23	.48	.47	.47	72	77	3.5	122	66	355	357	
TOTAL				23.10		20.55	3329	3597					10775	
AVERAGE				0.48		0.47	69	75					359	

(532) Meter Volume — Dry Meter Calibration Factor (819)

STATIC PRESSURE = −0.45 " H_2O

CORRECTED SAMPLE VOLUME = 68.64 Ft.^{3} X 0.990 = 67.95 Ft.^{3}

RUN NO. 10

~~PARTICULATE~~ & WATER CATCH

IMPINGER NO. 37	Final Weight 712.79	WATER WEIGHT GAIN	IMPINGER 1 60.14
	Initial Weight 652.65		IMPINGER 2 76.67
IMPINGER NO. 38	Final Weight 791.27		IMPINGER 3 31.06
	Initial Weight		IMPINGER 4 31.40
	Increase 714.60		TOTAL 199.27
IMPINGER NO. 39	Final Weight 736.66		
	Initial Weight		ORSAT
	Increase 705.60		CO_2 5.0
IMPINGER NO. 40	Final Weight 793.25	$M_s = 28.10$	O_2 17.5
	Initial Weight		
	Increase 761.85		CO —
FILTER NO.	Final Weight		N_2 77.5
	Initial Weight		
	Part. Catch		

SOLID WEIGHT GAIN

BEAKER NO.	Final Weight	BEAKER 1
	Initial Weight	BEAKER 2
	Increase	BEAKER 3
BEAKER NO.	Final Weight	BEAKER 4
	Initial Weight	TOTAL
	Increase	
BEAKER NO.	Final Weight	
	Initial Weight	
	Increase	
BEAKER NO. PROBE WASH	Final Weight	
	Initial Weight	
	Increase	

Moisture Content: Sample Vol. 67.95 ft.^{3} $\times \frac{(530)}{460 + 70}$ $\frac{}{460 + \text{Meter}}$ $\frac{}{(532)\text{Temp.}}$ X 28.3 L/ft.^{3} = 1916 L Dry Gas

Water Weight $\frac{199.27 \text{ gm.}}{18 \frac{\text{gm.}}{\text{mol.}}}$ x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 267 L H_2O Vapor

Total = 2183 L

$\frac{H_2O \text{ Vol.}}{\text{Total}}$ $\frac{267 \text{ L}}{2183 \text{ L}}$ x 100 = 12.2 %

SOx

~~PARTICULATE~~ FIELD DATA (BRAD)

57 (WB) R.H = 80%

Run No. 50 | Amb. Temp. °F 68 (DB) | Probe Tip Dia., In 1/4" | Heater Box Setting

Location SOUTH STACK | Bar. Press. "Hg. 29.63 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/6/77 | Assumed Moist 10% | Inp. Nos. 53 → 56 | READ & RECORD ALL DATA

Operator DVV | Test Periods 192 MIN | Sample Box No. SOx | START OF EACH TEST POINT

48 PTS. @ 4 MIN EACH | $\neq$ = .76

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O ΔP	Pitot In.. H_2O $\sqrt{\Delta P}$	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	12:53	711.26												
A - 1	:57	712.20	.12	.34	.23	.19	70	72	2.0	165	58	162	334	
2	13:01	713.28	.17	.41	.34	.25	69	70	2.2	136	59	165	348	
3	:05	714.47	.18	.42	.36	.31	68	69	2.2	154	59	161	354	
4	:09	715.68	.18	.42	.36	.32	67	69	2.5	142	59	169	359	
5	:13	716.97	.20	.45	.42	.37	67	69	2.5	169	60	160	351	
6	:17	718.27	.20	.45	.42	.38	67	70	2.5	166	56	160	367	
7	:21	719.60	.20	.45	.42	.39	66	70	2.5	123	59	151	362	
8	:25	720.87	.20	.45	.42	.36	66	70	2.5	113	61	160	367	
9	:29	722.18	.20	.45	.42	.39	66	71	2.5	123	59	163	361	
10	:33	723.53	.22	.47	.45	.42	65	71	2.8	175	58	158	353	
11	:37	724.68	.16	.40	.32	.30	65	71	2.2	144	58	152	356	
12	:41	725.94	.20	.45	.42	.35	65	72	2.5	136	59	153	362	
13	:45	727.24	.20	.45	.42	.38	66	72	2.5	242	59	162	360	
14	:49	728.55	.20	.45	.42	.39	66	72	2.8	170	59	162	360	
15	:53	729.84	.20	.45	.42	.36	66	72	2.8	158	60	157	364	
16	:57	731.15	.20	.45	.42	.39	66	72	2.8	126	59	152	365	
17	14:01	732.44	.20	.45	.42	.36	66	73	2.8	163	60	154	360	
18	:05	733.73	.20	.45	.42	.37	67	73	2.8	129	60	155	363	
19	:09	735.04	.20	.45	.42	.39	66	73	2.8	198	60	155	364	
20	:13	736.32	.20	.45	.42	.37	66	73	3.0	202	60	156	365	
21	:17	737.65	.20	.45	.42	.39	67	73	3.0	126	60	155	360	
22	:21	739.00	.20	.45	.42	.42	67	73	3.0	107	58	151	360	
23	:25	740.25	.18	.42	.36	.34	67	73	3.0	106	57	151	358	
24	:29	741.48	.18	.42	.36	.34	67	73	2.8	182	57	149	364	
TOTAL														
AVERAGE														

STATIC PRESSURE = −0.72" H_2O

CORRECTED SAMPLE VOLUME = _____ Ft.³ (Meter Volume) X _____ (Dry Meter Calibration Factor) = _____ Ft³

(CONT.) SOX ~~PARTICULATE~~ DRY FIELD DATA (BRAD)

Run No. 50
Location SOUTH STACK
Date 10/6/77
Operator DVV

Amb. Temp. °F 57 (WB) 61 (DB)
Bar. Press. "Hg. 29.63
Assumed Moist 10%
Test Periods 192 MIN
48 PTS. @ 4 MIN EACH

Probe Tip Dia., In. 1/4"
Probe Length 15 ft
Inp. Nos. 53 → 56
Sample Box No. 50X
f = .76

Heater Box Setting
FILL IN ALL BLANKS
READ & RECORD ALL DATA
START OF EACH TEST
POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	15:20	741.48	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
B-24	:24	742.80	.18	.42	.36	.39	65	67	2.8	100	57	108	367	
23	:28	744.12	.18	.42	.36	.39	66	68	2.8	108	57	124	381	
22	:32	745.31	.20	.45	.42	.31	66	68	2.8	109	57	114	363	
21	:36	746.61	.20	.45	.42	.38	66	69	3.0	122	57	114	367	
20	:40	747.92	.20	.45	.42	.39	67	70	3.0	145	61	115	369	
19	:44	749.26	.22	.47	.45	.39	67	71	3.0	139	61	117	369	
18	:48	750.61	.22	.47	.45	.42	67	72	3.0	125	62	125	369	
17	:52	751.94	.20	.45	.42	.39	68	73	3.0	198	64	121	369	
16	:56	753.26	.20	.45	.42	.39	68	73	3.0	144	64	124	367	
15	16:00	754.59	.20	.45	.42	.39	68	73	3.0	152	63	119	369	
14	:04	755.91	.20	.45	.42	.39	68	73	3.0	127	64	120	366	
13	:08	757.23	.20	.45	.42	.39	68	73	3.0	240	64	122	367	
12	:12	758.55	.20	.45	.42	.39	69	74	3.0	195	62	125	366	
11	:16	759.88	.20	.45	.42	.39	69	73	3.0	112	61	124	367	
10	:20	761.19	.20	.45	.42	.39	69	74	3.0	121	61	121	368	
9	:24	762.53	.20	.45	.42	.41	69	74	3.0	133	60	118	369	
8	:28	763.83	.20	.45	.42	.38	69	74	3.0	122	59	124	368	
7	:32	765.14	.18	.42	.36	.39	69	74	3.0	115	59	124	367	
6	:36	766.45	.20	.45	.42	.39	69	74	3.0	109	58	126	369	
5	:40	767.77	.20	.45	.42	.39	70	74	3.0	262	58	124	367	
4	:44	769.02	.18	.42	.36	.34	70	74	3.0	121	59	142	367	
3	:48	770.27	.18	.42	.36	.34	71	75	3.0	133	59	145	368	
2	:52	771.44	.15	.39	.30	.30	71	75	2.8	145	59	146	357	
1	:56	772.44	.10	.31	.20	.21	71	74	2.5	109	59	155	340	
TOTAL				20.99		17.47	3238	3455					17393	
AVERAGE				0.44		0.36	67	72					362	

(530) (822)

CORRECTED SAMPLE VOLUME = 61.18 (Meter Volume) Ft.3 X .990 (Dry Meter Calibration Factor) = 60.57 Ft

RUN NO. 50

~~50x~~ ~~PARTICULATE~~ & WATER CATCH

IMPINGER NO. 53	Final Weight 727.34	WATER WEIGHT GAIN	IMPINGER 1 68.05
	Initial Weight 659.29		IMPINGER 2 57.25
IMPINGER NO. 54	Final Weight 751.13		IMPINGER 3 19.66
	Initial Weight 693.88		IMPINGER 4 24.80
IMPINGER NO. 55	Final Weight 734.13		TOTAL 169.76
	Initial Weight 714.47		
IMPINGER NO. 56	Final Weight 783.40		ORSAT
	Initial Weight 758.60		CO_2 8.6
FILTER NO. None	Final Weight		O_2 15.0
	Initial Weight		CO —
	Part. Catch		N_2 76.4

$M_S = 28.57$

SOLID WEIGHT GAIN

BEAKER NO.	Final Weight	BEAKER 1
	Initial Weight	BEAKER 2
	Increase	BEAKER 3
BEAKER NO.	Final Weight	BEAKER 4
	Initial Weight	TOTAL
	Increase	
BEAKER NO.	Final Weight	
	Initial Weight	
	Increase	
BEAKER NO. PROBE WASH	Final Weight	
	Initial Weight	
	Increase	

Moisture Content: Sample Vol. 60.57 ft.^{3} x $\frac{(530)}{460 + 70}$ x 25.3 L/ft.^{3} = 1714 L Dry Gas

(530) Temp

Water Weight: $\frac{169.76 \text{ gm.}}{18 \frac{\text{gm.}}{\text{mol.}}}$ x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 227 L H_2O Vapor

Total = 1941

H_2O Vol. $\frac{227 \text{ L}}{\text{Total } 1941 \text{ L}}$ x 100 = 11.7%

[redacted] FIELD DATA (BRAD)

Run No. 52
Location SOUTH STACK
Date 10/7/77
Operator DVV

Amb. Temp. °F 44 (WB) 48 (DB)
Bar. Press. "Hg. 29.85
Assumed Moist 10%
Test Periods 192 MIN
48 PTS. @ 4 MIN EACH

Probe Tip Dia., In. 1/4"
Probe Length 15 ft
Inp. Nos. 5 → 8
Sample Box No. SOx
F = .76

Heater Box Setting
FILL IN ALL BLANKS
READ & RECORD ALL DATA
START OF RUN TEST
POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:23	772.80	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
A-1	:27	773.84	.12	.34	.23	.23	69	71	2.0	186	59	109	367	
2	:31	774.91	.15	.39	.30	.24	68	70	2.2	220	60	125	369	
3	:35	776.07	.17	.41	.34	.29	68	70	2.5	244	60	138	377	
4	:39	777.30	.18	.42	.36	.34	67	70	2.5	286	61	139	378	
5	:43	778.56	.18	.42	.36	.35	67	70	2.5	227	61	136	374	
6	:47	779.83	.18	.42	.36	.36	66	70	2.5	228	60	101	373	
7	:51	781.08	.18	.42	.36	.34	66	70	2.5	218	61	108	371	
8	:55	782.34	.18	.42	.36	.35	66	71	2.5	281	61	89	374	
9	:59	783.60	.18	.42	.36	.35	66	71	2.5	249	62	95	375	
10	10:03	784.86	.18	.42	.36	.35	66	71	2.5	248	62	99	374	
11	:07	786.03	.15	.39	.30	.30	66	72	2.2	244	63	101	372	
12	:11	787.33	.20	.45	.42	.38	66	72	2.8	210	64	97	378	
13	:15	788.59	.20	.45	.42	.35	66	72	2.8	213	64	98	373	
14	:19	789.90	.18	.42	.36	.38	66	73	2.8	234	64	98	374	
15	:23	791.13	.18	.42	.36	.34	66	72	2.5	261	64	93	374	
16	:27	792.33	.18	.42	.36	.32	66	72	2.5	250	65	94	374	
17	:31	793.52	.18	.42	.36	.32	66	72	2.8	228	65	95	374	
18	:35	794.79	.20	.45	.42	.36	66	73	3.0	217	65	92	379	
19	:39	796.10	.20	.45	.42	.39	67	73	3.0	198	65	87	378	
20	:43	797.44	.20	.45	.42	.41	67	73	3.0	194	63	75	380	
21	:47	798.79	.20	.45	.42	.42	67	74	3.0	182	62	79	375	
22	:51	800.10	.20	.45	.42	.39	68	74	3.0	242	60	78	374	
23	:55	801.41	.20	.45	.42	.39	68	74	3.0	253	59	78	372	
24	:59	802.69	.18	.42	.36	.36	68	74	2.8	271	59	79	377	
TOTAL														
AVERAGE														

STATIC PRESSURE = -0.65" H_2O

CORRECTED SAMPLE VOLUME = _____ Ft.3 (Meter Volume) X _____ (Dry Meter Calibration Factor) = _____ Ft

SOx (GARY)

FIELD DATA

(CONT.)

44 (WB) RH = 65%

Run No. 52 | Amb. Temp. °F 48 (DB) | Probe Tip Dia., In ¼" | Heater Box Setting

Location SOUTH STACK | Bar. Press. "Hg. 29.85 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/7/77 | Assumed Moist 10% | Inp. Nos. 5 → 8 | READ & RECORD AT

Operator DVV | Test Periods 192 MIN | Sample Box No. SOx | START OF EACH TEST

48 PTS. @ 4 MIN EACH | POINT

f = .76

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O ΔP	Pitot In.. H_2O $\sqrt{\Delta P}$	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	1:26	802.69												
B- 1	:30	803.58	.10	.31	.18	.16	66	68	2.0	165	57	103	309	
2	:34	804.73	.15	.39	.30	.30	67	68	2.8	182	57	107	310	
3	:38	805.97	.17	.41	.34	.34	67	69	2.8	211	59	112	346	
4	:42	807.21	.18	.42	.36	.34	67	70	2.8	239	58	115	360	
5	:46	808.45	.18	.42	.36	.34	67	70	3.0	214	59	117	353	
6	:50	809.77	.20	.45	.42	.39	67	70	3.0	205	59	118	354	
7	:54	811.10	.20	.45	.42	.39	67	72	3.0	195	61	120	355	
8	:58	812.37	.18	.42	.36	.36	67	72	2.8	192	60	121	352	
9	:02	813.63	.18	.42	.36	.35	68	73	2.8	191	60	133	362	
10	:06	814.95	.20	.45	.42	.39	67	73	2.8	191	59	129	358	
11	:10	816.21	.18	.42	.36	.35	68	73	2.8	189	60	91	350	
12	:14	817.48	.18	.42	.36	.36	68	73	2.8	200	59	118	352	
13	:18	818.74	.18	.42	.36	.34	68	73	2.8	243	60	126	370	
14	:22	820.01	.18	.42	.36	.36	67	73	3.0	229	61	128	372	
15	:26	821.29	.18	.42	.36	.36	68	73	3.0	223	60	128	373	
16	:30	822.59	.20	.45	.42	.38	68	74	3.0	183	60	91	370	
17	:34	823.88	.18	.42	.36	.36	68	74	3.0	199	59	123	369	
18	:38	825.14	.18	.42	.36	.34	68	74	3.0	194	59	127	367	
19	:42	826.49	.20	.45	.42	.42	68	74	3.0	192	58	110	368	
20	:46	827.85	.20	.45	.42	.42	68	74	3.0	188	59	129	369	
21	:50	829.21	.20	.45	.42	.42	68	74	3.0	188	59	123	372	
22	:54	830.49	.18	.42	.36	.37	69	75	3.0	143	60	99	368	
23	:58	831.88	.18	.42	.36	.45	69	74	3.0	184	59	114	367	
24	13:02	833.02	.18	.42	.36	.38	69	74	3.0	182	58	94	372	
TOTAL				20.30		16.98	3226	3461					17584	
AVERAGE				0.42		0.35	67	72					366	

(530) Meter Volume

(826) Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME = 60.22 Ft.³ X .990 = 59.62 Ft

Sox RUN NO. 52

PARTICULATE & WATER CATCH

IMPINGER NO. 5	Final Weight 775.85	WATER WEIGHT GAIN	IMPINGER 1 88.42
	Initial Weight 687.43		IMPINGER 2 61.91
IMPINGER NO. 6	Final Weight 772.63		IMPINGER 3 17.64
	Initial Weight 710.72		IMPINGER 4 14.69
IMPINGER NO. 7	Final Weight 726.68		TOTAL 182.66
	Initial Weight 709.0X		ORSAT
IMPINGER NO. 8	Final Weight 881.51		CO_2 8.4
	Initial Weight 866.82		O_2 14.6
FILTER NO. NONE	Final Weight	$M_S = 28.42$	CO
	Initial Weight		N_2 77
	Part. Catch		

SOLID WEIGHT GAIN

BEAKER NO.	Final Weight Initial Weight Increase	BEAKER 1 BEAKER 2 BEAKER 3 BEAKER 4 TOTAL
BEAKER NO.	Final Weight Initial Weight Increase	
BEAKER NO.	Final Weight Initial Weight Increase	
BEAKER NO. PROBE WASH	Final Weight Initial Weight Increase	

Moisture Content: Sample Vol. 59.62 ft.^{3} x $\frac{(530)}{460 + 70}$ X 28.3 L/ft.^{3} = 1687 L Dry Gas
$\frac{(530)}{460 + \text{Meter Temp.}}$

Water Weight ____ gm. / 18 gm. mol. x 24.1 L / mol. = 244 L H_2O Vapor

Total = 1931 L

H_2O Vol. 244 L / Total 1931 L x 100 = 12.6%

[redacted] (Sox) (GARY)

[redacted] FIELD DATA

51 (WB) RH = 74%

Run No. 54
Location NORTH STACK
Date 10/10/77
Operator DVV

Amb. Temp. °F 56 (DB)
Bar. Press. "Hg. 29.54"
Assumed Moist 15%
Test Periods 192 MIN
48 PTS. @ 4 MIN EACH

Probe Tip Dia., In. 1/4"
Probe Length 15 ft
Inp. Nos. 13 → 16
Sample Box No. SOx
γ = .72

Heater Box Setting

FILL IN ALL BLANKS
READ & RECORD AT THE
START OF EACH TEST
POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	10:47	834.09	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
A-1	:51	835.60	.22	.47	.42	.53	64	65	3.0	117	58	104	391	
2	:55	837.02	.30	.55	.56	.45	65	66	3.0	192	58	114	395	
3	:59	838.52	.32	.56	.62	.52	65	67	3.2	209	59	115	372	
4	11:03	840.07	.32	.56	.62	.56	64	67	3.5	189	60	109	371	
5	:07	841.68	.34	.58	.65	.60	65	69	3.5	209	60	107	377	
6	:11	843.28	.34	.58	.65	.60	64	70	3.5	219	61	106	370	
7	:15	844.81	.28	.53	.53	.53	65	71	3.5	193	61	152	372	
8	:19	846.32	.28	.53	.53	.53	65	71	3.5	218	62	153	376	
9	:23	847.78	.25	.50	.48	.49	65	71	3.2	235	62	152	385	
10	:27	849.27	.28	.53	.53	.50	66	72	3.5	223	63	155	389	
11	:31	850.70	.25	.50	.48	.48	66	72	3.5	273	65	142	371	
12	:35	852.17	.28	.53	.53	.49	66	72	3.5	209	64	146	365	
13	:39	853.68	.28	.53	.53	.53	66	72	5.5	244	65	157	364	
14	:43	855.05	.30	.55	.56	.42	67	73	5.5	159	66	167	361	
15	:47	856.51	.30	.55	.56	.49	67	73	5.5	175	66	157	368	
16	:51	857.94	.30	.55	.56	.47	67	73	5.0	248	66	158	351	
17	:55	859.41	.30	.55	.56	.50	67	74	5.0	198	65	157	357	
18	:59	860.87	.30	.55	.56	.49	66	73	4.8	240	64	154	346	
19	12:03	862.32	.30	.55	.56	.48	67	73	4.8	260	64	159	347	
20	:07	863.77	.32	.56	.62	.48	67	73	4.5	199	65	162	365	
21	:11	865.31	.34	.58	.65	.55	67	73	4.8	261	65	152	364	
22	:15	866.82	.32	.56	.62	.53	67	74	4.8	259	65	157	368	
23	:19	868.32	.32	.56	.62	.52	67	74	4.8	236	64	153	369	
24	:23	869.82	.32	.56	.62	.52	67	74	4.8	244	64	149	368	
TOTAL														
AVERAGE														

STATIC PRESSURE = −0.65 " H_2O

CORRECTED SAMPLE VOLUME = _____ Meter Volume Ft.3 X _____ Dry Meter Calibration Factor = _____

SOx (SHARON)

~~PARTICULATE~~ FIELD DATA

(CONT.)

Run No. 54 | Amb. Temp. °F 56 (DB) 51 (WB) | Probe Tip Dia., In 1/4" | Heater Box Setting

Location NORTH STACK | Bar. Press. "Hg. 29.54 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/10/77 | Assumed Moist 15% | Inp. Nos. 13 → 16 | READ & RECORD DATA AT

Operator DVV | Test Periods 192 MIN | Sample Box No. SOx | START OF EACH TEST POINT

48 PTS. @ 4 MIN EACH | $I = .72$

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	12:54	869.82	ΔP	$\sqrt{\Delta P}$	Desired	Actual	Inlet	Outlet						
B — 1	:58	871.06	.20	.45	.37	.34	67	68	4.5	209	58	104	341	
2	13 :02	872.35	.20	.45	.37	.37	67	68	4.5	200	60	108	340	
3	:06	873.69	.25	.50	.48	.40	67	69	4.8	254	62	107	341	
4	:10	875.06	.25	.50	.48	.42	66	69	4.8	198	61	116	345	
5	:14	876.47	.25	.50	.48	.45	66	69	5.0	243	61	116	342	
6	:18	877.88	.27	.52	.50	.45	66	70	5.5	291	61	110	349	
7	:22	879.34	.28	.53	.53	.49	66	71	5.2	259	62	110	344	
8	:26	880.82	.28	.53	.53	.50	67	72	5.2	198	63	109	336	
9	:30	882.29	.28	.53	.53	.50	67	72	5.2	231	63	108	335	
10	:34	883.76	.28	.53	.53	.50	67	73	5.5	267	63	111	338	
11	:38	885.22	.28	.53	.53	.49	66	72	5.5	228	63	112	338	
12	:42	886.74	.28	.53	.53	.53	67	73	5.8	187	63	116	347	
13	:46	888.24	.27	.52	.50	.52	67	73	5.5	223	63	126	361	
14	:50	889.72	.30	.55	.56	.50	67	74	5.5	220	63	133	369	
15	:54	891.20	.30	.55	.56	.50	67	73	5.5	243	63	126	371	
16	:58	892.73	.30	.55	.56	.53	67	74	5.8	244	63	121	376	
17	14 :02	894.27	.32	.56	.62	.55	67	74	5.8	282	63	125	386	
18	:06	895.82	.35	.59	.66	.56	67	74	5.8	248	64	127	381	
19	:10	897.33	.35	.59	.66	.53	67	74	5.8	246	64	126	382	
20	:14	898.88	.35	.59	.66	.56	68	75	5.8	253	65	133	384	
21	:18	900.43	.38	.61	.72	.56	68	74	5.8	193	66	117	382	
22	:22	901.97	.38	.61	.72	.55	67	74	5.8	257	65	121	381	
23	:26	903.52	.35	.59	.66	.56	68	74	5.8	226	65	126	379	
24	:30	905.05	.35	.59	.66	.53	68	74	5.8	246	63	117	380	
TOTAL				26.07		24.09	3189	3445					17390	
AVERAGE				0.54		0.50	66	72					362	

(529) Meter Volume | Dry Meter Calibration Factor | (822)

CORRECTED SAMPLE VOLUME = 70.96 Ft.^{3} X .990 = 70.25 Ft.

RUN NO. 54

~~PARTICULATE~~ SO2 & WATER CATCH

IMPINGER NO. 13	Final Weight 946.68	WATER WEIGHT GAIN	IMPINGER 1 293.68
	Initial Weight 653.00		IMPINGER 2 34.34
	Increase		IMPINGER 3 191.38
IMPINGER NO. 14	Final Weight 737.54		IMPINGER 4 58.39
	Initial Weight 703.20		TOTAL 195.03
	Increase		
IMPINGER NO. 15	Final Weight 515.50		ORSAT
	Initial Weight 706.88		CO_2 7.2
	Increase		
IMPINGER NO. 16	Final Weight 841.60		O_2 15.2
	Initial Weight 783.21		
	Increase	$M_s = 28.40$	CO —
FILTER NO. NONE	Final Weight		N_2 77.6
	Initial Weight		
	Part. Catch		

SOLID WEIGHT GAIN

BEAKER NO.	Final Weight		BEAKER 1
	Initial Weight		BEAKER 2
	Increase		BEAKER 3
BEAKER NO.	Final Weight		BEAKER 4
	Initial Weight		TOTAL
	Increase		
BEAKER NO.	Final Weight		
	Initial Weight		
	Increase		
BEAKER NO. PROBE WASH	Final Weight		
	Initial Weight		
	Increase		

Moisture Content: Sample Vol. 70.25 ft.^{3} x $\frac{(530)}{460 + \text{Meter Temp.}}$ $\frac{}{(529)}$ X 28.3 L/ft.^{3} = 1992 Dry Gas

Water Weight $\frac{195.03}{18 \text{ gm. mol.}}$ gm. x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 261 L H_2O Vapor

Total = 2253

H_2O Vol. $\frac{261 \text{ L}}{\text{Total } 2253 \text{ L}}$ x 100 = 11.6%

(S) (GAM)

~~PARTICULATE~~ FIELD DATA

Run No. 56
Location NORTH STACK
Date 10/11/77
Operator DVV

Amb. Temp. °F 45 (WB) 47 (DB) RH = 75%
Bar. Press. "Hg. 29.69
Assumed Moist 12%
Test Periods 192 MIN
48 PTS. @ 4 MIN EACH

Probe Tip Dia., In. 1/4"
Probe Length 15 ft
Inp. Nos. 21 → 24
Sample Box No. 50x
f = .74

Heater Box Setting
FILL IN ALL BLANKS
READ & RECORD AT THE START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O ΔP	Pitot In. H_2O $\sqrt{\Delta P}$	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:49	905.41												
A - 24	:53	907.00	.28	.53	.56	.58	69	70	4.0	175	66	148	375	
23	:57	908.49	.28	.53	.56	.50	68	69	4.0	266	70	141	367	
22	10:01	909.97	.29	.54	.59	.50	67	69	4.2	236	70	142	368	
21	:05	911.61	.30	.55	.59	.62	66	70	4.2	271	70	141	369	
20	:09	913.07	.30	.55	.59	.49	65	70	4.5	261	66	136	369	
19	:13	914.63	.30	.55	.59	.56	65	71	4.5	230	66	133	365	
18	:17	916.20	.30	.55	.59	.56	65	71	4.5	263	65	139	363	
17	:21	917.73	.28	.53	.56	.53	65	72	4.5	254	65	148	363	
16	:25	919.32	.30	.55	.59	.58	65	73	4.8	228	66	143	357	
15	:29	920.91	.30	.55	.59	.58	65	73	4.8	249	66	144	360	
14	:33	922.51	.30	.55	.59	.59	65	73	4.8	242	66	144	360	
13	:37	924.10	.30	.55	.59	.58	65	74	4.8	217	67	148	359	
12	:41	925.72	.29	.54	.59	.59	66	74	4.8	198	67	149	364	
11	:45	927.29	.29	.54	.59	.56	66	74	4.8	231	67	150	368	
10	:49	928.89	.30	.55	.59	.59	66	75	4.8	286	67	154	367	
9	:53	930.51	.30	.55	.59	.59	66	75	4.8	253	68	150	368	
8	:57	932.25	.28	.53	.56	.69	67	75	4.5	243	68	132	362	
7	11:01	933.73	.26	.51	.53	.50	67	75	4.5	249	68	141	371	
6	:05	935.10	.28	.53	.56	.42	67	75	4.5	228	68	146	377	
5	:09	936.67	.30	.55	.59	.56	67	75	4.8	215	67	149	375	
4	:13	938.24	.30	.55	.59	.56	67	75	4.8	245	67	148	375	
3	:17	939.79	.26	.51	.53	.55	67	75	4.5	234	67	107	371	
2	:21	941.28	.26	.51	.53	.50	67	75	4.5	217	67	131	386	
1	:25	942.76	.22	.47	.43	.50	67	74	4.2	214	67	131	376	
TOTAL														
AVERAGE														

STATIC PRESSURE = — 0.55" H_2O

CORRECTED SAMPLE VOLUME = Meter Volume ______ Ft.^{3} x Dry Meter Calibration Factor ______ = ______ Ft

[redacted] (DILUTION)

~~PARTICULATE~~ FIELD DATA

(CONT.) 45 (WB)

Run No. 56 | Amb. Temp. °F 47 (DB) | Probe Tip Dia., In. 1/4" | Heater Box Setting

Location NORTH STACK | Bar. Press. "Hg. 29.69 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/11/77 | Assumed Moist 12% | Imp. Nos. 21 → 24 | READ & RECORD AT START OF EACH TEST POINT

Operator DVV | Test Periods 192 MIN | Sample Box No. 50x

48 PTS. @ 4 MIN EACH | f = (.74)

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	11:50	942.76	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
B-24	:54	944.41	.35	.59	.70	.62	67	69	5.2	199	64	102	388	
23	:58	946.15	.35	.59	.70	.69	67	69	5.2	216	65	106	385	
22	12:02	947.76	.35	.59	.70	.60	66	70	5.2	238	66	116	389	
21	:06	949.48	.35	.59	.70	.69	66	70	5.2	286	67	112	388	
20	:10	951.10	.35	.59	.70	.61	66	72	5.5	262	68	117	383	
19	:14	952.94	.35	.59	.70	.79	66	73	5.5	225	68	125	386	
18	:18	954.67	.34	.58	.69	.69	66	73	5.8	260	69	167	388	
17	:22	956.34	.33	.57	.66	.65	67	74	5.2	240	70	178	385	
16	:26	958.01	.33	.57	.66	.65	66	74	5.2	259	70	179	380	
15	:30	959.60	.30	.55	.59	.58	67	74	5.0	231	70	183	378	
14	:34	961.19	.30	.55	.59	.59	67	74	5.0	283	73	185	378	
13	:38	962.78	.28	.53	.56	.58	67	74	5.0	235	71	183	375	
12	:42	964.29	.28	.53	.56	.52	67	75	5.0	211	71	174	367	
11	:46	965.87	.28	.53	.56	.58	67	74	5.0	233	70	169	362	
10	:50	967.39	.28	.53	.56	.53	68	75	5.0	292	68	169	352	
9	:54	968.95	.28	.53	.56	.56	68	75	5.0	247	67	173	361	
8	:58	970.50	.30	.55	.59	.56	68	75	5.0	205	67	172	353	
7	13:02	972.11	.28	.53	.56	.60	68	75	5.0	245	67	173	354	
6	:06	973.62	.28	.53	.56	.50	68	75	5.0	261	67	172	352	
5	:10	975.38	.28	.53	.56	.72	68	75	5.0	257	68	179	351	
4	:14	976.71	.27	.52	.53	.40	68	75	5.0	231	68	170	349	
3	:18	978.23	.25	.50	.50	.45	68	75	4.8	211	67	176	352	
2	:22	979.75	.25	.50	.50	.53	68	75	4.8	198	66	169	345	
1	:26	981.11	.20	.45	.39	.42	68	74	4.5	193	64	165	332	
TOTAL				25.99		27.59	3202	3516					17668	
AVERAGE				0.54		0.57	67	73					368	

(530) (828)

Meter Volume | Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME = 75.70 Ft.3 X .990 = 74.94 Ft

Sat RUN NO. 56

~~PARTICULATE~~ & WATER CATCH

IMPINGER NO. 21	Final Weight 794.58 Initial Weight 716.41 Increase	WATER WEIGHT GAIN	IMPINGER 1 78.17
IMPINGER NO. 22	Final Weight 798.32 Initial Weight 706.51 Increase		IMPINGER 2 91.81
IMPINGER NO. 23	Final Weight 734.38 Initial Weight 719.13 Increase		IMPINGER 3 15.25
IMPINGER NO. 24	Final Weight 837.18 Initial Weight 808.29 Increase		IMPINGER 4 28.89
FILTER NO. NONE	Final Weight ____ Initial Weight Part. Catch ____		TOTAL 214.12

ORSAT

CO_2 7.6

O_2 14.6

CO —

N_2 77.8

$M_s = 28.40$

SOLID WEIGHT GAIN

BEAKER NO. ____	Final Weight ____ Initial Weight Increase ____	BEAKER 1 ____
BEAKER NO. ____	Final Weight ____ Initial Weight Increase ____	BEAKER 2 ____ BEAKER 3 ____ BEAKER 4 ____
BEAKER NO. ____	Final Weight ____ Initial Weight Increase ____	TOTAL ____
BEAKER NO. PROBE WASH	Final Weight ____ Initial Weight Increase ____	

Moisture Content: Sample Vol. 74.94 ft.^{3} x $\frac{(530)}{460 + 70}$ x 28.3 L/ft.^{3} = 2121 L Dry Gas

$\frac{(530)}{460 + \text{Temp. °F}}$

Water Weight $\frac{214.12 \text{ gm.}}{18 \frac{\text{gm.}}{\text{mol.}}}$ x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 287 L H_2O Vapor

Total = 2408 L

H_2O Vol. / Total $\frac{287 \text{ L}}{2408 \text{ L}}$ x 100 = 11.9 %

(S) ~~PARTICULATE~~ FIELD DATA (GARY)

Run No. 58	Amb. Temp. °F. 43 (WB) RH = 56% 50 (DB)	Probe Tip Dia., In. 1/4	Heater Box Setting
Location NORTH STACK	Bar. Press. "Hg. 29.68	Probe Length 15 ft	FILL IN ALL BLANKS
Date 10/12/77	Assumed Moist 12%	Inp. Nos. 29 → 32	READ & RECORD AT THE
Operator DVV	Test Periods 192 MIN	Sample Box No. 50x	START OF EACH TEST
	48 PTS @ 4 MIN EACH	f = (.74)	POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O ΔP	Pitot In. H_2O √ΔP	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:28	981.46												
A - 1	:32	982.83	.18	.42	.34	.42	70	71	2.5	185	59	159	318	
2	:36	984.22	.26	.51	.53	.44	68	70	2.8	280	59	164	329	
3	:40	985.78	.28	.53	.56	.56	68	70	2.8	235	59	174	323	
4	:44	987.33	.26	.51	.53	.55	67	70	2.8	224	63	177	339	
5	:48	988.87	.28	.53	.56	.55	67	71	2.8	261	60	166	346	
6	:52	990.42	.28	.53	.56	.56	66	71	2.8	239	61	178	350	
7	:56	991.96	.28	.53	.56	.55	67	72	2.8	191	60	164	354	
8	10:00	993.52	.30	.55	.59	.56	67	73	3.0	237	60	162	358	
9	:04	995.17	.30	.55	.59	.62	67	73	3.0	212	60	164	357	
10	:08	996.97	.30	.55	.59	.75	67	68	3.0	225	58	168	367	
11	:12	998.40	.28	.53	.56	.46	67	69	3.0	197	61	172	367	
12	:16	999.93	.28	.53	.55	.53	67	69	3.0	258	62	169	360	
13	:20	(1001.47)	.28	.53	.56	.53	67	70	3.0	235	60	171	362	
14	:24	3.03	.28	.53	.56	.56	67	71	3.0	191	60	167	361	
15	:28	4.62	.30	.55	.59	.59	67	72	3.0	213	60	166	367	
16	:32	6.18	.28	.53	.56	.56	67	72	3.0	267	61	164	361	
17	:36	7.74	.28	.53	.56	.56	67	73	3.0	250	60	164	368	
18	:40	9.48	.35	.59	.72	.69	67	74	3.2	194	62	159	371	
19	:44	11.12	.35	.59	.72	.62	67	74	3.2	206	61	159	364	
20	:48	12.71	.28	.53	.56	.59	68	75	3.0	251	61	156	377	
21	:52	14.26	.28	.53	.56	.53	68	75	3.0	329	63	155	372	
22	:56	15.82	.28	.53	.56	.56	68	75	3.0	252	62	154	378	
23	11:00	17.36	.27	.52	.53	.55	68	75	3.0	193	62	151	373	
24	:04	18.93	.26	.51	.53	.56	68	75	3.0	198	61	151	376	
TOTAL								~~[illegible]~~					~~[illegible]~~	
AVERAGE								~~[illegible]~~					~~[illegible]~~	

STATIC PRESSURE = - 0.68 " H_2O

CORRECTED SAMPLE VOLUME = Meter Volume 74.31 Ft.^{3} x Dry Meter Calibration Factor .990 = 73.57 Ft

[redacted] SOx ~~PARTICULATE~~ FIELD DATA (SHARON)

(CONT.)

43 (WB)

Run No. 58 | Amb. Temp. °F 50 (DB) | Probe Tip Dia., In. 1/4 | Heater Box Setting

Location NORTH STACK | Bar. Press. "Hg. 29.68 | Probe Length 15 ft | FILL IN ALL BLANKS

Date 10/12/77 | Assumed Moist 12% | Inp. Nos. 29 → 32 | READ & RECORD ALL

Operator DVV | Test Periods 192 MIN | Sample Box No. SOx | START OF EACH TEST

48 PTS. @ 4 MIN EACH | $\gamma = (.74)$ | POINT

Point	Clock Time 13:14	Dry Gas Meter C.F. (1018.93)	Pitot In.. H_2O ΔP	Pitot In.. H_2O $\sqrt{\Delta P}$	Orifice ΔH In. H_2O Desired	Orifice ΔH In. H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
B-1	:18	20.52	.25	.50	.50	.58	67	69	2.8	195	58	171	374	
2	:22	21.87	.20	.45	.39	.42	67	68	2.8	199	58	175	373	
3	:26	23.27	.22	.47	.45	.44	67	69	2.8	218	59	174	375	
4	:30	24.68	.25	.50	.50	.45	67	70	2.8	239	60	171	373	
5	:34	26.23	.27	.52	.53	.55	67	71	3.0	230	61	165	366	
6 ~~6~~	:38	27.80	.27	.52	.53	.56	67	71	3.2	257	62	177	368	
7 ~~7~~	:42	29.37	.28	.53	.56	.56	67	72	3.2	236	61	172	368	
8 ~~8~~	:46	30.94	.28	.53	.56	.56	67	72	3.2	233	62	174	363	
9 ~~9~~	:50	32.51	.28	.53	.56	.56	67	73	3.2	242	63	172	363	
10 ~~10~~	:54	34.08	.28	.53	.56	.56	67	74	3.2	246	63	186	354	
11 ~~12~~	:58	35.64	.28	.53	.56	.56	68	74	3.0	248	64	189	362	
12 ~~13~~	13:02	37.18	.27	.52	.53	.55	68	74	3.0	243	63	181	362	
13 ~~14~~	:06	38.71	.29	.54	.59	.53	67	74	3.0	252	62	196	359	
14 ~~15~~	:10	40.27	.28	.53	.56	.56	68	75	3.2	249	62	178	359	
15 ~~16~~	:14	41.78	.25	.50	.50	.50	68	75	3.0	235	63	183	361	
16 ~~17~~	:18	43.29	.27	.52	.53	.53	68	75	3.0	230	62	180	361	
17 ~~18~~	:22	44.81	.27	.52	.53	.53	69	75	3.0	241	61	197	364	
18 ~~19~~	:26	46.38	.28	.53	.56	.56	69	75	3.0	239	62	164	362	
19 ~~20~~	:30	47.95	.28	.53	.56	.56	69	75	3.2	237	62	169	365	
20 ~~21~~	:34	49.53	.28	.53	.56	.58	69	75	3.2	239	62	161	358	
21 ~~22~~	:38	51.10	.30	.55	.59	.56	69	75	3.2	274	62	192	355	
22 ~~23~~	:42	52.68	.28	.53	.56	.58	69	75	3.2	259	63	167	353	
23 ~~24~~	:46	54.23	.27	.52	.53	.55	69	75	3.0	214	63	191	351	
24 5	:50	55.77	.27	.52	.53	.55	69	75	3.0	206	63	175	356	
TOTAL				25.19		26.39	3246	3483					17303	
AVERAGE				0.52		0.55	67	72					360	

(529) Meter Volume | Dry Meter Calibration Factor (820)

CORRECTED SAMPLE VOLUME = 74.31 Ft.3 X .990 = 73.57 Ft

RUN NO. 58

~~58~~ PARTICULATE & WATER CATCH

IMPINGER NO. 29	Final Weight 754.75 Initial Weight 643.80 Increase	WATER WEIGHT GAIN	IMPINGER 1 110.95
IMPINGER NO. 30	Final Weight 781.65 Initial Weight 706.36 Increase		IMPINGER 2 75.29
IMPINGER NO. 31	Final Weight 769.95 Initial Weight 743.45 Increase		IMPINGER 3 26.50
IMPINGER NO. 32	Final Weight 698.10 Initial Weight 675.26 Increase		IMPINGER 4 22.84
FILTER NO. _____	Final Weight _____ Initial Weight Part. Catch _____		TOTAL 235.58

ORSAT

CO_2 7.5

O_2 15.1

CO —

N_2 77.4

$M_s = 28.26$

SOLID WEIGHT GAIN

BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 1 _____
BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 2 _____
BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 3 _____
BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 4 _____
BEAKER NO. PROBE WASH	Final Weight _____ Initial Weight Increase _____	TOTAL _____

Moisture Content: Sample Vol. 73.57 ft.^{3} $\times \frac{(530)}{460 + 70} \frac{460 + \text{Meter}}{(529)\text{Temp.}}$ $\times$ 28.3 L/ft.^{3} = 2086 L Dry Gas

Water Weight $\frac{235.58 \text{ gm.}}{18 \frac{\text{gm.}}{\text{mol.}}} \times 24.1 \frac{\text{L}}{\text{mol.}}$ = 315 L H_2O Vapor

Total = 2401 L

H_2O Vol. / Total $\frac{315 \text{ L}}{2401 \text{ L}} \times 100$ = 13.1%

[redacted] FIELD DATA (SHARON)

43 (WB) RH = 72%

Run No. 60
Location SOUTH STACK
Date 10/13/77
Operator DVV

Amb. Temp. °F 47 (DB)
Bar. Press. "Hg. 29.72
Assumed Moist 10%
Test Periods 192 MIN

Probe Tip Dia., In. 1/4
Probe Length 15 ft
Inp. Nos. 37 → 40
Sample Box No. [redacted] SOx

48 PTS. @ 4 MIN EACH

f = .76

Heater Box Setting

FILL IN ALL BLANKS
READ & RECORD ALL DATA
START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:32	56.13	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
A - 1	:36	57.23	.11	.33	.21	.25	68	69	2.2	184	59	177	375	
2	:40	58.26	.12	.34	.23	.23	67	69	2.0	212	60	157	378	
3	:44	59.39	.15	.39	.30	.27	67	68	2.5	228	61	171	389	
4	:48	60.54	.15	.39	.30	.29	66	68	2.2	241	60	158	387	
5	:52	61.77	.17	.41	.34	.34	66	69	2.5	249	61	143	385	
6	:56	63.00	.18	.42	.36	.34	66	69	2.5	258	61	154	389	
7	10:00	64.28	.18	.42	.36	.36	66	70	2.8	256	62	145	387	
8	:04	65.67	.18	.42	.36	.42	65	70	2.8	265	62	149	385	
9	:08	66.86	.19	.43	.39	.32	66	71	2.8	263	61	148	385	
10	:12	68.15	.18	.42	.36	.36	66	72	2.8	262	62	149	384	
11	:16	69.44	.18	.42	.36	.37	66	72	2.8	259	62	144	384	
12	:20	70.74	.18	.42	.36	.38	66	72	2.8	269	62	148	381	
13	:24	71.98	.17	.41	.34	.34	66	72	2.8	268	62	146	384	
14	:28	73.22	.17	.41	.34	.34	68	73	2.8	273	62	147	381	
15	:32	74.41	.16	.40	.32	.32	67	73	2.5	267	61	140	382	
16	:36	75.67	.18	.42	.36	.35	67	73	2.8	262	62	159	386	
17	:40	76.94	.18	.42	.36	.36	67	73	2.8	229	62	152	383	
18	:44	78.22	.18	.42	.36	.36	68	74	2.8	243	62	150	378	
19	:48	79.50	.19	.43	.39	.36	68	74	2.8	198	62	174	377	
20	:52	80.79	.18	.42	.36	.36	68	74	3.0	231	62	174	383	
21	:56	82.07	.18	.42	.36	.36	68	74	3.0	247	61	162	381	
22	11:00	83.39	.19	.43	.39	.39	68	74	3.0	249	60	168	377	
23	:04	84.68	.18	.42	.36	.36	68	74	3.0	258	61	162	377	
24	:08	85.94	.17	.41	.34	.35	68	73	3.0	254	61	168	372	
TOTAL														
AVERAGE														

STATIC PRESSURE = − 0.70 "H_2O

CORRECTED SAMPLE VOLUME = _____ Meter Volume Ft.3 X _____ Dry Meter Calibration Factor = _____

S[redacted]

~~PARTICULATE~~ FIELD DATA (GARY)

(CONT.)

43(WB)

Run No. 60
Location SOUTH STACK
Date 10/13/77
Operator DVV

Amb. Temp. °F 47(DB)
Bar. Press. "Hg. 29.72
Assumed Moist 10%
Test Periods 192 MIN
48 PTS. @ 4 MIN EACH

Probe Tip Dia., In 1/4
Probe Length 15 ft
Inp. Nos. 37 → 40
Sample Box No. SOx
f = (.76)

Heater Box Setting

FILL IN ALL BLANKS
READ & RECORD ALL DATA
START OF RUN TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	11:37	85.94	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
B- 1	:41	86.98	.11	.33	.21	.23	68	69	2.2	131	57	155	329	
2	:45	88.09	.15	.39	.30	.27	68	69	2.2	221	59	157	364	
3	:49	89.37	.17	.41	.34	.36	68	69	3.0	262	60	157	389	
4	:53	90.67	.19	.43	.39	.38	68	70	3.0	264	58	152	381	
5	:57	91.96	.19	.43	.39	.36	67	70	3.0	221	61	141	380	
6	12:01	93.32	.19	.43	.39	.42	68	71	3.0	202	60	155	389	
7	:05	94.63	.18	.42	.36	.39	68	71	3.0	231	63	157	390	
8	:09	95.94	.17	.41	.34	.39	67	71	3.0	262	64	148	391	
9	:13	97.15	.18	.42	.36	.32	68	72	3.0	282	65	156	409	
10	:17	98.43	.18	.42	.36	.36	67	72	3.0	228	63	141	401	
11	:21	99.71	.18	.42	.36	.36	67	72	3.0	199	63	147	408	
12	:25	101.00	.18	.42	.36	.36	67	73	3.0	235	63	141	396	
13	:29	102.28	.18	.42	.36	.36	67	73	3.0	214	63	148	393	
14	:33	103.53	.17	.41	.34	.34	68	73	3.0	259	64	173	390	
15	:37	104.79	.17	.41	.34	.35	68	73	3.0	249	66	170	392	
16	:41	106.03	.17	.41	.34	.34	68	74	2.8	226	66	167	389	
17	:45	107.30	.18	.42	.36	.36	68	73	3.0	165	66	147	391	
18	:49	108.57	.18	.42	.36	.36	68	74	3.0	280	65	157	392	
19	:53	109.84	.18	.42	.36	.36	68	73	3.0	248	66	171	386	
20	:57	111.14	.19	.43	.39	.38	69	73	3.0	255	67	166	391	
21	13:01	112.44	.19	.43	.39	.38	69	74	3.0	259	67	168	391	
22	:05	113.71	.18	.42	.36	.36	69	73	3.0	275	67	163	390	
23	:09	114.97	.18	.42	.36	.35	68	74	3.0	223	66	148	385	
24	:13	116.20	.17	.41	.34	.34	68	73	3.0	232	68	142	386	
TOTAL				19.77		16.66	3234	3449					18473	
AVERAGE				0.41		0.35	67	72					(384)	

844

(529) Meter Volume

Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME = 60.07 Ft.3 X .990 = 59.47 Ft.

RUN NO. 60

~~SO2~~ ~~PARTICULATE~~ & WATER CATCH

WATER WEIGHT GAIN

IMPINGER NO. 37	Final Weight 763.70 Initial Weight 701.84 Increase	IMPINGER 1 61.86
IMPINGER NO. 38	Final Weight 783.21 Initial Weight 704.76 Increase	IMPINGER 2 78.45
IMPINGER NO. 39	Final Weight 732.90 Initial Weight 703.97 Increase	IMPINGER 3 28.93
IMPINGER NO. 40	Final Weight 733.32 Initial Weight 712.68 Increase	IMPINGER 4 20.64
FILTER NO. _____	Final Weight _____ Initial Weight Part. Catch _____	TOTAL 189.88

ORSAT

CO_2 8.0

O_2 15.0

CO —

N_2 77.0

$M_S = 28.32$

SOLID WEIGHT GAIN

BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 1 _____
BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 2 _____
BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 3 _____
BEAKER NO. _____	Final Weight _____ Initial Weight Increase _____	BEAKER 4 _____
BEAKER NO. PROBE WASH	Final Weight _____ Initial Weight Increase _____	TOTAL _____

Moisture Content: Sample Vol. 59.47 ft.^{3} x $\frac{(530)}{460 + 70}$ / $\frac{460 + \text{Meter}}{(529)\ \text{Temp.}}$ X 28.3 L/ft.^{3} = 1686 L Dry Gas

Water Weight $\frac{189.88 \text{ gm.}}{18 \frac{\text{gm.}}{\text{mol.}}}$ x 24.1 $\frac{\text{L}}{\text{mol.}}$ = 254 L H_2O Vapor

Total = 1940 L

$\frac{H_2O \text{ Vol.}}{\text{Total}}$ $\frac{254 \text{ L}}{1940 \text{ L}}$ x 100 = 13.1%

~~PARTICULATE~~ FIELD DATA (GARY)

50 (WB) RH = 80%

Run No. 62
Location SOUTH STACK
Date 10/14/77
Operator DVV

Amb. Temp. °F 53 (DB)
Bar. Press. "Hg. 29.44
Assumed Moist 12%
Test Periods 192 MIN
48 PTS. @ 4 MIN EACH

Probe Tip Dia., In. 1/4
Probe Length 15 ft
Inp. Nos. 45 → 48
Sample Box No. SOx
f = (.76)

Heater Box Setting
FILL IN ALL BLANKS
READ & RECORD AT THE START OF EACH TEST POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In.. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	9:54	116.55	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
A-1	:58	117.46	.08	.28	.15	.18	70	72	2.0	213	62	127	360	
2	10:02	118.65	.17	.41	.34	.31	68	70	3.0	268	61	135	367	
3	:06	119.86	.18	.42	.37	.32	66	69	3.0	255	60	135	394	
4	:10	121.15	.18	.42	.37	.37	67	70	3.0	281	61	142	395	
5	:14	122.46	.18	.42	.37	.39	66	70	3.0	277	61	145	406	
6	:18	123.76	.18	.42	.37	.36	66	71	3.0	238	61	142	406	
7	:22	125.05	.19	.43	.39	.37	67	71	3.0	201	60	151	409	
8	:26	126.35	.19	.43	.39	.38	66	72	3.0	220	61	143	414	
9	:30	127.66	.19	.43	.39	.39	66	72	3.0	251	61	146	412	
10	:34	128.96	.19	.43	.39	.38	66	72	3.0	252	61	146	407	
11	:38	130.27	.19	.43	.39	.39	66	73	3.0	261	62	151	406	
12	:42	131.56	.18	.42	.37	.37	67	73	3.0	268	62	150	405	
13	:46	132.86	.18	.42	.37	.38	67	73	3.0	272	62	158	403	
14	:50	134.15	.18	.42	.37	.36	67	73	3.0	262	62	160	401	
15	:54	135.47	.18	.42	.37	.38	67	73	3.1	252	62	170	397	
16	:58	136.73	.19	.43	.39	.35	67	74	3.1	267	61	167	403	
17	11:02	138.01	.19	.43	.39	.37	67	74	3.1	250	59	161	401	
18	:06	139.30	.19	.43	.39	.37	68	74	3.1	239	59	160	397	
19	:10	140.60	.19	.43	.39	.38	68	74	3.1	239	59	161	400	
20	:14	141.88	.18	.42	.37	.37	68	74	3.1	243	59	161	397	
21	:18	143.17	.18	.42	.37	.37	68	74	3.1	246	59	161	395	
22	:22	144.42	.17	.41	.34	.34	68	74	3.0	253	60	161	389	
23	:26	145.65	.17	.41	.34	.34	69	74	3.0	251	59	160	391	
24	:30	146.90	.17	.41	.34	.34	70	74	3.0	248	59	159	387	
TOTAL				(9.99)		(8.26)	(1615)	(1740)					(9542)	
AVERAGE														

STATIC PRESSURE = - 0.64 " H_2O

CORRECTED SAMPLE VOLUME = _____ Ft.3 X Meter Volume _____ Dry Meter Calibration Factor = _____ Ft

50 (ED)

~~PARTICULATE~~ FIELD DATA

(CONT.)

50 (WB)

Run No. 62
Location SOUTH STACK
Date 10/14/1977
Operator DVV

Amb. Temp. °F 53 (DB)
Bar. Press. "Hg. 29.44
Assumed Moist 12%
Test Periods 192 MIN
48 PTS. @ 4 MIN EACH

Probe Tip Dia., In. 1/4
Probe Length 15 ft
Inp. Nos. 45 → 48
Sample Box No. 50x
f = (.76)

Heater Box Setting
FILL IN ALL BLANKS
READ & RECORD ALL
START OF EACH TEST
POINT

Point	Clock Time	Dry Gas Meter C.F.	Pitot In. H_2O		Orifice ΔH In. H_2O		Dry Gas Temp. °F		Vac. In. Hg Gage	Box Temp. °F	Imp. Temp. °F	Probe Temp. °F	Stack Temp. °F	Stack Press. In. H_2O
	12:12	146.90	ΔP	√ΔP	Desired	Actual	Inlet	Outlet						
B-1	:16	148.09	.15	.39	.29	.31	69	69	2.9	218	50	109	377	
2	:20	149.37	.18	.42	.37	.36	69	69	3.1	232	51	115	378	
3	:24	150.65	.18	.42	.37	.37	69	69	3.1	245	52	115	382	
4	:28	151.95	.18	.42	.37	.38	69	69	3.1	274	52	121	386	
5	:32	153.25	.18	.42	.37	.38	69	70	3.1	250	53	124	389	
6	:36	154.55	.19	.43	.39	.38	69	70	3.1	244	52	123	388	
7	:40	155.85	.19	.43	.39	.38	68	70	3.1	256	52	125	385	
8	:44	157.14	.19	.43	.39	.37	68	71	3.1	253	52	125	388	
9	:48	158.44	.19	.43	.39	.38	69	72	3.1	248	51	127	384	
10	:52	159.74	.19	.43	.39	.38	67	72	3.1	259	51	126	383	
11	:56	161.03	.20	.45	.42	.38	67	72	3.1	268	51	129	385	
12	13:00	162.33	.19	.43	.39	.38	67	72	3.1	250	50	128	380	
13	:04	163.64	.18	.42	.37	.39	67	72	3.2	267	50	117	384	
14	:08	164.91	.18	.42	.37	.37	68	73	3.2	303	50	122	385	
15	:12	166.17	.18	.42	.37	.35	68	73	3.1	252	50	128	383	
16	:16	167.41	.18	.42	.37	.34	68	73	3.1	200	50	131	385	
17	:20	168.71	.19	.43	.39	.37	68	73	3.1	210	50	124	386	
18	:24	170.02	.19	.43	.39	.39	68	73	3.1	244	49	132	381	
19	:28	171.29	.18	.42	.37	.37	68	73	3.1	245	50	131	391	
20	:32	172.56	.18	.42	.37	.36	69	74	3.1	298	51	134	392	
21	:36	173.83	.17	.41	.34	.36	70	74	3.1	244	52	140	383	
22	:40	175.07	.17	.41	.34	.34	70	73	3.1	193	52	141	381	
23	:44	176.32	.16	.40	.32	.34	70	73	3.0	219	53	139	388	
24	:48	177.55	.16	.40	.32	.34	70	73	3.0	260	53	137	391	
TOTAL				20.09		17.03	(1643)	(1722)					(9235)+(9542	
AVERAGE				0.42		0.35	68	72					391	

(530) Meter Volume

(851) Dry Meter Calibration Factor

CORRECTED SAMPLE VOLUME = 61.00 Ft.3 X .990 = 60.39 Ft

RUN NO. 62

~~PARTICULATE~~ & WATER CATCH

IMPINGER NO. 45	Final Weight 767.48	WATER WEIGHT GAIN	IMPINGER 1 84.4
	Initial Weight 683.00		IMPINGER 2 51.6
IMPINGER NO. 46	Final Weight 797.59		IMPINGER 3 11.6
	Initial Weight 745.91		IMPINGER 4 47.5
IMPINGER NO. 47	Final Weight 708.01		TOTAL 195.3
	Initial Weight 696.34		ORSAT
IMPINGER NO. 48	Final Weight 729.83		CO_2 8.0
	Initial Weight 682.27		O_2 15.0
FILTER NO. NONE	Final Weight		CO —
	Initial Weight		N_2 77.0
	Part. Catch		

$M_s = 28.31$

SOLID WEIGHT GAIN

BEAKER NO.	Final Weight	BEAKER 1
	Initial Weight	BEAKER 2
	Increase	BEAKER 3
BEAKER NO.	Final Weight	BEAKER 4
	Initial Weight	TOTAL
	Increase	
BEAKER NO.	Final Weight	
	Initial Weight	
	Increase	
BEAKER NO. PROBE WASH	Final Weight	
	Initial Weight	
	Increase	

Moisture Content: Sample Vol. 60.39 ft.^{3} x $\frac{(530)}{(460 + 70)}$ x 28.3 L/ft.^{3} = 1709 L Dry Gas

Water Weight $\frac{195.39}{18}$ gm./gm. mol. x 24.1 L/mol. = 261 L H_2O Vap

Total = 1970

$\frac{H_2O \text{ Vol.}}{\text{Total}}$ $\frac{261 \text{ L}}{1970 \text{ L}}$ x 100 = 13.2%