Victorville #2

Precal - coal

D. Y. Ma

AP-42 Section 11.6
Reference 56
Report Sect. 4
Reference 61

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

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

PERFORMANCE GUARANTEE TESTING AT SOUTHWESTERN PORTLAND CEMENT

February 5 through 8, 1985

Prepared for

Southwestern Portland Cement
15000 Seventh Street, Suite 201
Victorville, California 92392

February 1985

Prepared by

Pape & Steiner Environmental Services
5801 Norris Road
Bakersfield, California 93308

Report PS-85-382/Project 5371-85

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SECTION 1

INTRODUCTION

At the request of Southwestern Portland Cement, Pape & Steiner Environmental Services conducted a series of emission tests on the effluent from #2 Kiln Stack, the #2 Raw Mill Stack, the #12 Finish Mill and the #2 Clinker Cooler Stack from February 5 to February 8, 1985. The purpose of these tests was to determine if the air pollution control devices serving each of these point sources met the manufacturer's performance guarantee.

Section 2 of this report summarizes the test matrix for this program. Section 3 presents the test results. Sections 4 and 5 describe the sampling and analysis procedures used to obtain these results. Section 6 summarizes the QA/QC steps taken on this program. Finally, the Appendix contains all the raw data and calculations.

SECTION 2

TEST MATRIX

Recently, Southwestern Portland Cement (SWPC) completed a large expansion of their cement plant located near Victorville, California. A new kiln (#2) equipped with a baghouse, a new clinker cooler (#2) equipped with a gravel bed filter, a new raw mill (#2) equipped with a baghouse, and a new finish mill (#12) also equipped with a baghouse for air pollution control have been added to the existing plant.

The purpose of this test program was to determine if the particulate and gaseous emissions from these sources met the performance guarantee stated by the supplier (Humboldt Wedag). According to the contract with SWPC, the performance guarantee tests were to be run over a three day period to insure each control device operated within the specifications over different process conditions. Table 2-1 summarizes the tests performed on these control devices. Since operational difficulties occurred with the kiln during this week, SWPC shortened the test period on the kiln to two days, instead of three days, to insure all the tests would be completed that week.

TABLE 2-1. SWPC PERFORMANCE GUARANTEE TEST MATRIX

Unit	Date	Pollutant	Test No.	Test Time
Kiln	02/06/85	Particulates	1	10:20 am - 12:40 pm[a]
			2	2:47 pm - 5:06 pm[b]
	02/07/85	Particulates	3	8:37 am - 10:54 am[a]
	02/06/85	NO_x,SO_2,CO,HC		7:45 am - 10:20 am[a]
				10:35 am - 1:10 pm[a]
				1:35 pm - 5:15 pm[b]
	02/07/85	NO_x,SO_2,CO,HC		7:40 am - 12:00 pm[a]
				12:30 pm - 4:30 pm[a]
	02/08/85	NO_x,SO_2,CO,HC		7:30 am - 12:00 pm[a]
Clinker	02/06/85	Particulates	1	11:00 am - 12:33 pm[a]
			2	2:45 pm - 4:21 pm[b]
	02/08/85	Particulates	3	9:26 am - 10:52 am[a]
Finish Mill	02/05/85	Particulates	1	1:05 pm - 3:09 pm
	02/07/85	Particulates	2	11:53 am - 4:00 pm
	02/08/85	Particulates	3	9:25 am - 11:31 am
Raw Mill	02/05/85	Particulates	1	11:44 am - 1:50 pm
	02/07/85	Particulates	2	9:35 am - 11:43 am
	02/08/85	Particulates	3	1:26 pm - 3:31 pm

[a]215 TPH [b]190 TPH ← Kiln Feed

SECTION 3

TEST RESULTS

Tables 3-1 to 3-4 summarize the results of the particulate tests performed on the Kiln, Clinker Cooler, Finish Mill and Raw Mill. Table 3-5 compares the measured volumetric flowrates to the design value for each point source. Finally Table 3-6 presents the results of the gaseous emissions performed on the #2 Kiln.

3.1 PARTICULATE TESTS

All of the point sources tested with the exception of the Clinker Cooler Gravel Bed Filter were well within the specification guaranteed by the equipment manufacturer. It should be noted that the actual volumetric flowrate through the baghouses serving the Kiln, Finish Mill and Raw Mill were considerably less than the design flowrate. Since the volume of gas handled by these baghouses is less than design, the face velocity across the bags is reduced which is very beneficial to the performance of the baghouse.

The volume of gas being processed by the gravel bed filter serving the Clinker Cooler greatly exceeds the design specification. This may be causing some carryover of fine dust particles out of the bed. It should be

noted that the results of Test #1 on February 6, 1985 are suspect. An examination of the residue after evaporation of the sampling nozzle and probe acetone rinsing revealed several large particles which were not present in the remaining samples. The high nozzle and probe catch measured for Test #1 may be the result of contamination (i.e., the nozzle may have touched the stack wall or scraped the sample port during the test).

3.2 GASEOUS TESTS

NO_x and CO emissions from the Kiln were variable but SO_2 emissions were constant and very low. NO_x and CO emissions decreased when the Kiln production rate decreased from 215 TPH to 190 TPH. CO emissions on February 8, 1985, were very much higher than previous tests. NO_x emissions were lower but so was the Kiln O_2 content.

HC emissions were also variable even at the same Kiln production rate.

TABLE 3-1. SUMMARY OF SOURCE EMISSION TEST DATA

UNIT TESTED: #2 Kiln LOCATION: Baghouse Outlet

Test number	1	2	3	Average
Date	02/06/85	02/06/85	02/07/85	
Test condition	215 TPH	190 TPH	215 TPH	
Barometric pressure (in. Hg)	26.46	26.43	26.52	
Stack pressure (in. Hg)	26.44	26.42	26.50	
Stack area (Ft^2)	139.63	139.63	139.63	
Elapsed sampling time (min)	120	120	120	
Volume gas sampled (dscf)	75.9941	72.3753	76.2440	
F factor				
GAS DATA				
Average gas velocity (fps)	36.0	33.6	36.0	35.2
Average gas temperature (^oF)	381.1	362.8	380.3	374.7
Gas flowrate (dscfm)	159,581	152,109	159,898	157,196
Gas analysis (dry percent basis)				
Carbon dioxide	18.70	18.69	19.04	
Oxygen	9.17	9.30	9.10	
Carbon monoxide – See Table 3-6.	---	---	---	
Water	4.58	4.59	4.63	4.60
EMISSION CONCENTRATION – Also See Table 3-6				
Filterable particulate (gr/dscf)	0.0025	0.0015	0.0020	0.0020
Total particulate (gr/dscf)				
Total sulfate (gr/dscf)				
SO_3 (ppm)				
SO_2 (ppm)				
NO_x (ppm)				
EMISSION RATE				
Filterable particulate (lb/hr)	3.42	2.00	2.69	2.70
Total particulate (lb/hr)				
Total sulfate (lb/hr)				
SO_3 (lb/hr)				
SO_2 (lb/hr)				
NO_x (lb/hr)				
Lb/MMBtu-EMISSION FACTOR				
Filterable particulate				
Total particulate				
Total sulfate				
SO_2				
NO_x				
Lb/Bbl-EMISSION FACTOR				
Total particulate				
Total sulfate				
SO_2				
NO_x				

TABLE 3-2. SUMMARY OF SOURCE EMISSION TEST DATA

UNIT TESTED: #2 Clinker cooler LOCATION: Gravel Bed Filter Outlet

#295

Test number	1	2	3	Average
Date	02/06/85	02/06/85	02/08/85	
Test condition	215 TPH	190 TPH	215 TPH	
Barometric pressure (in. Hg)	26.46	26.43	26.43	
Stack pressure (in. Hg)	26.42	26.39	26.41	
Stack area (Ft^2)	92.18	92.18	92.18	
Elapsed sampling time (min)	72	72	72	
Volume gas sampled (dscf)	46.2141	49.7283	48.4111	
F factor				
GAS DATA				
Average gas velocity (fps)	47.5	52.2	48.4	49.4
Average gas temperature (^oF)	358.1	377.8	361.7	365.9
Gas flowrate (dscfm)	149,158	159,950	150,857	153,322
Gas analysis (dry percent basis)				
Carbon dioxide	0.00	0.00	0.00	
Oxygen	20.90	20.90	20.90	
Carbon monoxide	---	---	---	
Water	0.39	0.36	0.64	0.46
EMISSION CONCENTRATION				
Filterable particulate (gr/dscf)	0.0800	0.0233	0.0198	0.0410
Total particulate (gr/dscf)				
Total sulfate (gr/dscf)				
SO_3 (ppm)				
SO_2 (ppm)				
NO_x (ppm)				
EMISSION RATE				
Filterable particulate (lb/hr)	102.25	31.99	25.63	53.29
Total particulate (lb/hr)				
Total sulfate (lb/hr)		28.81		
SO_3 (lb/hr)				
SO_2 (lb/hr)				
NO_x (lb/hr)				
Lb/MMBtu-EMISSION FACTOR				
Filterable particulate				
Total particulate				
Total sulfate				
SO_2				
NO_x				
Lb/Bbl-EMISSION FACTOR				
Total particulate				
Total sulfate				
SO_2				
NO_x				

TABLE 3-3. SUMMARY OF SOURCE EMISSION TEST DATA

UNIT TESTED: #12 Finish Mill LOCATION: Baghouse Outlet

Test number	1	2	3	Average
Date	02/05/85	02/07/85	02/07/85	
Test condition	Normal	Normal	Normal	
Barometric pressure (in. Hg)	27.35	27.28	27.18	
Stack pressure (in. Hg)	27.34	27.27	27.17	
Stack area (Ft^2)	19.63	19.63	19.63	
Elapsed sampling time (min)	120	120	120	
Volume gas sampled (dscf)	81.7199	73.0523	75.8621	
F factor				
GAS DATA				
Average gas velocity (fps)	22.0	21.0	21.1	21.4
Average gas temperature (^oF)	186.0	195.3	185.6	189.0
Gas flowrate (dscfm)	17,914	16,504	17,007	17,142
Gas analysis (dry percent basis)				
Carbon dioxide	0.0	0.00	0.00	
Oxygen	20.90	20.90	20.90	
Carbon monoxide	---	---	---	
Water	7.23	9.18	8.02	8.14
EMISSION CONCENTRATION				
Filterable particulate (gr/dscf)	0.0054	0.0050	0.0013	0.0039
Total particulate (gr/dscf)				
Total sulfate (gr/dscf)				
SO_3 (ppm)				
SO_2 (ppm)				
NO_x (ppm)				
EMISSION RATE				
Filterable particulate (lb/hr)	0.84	0.71	0.19	0.58
Total particulate (lb/hr)				
Total sulfate (lb/hr)				
SO_3 (lb/hr)				
SO_2 (lb/hr)				
NO_x (lb/hr)				
Lb/MMBtu-EMISSION FACTOR				
Filterable particulate				
Total particulate				
Total sulfate				
SO_2				
NO_x				
Lb/Bbl-EMISSION FACTOR				
Total particulate				
Total sulfate				
SO_2				
NO_x				

TABLE 3-4. SUMMARY OF SOURCE EMISSION TEST DATA

UNIT TESTED: #2 Raw Mill LOCATION: Baghouse Outlet

	1	2	3	Average
Test number	1	2	3	
Date	02/05/85	02/07/85	02/07/85	
Test condition	Normal	Normal	Normal	
Barometric pressure (in. Hg)	26.45	26.52	26.52	
Stack pressure (in. Hg)	26.42	26.49	26.49	
Stack area (Ft^2)	28.27	28.27	28.27	
Elapsed sampling time (min)	120	120	120	
Volume gas sampled (dscf)	86.8368	87.6826	92.2257	
F factor				
GAS DATA				
Average gas velocity (fps)	46.8	49.0	51.6	49.1
Average gas temperature (^oF)	157.4	171.3	169.7	166.1
Gas flowrate (dscfm)	56,826	58,851	61,797	59,158
Gas analysis (dry percent basis)				
Carbon dioxide	0.00	0.00	0.00	
Oxygen	20.90	20.90	20.90	
Carbon monoxide	---	---	---	
Water	5.14	4.45	4.89	4.83
EMISSION CONCENTRATION				
Filterable particulate (gr/dscf)	0.0034	0.0036	0.0036	0.0035
Total particulate (gr/dscf)				
Total sulfate (gr/dscf)				
SO_3 (ppm)				
SO_2 (ppm)				
NO_x (ppm)				
EMISSION RATE				
Filterable particulate (lb/hr)	1.65	1.82	1.93	1.80
Total particulate (lb/hr)				
Total sulfate (lb/hr)				
SO_3 (lb/hr)				
SO_2 (lb/hr)				
NO_x (lb/hr)				
Lb/MMBtu-EMISSION FACTOR				
Filterable particulate				
Total particulate				
Total sulfate				
SO_2				
NO_x				
Lb/Bbl-EMISSION FACTOR				
Total particulate				
Total sulfate				
SO_2				
NO_x				

TABLE 3-5. COMPARISON OF ACTUAL AND DESIGN DATA FOR AIR POLLUTION CONTROL DEVICES

Point Source	Actual Flowrate (acfm)	Design Flowrate (acfm)	Actual Emissions gr/scf	Actual Emissions lb/hr	Design Emissions gr/scf	Design Emissions lb/hr
Kiln Baghouse	[a]301,454 @ 381°F	400,000 @ 400°F	0.0024	3.42		
	[b]281,359 @ 363°F		0.0014	2.00		
	[a]301,321 @ 380°F		0.0019	2.69		
	294,711 @ 375°F		0.0019	2.69	0.015	22.6
Clinker GBF	[a]262,704 @ 358°F	187,700 @ 428°F	0.0517[d]	102.25 N.G.		
	[b]288,760 @ 378°F	gr/acf	0.0148	31.99 28.81		
	[a]267,693 @ 362°F		0.0127	25.63		
	273,052 @ 366°F		0.0264[c]	53.29	0.010[a] gr/acf	17.5
Finish Mill	25,855 @ 186°F	35,000 @ 230°F	0.0050	0.84		
	24,741 @ 195°F		0.0045	0.71		
	24,903 @ 186°F		0.0012	0.19		
	25,166 @ 189°F		0.0036	0.58	0.015	19.5
Raw Mill	79,346 @ 157°F	95,000 @ 195°F	0.0032	1.65		
	83,170 @ 171°F		0.0034	1.82		
	87,507 @ 170°F		0.0034	1.93		
	83,341 @ 166°F		0.0033	1.80	0.015	24.2

[a]215 TPH [b]190 TPH [c]gr/acf [d]contamination in probe and nozzle; result too high

From Bill Ogle 4/8/85

$Cl = \frac{KF \times 0.87}{1.65} + \text{Coal Ash}$; Coal Ash 15 T/d = .625 T/hr

14.62 T/hr Coal 14.6 T/hr Coal | 13.37 T/hr Coal

114 TCl/hr 114 TCl/hr | 100.8 TCl/hr

TABLE 3-6. GASEOUS EMISSIONS FROM KILN

215 T/hr KF ~~215~~ T/hr KF ~~190~~ T/hr KF

Concentration (ppm,dry)		Date 02/06/85	7:45 am - 10:20 am[a]	Time 10:55 am - 1:10 pm[a]	1:55 pm - 4:15 pm[b]
Range	NO_x		460 - 510	510 - 600	470 - 550
	SO_2		4	0 - 3	0 - 5
	CO		275 - 400	150 - 270	70 - 220
Average	NO_x		487	549	498
	SO_2		4	2	3
	CO		306	210	158
	* C_1,>C_1 HC			Methane → 2.6/49.1	3.2/23.5
Emission Rate (lb/hr)				← Greater than Methane	
Range	NO_x		526 - 583	583 - 686	512 - 599
	SO_2		6.4	0 - 4.8	0 - 7.6
	CO		191 - 278	104 - 188	46 - 146
Average	NO_x		557 — 4.88	628 — 5.51	543 — 539 — 576 — 5.26
	SO_2		6.4 — .056	3.2 — .028	4.6 — .046
	CO		213	146	105
	C_1,>C_1 HC			1.0/19.5	1.2/8.9

Avg 3

#/TCl #/TCl #/hr #/TCl

= 4.7 / 155

Concentration (ppm,dry)		02/07/85	7:40 am - 12:00 pm 215 T/hr	12:30 pm - 4:30 pm 215
Range	NO_x		460 - 570	410 - 510
	SO_2		4 - 5	3 - 4
	CO		250 - 350	225 - 330
Average	NO_x		481	455
	SO_2		4	3
	CO		306	273
	* C_1,>C_1 HC		7.6/15.4	
Emission Rate (lb/hr)			14.5 T/hr-Coal	— 14.5 T/hr
Range	NO_x		527 - 653	470 - 584
	SO_2		6.4 - 8.0	4.8 - 6.4
	CO		174 - 244	157 - 230
Average	NO_x		551	521
	SO_2		6.5 — .057	5.4 — 0.047
	CO		213	190
	* C_1,>C_1 HC		3.0/6.1	

Avg 2

#/hr	#/TCl
536	4.70
5.95	0.05
202	1.77

Concentration (ppm,dry)		02/08/85	7:30 am - 12:00 pm 215
Range	NO_x		340 - 370
	SO_2		6 - 8
	CO		400 - 750
Average	NO_x		358 - ppm
	SO_2		7.1
	CO		575

14.4 T/hr Coal

lb/hr 11.5 — .101

Avg 5 runs

#/hr	
560 - NO_x	5.03 #/TCl
5.2 - SO_2	0.046
174 - CO	1.52

$NO_x = 1.549 \frac{\# NO_x}{MMBTU}$

[a] 215 TPH [b] 190 TPH

Coal @ 12,800 BTU/lb

* see page 5-2

SECTION 4

SAMPLING EQUIPMENT AND PROCEDURES

This section of the report describes the equipment and procedures used to conduct the particulate gaseous tests on this program.

4.1 PRELIMINARY MEASUREMENTS

Before conducting the stack tests a series of preliminary measurements were made to determine:

- The location of the sampling site and the number and location of the sampling points to be used (EPA Method 1)
- The velocity, temperature, and pressure of the gases in the stack (EPA Method 2)
- The composition of the stack gases (EPA Method 3)
- The moisture content of the stack gases (psychrometric chart)

Using the results of these preliminary measurements and the calibration constants for the sampling train, a series of calculations were made to determine the value of K, a constant, and N_d, ideal nozzle diameter, required to run an isokinetic test according to the equation:

$$\Delta H = \left\{ \frac{60^2 \pi^2 K_p^2 C_p^2 (1 - B_{wo})^2 P_s MW_d}{576^2 K_o^2 MW_s P_m} \right\} \left(N_d^4 \right) \left(\frac{T_m}{T_s} \right) (\Delta P)$$

where

$$K = \left\{ \frac{60^2 \pi^2 K_p^2 C_p^2 (1 - B_{wo})^2 P_s MW_d}{576^2 K_o^2 MW_s P_m} \right\}$$

An actual nozzle, whose diameter was as close as possible to the ideal nozzle diameter, was selected for the test. Isokinetic sampling rates for each sampling point in the stack were computed using the equation:

$$\Delta H = (K)(N_d^4)\left(\frac{T_m}{T_s}\right)(\Delta P)$$

Since K and N_d are known, and remain constant during a test, the only variables are the meter temperature, the stack temperature and the velocity pressure for each sampling point.

4.2 PREPARATION OF THE PARTICULATE SAMPLING TRAIN

All sampling train components were cleaned in the laboratory (soap and water, tap water rinse, distilled water rinse, and IPA rinse) to eliminate previous contamination. The sampling train components were sealed and transported to the sampling site in a mobile lab. The EPA Method 5 equipment used to measure particulates (filterable) consisted of:

- A calibrated 316 stainless steel nozzle for isokinetic sampling
- A heated Pyrex glass sampling probe (8' long for Raw Mill; 6' long for Kiln, Clinker and Finish Mill) equipped with an S-type

pitot tube and a thermocouple to measure stack velocity, pressure and temperature

- A heated Pyrex glass filter holder containing a weighed 100-mm Reeve Angel 934 AH glass fiber filter
- A Pyrex glass impinger train in an icebath (impingers 1 and 2 contained 100 ml distilled water; impinger 3 was dry; bubbler 4 contained a weighed amount of silica gel)
- An umbilical to connect the probe and sample box to the control module
- A control module containing a vacuum pump, a calibrated dry gas meter and a calibrated orifice meter to measure the pressure, temperature and flowrate throughout the train.

The sampling train was charged in the mobile lab using freshly prepared reagents. Each impinger and its contents was weighed to the nearest 0.1 gm on a calibrated electronic balance. Blanks of all filters and reagents were retained for subsequent analysis. The sampling point locations were marked on the probe using a high-temperature marker. The sampling train was completely assembled and lifted to the sampling site.

4.3 SAMPLING PROCEDURES FOR PARTICULATE SAMPLING TRAIN

Prior to a test, the sampling train was heated and leak-checked at 15 inches Mercury to insure leakage was less than 0.02 cfm. The S-type pitot tube was also leak-checked. The sampling train was installed on the unirail and the probe was inserted into the stack at the farthest point.

An isokinetic sampling rate was calculated using an HP-41CV calculator for each sampling point on the traverse (6 points per traverse, 4 traverses @ 90° for Kiln; 6 points per traverse, 4 traverses @ 90° for Clinker; 8 points per traverse, 2 traverses @ 90° for Finish Mill; 6 points per traverse, 2 traverses @ 90° for Raw Mill). Each point was sampled for an equal period of time (5 minutes for Kiln; 3 minutes for Clinker; 7.5 minutes for Finish Mill; 10 minutes for Raw Mill) and all pertinent data was recorded on the data sheet for each point. The probe and sample box were maintained at $250^{o}F$ throughout the traverse. The gases leaving the impinger train were maintained at $<70^{o}F$. At the end of a traverse, the probe was withdrawn from the stack and the entire sampling train was transferred (intact) to the next sampling port. Another traverse of the stack was completed and the sampling train was withdrawn for the final leak check. This leak check was performed at 15 inches Mercury or at the highest vacuum achieved during the test. The S-type pitot tube was also checked at this time. The probe, nozzle, filter holder, and impinger train were sealed with tin foil and lowered to the mobile lab for sample recovery.

4.4 SAMPLE RECOVERY PROCEDURES FOR PARTICULATE SAMPLING TRAIN

Sample recovery occurred in the mobile lab. The nozzle and probe were brushed and rinsed three times using ACS reagent grade acetone into a polyethylene sample bottle. The 100-mm filter was removed from the 4-inch filter holder and sealed in its petri dish. The front half of the 4-inch glass filter holder was brushed and rinsed with acetone. Each impinger was

removed from the icebath, wiped dry and weighed to the nearest 0.1 gm. All sample bottles and petri dishes were marked and labeled. A chain-of-custody log was completed and the field data sheet was also labeled with the sample ID numbers. The sampling train was then recharged in preparation for the next test.

4.5 SAMPLING PROCEDURES FOR CONTINUOUS MONITORING

The continuous monitors used in the Pape & Steiner Mobile Monitoring Lab are shown in Table 4-1. Figure 4-1 is a schematic of the continuous monitoring system. The procedures used to continuously monitor stack gases for NO_x, SO_2, CO, CO_2, and O_2 strictly follow CARB Method 1-100.

Sample was taken from the stack using a 316 stainless steel probe. A Balston filter holder and fiberglass filter (99.9999 percent efficiency retention of 0.6 micron particles) was connected to the outlet of the probe. Sample gas was transported through heated Teflon sample line (maintained at >250°F) by a Teflon-lined diaphragm pump to a 316 stainless steel refrigeration type conditioner (Hankison Model E-4G-SS). The sample gas was passed through the conditioner two separate times under vacuum before entering the pump, then two additional times under pressure. The clean, dry sample gas ($\sim$35°F) was then transported to the continuous analyzer system through an unheated Teflon line. A series of flowmeters, valves, and regulators maintain constant flow through the system at a constant pressure.

TABLE 4-1. CONTINUOUS MONITORING LAB

NO_X CHEMILUMINESCENT ANALYZER -- THERMO ELECTRON MODEL 10

Response Time (0-90%)	1.5 sec -- NO mode 1.7 sec -- NO_x mode
Zero Drift	Negligible after 1/2 hour warmup
Linearity	±1% of full scale
Accuracy	Derived from the NO or NO_2 calibration gas, ±1% of full scale
Output	0.100 mV, 0-10 mV, 0-5 V, 0-10 V

O_2 ANALYZER, FUEL TYPE -- TELEDYNE MODEL 326

Response Time (0-90%)	60 seconds
Accuracy	±1% of scale at constant temperatures; ±1% of scale of ±5% of reading, whichever is greater, over the operating temperature range
Output	0-1 V

CO_2/CO INFRARED ANALYZER -- ANARAD MODEL AR-600

Response Time (0-90%)	5 seconds
Zero Drift	±1%
Span Drift	±1%
Linearity	±1%
Resolution	Less than 1% of full scale
Output	0-1 V

SO_2 UV ANALYZER -- DUPONT MODEL 400

Response Time (0-90%)	Less than 1 second
Zero Drift	Less than 1% full scale in 24 hours
Linearity	±1% full scale
Accuracy	±2% full scale
Output	0-10 mV
Operating Ranges	0-100 ppm, 0-1000 ppm

STRIP CHART RECORDERS (3) -- LINEAR MODEL 486

Pen Response	20 inches/second
Span -- full scale	1 mV through 10 V
Zero Set	Electronically adjustable full scale with 1 full scale of zero supression
Accuracy Dead Band Linearity Repeatability	Total limit of error ±0.5%

SCOTSMAN TRAILER

Fully Insulated
Air conditioned
8-ft x 14-ft x 11-ft

1. Filter 0.6 μ, 99.9999 percent efficient
2. Duct
3. 316 stainless steel probe
4. 3/8-inch, heated (250°F) Teflon
5. Four-pass conditioner-dryer, 316 stainless steel internals
6. 3/8-inch, unheated Teflon
7. Teflon-lined sample pump
8. 3/8-inch unheated Teflon
9. Rotameter
10. 1/4-inch Teflon tubing
11. Calibration gas manifold
12. Calibration gas selector valve
13. Calibration gas cylinders
14. Backpressure regulator
15. Auxiliary analysis port

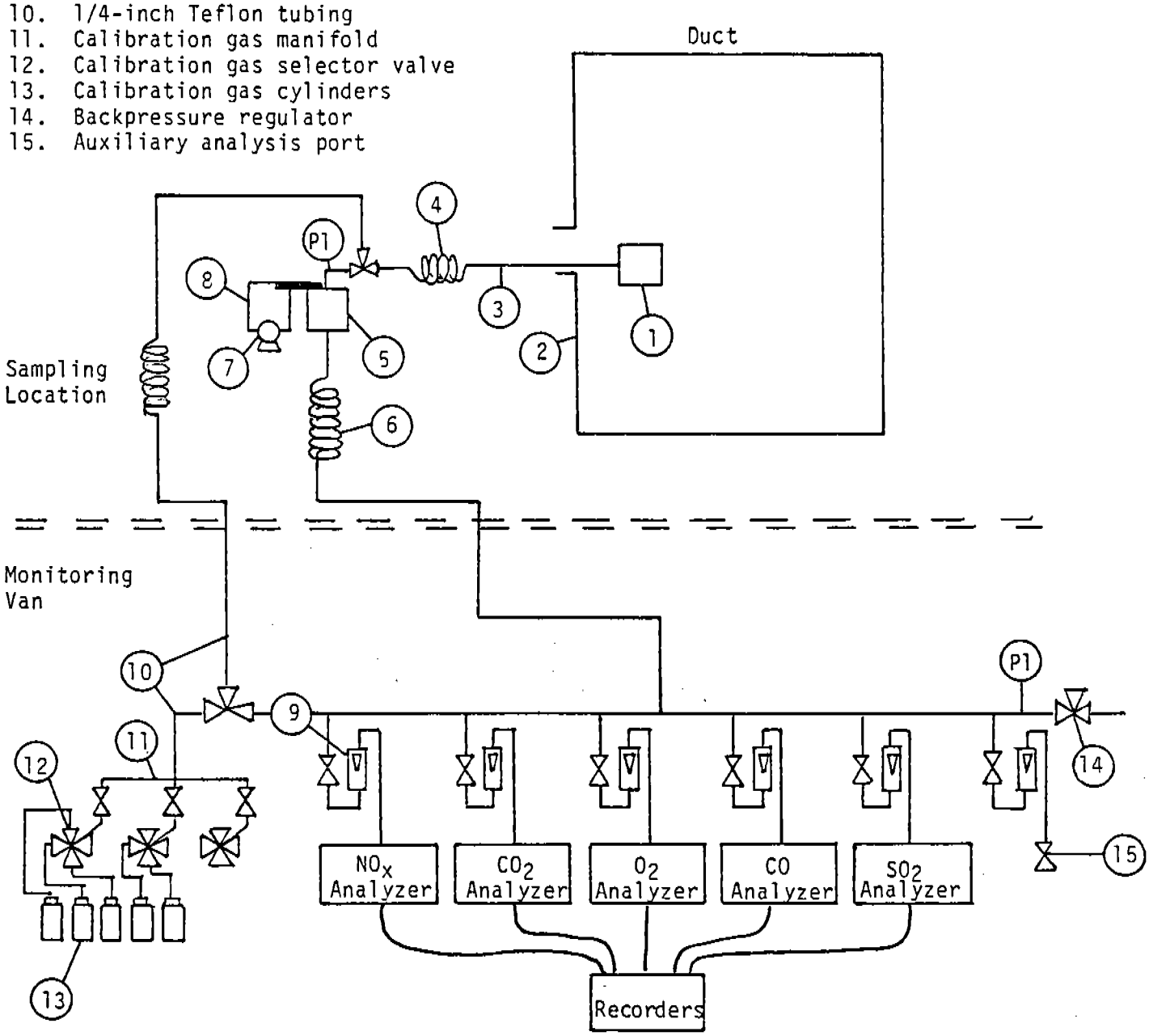


Figure 4-1. Schematic of Continuous Monitoring System.

Calibrations of the continuous analyzers were performed using EPA Protocol 1 calibration gases (± 1 percent) for criteria pollutant analysis (NO_x/SO_2) and certified calibration gases (± 1 percent) for fixed gas analysis. Copies of the gas certifications are included in the Appendix of this report. All pertinent data (date, time, test locations, analyzer range, cal gas value) were recorded on both the field data sheets and continuous analyzer strip charts in the field.

At the start of the test, a leak-check was performed. The sample probe was removed from the stack and the end was sealed with a Swagelok cap. A leak-check is successful only if pressure at the analyzer system and flow through the rotameters to the individual analyzers all drop to zero. A mandatory leak-check was performed at the completion of each test.

An initial calibration was performed at the start of the test period by introducing zero and span gases for each analyzer and making the necessary adjustments. Calibration gas values were recorded on the continuous monitor strip charts and field data sheets. A calibration check was completed at the end of the test and adjustments (if necessary) to the analyzers were made in preparation for another test.

Test data was collected by continuously recording data onto strip charts for each test.

4.6 SAMPLING PROCEDURES FOR HYDROCARBONS

The sampling train for hydrocarbons consisted of a probe (short piece of stainless steel), a Teflon sample line, a 500 ml glass sampling bomb; and a squeeze bulb. The entire train was purged with stack gas several

times before collecting a sample. After sample collection, the glass bomb was taken to the mobile lab for immediate analysis. One grab sample was collected during each test on the Kiln.

SECTION 5

ANALYSIS PROCEDURES

This section of the report describes the procedures used to analyze the samples collected during the test program. All analyses were performed in the Pape & Steiner climate-controlled laboratory in Bakersfield.

5.1 ANALYSIS OF PARTICULATE SAMPLES

5.1.1 Nozzle, Probe, Filter Holder Wash

The volume of the acetone washings were measured and the washings were transferred to clean, tared, aluminum weighing dishes. The dishes were placed on a hot plate in a fume hood and gently heated to dryness. The dishes with the dry residue were desiccated and weighed repeatedly at 6-hour intervals until a constant weight was achieved (to the nearest 0.01 mg with a tolerance of <0.1 mg between weighings). The ACS reagent grade acetone blank was treated in the same manner.

5.1.2 Filter

The 100 mm filter was removed from its petri dish and transferred to an oven where it was heated for 2 hours at 105°C. The filter was then desiccated and weighed repeatedly at 6-hour intervals until a constant weight was achieved (to nearest 0.01 mg with a tolerance of <0.1 mg between weighings). An unused, tared blank filter was treated in the same manner.

5.2 ANALYSIS OF HYDROCARBON SAMPLES

The grab sample of hydrocarbons was analyzed using Carle Model 211 AGC-FID. After purging the syringe three times, a 1-ml syringe sample was extracted from the syringe port on the glass bomb and injected onto a 6-foot long, 1/8-inch stainless steel column containing 80/100 mesh PoraPac Q, maintained at 150°C. Any C_1 through C_5 hydrocarbons were speciated and the greater than C_5 hydrocarbons were backflushed to the detector for quantitation as a single peak. An HP Model 3390A reporting integrator was used to record and integrate the signal from the GC. A ± 1 percent certified calibration gas (C_1-C_6 HC in N_2) was used to calibrate the GC and to quantitate the C_1 through C_5 and greater than C_5 hydrocarbons.

SECTION 6

QUALITY ASSURANCE

6.1 PARTICULATE SAMPLING EQUIPMENT

A detailed record of repair and maintenance to each sampling train is kept. Preventative maintenance to each system is performed periodically to avoid complete component breakdown during a field test.

A detailed record of sampling system calibrations is also kept. Calibration data for the sampling nozzles, pitot tubes, dry gas meters and orifice meters are available for review. Results of the EPA Quality Assurance Branch biannual audits of the dry gas meter and orifice meter combinations are also logged and verify our in-house calibration data. The calibration data for the equipment used on this program can be found in the Appendix.

6.2 LAB ANALYSIS

All field samples are assigned a label and an ID number. This ID is also affixed to a chain-of-custody log and to the field data sheet to eliminate any chance of sample mixup.

Prior to analysis, all glassware is thoroughly cleaned (soap and water, tap water rinse, distilled water rinse, IPA rinse) to eliminate any contamination. The evaporating dishes used to evaporate the washings are

treated the same as a sample (dried in an oven, desiccated and weighed repeatedly at 6-hour intervals until a constant weight is achieved). The glassware used to measure volumes and make transfers and dilutions are all NBS Class A to insure accurate measurements. All weighings are carried out on a Mettler Model H54AR analytical balance supported by a marble table in a separate room from the main analytical laboratory. The balance is calibrated regularly against an NBS Class S-1 weight.

All reagents used in the field and in the laboratory are ACS reagent grade and blanks of these reagents are evaluated for every set of tests. Blanks are taken in the field from the squeeze bottles and not the original container. Records are kept on these blanks to insure consistent quality of the reagents.

6.3 CONTINUOUS MONITORS

Prior to the test program, an internal and external calibration of the sampling system was performed using the calibration gases. There was excellent agreement between the internal and external calibrations (indicating no sample loss in the system) over the test period. The calibration gas certificates for the gases used on this test program appear in the Appendix.

APPENDIX

- Sampling Point Locations
- Velocity Traverse Data Sheets
- Particulate Data Sheets
- Continuous Monitor Data Sheets
- Continuous Monitor Strip Charts
- GC Strip Chart
- Sample Handling Log
- Analytical Reports
- Isokinetic Calculations
- Emission Rate Calculations
- Equipment Calibration Data
- Calibration Gas Certificates

Pape & Steiner Environmental Services

SAMPLING POINT LOCATION DATA SHEET

Plant Southwestern Portland

Date 2/4/85

Test Location #2 Kiln Outlet

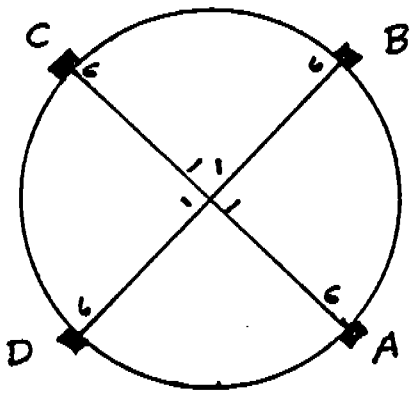
Upstream Dist./Dia. 92"/0.6 ∅

Downstream Dist./Dia. 416"/2.6 ∅

No. of Sampling Points 24

Stack Dimension 160"

Coupling Length 5.5"



Sample Point	Dist	Sample Point	Dist	Sample Point	Dist	Sample Point	Dist
1	8.9						
2	16.2						
3	24.4						
4	33.9						
5	45.5						
6	62.4						

SAMPLING POINT RELOCATION:

Pape & Steiner Environmental Services

SAMPLING POINT LOCATION DATA SHEET

Plant Southwestern Portland

Date 2/4/85

Test Location Clinker Outlet

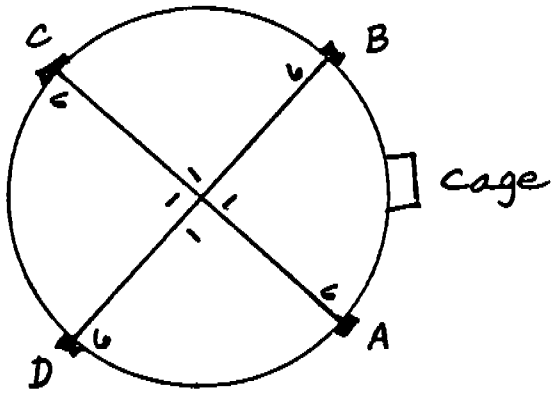
Upstream Dist./Dia. 76" / 0.6 ø

Downstream Dist./Dia. 300" / 2.3 ø

No. of Sampling Points 24

Stack Dimension 130"

Coupling Length 4.5"



Sample Point	Dist	Sample Point	Dist	Sample Point	Dist	Sample Point	Dist
1	7.3						
2	13.2						
3	19.9						
4	27.5						
5	37.0						
6	50.7						

SAMPLING POINT RELOCATION:

Pape & Steiner Environmental Services

2, 4" flanges @ 90°

SAMPLING POINT LOCATION DATA SHEET

Plant Southwestern Portland

Date 2/4/85

Test Location #2 Raw Mill Outlet

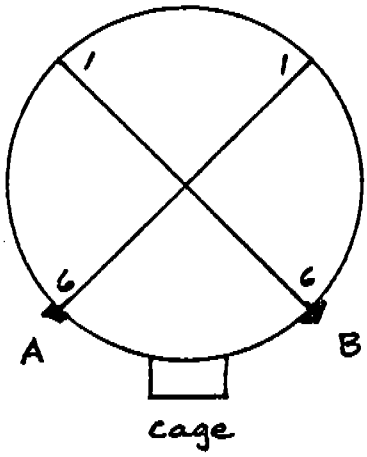
Upstream Dist./Dia. 168"/2.3 ø

Downstream Dist./Dia. 706"/9.8 ø

No. of Sampling Points 12

Stack Dimension 72"

Coupling Length 13.25"



Sample Point	Dist	Sample Point	Dist	Sample Point	Dist	Sample Point	Dist
1	16.4						
2	23.8						
3	34.6						
4	63.9						
5	74.7						
6	82.1						

SAMPLING POINT RELOCATION: none

Pape & Steiner Environmental Services

VELOCITY TRAVERSE DATA SHEET

Plant SWPC

Date 2/6/85

Test Location Kiln

Static Pressure (in. wg)

Barometric Pressure 26.46

Probe Type/Length glass/6'

Pitot Coefficient 0.84

Stack Dimension 160

	Smpl Pt.	ΔP	Ts	Smpl Pt	ΔP	Ts	Smpl Pt.	ΔP	Ts	Smpl Pt	ΔP	Ts
9:12	B 1	0.29	376	9:31 D 1	0.18	372						
	2	0.35	376	2	0.17	374						
	3	0.41	376	3	0.15	374						
	4	0.43	376	4	0.18	374						
	5	0.47	376	5	0.18	372						
	6	0.39	376	6	0.17	372						
9:18	A 1	0.24	376	9:39 C 1	0.16	369						
	2	0.30	373	2	0.14	370						
	3	0.35	375	3	0.14	369						
	4	0.40	376	4	0.13	369						
	5	0.43	375	5	0.11	368						
	6	0.38	375	6	0.10	368						

SAMPLING POINT RELOCATION:

Avg $\sqrt{\Delta P}$ = 0.4963

Avg ΔP = 0.2463

Avg Ts ~ 373

Pape & Steiner Environmental Services

VELOCITY TRAVERSE DATA SHEET

Plant SWPC

Date 2-6-85

Test Location CLINKER

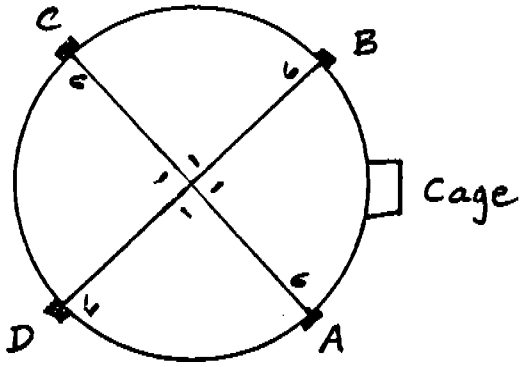
Static Pressure (in. wg) -.48

Barometric Pressure 26.45

Probe Type/Length Glass 6'

Pitot Coefficient .840

Stack Dimension 130"



0920 D Smpl Pt.	ΔP	Ts	Smpl Pt 0931 A	ΔP	Ts	Smpl Pt. B	ΔP 0950	Ts	Smpl Pt 0956 C	ΔP	Ts
1	.41	350	1	.53	358	1	.52	351	1	.33	335
2	.42	350	2	.65	361	2	.55	358	2	.36	340
3	.37	356	3	.75	365	3	.64	362	3	.35	346
4	.35	358	4	.78	367	4	.68	365	4	.32	349
5	.30	360	5	.78	368	5	.68	365	5	.28	353
6	.21	356	6	.55	348	6	.56	358	6	.22	350

SAMPLING POINT RELOCATION:

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VELOCITY TRAVERSE DATA SHEET

Plant SWPC

Date 3/5/85

Test Location #12 Finish Mill

Static Pressure (in. wg) -0.11

Barometric Pressure 26.35

Probe Type/Length glass/6'

Pitot Coefficient 0.84

Stack Dimension 6.0

12:29				12:39							
Smpl Pt.	ΔP	Ts	Smpl Pt	ΔP	Ts	Smpl Pt.	ΔP	Ts	Smpl Pt	ΔP	Ts
A1	0.11	186	B1	0.11	187						
2	0.12	187	2	0.11	187						
3	0.12	187	3	0.11	188						
4	0.12	188	4	0.11	189						
5	0.12	189	5	0.13	190						
6	0.11	189	6	0.12	191						
7	0.10	189	7	0.11	191						
8	0.07	189	8	0.09	189						

SAMPLING POINT RELOCATION:

Avg $\sqrt{\Delta P}$ = 0.3309

Avg T_s ~ 189

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VELOCITY TRAVERSE DATA SHEET

Plant SWPC

Date 2-5-85

Test Location RAW MILL

Static Pressure (in. wg) -0.47

Barometric Pressure 26.45

Probe Type/Length Glass 8'

Pitot Coefficient .840

Stack Dimension 22"

	Smpl Pt.	ΔP	Ts	Smpl Pt	ΔP	Ts	Smpl Pt.	ΔP	Ts	Smpl Pt	ΔP	Ts
SW 10:30	1	.52	153	NW 10:45	.58	156						
	2	.57	154		.58	157						
	3	.55	155		.55	157						
	4	.50	156		.52	158						
	5	.49	155		.49	157						
	6	.41	153		.37	156						

SAMPLING POINT RELOCATION:

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 2)

Date 2/6/85
Test Location RUN 2
Run Number #1
Stack Diameter 160
Operator JB
Filter No. 10-270

Barometric Pressure 26.46
Static in. wg. -0.33
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 635/1.0096
Nozzle No./Size 1548/.3207

Impinger Volumes/Weights			
Contents	Final	Initial	Net
100ml DI	616.0	569.9	46.1
100ml DI	545.5	529.6	15.9
DRY	470.9	468.9	2.0
S.G.	628.3	614.8	13.5
		Total	77.5

Gas Composition			
Time	CO_2	O_2	CO
	18.20	9.13	

Leak Rate	cfm	"Hg
Initial	0.019	15
Final		

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
A 1	10:20 0	0.15	0.98	402.765	370	275	254	55	55	55	2.5	0.387	pitot ok
2	5	0.15	0.98	405.565	379	255	258	49	64	55	2.0	0.387	
3	10	0.13	0.87	408.310	376	254	258	47	70	65	2.0	0.361	
4	15	0.12	0.80	410.940	376	269	255	46	74	56	2.0	0.346	
5	20	0.10	0.67	413.460	375	272	256	44	77	58	1.5	0.316	
6	25	0.08	0.53	415.810	375	275	252	43	79	59	1.0	0.283	
	30			417.943									
B 1	10:55 0	0.145	0.96	417.943	374	269	253	37	67	63	2.0	0.381	
2	5	0.15	1.00	420.647	380	236	255	35	80	64	2.5	0.387	
3	10	0.17	1.14	423.490	382	225	255	35	83	65	2.5	0.412	
4	15	0.19	1.27	426.470	384	227	253	34	84	66	3.0	0.436	
5	20	0.18	1.21	429.665	380	241	254	35	86	67	3.0	0.424	
6	25	0.15	1.01	432.797	380	251	255	37	87	69	2.0	0.387	
	30			435.710									

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 2 of 2)

Date 2/6/85
Test Location Kiln
Run Number 1
Stack Diameter 160
Operator JS
Filter No. 10-270

Barometric Pressure 26.46
Static in. wg. -0.33
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 635/1.0098
Nozzle No./Size 1548/.3207

Impinger Volumes/Weights			
Contents	Final	Initial	Net
S.G.			
		Total	

Gas Composition			
Time	CO_2	O_2	CO
Leak Rate		cfm	"Hg
Initial			
Final		0.009	9.0

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
B 1	11:32 0	0.295	1.96	435.710	380	275	245	38	69	68	4.5	0.543	
2	5	0.36	2.41	439.555	383	275	244	38	81	68	5.5	0.600	
3	10	0.405	2.72	443.795	383	275	248	38	84	69	6.0	0.636	
4	15	0.46	3.08	448.300	386	275	248	37	84	70	7.0	0.678	
5	20	0.51	3.43	453.060	385	275	251	38	86	70	8.0	0.714	
6	25	0.41	2.77	458.100	385	275	253	39	87	72	6.5	0.640	
	30			462.941									
D 1	12:10 0	0.28	1.90	462.941	380	275	247	49	80	76	4.0	0.529	
2	5	0.305	2.07	466.800	385	265	249	42	89	75	4.5	0.552	
3	10	0.365	2.48	470.775	386	262	248	40	92	76	5.5	0.604	Acel 855876
4	15	0.42	2.85	475.075	388	264	248	41	94	77	6.5	0.648	
5	20	0.37	2.51	479.715	388	266	249	40	92	78	5.5	0.608	FLT 1 855877
6	25	0.315	2.14	484.185	388	267	249	40	92	78	5.0	0.561	
	30			488.412									pitstok
			1.74	85.657	386.08				74.04			0.4427	

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 1)

Date 2/6/85
Test Location Kiln
Run Number #2
Stack Diameter 160
Operator JB
Filter No. a99

Barometric Pressure 26.43
Static in. wg. -0.18
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 635/1.0048
Nozzle No./Size 548/.3207

Impinger Volumes/Weights			
Contents	Final	Initial	Net
DI	565.4	524.1	41.3
DI	526.4	510.9	15.5
DRY	439.2	437.6	1.6
S.G.	642.0	626.5	15.5
		Total	73.9

Gas Composition			
Time	CO_2	O_2	CO
	18.69	9.30	

Leak Rate	cfm	"Hg
Initial	0.019	15
Final		

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
B 1	2:47 0	0.25	1.67	489.245	364	225	239	34	61	61	4.5	0.500	pitot ok
2	5	0.33	2.21	492.765	368	225	237	40	71	59	6.0	0.574	190 TPH
3	10	0.37	2.49	496.900	369	225	240	40	76	59	7.0	0.608	
4	15	0.40	2.70	501.050	371	233	258	38	79	61	7.5	0.632	
5	20	0.375	2.55	505.465	368	238	237	40	82	63	7.0	0.612	
6	25	0.345	2.36	509.860	368	248	227	40	84	69	7.0	0.587	
	30			514.171									
A 1	3:22 0	0.21	1.42	514.171	368	275	275	38	72	67	3.5	0.458	
2	5	0.26	1.78	517.505	365	275	272	42	83	69	4.5	0.510	
3	10	0.32	2.21	521.150	364	275	270	44	86	69	6.0	0.566	
4	15	0.38	2.61	525.200	368	275	239	46	87	70	7.0	0.616	
5	20	0.385	2.66	529.590	365	261	253	43	87	71	7.5	0.620	
6	25	0.31	2.14	534.150	365	234	233	44	88	71	6.0	0.557	
	30			538.451									

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 2 of 2)

Date 2/6/85
Test Location Kiln
Run Number 2
Stack Diameter 160
Operator JB
Filter No. 299

Barometric Pressure 26.43
Static in. wg. -0.18
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 635/1.0098
Nozzle No./Size 1548/.3207

Impinger Volumes/Weights			
Contents	Final	Initial	Net
S.G.			
		Total	

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial		
Final	0.009	8.0

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
0 1	4:03 0	0.15	1.02	538.~~450~~	365	264	275	40	71	69	2.5	0.387	
2	5	0.14	0.96	541.330	362	245	262	42	80	70	2.5	0.374	
3	10	0.13	0.90	544.138	359	237	260	40	84	69	2.5	0.361	
4	15	0.15	1.04	546.845	359	244	268	37	85	69	2.5	0.387	
5	20	0.16	1.11	549.715	359	248	257	37	87	69	3.0	0.400	
6	25	0.145	1.01	552.725	359	247	253	37	88	69	2.5	0.361	
	30			555.640									
C 1	4:36 0	0.14	0.96	555.640	357	275	237	40	72	69	2.5	0.374	
2	5	0.12	0.83	558.420	359	275	252	40	85	71	2.0	0.346	Ace 2 85 5880
3	10	0.13	0.91	561.080	357	274	253	36	86	71	2.5	0.361	
4	15	0.11	0.77	563.800	357	265	265	39	87	71	2.0	0.332	FLT 2 85 5881
5	20	0.10	0.70	566.360	355	258	252	41	87	71	2.0	0.316	
6	25	0.085	0.59	568.930	355	249	253	40	87	71	1.5	0.292	pitot ok
	30			571.050									
			1.57	81.805	362.75				74.67			0.4647	

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 2)

Date 2/7/85
Test Location Kiln
Run Number 3
Stack Diameter 160
Operator JS
Filter No. 221

Barometric Pressure 26.52
Static in. wg. -0.33
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 635/1.0098
Nozzle No./Size 1548/.3207

Impinger Volumes/Weights			
Contents	Final	Initial	Net
DI	665.5	616.1	49.4
DI	596.6	583.3	13.3
dry	434.6	433.7	0.9
S.G.	626.6	611.5	15.1
		Total	78.7

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	0.019	15
Final		

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
C 1	8:31 0	0.14	0.92	581.177	375	225	225	50	61	61	2.0	0.374	pitot ok
2	5	0.14	0.93	583.910	381	244	234	44	73	62	2.0	0.374	
3	10	0.14	0.94	586.610	378	268	249	44	77	63	2.0	0.374	
4	15	0.13	0.87	589.335	379	270	252	44	79	63	2.0	0.361	
5	20	0.095	0.64	591.975	376	268	252	44	81	64	1.5	0.308	
6	25	0.09	0.61	594.330	376	262	252	44	80	65	1.5	0.300	
	30			596.591									
D 1	9:11 0	0.17	1.13	596.591	376	273	255	42	67	65	2.5	0.412	
2	5	0.16	1.07	599.615	380	251	256	37	80	66	2.5	0.400	
3	10	0.17	1.14	602.700	381	245	255	35	82	66	2.5	0.412	
4	15	0.175	1.18	605.475	381	240	255	36	84	67	2.5	0.418	
5	20	0.185	1.25	608.520	380	245	254	35	85	67	3.0	0.430	
6	25	0.17	1.15	611.690	380	250	255	35	86	68	2.5	0.412	
	30			614.965									

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 2 of 2)

Date 2/7/85
Test Location Kiln
Run Number 3
Stack Diameter 160
Operator JS
Filter No. 271

Barometric Pressure 26.52
Static in. wg. −0.33
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 635/1.0098
Nozzle No./Size 1548/.3207

Impinger Volumes/Weights				
Contents.	Final	Initial	Net	
S.G.				
		Total		

Gas Composition			
Time	CO_2	O_2	CO
Leak Rate		cfm	"Hg
Initial			
Final		0.015	8.0

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
B 1	9:48 0	0.28	1.86	614.965	379	238	245	39	69	67	4.0	0.529	
2	5	0.34	2.28	618.740	383	225	245	37	81	68	5.0	0.583	
3	10	0.42	2.84	622.835	384	225	240	37	84	69	6.5	0.648	
4	15	0.45	3.02	627.390	386	225	242	36	85	70	7.0	0.671	
5	20	0.465	3.14	632.155	383	239	242	37	86	72	7.5	0.682	
6	25	0.42	2.84	637.350	383	242	243	37	87	73	6.5	0.648	
	30			641.774									
A 1	10:24 0	0.27	1.83	641.774	380	275	245	40	80	75	4.0	0.520	
2	5	0.29	1.96	645.540	381	272	247	41	84	74	4.5	0.539	
3	10	0.34	2.31	649.390	381	265	247	40	87	74	5.0	0.583	FLT3 855885 / Ace3 855884
4	15	0.40	2.72	653.600	383	257	245	41	90	74	6.0	0.632	
5	20	0.41	2.79	658.020	383	261	242	40	91	74	6.5	0.640	
6	25	0.35	2.39	662.445	380	269	247	38	90	74	5.5	0.592	pitot ok
	30			667.057									
			1.74	85.880	380.29				74.88			0.4935	

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE B5 FIELD TEST DATA SHEET (Page 1 of 2)

Date 2-6-85
Test Location SINKER 2
Run Number 1
Stack Diameter 130"
Operator CEO
Filter No. 295

Barometric Pressure 26.45
Static in. wg. -.48
Probe Type/Length Glass 6'
Pitot Coefficient .840
Meter Box No./γ 609/.98
Nozzle No./Size 448/.3180

Impinger Volumes/Weights			
Contents	Final	Initial	Net
100ml DI	530.4	540.2	-9.8
100ml DI	537.9	534.6	3.3
DRY	448.5	447.3	1.2
S.G.	609.2	600.1	9.1
		Total	3.8

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	.015	16
Final		

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
A 1	1100 0	.56	2.07	190.807	341	262	228	42	61	60	5.0	0.748	PITOT - OK
2	3	.66	2.42	193.30	354	267	245	39	69	62	7.0	0.812	
3	6	.70	2.63	195.98	338	272	250	39	73	62	7.5	0.837	
4	9	.73	2.74	198.87	342	251	254	43	76	62	8.0	0.854	
5	12	.64	2.39	201.82	348	265	255	46	77	63	7.0	0.800	
6	15	.56	2.16	204.44	323	261	256	47	79	64	6.0	0.748	
	18			206.940									
D 1	1120 0	.34	1.30	206.940	328	235	258	49	71	66	3.5	0.583	
2	3	.36	1.35	208.97	343	237	256	50	72	65	4.0	0.600	
3	6	.31	1.15	210.98	355	245	256	51	79	66	3.0	0.557	
4	9	.29	1.09	213.00	350	252	256	49	81	67	3.0	0.539	
5	12	.27	1.01	214.81	352	258	257	51	82	67	3.0	0.520	
6	15	.22	0.82	216.66	359	260	256	52	82	67	2.5	0.469	
	18			218.436									

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE MIS FIELD TEST DATA SHEET (Page 1 of 2)

Date 2-6-85
Test Location SINKER 2
Run Number 1
Stack Diameter 130"
Operator GEO
Filter No. 295

Barometric Pressure 26.45
Static in. wg. -.48
Probe Type/Length Glass 6'
Pitot Coefficient .840
Meter Box No./γ 609/.98
Nozzle No./Size 1428/.2680

Impinger Volumes/Weights			
Contents	Final	Initial	Net
S.G.			
		Total	

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial		
Final	.011	10

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
B 1	1150 0	.40	1.47	218.436	364	229	252	50	75	74	4.0	0.632	
2	3	.50	1.79	221.00	390	234	251	45	81	71	5.0	0.707	
3	6	.55	1.94	222.80	410	249	252	45	87	72	5.5	0.742	
4	9	.60	2.15	225.34	395	253	250	44	87	72	6.0	0.775	
5	12	.60	2.11	227.91	412	255	250	44	88	73	6.0	0.775	
6	15	.45	1.59	230.49	409	254	249	43	89	73	5.0	0.671	
	18			232.861									
C 1	1215 0	.28	1.04	232.861	363	228	253	48	78	75	3.0	0.529	
2	3	.24	0.89	234.70	364	229	253	49	81	73	3.0	0.490	
3	6	.26	0.97	236.48	360	246	256	53	86	73	3.0	0.510	
4	9	.26	1.01	238.28	331	254	256	53	87	74	3.0	0.510	
5	12	.24	0.93	240.13	334	253	255	51	87	77	3.0	0.49	Acc 85 5878
6	15	.17	0.66	242.00	330	256	253	47	87	73	2.5	0.412	
	18			243.505									FLT 85 5879
			1.57	52.698	358.13				74.40			0.6379	

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE 1-5 FIELD TEST DATA SHEET (Page 1 of 2)

Date 2-6-85
Test Location CLINKER
Run Number #2
Stack Diameter 130"
Operator JCO
Filter No. 283

Barometric Pressure 26.43
Static in. wg. -.50
Probe Type/Length Glass 6'
Pitot Coefficient .840
Meter Box No./γ 609/.98
Nozzle No./Size 1428/.2680

Impinger Volumes/Weights				
Contents	Final	Initial	Net	
1 DI	523.4	533.6	-9.7	
DI	545.1	544.0	1.1	
DRY	438.2	437.3	0.9	
S.G.	654.6	643.1	11.5	
		Total	3.8	

Gas Composition			
Time	CO_2	O_2	CO
Leak Rate		cfm	"Hg
Initial		.017	15
Final			

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
A 1	1445 0	.60	2.15	244.017	377	268	233	52	67	66	7.5	0.775	PITOT-OK
2	3	.74	2.70	246.58	371	272	241	47	76	69	9.5	0.860	
3	6	.80	2.85	249.50	390	268	244	45	79	68	10.5	0.894	
4	9	.84	3.00	252.33	392	258	236	46	80	69	11.5	0.917	
5	12	.84	3.06	255.35	374	258	234	47	81	69	12.5	0.917	
6	15	.60	2.16	258.41	385	257	237	47	81	69	7.5	0.775	
	18			261.057									
D 1	0	.40	1.46	261.057	366	227	234	47	73	71	5.0	0.632	
2	3	.40	1.47	263.30	370	229	242	47	81	70	5.0	0.632	
3	6	.36	1.30	265.44	386	243	230	49	83	70	4.5	0.600	Acez 85 5882
4	9	.30	1.08	267.52	389	252	254	50	84	71	4.0	0.548	
5	12	.33	1.20	269.59	378	256	240	50	84	70	4.0	0.574	FLTZ 85 5883
6	15	.20	0.72	271.40	387	257	237	50	85	70	3.0	0.447	
	18			273.029									

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 2 of 2)

Date 2-6-85
Test Location CLINKER
Run Number #2
Stack Diameter 130
Operator JEO
Filter No. 293

Barometric Pressure 26.42
Static in. wg. -.50
Probe Type/Length Glass 6'
Pitot Coefficient .840
Meter Box No./γ 609/1.98
Nozzle No./Size 1408/.2680

Impinger Volumes/Weights				
Contents	Final	Initial	Net	
S.G.				
			Total	

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial		
Final	.011	13

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Gas Meter Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
B 1	1540 0	.55	1.98	273.029	382	242	233	53	75	74	7.0	0.742	
2	3	.62	2.23	275.54	390	257	233	52	83	72	8.0	0.787	
3	6	.62	2.36	278.32	383	268	239	51	86	73	8.0	0.787	
4	9	.70	2.59	280.94	369	271	238	52	86	73	10.0	0.837	
5	12	.68	2.46	283.71	389	248	234	50	86	73	10.0	0.825	
6	15	.60	2.16	286.61	392	231	233	51	85	72	8.0	0.775	
	18			289.189	~~369~~	~~238~~	~~237~~	~~52~~	~~86~~	~~72~~			
C 1	1603 0	.36	1.35	289.189	352	233	238	53	76	73	5.0	0.600	
2	3	.30	1.12	291.48	359	233	230	50	82	73	4.0	0.548	
3	6	.30	1.10	293.30	375	238	228	48	85	72	4.0	0.548	
4	9	.33	1.21	295.35	378	240	230	46	86	73	4.5	0.574	
5	12	.30	1.12	297.21	364	239	235	44	86	72	4.0	0.548	
6	15	.23	0.85	299.23	370	236	233	43	86	72	3.0	0.480	
	18			300.945									PITOT - OK
			1.81		377.83				76.25			0.6925	

56.928

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PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 2)

Date 2-8-85
Test Location CLINKER #2
Run Number #3
Stack Diameter 130"
Operator JPO
Filter No. 297

Barometric Pressure 26.43
Static in. wg. -.30
Probe Type/Length Glass 6'
Pitot Coefficient .840
Meter Box No./γ 609/.98
Nozzle No./Size 1428/.2680

Impinger Volumes/Weights			
Contents	Final	Initial	Net
DI	543.3	551.5	-8.2
DI	566.7	562.8	3.9
DRY	433.7	433.0	0.7
S.G.	615.8	605.6	10.2
		Total	6.6

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	.017	16
Final		

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
A 1	0926 0	.49	1.85	301.595	346	265	225	35	71	72	4.0	0.700	PITOT-04
2	3	.60	2.30	304.04	338	256	240	32	74	73	5.0	0.775	
3	6	.64	2.44	306.68	346	256	248	31	81	73	6.0	0.800	
4	9	.68	2.65	309.46	331	260	252	34	82	73	6.0	0.825	
5	12	.67	2.58	312.34	341	261	251	36	83	72	6.0	0.819	
6	15	.55	2.09	315.21	351	258	251	37	82	71	5.0	0.742	
	18			317.794									
D 1	0949 0	.37	1.38	317.794	350	260	248	41	70	68	3.5	0.608	
2	3	.34	1.30	319.98	342	270	249	41	77	68	3.0	0.583	
3	6	.32	1.20	321.98	359	270	256	43	81	68	3.0	0.566	
4	9	.32	1.19	324.04	362	271	251	43	81	68	3.0	0.566	
5	12	.24	0.92	326.04	340	273	255	44	82	68	2.5	0.490	
6	15	.20	0.75	327.90	356	266	254	45	81	68	2.0	0.447	
	18			329.509									

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 2 of 2)

Date 2-8-85
Test Location CLINKER #2
Run Number #3
Stack Diameter 130"
Operator GEO
Filter No. 397

Barometric Pressure 26.43
Static in. wg. -.30
Probe Type/Length Glass 6'
Pitot Coefficient .840
Meter Box No./γ 609/.98
Nozzle No./Size 1428/.2680

Impinger Volumes/Weights			
Contents	Final	Initial	Net
S.G.			
		Total	

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	.017	16
Final	.008	9

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
B 1	1015 0	.46	1.64	329.509	392	233	247	45	72	69	4.0	0.678	
2	3	.54	2.00	332.60	366	237	243	37	81	68	5.0	0.735	
3	6	.54	1.98	334.95	379	239	242	38	84	69	5.0	0.735	
4	9	.56	2.05	337.58	380	250	242	40	85	70	5.0	0.748	
5	12	.58	2.10	340.10	363	265	242	41	85	70	5.0	0.748	
6	15	.50	1.86	342.67	368	270	251	42	86	70	5.0	0.707	
	18			345.172	~~338~~	~~275~~	~~251~~	~~42~~	~~85~~	~~70~~			
1	1034 0	.26	0.94	345.172	376	266	239	41	71	69	3.0	0.510	
2	3	.28	1.03	347.08	367	246	235	37	75	68	3.0	0.529	BAce 855896 BFLT 855897
3	6	.30	1.09	348.97	382	229	232	35	80	68	3.5	0.548	
4	9	.34	1.22	350.92	393	226	235	34	81	67	3.5	0.583	Acc3 855892 FLT3 855893
5	12	.32	1.18	353.02	370	228	235	34	82	67	3.5	0.566	
6	15	.30	1.09	355.08	382	227	237	35	82	67	3.0	0.548	
	18			356.857									
			1.62		361.67				74.44			0.6481	

55.262

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PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 2)

Date 2/5/85
Test Location Ewish mill 12
Run Number 1
Stack Diameter 60
Operator JF
Filter No. 298

Barometric Pressure 28.35
Static in. wg. -0.11
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 646/.9698
Nozzle No./Size 1265/.3652

Impinger Volumes/Weights			
Contents	Final	Initial	Net
100ml DI	629.3	540.5	88.8
100ml DI	556.9	528.6	28.3
DRY	437.7	434.4	3.3
S.G.	620.9	605.9	15.0
		Total	135.4

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	0.015	15
Final		

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
B1	1:05 0	0.11	1.77	383.801	184	260	252	44	58	58	5.0	0.332	pitot ok
2		0.11	1.76	389.345	184	261	252	48	55	55	5.5	0.332	
3	15	0.11	1.76	394.195	186	260	252	50	55	55	5.5	0.332	
4		0.115	1.84	400.550	186	259	253	49	55	55	5.5	0.339	
5	30	0.12	1.92	406.200	187	259	253	45	55	55	5.5	0.346	
6		0.13	2.07	411.945	187	258	254	44	55	55	6.0	0.361	
7	45	0.12	1.92	417.935	186	259	254	44	55	55	6.0	0.346	
8		0.095	1.52	423.795	185	260	254	44	55	55	4.5	0.308	
	60			429.086									

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 2 of 2)

Date 2/5/85
Test Location #12 Finish
Run Number 1
Stack Diameter 60
Operator JJ
Filter No. 298

Barometric Pressure 27.35
Static in. wg. -0.11
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 646/.9698
Nozzle No./Size 1365/.3652

Impinger Volumes/Weights			
Contents	Final	Initial	Net
S.G.			
		Total	

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial		
Final	0.009	6.5

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
A1	2:09 0	0.11	1.76	429.086	185	265	255	42	54	55	5.0	0.332	
2		0.11	1.76	434.777	185	262	253	42	55	55	5.0	0.332	
3	15	0.115	1.84	440.120	186	260	252	42	55	55	5.5	0.339	
4		0.12	1.92	445.815	187	259	252	44	55	55	5.5	0.346	Acet 85 5874
5	30	0.125	2.00	451.635	187	259	251	44	58	57	5.5	0.354	
6		0.115	1.85	457.530	187	259	252	44	58	58	5.5	0.339	FLT 1 85 5875
7	45	0.10	1.61	463.275	187	259	252	44	59	58	5.0	0.316	
8		0.075	1.21	468.666	187	259	252	44	60	59	4.0	0.274	
	60			473.460									pitot ok
			1.78	89.659	186.00				56.00			0.3330	

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 1)

Date 2/7/85
Test Location Finish Mill
Run Number 2
Stack Diameter 60
Operator JS
Filter No. 222

Barometric Pressure 27.28
Static in. wg. -0.115
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 646/.9698
Nozzle No./Size 1265/.3652

Impinger Volumes/Weights			
Contents	Final	Initial	Net
DI	685.0	565.3	119.7
DI	547.7	526.3	21.4
dry	441.4	439.1	2.3
S.G.	639.7	626.3	13.4
		Total	156.8

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	0.016	15.5
Final		

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
A 1	1163 0	0.09	1.40	474.064	192	251	250	59	85	88	3.5	0.300	pitot ok
2		0.10	1.54	479.145	193	254	250	59	82	84	4.5	0.316	
3	15	0.10	1.54	484.400	194	259	250	58	81	82	4.5	0.316	ACE #2 85 5886
4		0.105	1.60	489.700	195	261	251	58	78	80	4.5	0.324	
5	30	0.11	1.67	495.085	195	260	253	56	76	78	4.5	0.332	PF #2 85 5887
6		0.115	1.74	500.550	196	260	253	56	75	77	5.0	0.339	
7	45	0.10	1.57	506.135	195	258	251	56	76	76	4.5	0.316	
8		0.08	1.22	511.480	195	256	252	56	77	77	3.5	0.283	
	60			516.320									

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 2 of 3)

Date 2/7/85
Test Location Finish Mill
Run Number 2
Stack Diameter 60
Operator GF
Filter No. 272

Barometric Pressure 27.28
Static in. wg. −0.115
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 646/.9698
Nozzle No./Size 1265/.3652

Impinger Volumes/Weights				
Contents	Final	Initial	Net	
S.G.				
		Total		

Gas Composition			
Time	CO_2	O_2	CO
Leak Rate		cfm	"Hg
Initial			
Final		0.009	6.0

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
B 1	3:00 0	0.095	1.45	516.320	195	265	247	55	77	79	4.0	0.308	
2		0.105	1.60	521.400	194	264	244	54	77	78	4.5	0.324	
3	15	0.105	1.60	526.720	196	260	248	55	78	78	4.5	0.324	
4		0.105	1.59	532.100	196	258	249	55	76	78	4.5	0.324	
5	30	0.105	1.59	537.477	198	259	249	55	78	78	4.5	0.324	
6		0.105	1.60	542.835	198	257	248	55	79	79	4.5	0.324	
7	45	0.095	1.45	548.185	197	257	247	55	79	79	4.5	0.308	
8		0.075	1.14	553.360	195	256	246	55	78	78	3.5	0.274	pitot ok
	60			558.024									
			1.52	83.960	195.25				78.10			0.3148	

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 2)

Date 2/8/85
Test Location Finish Mill
Run Number 3
Stack Diameter 60
Operator JJ
Filter No. 300

Barometric Pressure 27.18
Static in. wg. -0.11
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 646/0.9698
Nozzle No./Size 1265/.3652

Impinger Volumes/Weights			
Contents	Final	Initial	Net
DI	659.7	569.7	90.0
DI	583.6	563.6	20.0
dry	444.8	441.6	3.2
S.G.	673.6	646.3	27.3
		Total	140.5

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	0.019	15.5
Final		

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
A 1	9:25 0	0.095	1.41	558.836	183	261	251	60	56	56	5.0	0.308	pitot ok
2		0.10	1.49	563.885	183	263	250	50	57	57	5.5	0.316	K = 1043.067
3	15	0.105	1.56	569.075	185	260	250	50	57	57	6.0	0.324	KNO = 18.554
4		0.105	1.56	574.415	186	258	250	51	58	58	6.0	0.324	
5	30	0.115	1.71	579.770	187	255	250	52	59	59	6.0	0.339	
6		0.115	1.71	585.340	187	256	249	53	60	60	6.5	0.339	
7	45	0.095	1.42	590.945	187	258	249	53	61	61	5.0	0.308	
8		0.085	1.27	596.110	187	259	251	55	62	62	4.5	0.292	
	60			600.960									

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 2 of 2)

Date 2/8/85
Test Location Finish Mill
Run Number 3
Stack Diameter 60
Operator JK
Filter No. 300

Barometric Pressure 27.18
Static in. wg. -0.11
Probe Type/Length glass/6'
Pitot Coefficient 0.84
Meter Box No./γ 646/.9698
Nozzle No./Size 1265/.3652

Impinger Volumes/Weights				
Contents	Final	Initial	Net	
S.G.				
		Total		

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial		
Final	0.008	7.0

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Gas Meter Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
B1	1031 0	0.095	1.42	600.960	187	270	255	57	61	61	4.5	0.308	
2		0.105	1.59	605.980	185	268	254	51	65	65	5.5	0.324	
3	15	0.115	1.73	611.345	186	265	254	51	65	65	6.0	0.339	
4		0.115	1.73	616.935	187	260	254	51	65	65	6.0	0.339	
5	30	0.110	1.66	622.540	187	257	254	52	65	65	5.5	0.332	
6		0.10	1.51	628.075	186	259	252	52	65	65	5.5	0.316	
7	45	0.095	1.43	633.415	185	259	251	53	64	64	5.0	0.308	
8		0.085	1.28	638.605	185	250	251	53	63	64	5.0	0.292	pitot ok
	60			643.531									
													Acc 3 855894
													FLT 3 855895
			1.53	84.695	185.81				61.47			0.3193	

Pape & Steiner Environmental Services

PLANT SW PC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 1)

Date 2-5-85
Test Location Raw Mill #2
Run Number 1
Stack Diameter 72"
Operator JCO
Filter No. 292

Barometric Pressure 26.45
Static in. wg. -.47
Probe Type/Length Glass 8'
Pitot Coefficient .840
Meter Box No./γ 446/.9828
Nozzle No./Size .461/0.2530

Impinger Volumes/Weights			
Contents	Final	Initial	Net
100ml DI	608.6	548.6	60.0
100 ml DI	581.0	561.7	19.3
DRY	437.3	435.0	2.3
S.G.	674.5	656.1	18.4
		Total	100.0

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	.017	15
Final	.013	11

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
NW 1	1144 0	.54	1.94	218.012	155	263	238	47	57	58	8.5	0.735	PITOT - OK
2	10	.58	2.09	226.30	156	236	243	47	62	58	10.0	0.762	
3	20	.56	2.02	234.87	157	232	241	48	64	57	10.0	0.748	
4	30	.52	1.87	243.45	158	235	241	46	64	58	9.0	0.721	
5	40	.50	1.80	251.72	157	227	237	45	64	58	8.5	0.707	
6	50	.43	1.55	259.81	157	261	237	44	65	59	7.5	0.656	
	60			267.385									
1	1250 0	.52	1.87	267.38	156	259	238	48	61	59	8.5	0.721	
2	10	.555	2.00	275.68	157	265	243	49	67	62	9.0	0.742	
3	20	.54	1.95	284.27	159	238	243	47	67	61	9.0	0.735	-
4	30	.52	1.88	292.57	159	238	235	47	67	61	9.0	0.721	Ace 1 85 5872 / FLT 1 85 5873
5	40	.48	1.75	300.75	158	264	233	48	70	64	8.0	0.693	
6	50	.43	1.57	308.90	160	270	239	59	72	66	7.5	0.656	
	60			316.418									PITOT - OK
			1.86	98.406	157.42				62.54			0.7164	

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 1)

Date 2-7-85
Test Location RAW Mill
Run Number #2
Stack Diameter 72"
Operator JCO
Filter No. 294

Barometric Pressure 26.52
Static in. wg. -.35
Probe Type/Length glass 6'
Pitot Coefficient .840
Meter Box No./γ 446/.9828
Nozzle No./Size 1461/.02530

Impinger Volumes/Weights			
Contents	Final	Initial	Net
DI	569.7	523.9	45.8
DI	563.6	545.2	18.4
DRY	441.6	438.2	3.4
S.G.	664.3	645.1	19.2
		Total	86.8

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	.016	17
Final	.012	17

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Gas Meter Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
NW 0935 1	0	.96	3.23	323.645	170	228	271	27	54	54	16.0	0.980	PITOT - OK
2	10	.56	1.91	333.90	167	243	234	37	61	57	8.5	0.748	cyc mill went
3	20	.60	2.08	342.56	163	255	240	39	66	59	9.5	0.775	down for 6 min high velocity
4	30	.56	1.95	351.17	162	238	233	40	68	62	9.0	0.748	
5	40	.51	1.79	359.58	161	262	234	47	70	65	8.0	0.714	MF 2 85 5889
6	50	.44	1.55	367.64	159	267	231	48	71	66	7.0	0.663	
	60			375.205	15								ace 2 85 5888
SW 1043 1	0	.60	2.11	375.205	159	273	230	51	68	67	9.0	0.775	
2	10	.63	2.22	383.91	165	271	234	46	76	72	10.0	0.794	
3	20	.55	1.72	392.93	169	241	244	43	74	70	8.0	0.742	
4	30	.45	1.56	400.97	171	261	232	47	73	67	7.5	0.671	
5	40	.43	1.50	408.58	168	267	230	47	73	68	7.0	0.656	
6	50	.45	1.57	416.00	170	237	232	49	74	69	7.5	0.671	
	60			423.543									
			1.93	99.898	171.33				66.83			0.7447	

Pape & Steiner Environmental Services

PLANT SWPC TEST TYPE M5 FIELD TEST DATA SHEET (Page 1 of 1)

Date 2-7-85
Test Location RAW MILL
Run Number #3
Stack Diameter 72
Operator gco
Filter No. 296

Barometric Pressure 26.52
Static in. wg. -.35
Probe Type/Length Glass 8'
Pitot Coefficient .840
Meter Box No./γ 446/.9828
Nozzle No./Size 146/.2530

Impinger Volumes/Weights			
Contents	Final	Initial	Net
DI	587.5	530.4	57.1
DI	560.2	537.9	22.3
DRY	451.5	448.3	3.2
S.G.	630.8	612.6	18.2
		Total	100.8

Gas Composition			
Time	CO_2	O_2	CO

Leak Rate	cfm	"Hg
Initial	.015	17
Final	.007	10

Sample Point	Time	ΔP in wg	ΔH in wg	Gas Meter Volume Ft^3	Temperature °F Stack	Probe	Oven	Imp.	Gas Meter In	Out	Pump Vacuum in. Hg	$\sqrt{\Delta P}$	Comments
SW 1	1326 0	.61	2.11	424.460	164	245	248	44	63	64	7.0	0.781	PITOT-OK
2	10	.66	2.33	433.06	162	248	253	46	75	69	8.5	0.812	
3	20	.63	2.23	442.32	165	228	256	49	78	72	8.0	0.794	ac 3 855890
4	30	.63	2.22	451.38	169	252	255	47	80	74	8.0	0.794	
5	40	.60	2.11	460.47	172	259	254	46	81	74	7.5	0.775	MF 3 855891
6	50	.52	1.83	469.30	172	262	254	47	81	75	7.0	0.721	
	60			477.536									
NW 1	1431 0	.66	2.31	477.536	170	235	255	49	76	75	8.0	0.812	
2	10	.70	2.46	486.70	173	229	267	45	81	76	9.0	0.837	
3	20	.66	2.31	496.18	175	231	257	46	82	76	8.0	0.812	
4	30	.62	2.17	505.49	175	236	257	45	82	77	8.0	0.787	
5	40	.60	2.11	514.47	172	254	258	48	82	76	7.5	0.775	
6	50	.50	1.78	523.215	167	260	258	48	82	77	6.5	0.707	
	60			531.329									
			2.16	106.869	169.67				76.17			0.7839	

Pape & Steiner Environmental Services

CONTINUOUS MONITOR DATA SHEET

Plant: SW PC
Date: 2-6-85
Test Location: Kiln
Run Number: load 215 TPH
Operator: JCO

Ambient Temperature:
Barometric Pressure:
Static Pressure Duct:
Fuel:

Time	Sample Point	Fuel Flow	Dry Uncorrected O_2 %	Dry Uncorrected CO_2 %	Dry Uncorrected CO ppm	Dry Uncorrected SO_2 ppm	Dry Uncorrected NO ppm	Dry Uncorrected NO_x ppm	3% O_2 Dry ppm	3% O_2 Dry NO_x ppm	Hydrocarbons THC	Hydrocarbons CH_4	Hydrocarbons Non CH_4				Comments
0740			7.57	16.0	403.2	80.9		457.25									span gas value good leak check
	20 min Avg																
0745			9.70	18.8	300	4		510									
0805			9.50	18.6	280	4		500									
0825			9.55	18.8	320	4		510									
0845			9.50	18.8	275	4		490									
0905			9.25	19.0	300	4		460									
0925			9.25	19.0	330	4		470									
0945			9.25	19.0	325	4		470									
1005			9.10	19.0	340	4		470									
1020			9.10	19.0	285	4		500									
			0	0	0	0		0									zero reading
			7.38	15.9	403	79.9		447									span reading
1235			9.00	19.2	270	3		510									
1255			9.25	18.6	220	2		570									
1115			9.08	18.8	210	3		580									
1135			9.38	19.0	205	2		600									
1155			9.30	18.4	220	2		540									
1215			9.25	18.2	150	1		510									
1235			9.00	18.4	200	1		550									
1255			8.90	18.8	235	2		530									
1310			9.00	16.4	180	2		550									
			-0.2	0	10	0		-3									zero reading
			7.15	15.8	423	80.2		436									span reading
			9.24	18.77	258.0	3.0		517.78									

Pape & Steiner. ironmental Services

CONTINUOUS MONITOR DATA SHEET

Plant: SWPC

Date: 2-6-85

Test Location: Kiln

Run Number: 190 TPH

Operator: gco

Ambient Temperature:

Barometric Pressure:

Static Pressure Duct:

Fuel:

Time	Sample Point	Fuel Flow	Dry Uncorrected O_2 %	Dry Uncorrected CO_2 %	Dry Uncorrected CO ppm	Dry Uncorrected SO_2 ppm	Dry Uncorrected NO ppm	Dry Uncorrected NO_x ppm	3% O_2 Dry ppm	3% O_2 Dry NO_x ppm	Hydrocarbons THC	Hydrocarbons CH_4	Hydrocarbons Non CH_4				Comments
			7.57	16.0	403.2	80.9		457.25									span gas value, good leak check
1335			10.38	17.2	70	0		510									
1355			10.25	17.2	70	0		510									
1415			9.88	18.0	100	0		520									
1435			9.75	18.4	150	2		550									
1455			9.50	18.6	160	3		490									
1515			9.25	18.8	210	4		470									
1535			9.25	18.6	180	4		480									
1555			9.38	18.6	180	4		490									
1615			9.00	18.8	200	4		490									
1635			9.25	18.6	175	5		500									
1655			9.25	18.8	180	5		490									
1715			9.05	19.0	220	5		480									
			0.2	-0.1	2	0		5									zero reading
			7.38	16.1	355	80.5		456									span reading
			9.52	18.38	157.9	3.0		498.33									

Pape & Steiner Environmental Services

CONTINUOUS MONITOR DATA SHEET

Plant: SWPC
Date: 2-7-85
Test Location: Kiln
Run Number: 218 TPH
Operator: geo

Ambient Temperature:
Barometric Pressure:
Static Pressure Duct:
Fuel:

Time	Sample Point	Fuel Flow	Dry Uncorrected O_2 %	Dry Uncorrected CO_2 %	Dry Uncorrected CO ppm	Dry Uncorrected SO_2 ppm	Dry Uncorrected NO ppm	Dry Uncorrected NO_x ppm	3% O_2 Dry ppm	3% O_2 Dry NO_x ppm	Hydrocarbons THC	Hydrocarbons CH_4	Hydrocarbons Non CH_4				Comments
			2.57	16.0	403.2	80.9		457.25									span gas value
																	good leak check
0																	
0740			9.50	18.8	350	4		460									
0800			9.50	18.6	250	4		480									
0820			9.25	19.0	250	5		460									
0840			9.25	18.8	260	4		480									
0900			9.25	19.0	250	4		490									
0920			9.38	19.0	260	4		570									
0940			9.10	19.0	290	4		510									
1000			9.10	19.1	320	4		490									
1020																	lost fire
1040			8.80	19.0	325	4		450									
1100			8.80	19.4	350	4		470									
1120			9.00	19.0	370	4		460									
1140			8.80	19.0	350	4		450									
1200			8.80	19.0	350	4		480									
			-0.2	-0.1	10	0		0									zero reading
			7.20	15.8	427	79.5		435									span reading

Pape & Steine /ironmental Services

CONTINUOUS MONITOR DATA SHEET

Plant: SWPC
Date: 2-7-85
Test Location: Kiln
Run Number: 215 TPH
Operator: JEO

Ambient Temperature:
Barometric Pressure:
Static Pressure Duct:
Fuel:

Time	Sample Point	Fuel Flow	Dry Uncorrected O_2 %	Dry Uncorrected CO_2 %	Dry Uncorrected CO ppm	Dry Uncorrected SO_2 ppm	Dry Uncorrected NO ppm	Dry Uncorrected NO_x ppm	3% O_2 Dry ppm	3% O_2 Dry NO_x ppm	Hydrocarbons THC	Hydrocarbons CH_4	Hydrocarbons Non CH_4				Comments
			7.57	16.0	403.2	80.9		457.25									span gas values
1230			8.25	19.2	270	3		500									
1250			8.25	19.4	280	3		510									
1310			8.88	19.2	290	3		490									
1330			9.00	19.0	225	3		480									
1350			8.25	19.4	240	3		460									
1410			8.25	19.2	260	4		450									
1430			8.25	19.2	270	3		440									
1450			8.25	19.2	270	3		460									
1510			8.25	19.2	285	4		440									
1530			8.55	19.2	300	4		430									
1550			8.55	19.2	330	4		420									
1610			8.50	19.2	300	4		410									
1630			8.50	19.0	280	3		450									
			0.3	0	2	0		0									zero reading
			7.0	15.9	415	79.2		441									span reading
			8.91	19.09	289.4	3.73		467.69									avg (both pages)

Pape & Stein vironmental Services

CONTINUOUS MONITOR DATA SHEET

Plant Southwestern Portland Cement

Date 2-8-85

Test Location Kiln

Run Number

Operator JCO

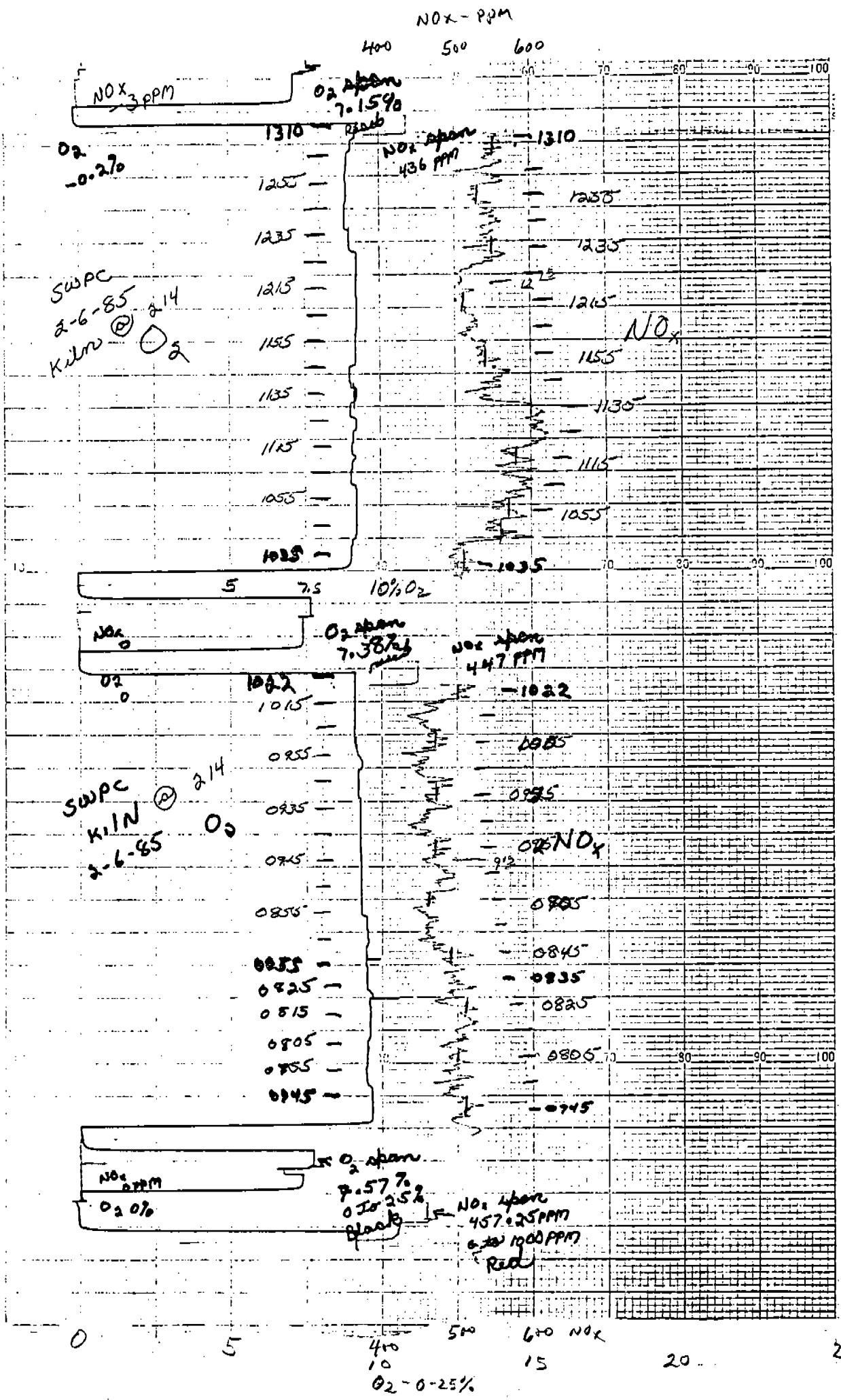
Ambient Temperature

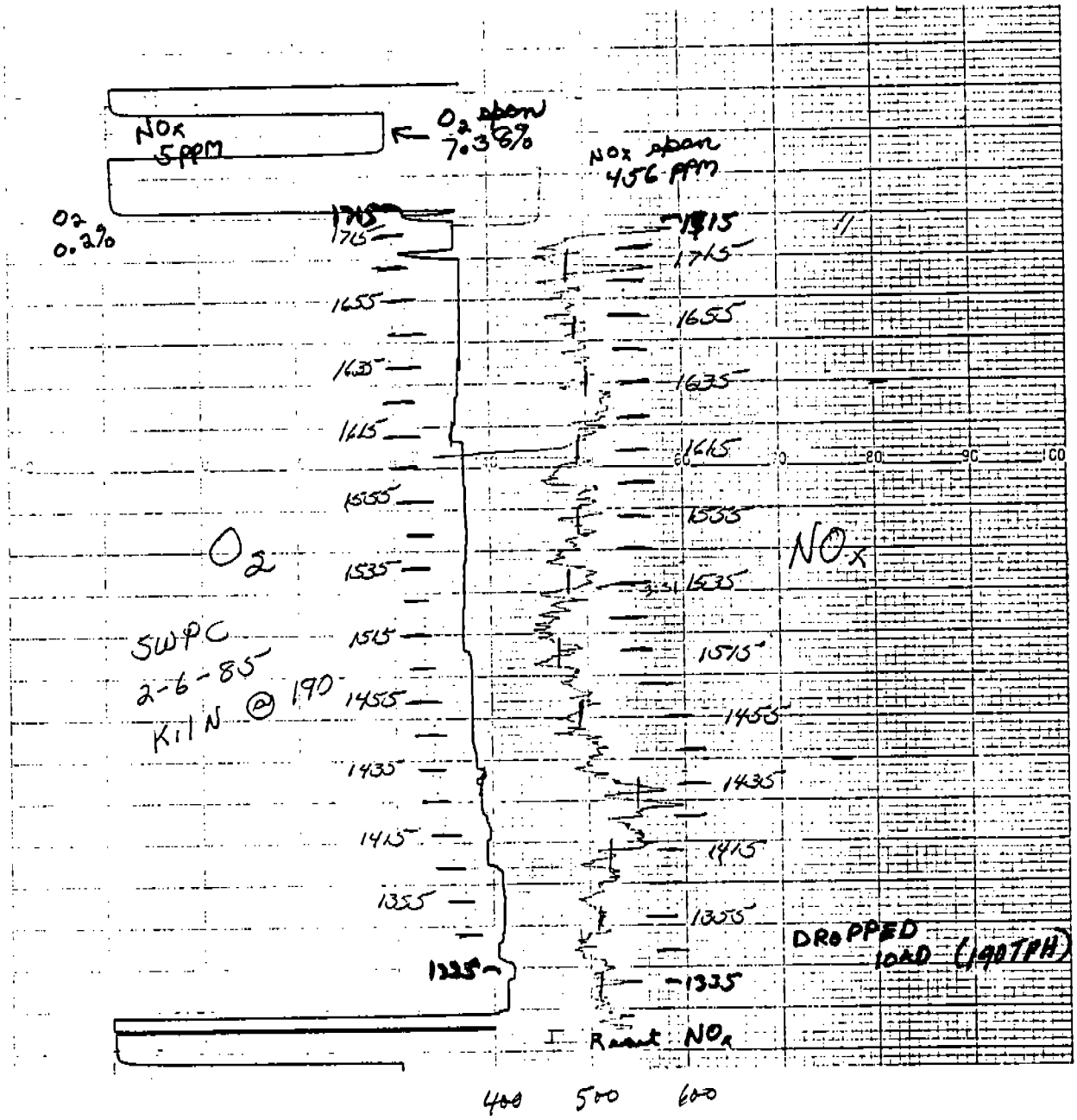
Barometric Pressure

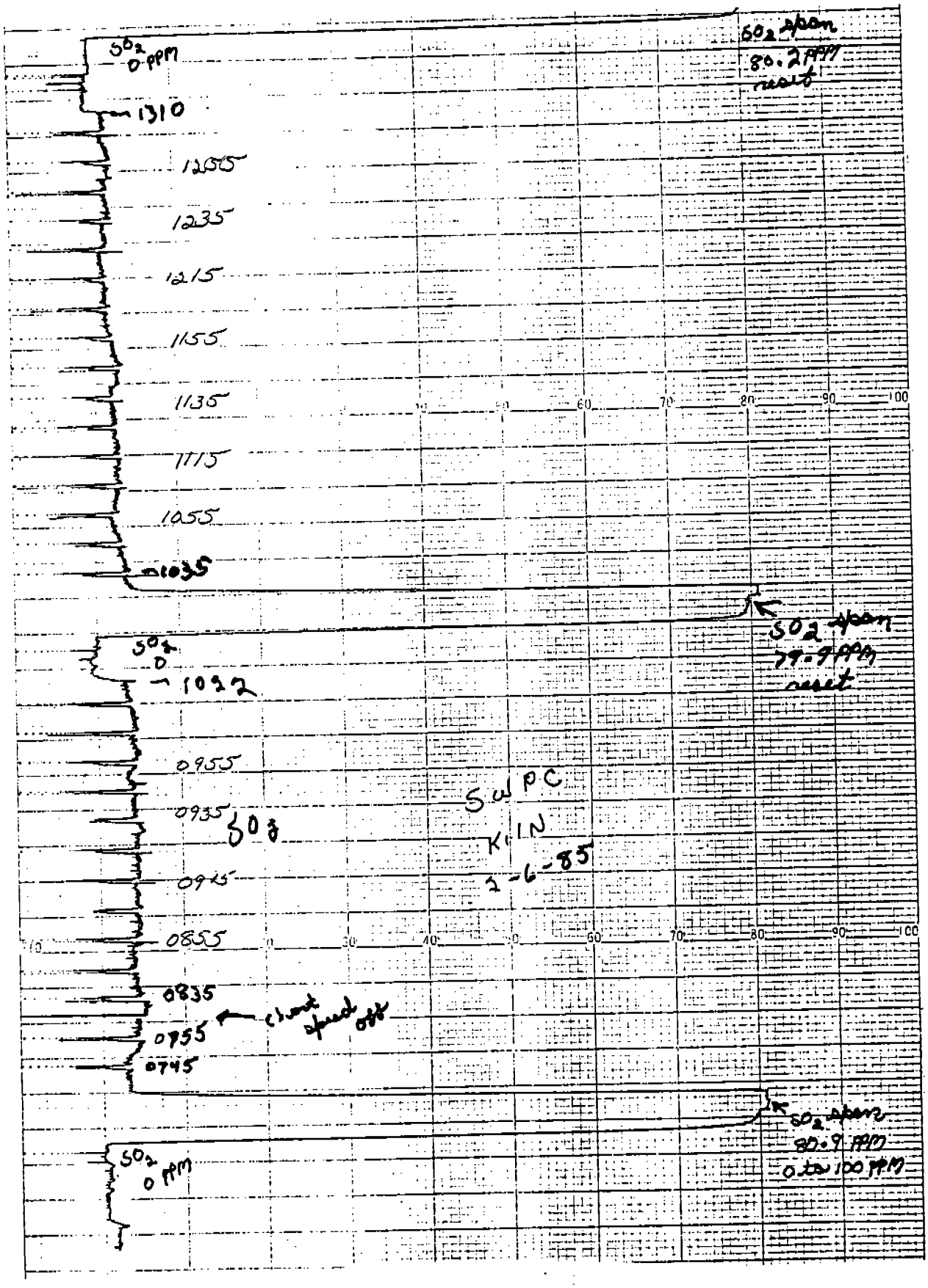
Static Pressure Duct

Fuel

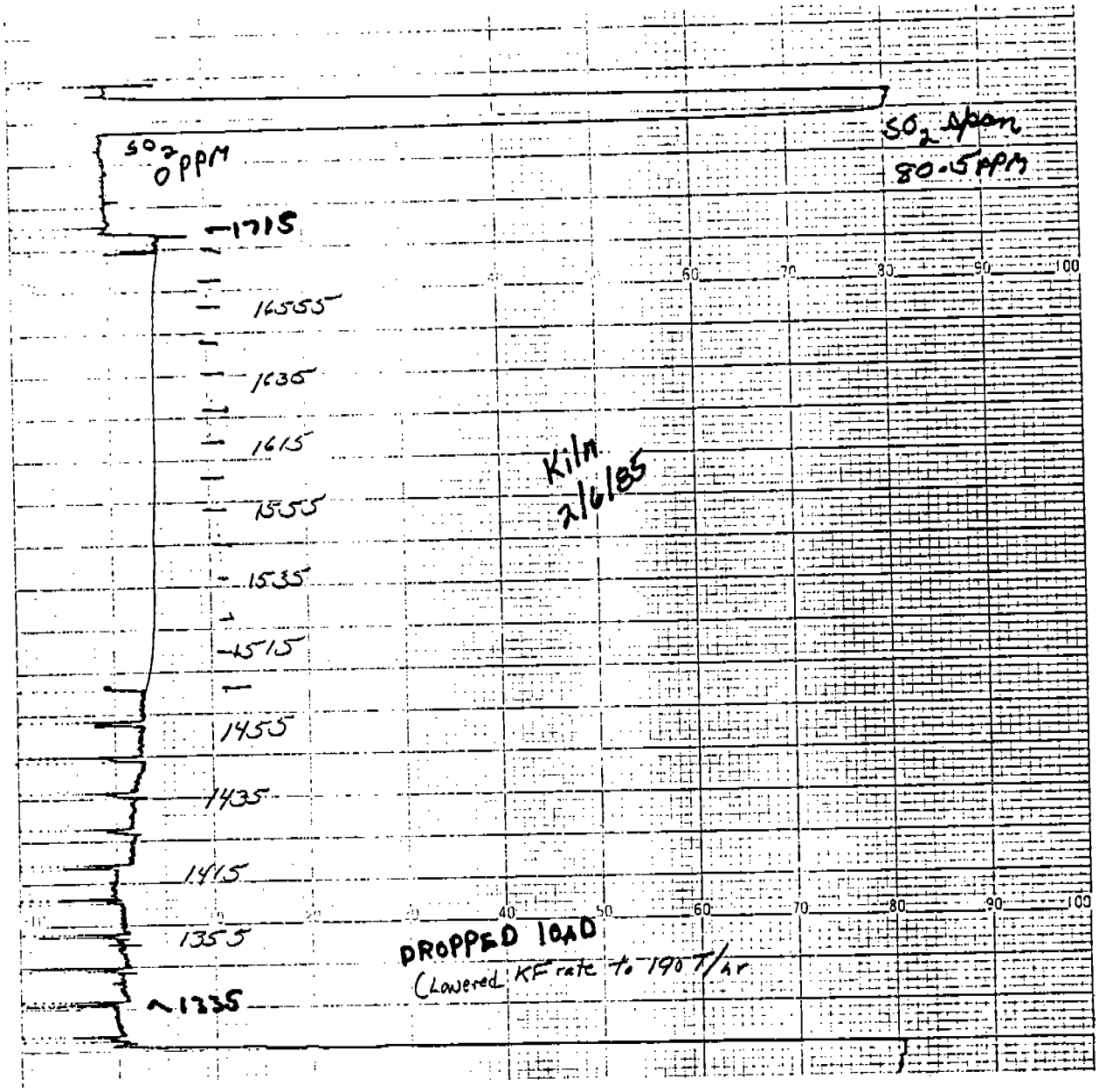
Time	Sample Point	Fuel Flow	Dry Uncorrected O_2 %	Dry Uncorrected CO_2 %	Dry Uncorrected CO ppm	Dry Uncorrected SO_2 ppm	Dry Uncorrected NO ppm	Dry Uncorrected NO_x ppm	3% O_2 Dry ppm	3% O_2 Dry NO_x ppm	Hydrocarbons THC	Hydrocarbons CH_4	Hydrocarbons Non CH_4				Comments
			7.57	16.0	403.2	80.9		457.2									span gas value good leak check
0730			9.50	19.0	600	7		350									
0800			9.25	19.2	600	7		360									
0830			9.05	19.3	600	8		370									
0900			9.00	19.4	550	8		350									
0930			8.65	19.6	700	8		350									
1000			8.80	19.3	600	7		360									
1030			8.90	19.2	450	7		370									
1100			8.85	19.2	500	7		360									
1130			8.80	19.0	750	6		340									
1300			8.80	18.8	400	6		370									
			-0.20	-0.2	0	0		0									zero reading
			7.25	15.6	450	29.0		430									span reading
			8.96	19.2	575	7.10		358									avg

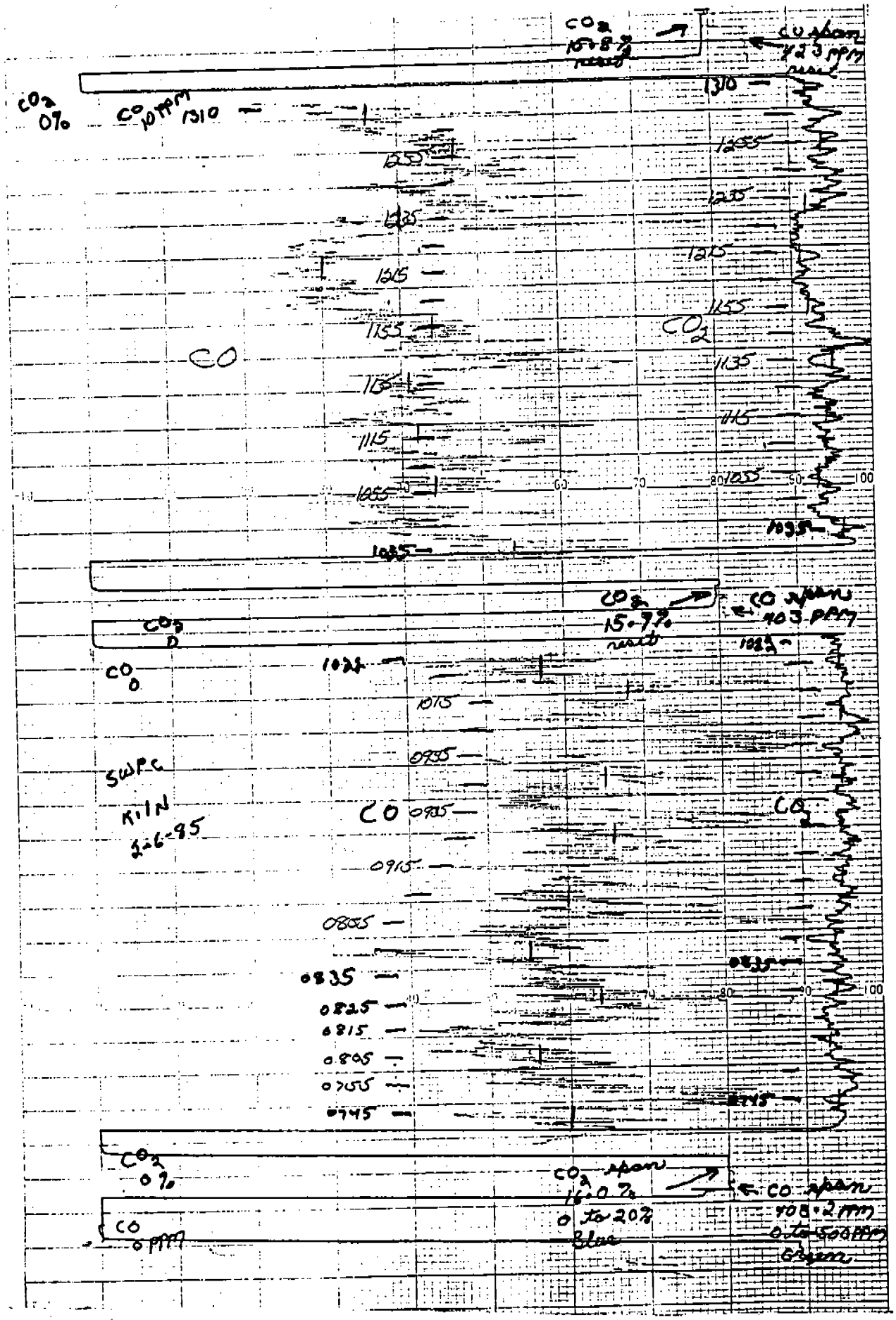

NOx - PPM
400
500
600
NOx 3 PPM
O2 span 7.15%
1310
O2 -0.2%
NOx span 436 PPM
1310
1255
1235
1215
1155
1135
1115
1055
1035
SWPC 2-6-85 Kiln @ 214 O2
NOx
5
7.5
10% O2
NOx 0
O2 span 7.38%
NOx span 447 PPM
O2 0
1022
1015
0955
0935
0915
0855
0845
0835
0825
0815
0805
0755
0745
SWPC KILN @ 214 2-6-85 O2
NOx
NOx 0 PPM
O2 0%
O2 span 7.57% 0 to 25% Black
NOx span 457.25 PPM 0 to 1000 PPM Red
0
5
400
500
600 NOx
10
15
20
25% O2
O2 - 0-25%


NOx 5 PPM
O2 span 7.3%
NOx span 456 PPM
O2 0.2%
1745
1655
1635
1615
1555
1535
1515
1455
1435
1415
1355
1335
1815
1745
1655
1635
1615
1555
1535
1515
1455
1435
1415
1355
1335
O2
NOx
SWPC
2-6-85
KILN @ 190
DROPPED LOAD (190TPH)
Raw NOx
400
500
600

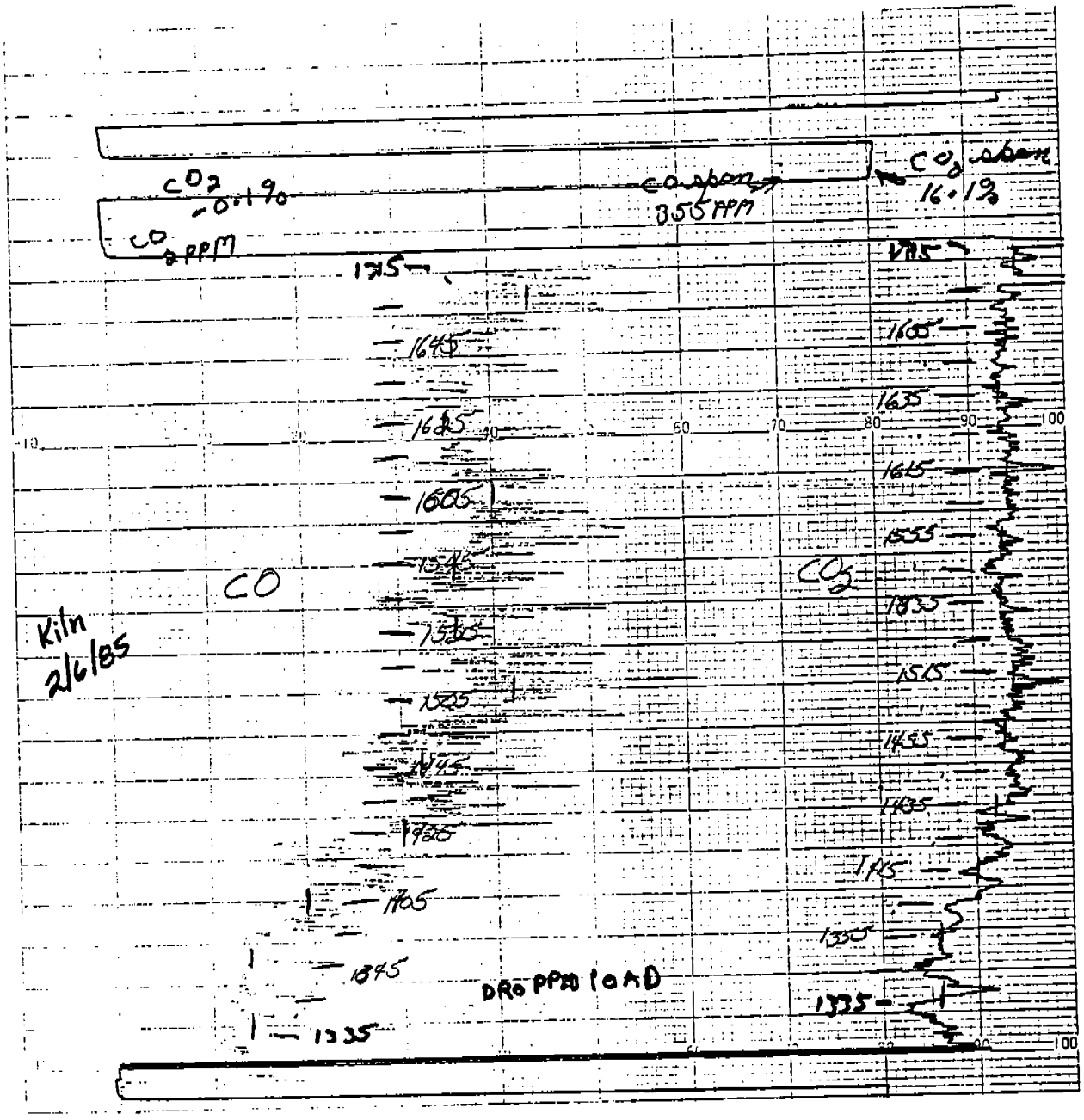


SO2 0 PPM
1310
1255
1235
1215
1155
1135
1115
1055
1035
SO2 span 80.2 PPM reset
SO2 span 79.9 PPM reset
SO2 0
1022
0955
0935
SO2
0915
0855
0835
0755
0745
SWPC
KILN
2-6-85
SO2 span 80.9 PPM 0 to 100 PPM
SO2 0 PPM

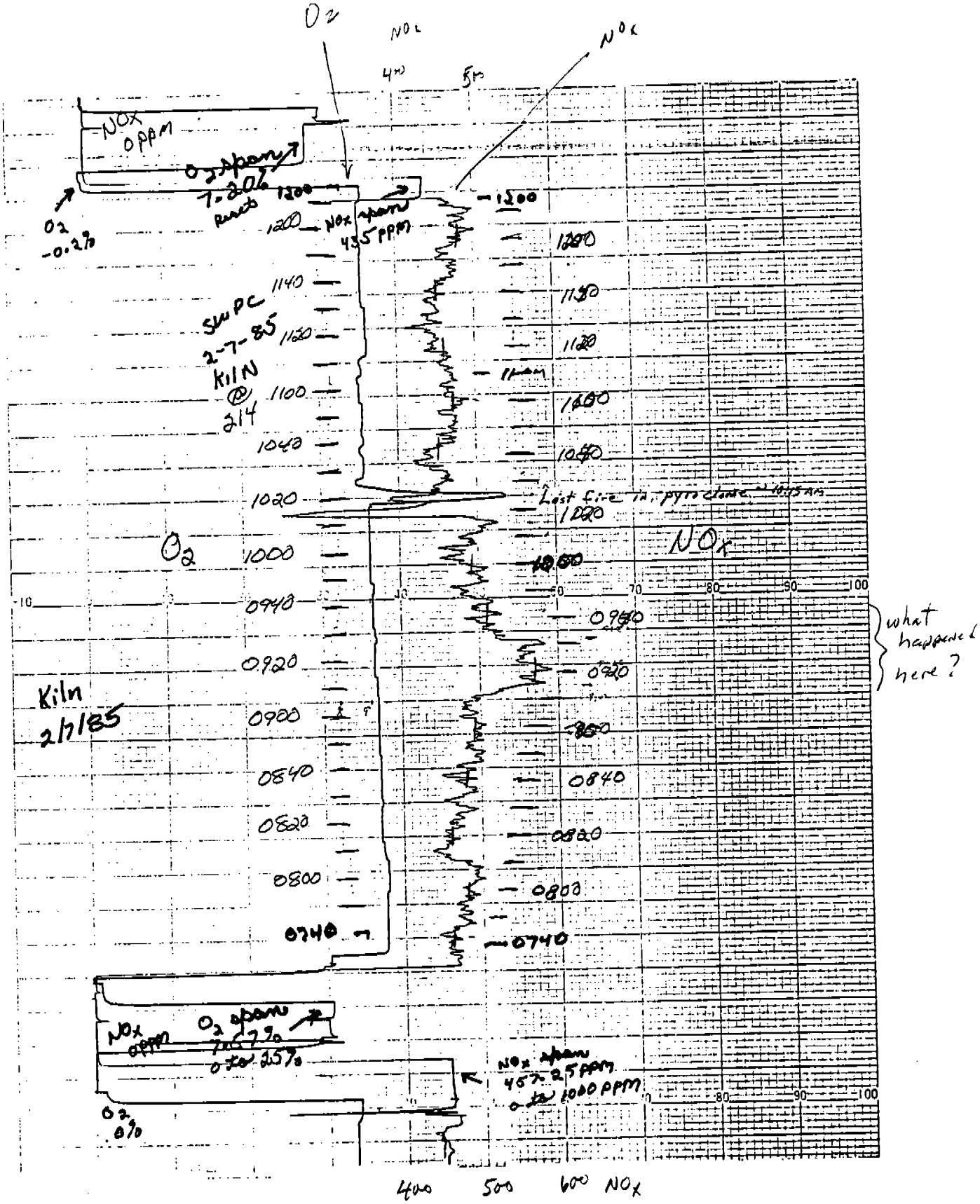

SO_2 Span
80.5 PPM
SO_2
0 PPM
1715
1655
1635
1615
1555
1535
1515
1455
1435
1415
1355
~1335
Kiln
2/6/85
DROPPED LOAD
Lowered KF rate to 190 T/hr



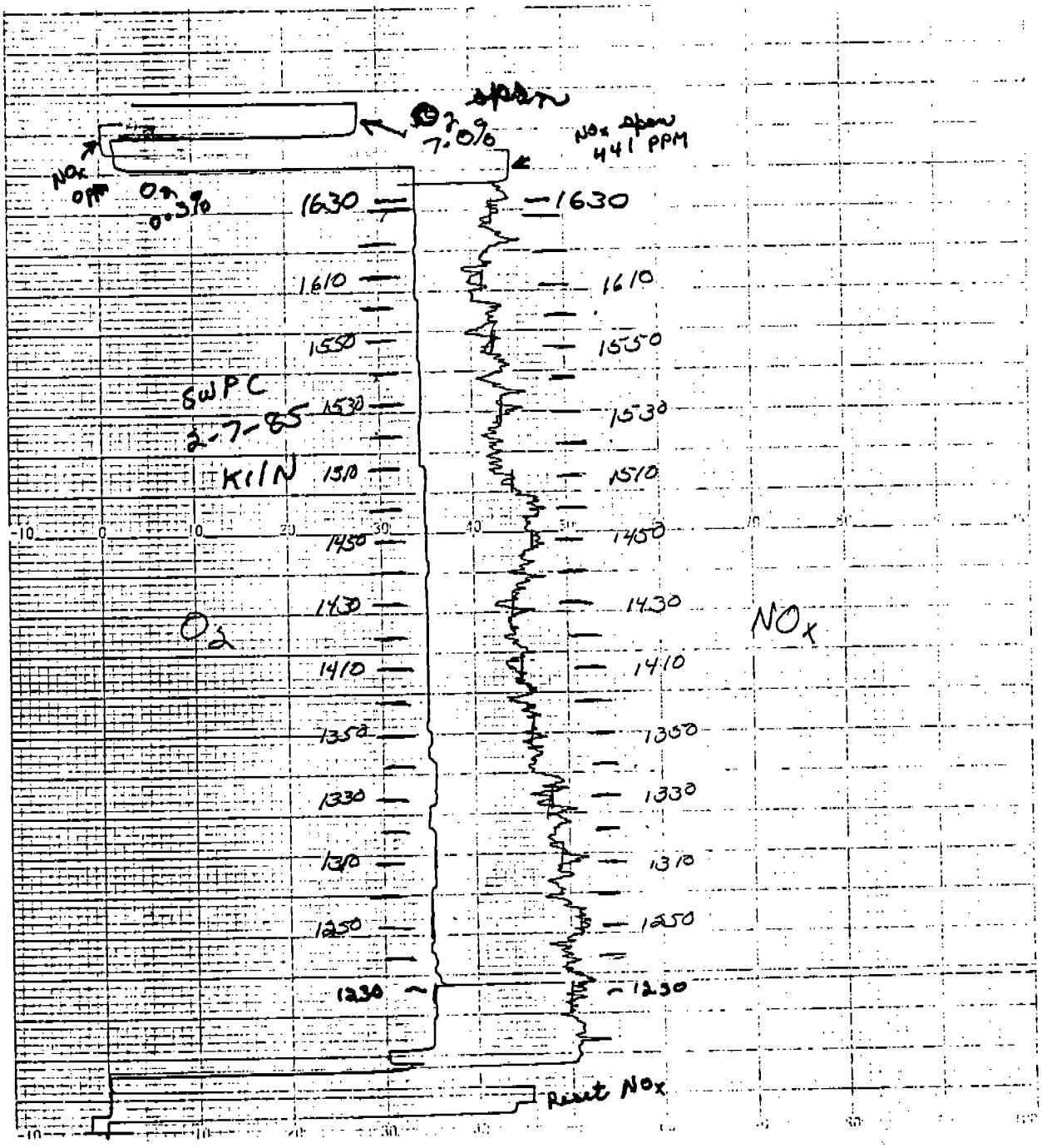
CO2 15.8% reset
CO span 423 PPM reset
CO2 0%
CO 10 PPM 1310
1310
1255
1235
1215
1155
1135
1115
1055
1035
CO
CO2
CO2 15.7% reset
CO span 403 PPM
CO2 0
CO 0
1022
1015
0955
0935
0915
0855
0835
0825
0815
0805
0755
0745
SWPC
KILN
2-6-95
CO
CO2
CO2 0%
CO 0 PPM
CO2 span 16.0% 0 to 20% Blue
CO span 408.2 PPM 0 to 500 PPM Green

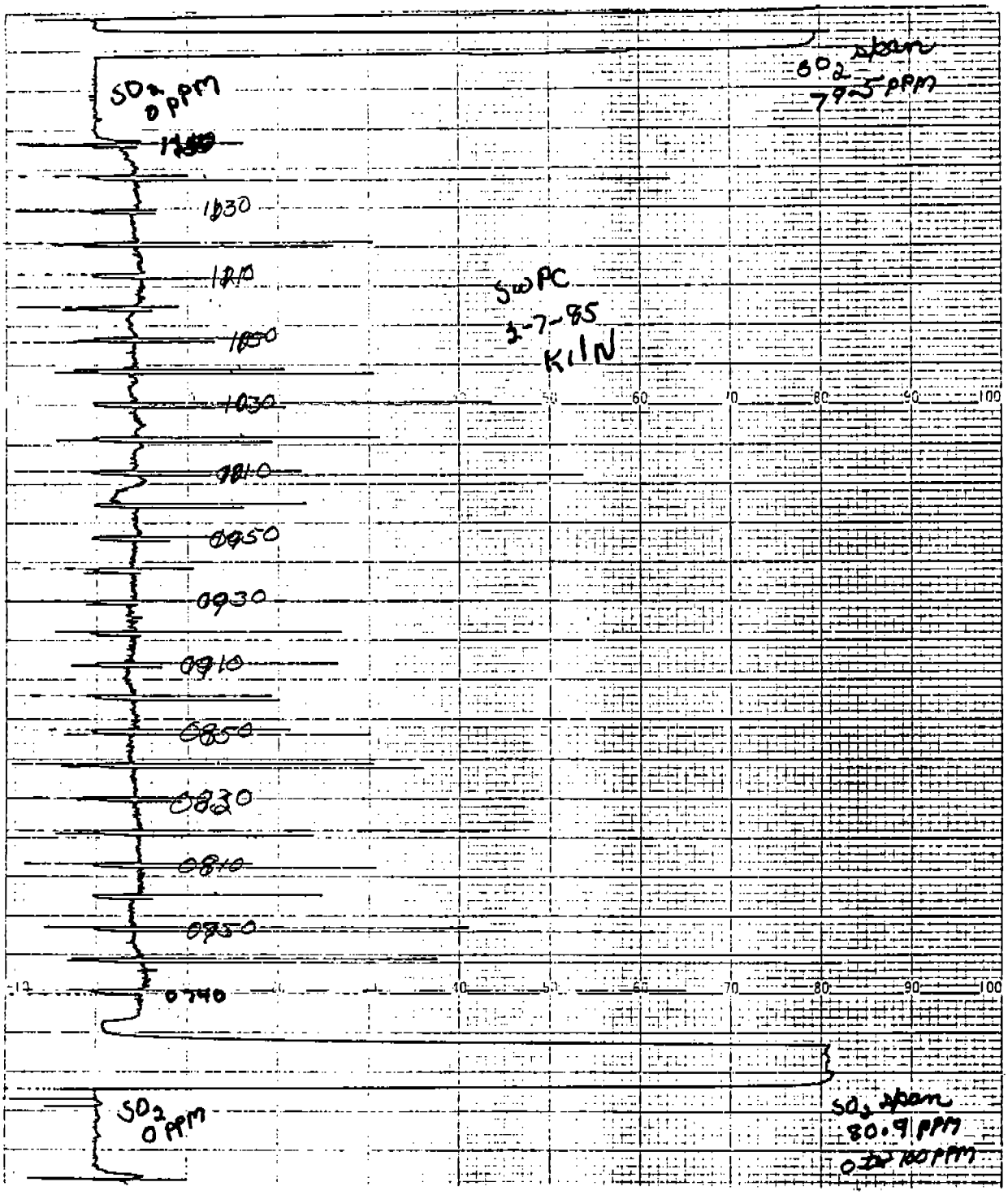


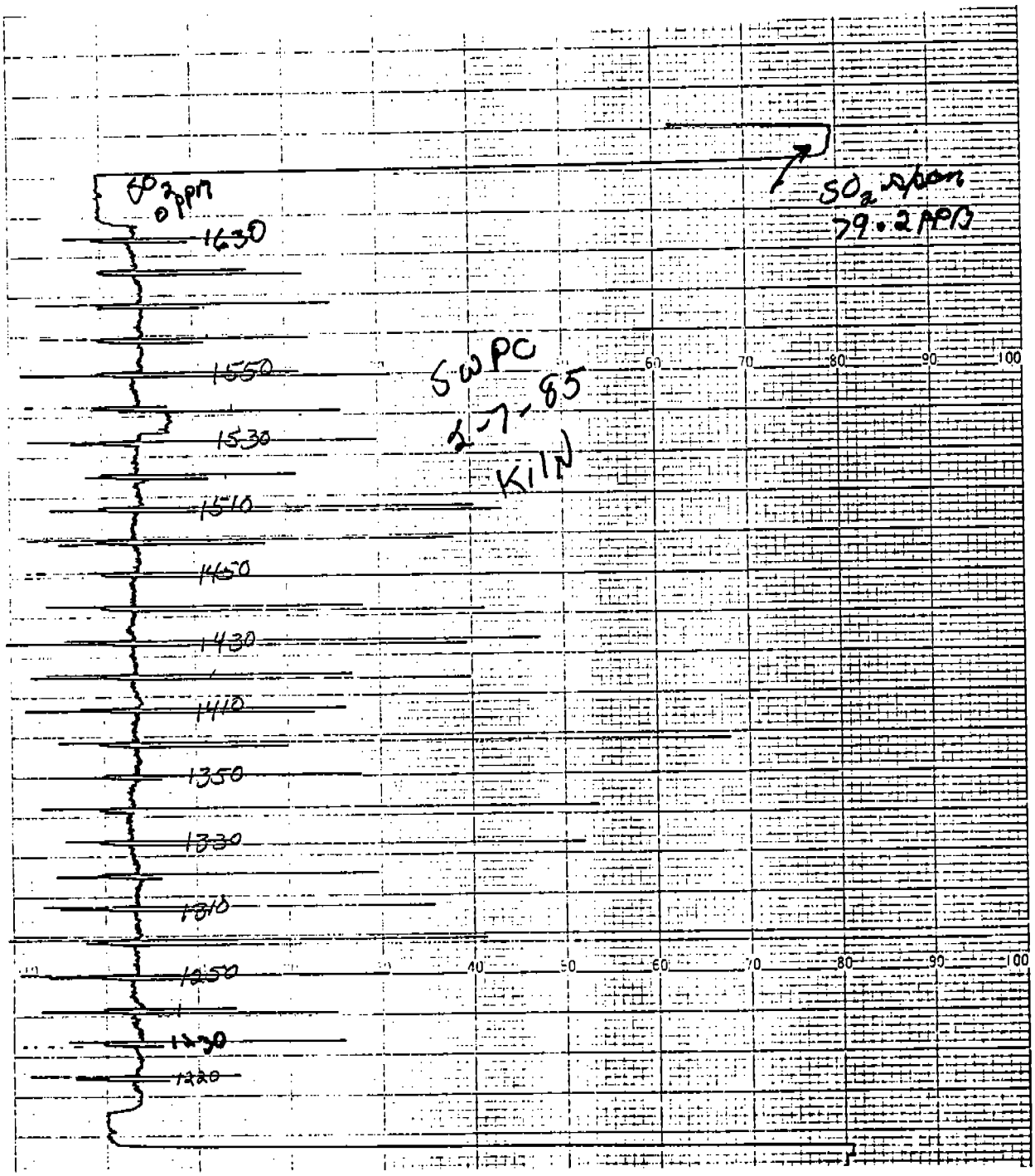
CO2 -0.1%
CO 2 PPM
CO span 355 PPM
CO2 span 16.1%
CO
CO2
Kiln 2/6/85
DROPPED LOAD
1715
1645
1625
1605
1545
1525
1505
1445
1425
1405
1345
1335
1715
1655
1635
1615
1555
1535
1515
1455
1435
1415
1355
1335

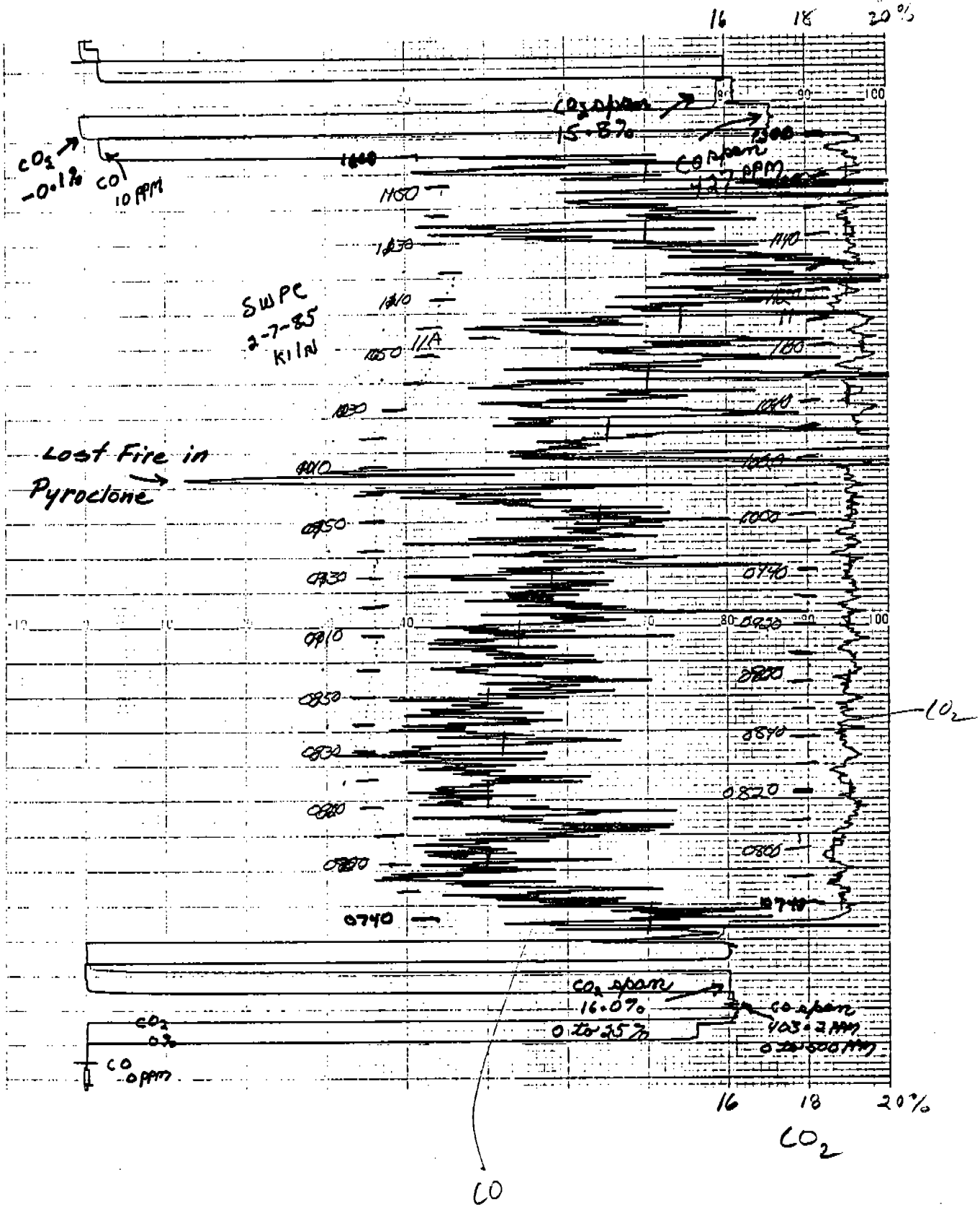


O2
NOx
NOx
NOx 0ppm
O2 span 7.20% reset
O2 -0.2%
NOx span 435 ppm
SWPC 2-7-85 Kiln @ 214
Lost fire in pyroclone ~10:15 AM
O2
NOx
what happened here?
Kiln 2/7/85
NOx 0ppm
O2 span 7.57% 0 to 25%
NOx span 457.25 ppm 0 to 1000 ppm
O2 0%
400
500
600
NOx

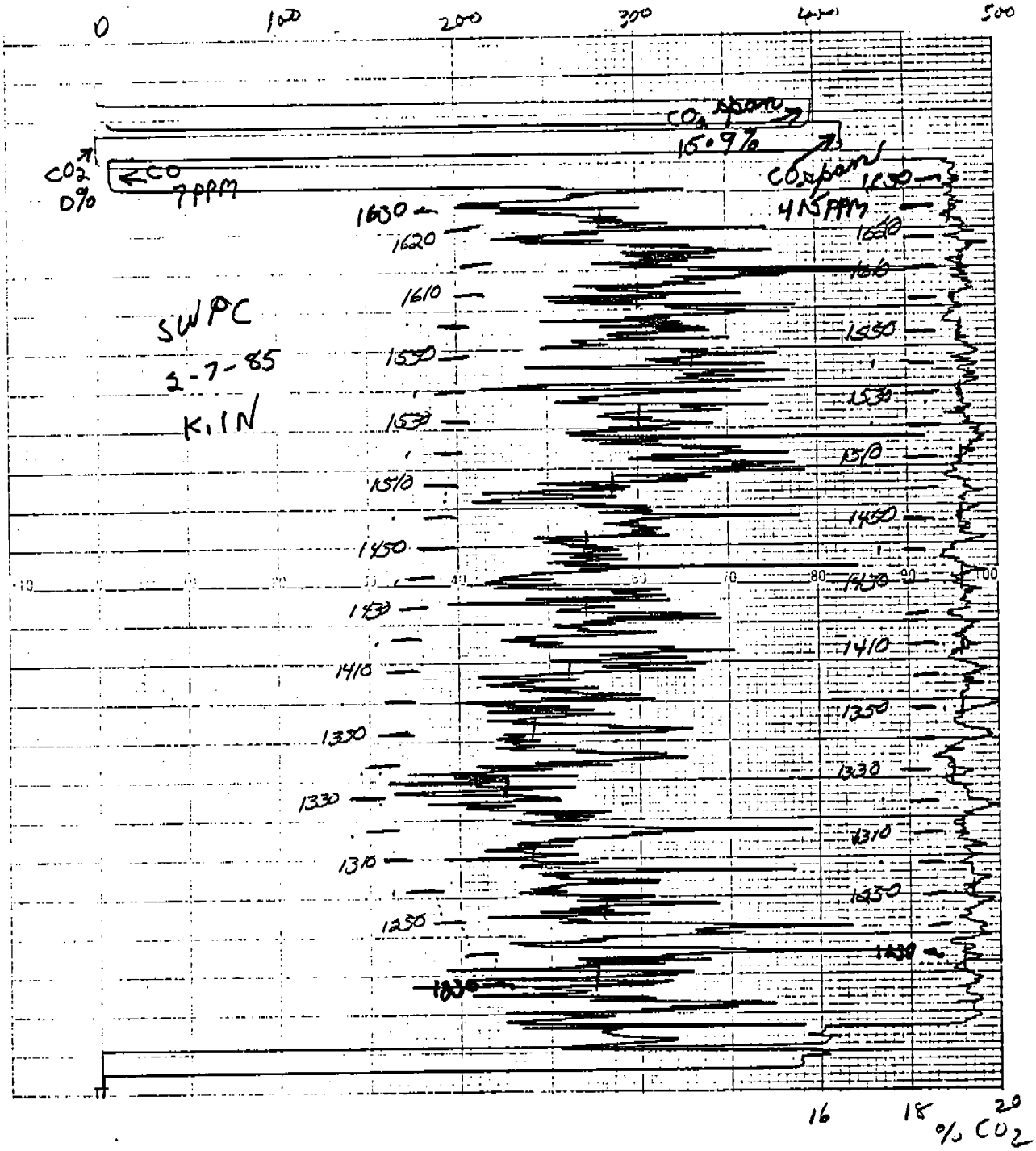

span
O2 7.0%
NOx span 441 PPM
NOx off
O2 0.3%
1630
1610
1550
1530
1510
1450
1430
1410
1350
1330
1310
1250
1230
GWPC
2-7-85
KILN
O2
NOx
Reset NOx


SO2 span
79.5 PPM
SO2
0 PPM
1230
1210
1050
1030
1010
0950
0930
0910
0850
0830
0810
0750
0740
SWPC
3-7-85
KILN
40
50
60
70
80
90
100
SO2
0 PPM
SO2 span
80.9 PPM
0 to 100 PPM

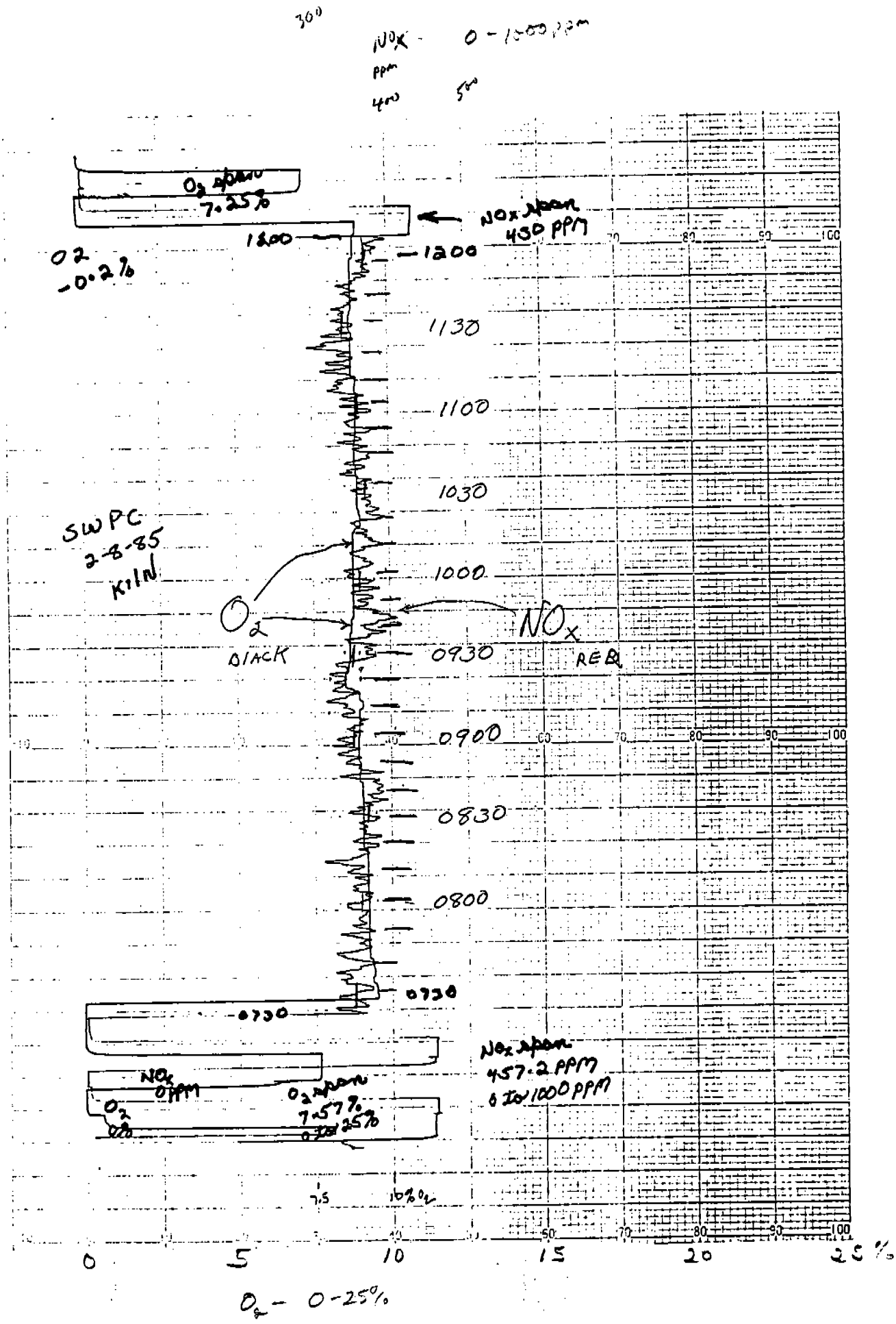

SO_2 ppm
0
1630
1550
1530
1510
1450
1430
1410
1350
1330
1310
1250
1230
1220
40
50
60
70
80
90
100
SO_2 span
79.2 PPM
SWPC
2-7-85
KILN

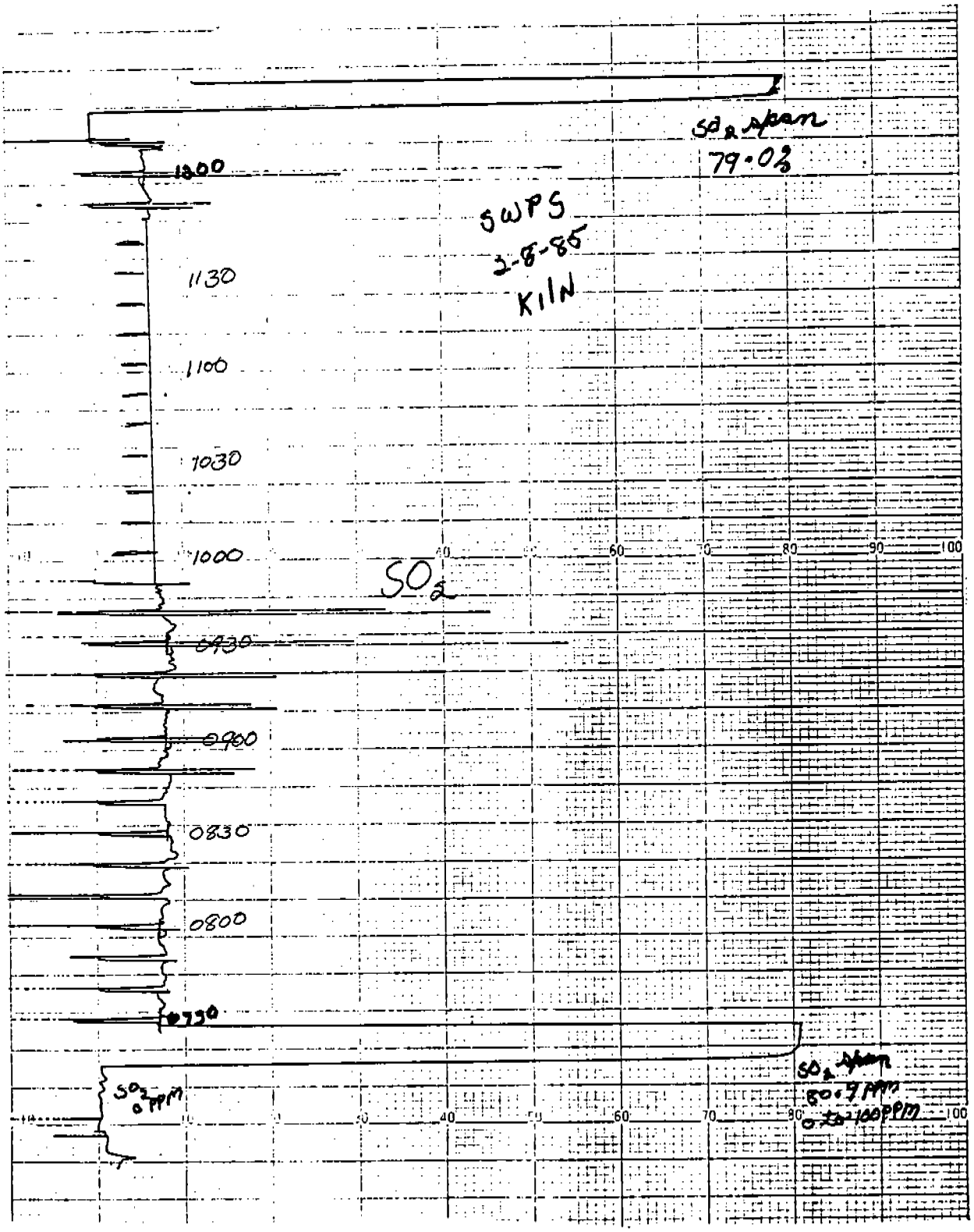

16
18
20 %
CO2 span
15.8%
CO span
127 PPM
CO2
-0.1%
CO
10 PPM
SWPC
2-7-85
KILN
11A
Lost Fire in
Pyroclone
CO2
CO2 span
16.07%
0 to 25%
CO span
403.2 PPM
CO
0 PPM
CO2
CO

CO - 0-500 ppm



0
100
200
300
400
500
CO2 span
15.9%
CO2
0%
CO
7PPM
CO span
415PPM
SWPC
2-7-85
KILN
1630
1620
1610
1550
1530
1510
1450
1430
1410
1350
1330
1310
1250
1230
16
18
20
% CO2

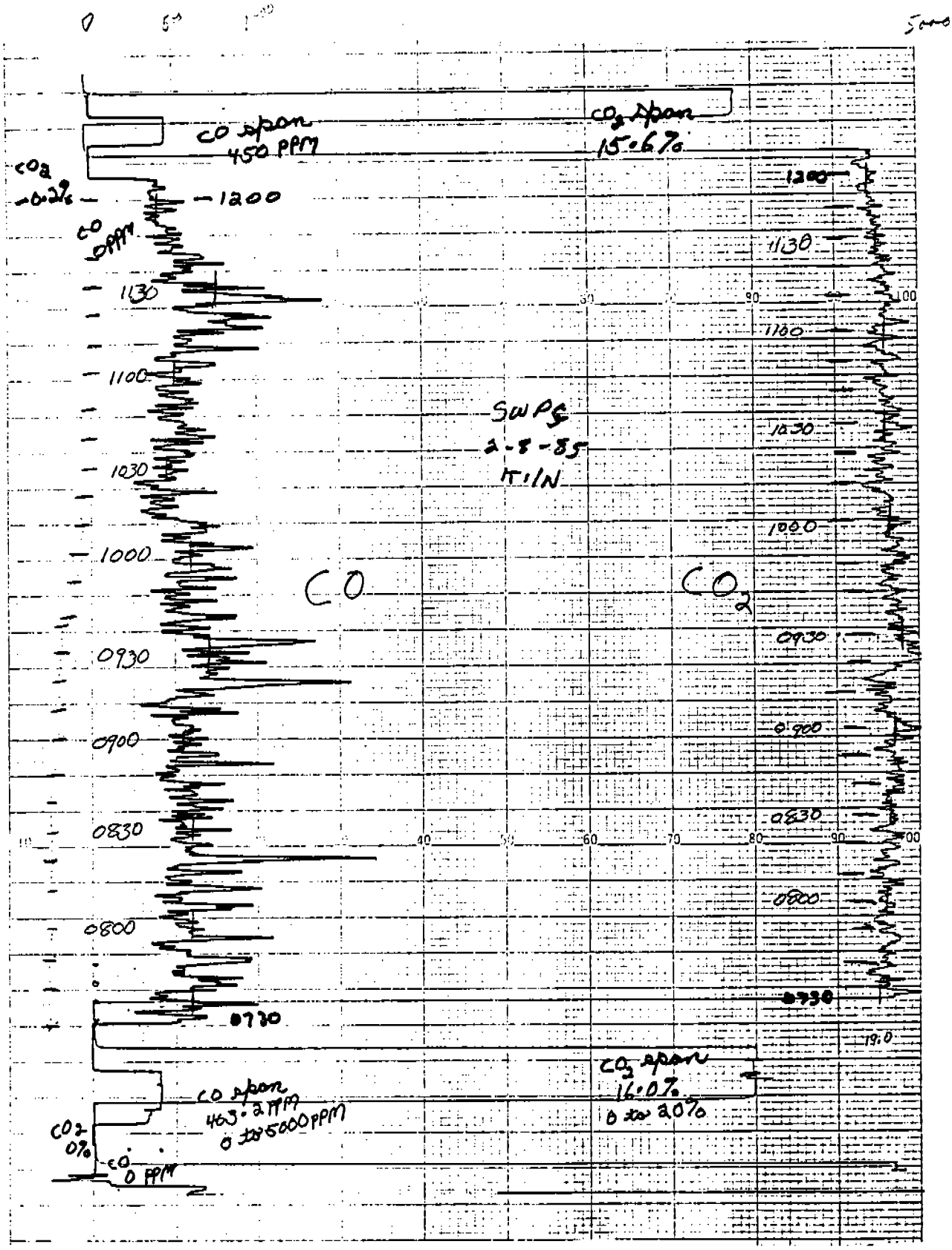

300
NOx - 0 - 1000 ppm
ppm
400
500
O2 span
7.25%
NOx span
430 PPM
1800
1200
O2
-0.2%
1130
1100
1030
SWPC
2-8-85
KILN
1000
O2
BLACK
NOx
REQ
0930
0900
0830
0800
0730
0730
NOx span
457.2 PPM
0 to 1000 PPM
NOx
0 PPM
O2
0%
O2 span
7.57%
7.25%
7.5
10% O2
0
5
10
15
20
25%
O2 - 0-25%

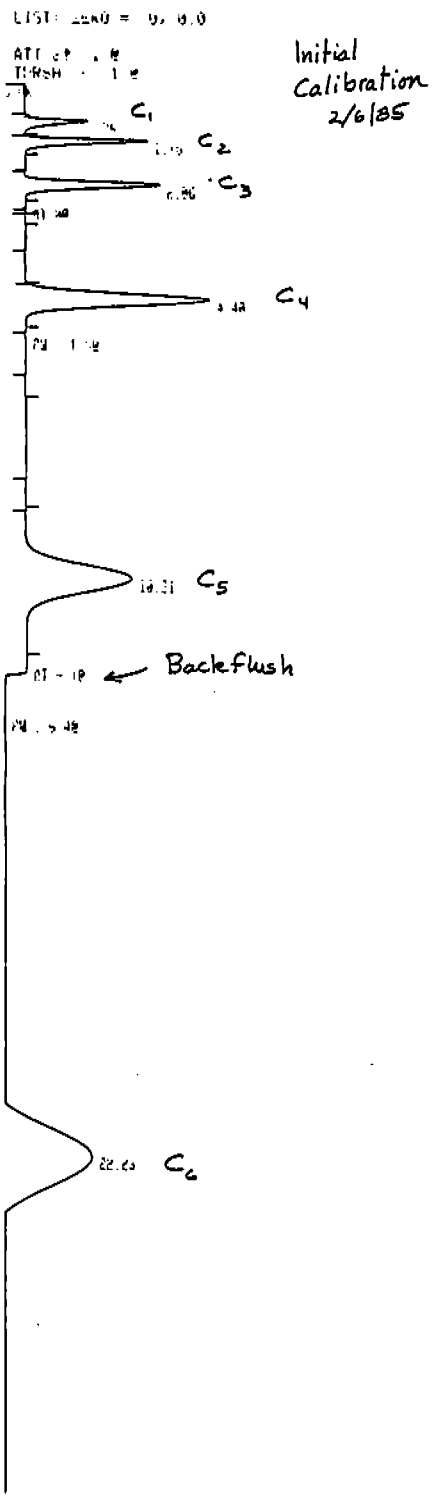


SO2 span
79.0%
SWPS
2-8-85
KILN
1200
1130
1100
1030
1000
SO2
0930
0900
0830
0800
0730
SO2 0 PPM
SO2 span
80.9 PPM
0 to 100 PPM

CO - 0-5000 ppm

CO_2 0-20%





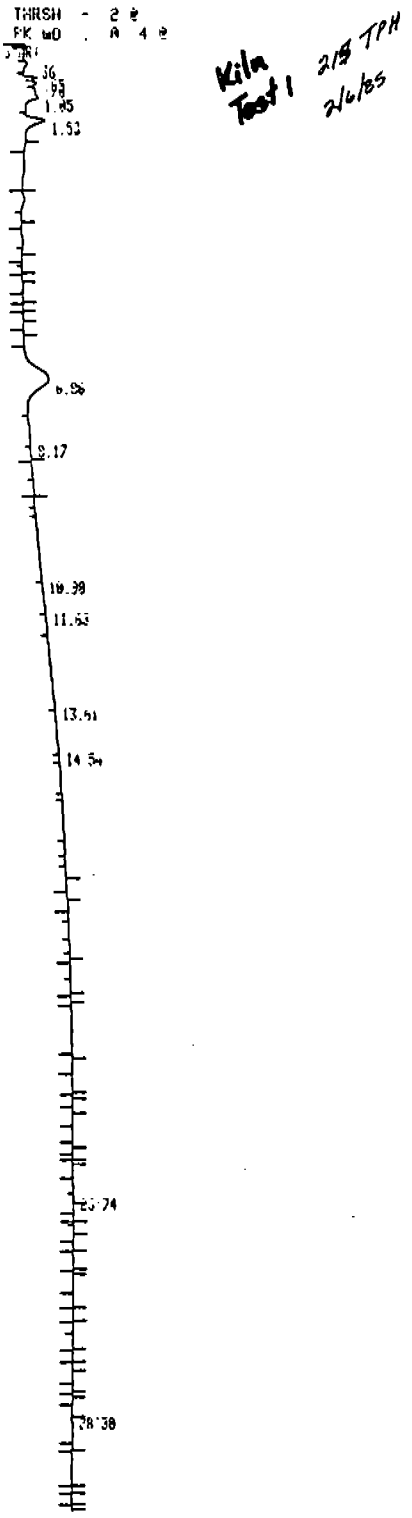
STOP

RUN # 1

AREA%

RT	AREA	TYPE	AR/HT	AREA%
0.64	588	BV	0.043	0.150
0.76	20170	VB	0.115	5.131
1.15	38819	BB	0.114	9.875
2.06	56734	PB	0.152	14.433
4.40	72191	BB	0.232	18.365
10.21	95257	BB	0.651	24.232
22.23	109340	PB	1.517	27.815

TOTAL AREA= 393100
MUL FACTOR= 1.0000E+00



STOP

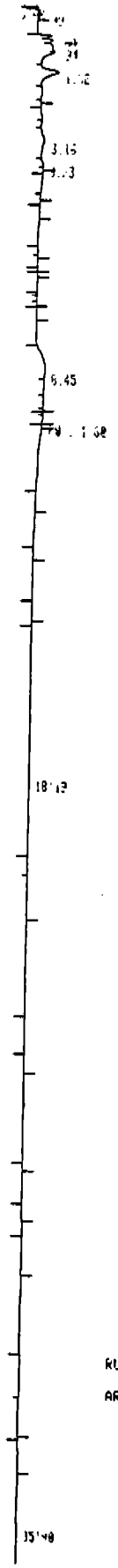
RUN # 2

AREA%

RT	AREA	TYPE	AR/HT	AREA%
0.36	344	PP	0.110	1.721
0.65	628	PV	0.068	3.141
0.76	942	VV	0.098	4.711 C1
1.05	2579	VV	0.256	12.899
1.53	2255	VB	0.167	11.278
6.86	7916	PP	0.487	39.592
8.17	156	PV	0.371	0.780
10.98	475	PV	0.720	2.376
11.63	522	VV	0.414	2.611
13.61	2359	VV	1.123	11.799
14.54	1818	VV	0.842	9.093

TOTAL AREA= 19994
MUL FACTOR= 1.0000E+00

Kiln Test 2 190 TPH



STOP

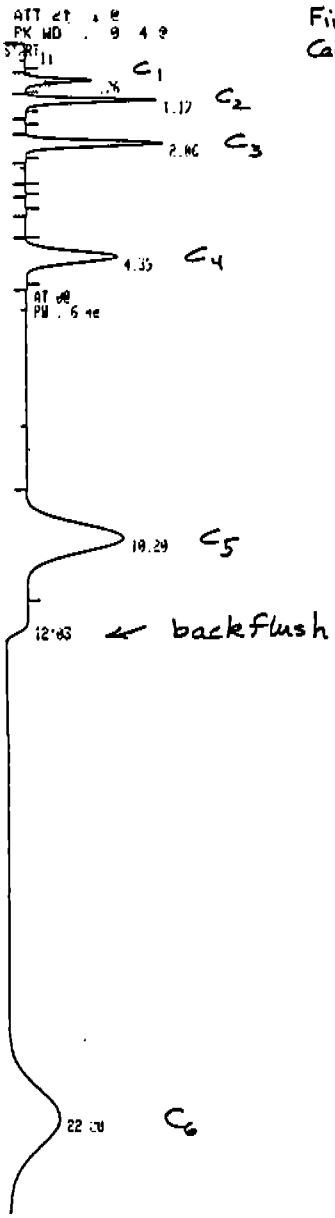
RUN # 3

AREA%

RT	AREA	TYPE	AR/HT	AREA%
0.09	242	PB	0.106	2.249
0.64	705	BV	0.084	6.552
0.76	1161	VV	0.092	10.790 C_1
0.94	1848	VV	0.156	17.175
1.52	2942	VV	0.136	27.342
3.16	831	PP	0.295	7.723
3.73	53	PV	0.055	0.493
8.45	2978	BV	0.564	27.677

TOTAL AREA= 10760
MUL FACTOR= 1.0000E+00

Final Calibration



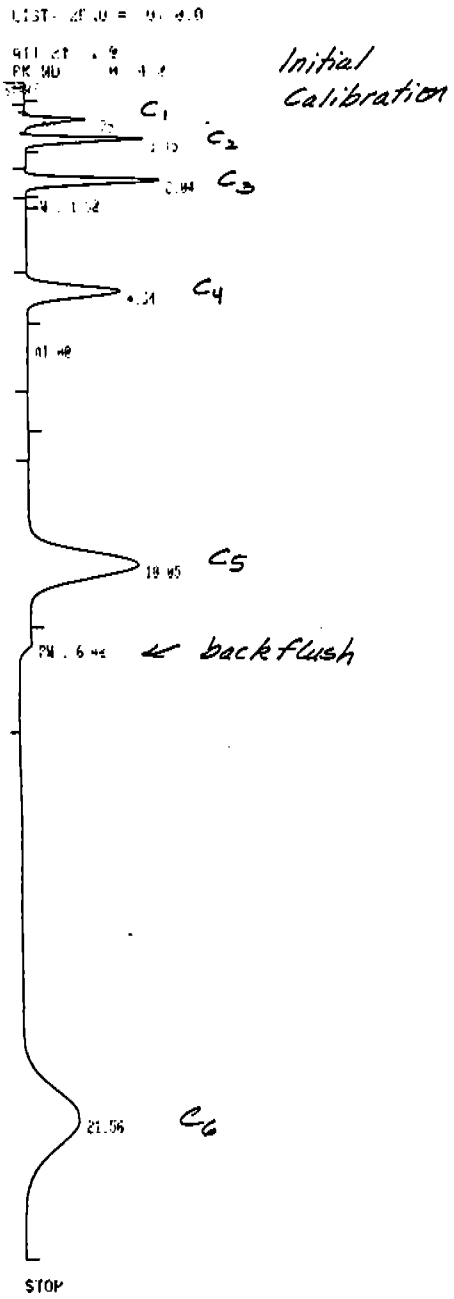
STOP

RUN # 4

AREA%

RT	AREA	TYPE	AR/HT	AREA%
0.11	368	PV	0.157	0.095
0.64	575	BV	0.040	0.149
0.76	19270	VB	0.105	4.981
1.17	37727	PB	0.104	9.751
2.86	55188	BB	0.145	14.264
4.39	70481	PB	0.280	18.217
10.20	92372	BB	0.686	23.874
22.20	110930 I	BH	1.565	28.670

TOTAL AREA= 386910
MUL FACTOR= 1.0000E+00

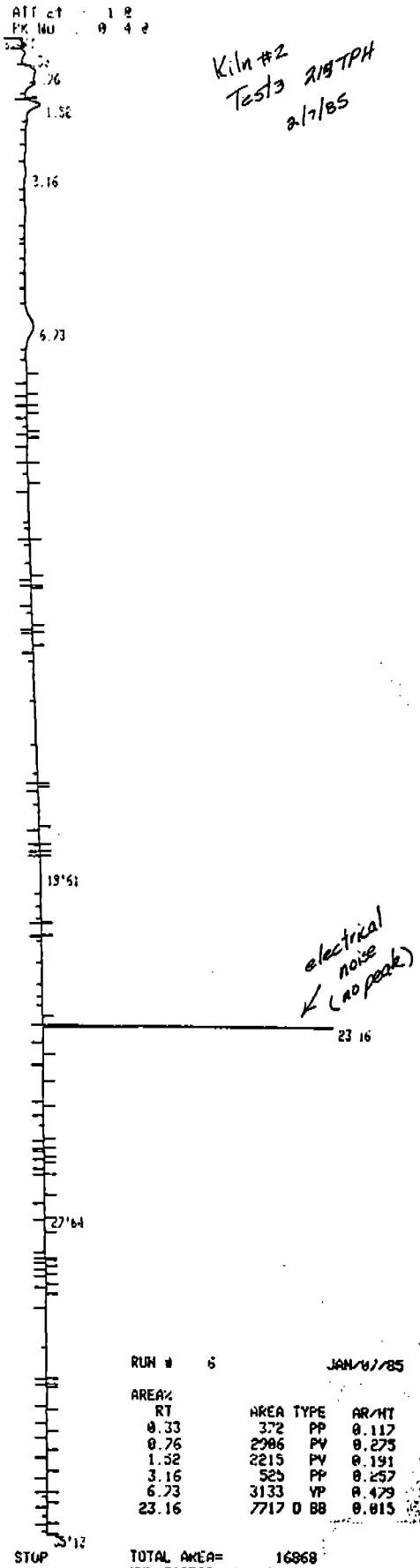


RUN # 5 JAN/07/85 11:11:59

AREA%

RT	AREA	TYPE	AR/HT	AREA%
0.64	367	PV	0.038	0.091
0.75	20474	VP	0.122	5.065
1.15	39642	PB	0.121	9.807
2.04	57861	PB	0.155	14.314
4.34	73991	PB	0.287	18.282
10.05	97019	PB	0.645	24.001
21.56	114970	BB	1.514	28.441

TOTAL AREA= 404230
MUL FACTOR= 1.0000E+00



RUN # 6 JAN/07/85 11:47:26

AREA%

RT	AREA	TYPE	AR/HT	AREA%	
0.33	372	PP	0.117	2.205	
0.76	2906	PV	0.275	17.228	O_1
1.52	2215	PV	0.191	13.131	
3.16	525	PP	0.257	3.112	
6.73	3133	VP	0.479	18.574	
23.16	7717	D BB	0.015	45.749	np

TOTAL AREA= 16868
MUL FACTOR= 1.0000E+00

Pape & Steiner Environmental Services

SAMPLE HANDLING/LOG-IN

Date 2/5/85, 2/6/85 Test Location Raw Mill 2 Kiln 2 Finish Mill 2 Clinker

	Sample Type (Meth / Sample / Test)	Volume	Comments
1.	85 5872 5 / Ace / RM1		
2.	85 5873 5 / FLT / RM1		
3.	855874 5 / Ace / FM1		
4.	855875 5 / FLT / FM1		
5.	855876 5 / Ace / K1		
6.	85 5877 5 / FLT / K1		
7.	85 5878 5 / Ace / C1		
8.	85 5879 5 / FLT / C1		
9.	85 5880 5 / Ace / K2		
10.	85 5881 5 / FLT / K2		
11.	85 5882 5 / Ace / C2		
12.	85 5883 5 / FLT / C2		

CHAIN OF CUSTODY

JE

JEA

Pape & Steiner Environmental Services

SAMPLE HANDLING/LOG-IN

Date 2/7/85, 2/8/85 Test Location Kiln, Raw Mill Clinker, Finish Mill

	Sample Type	Volume	Comments
1.	855885 5 (Meth) FLT (Sample) K3 (Test)		
2.	85 5884 5 (Meth) Ace (Sample) K3 (Test)		
3.	855886 5 (Meth) ACE (Sample) #2 (Test)		
4.	85 5887 5 (Meth) MF (Sample) #2 (Test)		
5.	855888 5 (Meth) ace (Sample) 2 (Test)		
6.	85 5889 5 (Meth) MF (Sample) 2 (Test)		
7.	85 5890 5 (Meth) ace (Sample) 3 (Test)		
8.	85 5891 5 (Meth) MF (Sample) 3 (Test)		
9.	855892 5 (Meth) Ace (Sample) C3 (Test)		
10.	855893 5 (Meth) FLT (Sample) C3 (Test)		
11.	855894 5 (Meth) Ace (Sample) FM3 (Test)		
12.	855895 5 (Meth) FLT (Sample) FM3 (Test)		

CHAIN OF CUSTODY

JS

Pape & Steiner Environmental Services

SAMPLE HANDLING/LOG-IN

Date 2/5/85 Test Location all

	Sample Type	Volume	Comments
1.			
2.	855896 5 (Meth) BAce (Sample) all (Test)		
3.	855897 5 (Meth) BFLT (Sample) all (Test)		
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

CHAIN OF CUSTODY

JS

Pape & Steiner Environmental Services

ANALYTICAL REPORT

SAMPLE TYPE Filterable Particulate DATE 2/11/85

SAMPLE COMPONENT 100mm filter ANALYST SK

REQUESTED BY SWPC

ANALYTICAL METHOD Gravimetric

Sample ID No.	Test No.	Sample Volume	Sample Aliquot	Titer mls or (Absorbance)	Analytical Result (total sample) grams	
					Uncorrected	Blank corrected
Kiln 2						
10-270	K1				-0.00175	0.00000
10-299	K2				-0.00020	0.00000
10-271	K3				-0.00149	0.00000
Clinker						
10-295	C1				0.07411	0.07416
10-293	C2				0.05082	0.05087
10-297	C3				0.05354	0.05359
Raw Mill #2						
10-292	RM1				0.00362	0.00367
10-294	RM2				0.00342	0.00347
10-296	RM3				0.00414	0.00419
Finish Mill #12						
10-298	FM1				0.00003	0.00008
10-272	FM2				-0.00017	0.00000
10-300	FM3				0.00012	0.00017
10-269	Blk.				-0.00005	

Pape & Steiner Environmental Services

ANALYTICAL REPORT

SAMPLE TYPE Front Half Wash DATE 2/11/85

SAMPLE COMPONENT Acetone ANALYST SK

REQUESTED BY SLUPC.

ANALYTICAL METHOD Gravimetric

Sample ID No.	Test No.	Sample Volume	Sample Aliquot	Titer mls or (Absorbance)	Analytical Result (total sample) grains	
					Uncorrected	Blank corrected
Kiln 2	K1	227	227		0.01342	0.01233
	K2	225	225		0.00828	0.00720
	K3	178	178		0.01055	0.00970
Clinker	C1	218	218		0.16643	0.16538
	C2	210	210		0.02534	0.02433
	C3	189	189		0.00952	0.00861
Raw Mill #2	RM1	249	249		0.01665	0.01545
	RM2	137	137		0.01767	0.01701
	RM3	202	202		0.01857	0.01760
Finish Mill #12	FM1	255	255		0.02996	0.02874
	FM2	199	199		0.02478	0.02382
	FM3	149	149		0.00688	0.00616
	Blk.	100	100		0.00048	

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 1 Date 2/6/85 Location Kiln #2 Stack

T_m	74.04	V_m	85.657	O_2	9.17	Stack ID "	160
T_s	381.08	γ	1.0098	CO_2	18.80	Stack Area Ft^2	139.63
$\sqrt{\Delta P}$	0.4927	P_b	26.46	Static	-0.33	Test Time	120
ΔH	1.74	V_{1c}	77.5	C_p	0.84	N_d	0.3207

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 75.9941$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 3.6479$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0458$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 31.36$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 30.75$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 26.44$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 35.99$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
301453.93

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 159580.76$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 98.86$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 2 Date 2/6/85 Location Kiln #2

T_m	74.67	V_m	81.805	O_2	9.30	Stack ID "	160
T_s	362.75	γ	1.0098	CO_2	18.69	Stack Area Ft^2	139.63
$\sqrt{\Delta P}$	0.4647	P_b	26.43	Static	-0.18	Test Time	120
ΔH	1.57	V_{1c}	73.9	C_p	0.84	N_d	0.3207

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 72.3753$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 3.4785$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0459$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 31.36$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 30.75$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 26.42$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 33.58$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
281358.68

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 152409.33$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 98.79$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 1 Date 2/6/85 Location Clinker GBF

T_m	74.40	V_m	52.698	O_2	20.9	Stack ID "	130
T_s	358.13	γ	0.9993	CO_2	0.0	Stack Area Ft^2	92.18
$\sqrt{\Delta P}$	0.6379	P_b	26.46	Static	-0.48	Test Time	72
ΔH	1.57	V_{1c}	3.8	C_p	0.84	N_d	0.2680

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 46.2141$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 0.1789$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0039$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 28.84$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 28.79$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 26.42$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 47.50$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 149158.17$$

262703.56

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 101.34$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 3 Date 2/7/85 Location Kiln

T_m	74.86	V_m	85.880	O_2	9.10	Stack ID "	160
T_s	380.29	γ	1.0098	CO_2	19.04	Stack Area Ft^2	139.63
$\sqrt{\Delta P}$	0.4935	P_b	26.52	Static	-0.33	Test Time	120
ΔH	1.74	V_{1c}	78.7	C_p	0.84	N_d	0.3207

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 76.2440$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 3.7044$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0463$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 31.40$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 30.78$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 26.50$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 35.97$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 159897.81$$

301320.71

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 98.99$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 2 Date 2/6/85 Location Clinker GBF

T_m	76.25	V_m	56.928	O_2	20.9	Stack ID "	130
T_s	377.83	γ	0.9993	CO_2	0.0	Stack Area Ft^2	92.18
$\sqrt{\Delta P}$	0.6925	P_b	26.43	Static	-0.50	Test Time	72
ΔH	1.81	V_{1c}	3.8	C_p	0.84	N_d	0.2680

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 49.7283$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 0.1789$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0036$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 28.84$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 28.80$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 26.39$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 52.21$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
288759.65

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 159950.21$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 101.68$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 3 Date 2/8/85 Location Clinker 6BF

T_m	74.44	V_m	55.262	O_2	20.9	Stack ID "	130
T_s	361.67	γ	0.9993	CO_2	0.0	Stack Area Ft^2	92.18
$\sqrt{\Delta P}$	0.6481	P_b	26.43	Static	-0.30	Test Time	72
ΔH	1.62	V_{1c}	6.6	C_p	0.84	N_d	0.2680

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 48.4111$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 0.3107$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0064$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 28.84$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 28.77$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 26.41$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 48.40$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
267692.89

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 150857.46$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 104.96$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 1 Date 2/5/85 Location Finish Mill

T_m	56	V_m	89.659	O_2	20.9	Stack ID "	60
T_s	186	γ	27.35	CO_2	0.0	Stack Area Ft^2	19.63
$\sqrt{\Delta P}$	0.3330	P_b	0.698	Static	-0.11	Test Time	120
ΔH	1.78	V_{1c}	135.4	C_p	0.84	N_d	0.3652

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 81.7199$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 6.3733$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0723$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 28.84$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 28.05$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 27.34$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 21.95$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
25854.70

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 17913.99$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 102.69$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 2 Date 2/7/85 Location Finish Mill

T_m	78.78	V_m	83.960	O_2	20.9	Stack ID "	60
T_s	195.25	γ	0.9698	CO_2	0.0	Stack Area Ft^2	19.63
$\sqrt{\Delta P}$	0.3148	P_b	27.28	Static	-0.115	Test Time	120
ΔH	1.52	V_{1c}	156.8	C_p	0.84	N_d	0.3652

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 73.0523$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 7.3806$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0918$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 28.84$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 27.84$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 27.27$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 21.00$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
24740.67

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 16503.85$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 99.65$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 3 Date 2/8/85 Location Finish Mill

T_m	61.47	V_m	84.695	O_2	20.9	Stack ID "	60
T_s	185.81	γ	0.9698	CO_2	0.0	Stack Area Ft^2	19.63
$\sqrt{\Delta P}$	0.3193	P_b	27.18	Static	-0.11	Test Time	120
ΔH	1.53	V_{1c}	140.5	C_p	0.84	N_d	0.3652

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 75.8621$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 6.6133$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0802$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 28.84$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 27.97$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 27.17$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 21.14$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
24902.51

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 17007.08$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 100.42$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 1 Date 2-5-85 Location Rail mill #2

T_m	62.54	V_m	98.406	O_2	20.9	Stack ID "	72
T_s	152.42	γ	.9828	CO_2	0.0	Stack Area Ft^2	28.27
$\sqrt{\Delta P}$	0.7164	P_b	26.45	Static	-.47	Test Time	120
ΔH	1.86	V_{1c}	100.0	C_p	.840	N_d	0.2530

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 86.8368$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 4.7070$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0514$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 28.84$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 28.28$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 26.42$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 46.77$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
79,345.90

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 56,826.04$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 103.22$$

Pape & Steiner Environmental Services

ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 2 Date 2/7/85 Location Raw Mill

T_m	66.83	V_m	99.898	O_2	20.9	Stack ID "	72
T_s	171.33	γ	0.9828	CO_2	0.0	Stack Area Ft^2	28.27
$\sqrt{\Delta P}$	0.7442	P_b	26.52	Static	-0.35	Test Time	120
ΔH	1.93	V_{1c}	86.8	C_p	0.84	N_d	0.2530

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 87.6826$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 4.0857$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0445$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 28.84$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 28.35$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 26.49$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 49.03$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
83170.26

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 58851.19$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 100.64$$

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ISOKINETIC CALCULATIONS

Standard temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

Test 3 Date 2/7/85 Location Raw Mill

T_m	76.17	V_m	106.869	O_2	20.9	Stack ID "	72
T_s	169.62	γ	0.9828	CO_2	0.0	Stack Area Ft^2	28.27
$\sqrt{\Delta P}$	0.7939	P_b	26.52	Static	-0.35	Test Time	120
ΔH	2.16	V_{1c}	100.8	C_p	0.84	N_d	0.2530

1. Volume of dry gas sampled at standard conditions (dscf)
(R-17)

$$V_{m,std} = \left(\frac{S_t + 460}{29.92}\right)(\gamma)V_m\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right) = 92.2257$$

2. Stack gas moisture condensed at standard conditions (scf)
(R-18)
($V_{m,std} + V_{w,std}$; R-04)

$$V_{w,std} = 8.9148 \times 10^{-5}(S_t + 460)(V_{1c}) = 4.7447$$

3. Stack gas proportion of water vapor, by volume
(R-19)

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}} = 0.0489$$

4. Stack gas dry molecular weight (lb/lb mole)
(R-21)

$$MW_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = 28.84$$

5. Stack gas molecular weight (lb/lb mole)
(R-22)

$$MW_s = MW_d(1 - B_{wo}) + 18(B_{wo}) = 28.31$$

6. Pressure stack, in. Hg
(R-23)

$$P_s = P_b + \left(\frac{P_{static}}{13.6}\right) = 26.49$$

7. Stack gas velocity, at stack conditions (ft/sec)
(R-24)

$$V_s = 85.49(C_p)(\sqrt{\Delta P})_{avg}\sqrt{\frac{T_s + 460}{P_s(MW_s)}} = 51.58$$

8. Stack gas volume at standard conditions (dscfm)
(R-26)
(ACFM; R-25)
87506.78

$$Q_s = 60(1 - B_{wo})V_sA_s\left(\frac{S_t + 460}{T_s + 460}\right)\left(\frac{P_s}{29.92}\right) = 61796.58$$

9. Test percent isokinetic
(R-02)

$$\%I = \frac{9142.88(T_s + 460)(V_{w,std} + V_{m,std})}{(S_t + 460)\ \theta\ V_sP_s(D_n)^2} = 100.80$$

Pape & Steiner Environmental Services

TEST 1,2,3

LOCATION Kiln

EMISSION RATE DATA -- 68°F

Standard Temperature, S_t = 68°F; 29.92 inches Hg

XEQ FF

XEQ RAT

ENTER:	Test 1	Test 2	Test 3	Average
R-17 $V_{m,std}$	75.9941	72.3753	76.2440	
R-26 Q_s	159580.76	152109.33	159897.81	157195.97
R-22 O_2%	9.17	9.30	9.10	9.19

LAB DATA

	Test 1	Test 2	Test 3	Average
Front Half Wash (g)	0.01233	0.00720	0.00970	
Mass Filter (g)	0.00000	0.00000	0.00000	
Back Half Catch (g)				
Front Half Sulfate (mg H_2SO_4)				
Back Half Sulfate (mg H_2SO_4)				
H_2O_2 Catch (mg H_2SO_4)				

RESULTS

		Test 1	Test 2	Test 3	Average
F Factor	1				
Filt. Particulate gr/dscf	6	0.0025	0.0015	0.0020	0.0020
Filt. Particulate lb/hr	7	3.42	2.00	2.69	2.70
Total Particulate gr/dscf	8				
Total Particulate lb/hr	10				
Total Sulfate gr/dscf	11				
Total Sulfate lb/hr	13				
SO_3 ppm	14				
SO_3 lb/hr	15				
SO_2 ppm	16				
SO_2 lb/hr	17				
SO_2 @ 3% O_2	18				
SO_2 lb/MMBtu					
S lb/MMBtu					

Pape & Steiner Environmental Services

TEST 1, 2, 3

LOCATION Clinker GBF

EMISSION RATE DATA -- 68°F

Standard Temperature, S_t = 68°F; 29.92 inches Hg

XEQ FF

XEQ RAT

ENTER:	Test 1	Test 2	Test 3	Average
R-17 $V_{m,std}$	46.2141	49.7283	48.4111	
R-26 Q_s	149158.17	159950.21	150857.46	153321.95
R-22 O_2%	20.9	20.9	20.9	

LAB DATA

	Test 1	Test 2	Test 3	Average
Front Half Wash (g)	0.16538	0.02433	0.00861	
Mass Filter (g)	0.07416	0.05087	0.05359	
Back Half Catch (g)				
Front Half Sulfate (mg H_2SO_4)				
Back Half Sulfate (mg H_2SO_4)				
H_2O_2 Catch (mg H_2SO_4)				

RESULTS

		Test 1	Test 2	Test 3	Average
F Factor	1				
Filt. Particulate gr/dscf	6	0.0800	0.0233	0.0198	0.0410
Filt. Particulate lb/hr	7	102.25	31.99	25.63	53.29
Total Particulate gr/dscf	8				
Total Particulate lb/hr	10				
Total Sulfate gr/dscf	11				
Total Sulfate lb/hr	13				
SO_3 ppm	14				
SO_3 lb/hr	15				
SO_2 ppm	16				
SO_2 lb/hr	17				
SO_2 @ 3% O_2	18				
SO_2 lb/MMBtu					
S lb/MMBtu					

& Steiner Environmental Services

TEST 1, 2, 3

LOCATION Finish Mill

EMISSION RATE DATA -- 68°F

Standard Temperature, S_t = 68°F; 29.92 inches Hg

XEQ FF

XEQ RAT

ENTER:	Test 1	Test 2	Test 3	Average
R-17 $V_{m,std}$	81.7199	73.0523	75.8621	
R-26 Q_s	17913.99	16503.85	17007.08	17141.64
R-22 O_2%	20.9	20.9	20.9	

LAB DATA

	Test 1	Test 2	Test 3	Average
Front Half Wash (g)	0.02874	0.02382	0.00616	
Mass Filter (g)	0.00008	0.00000	0.00017	
Back Half Catch (g)				
Front Half Sulfate (mg H_2SO_4)				
Back Half Sulfate (mg H_2SO_4)				
H_2O_2 Catch (mg H_2SO_4)				

RESULTS

		Test 1	Test 2	Test 3	Average
F Factor	1				
Filt. Particulate gr/dscf	6	0.0054	0.0050	0.0013	0.0039
Filt. Particulate lb/hr	7	0.84	0.71	0.19	0.58
Total Particulate gr/dscf	8				
Total Particulate lb/hr	10				
Total Sulfate gr/dscf	11				
Total Sulfate lb/hr	13				
SO_3 ppm	14				
SO_3 lb/hr	15				
SO_2 ppm	16				
SO_2 lb/hr	17				
SO_2 @ 3% O_2	18				
SO_2 lb/MMBtu					
S lb/MMBtu					

Pape & Steiner Environmental Services

TEST 1

LOCATION Kiln

CM SO_2, NO_x, HC, CO EMISSION RATE DATA 3/6/85

Standard Temperature, St 68 (XEQ 60 or 68); 29.92 inches Hg

ENTER	Test 1 (7:45-10:20)	Test 2 (10:35-1:10)	Test 3 (2:35-5:15 *)	Average
R-22 O_2%	9.36	9.12	9.52	
R-26 Q_s	159 580.76	159 580.76	152 109.33	
R-15 NO_x ppm	486.67	548.89	498.33	
R-15 SO_2 ppm	4.00	2.00	3.00	
R-15 CO ppm	306.11	210.00	157.92	
$C_1, > C_1$ R-15 HC ppm		2.56/49.1	3.16/23.51	
XEQ FF				
XEQ SO2 F Factor				

N-14
O_2-32
46

RESULTS:

See Next page for Average of 3 Tests

	Test 1	Test 2	Test 3	Average
MW = 46				
NO_x lb/hr — as NO_2	556.50	627.65	543.16	575.5
NO_x ppm @ 3% O_2	754.89	834.29	783.55	791
NO_x lb/MMBtu				
NO_x lb/Bbl				
MW = 64.1				
SO_2 lb/hr	6.37	3.19	4.56	
SO_2 ppm @ 3% O_2	6.20	3.04	4.72	
SO_2 lb/MMBtu				
SO_2 lb/Bbl				
MW = 28				
CO lb/hr	213.02	146.14	104.75	
CO ppm @ 3% O_2	474.82	319.19	248.31	
CO lb/MMBtu				
CO lb/Bbl				
MW = 16				
HC lb/hr		1.02/19.52	1.20/8.91	
HC ppm @ 3% O_2		3.89/74.63	4.97/36.97	
HC lb/MMBtu				
HC lb/Bbl				

* 190 TPH

Pape & Steiner Environmental Services

TEST _____

LOCATION Kiln

CM SO_2, NO_x, HC, CO EMISSION RATE DATA 2/7/85

Standard Temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

ENTER		7:40 - 12:00 Test 1	12:30-4:30 Test 2	Test 3	Average
R-22	O_2%	9.12	8.71		
R-26	Q_s	159897.81	159897.81		
R-15	NO_x ppm	480.71	454.62		
R-15	SO_2 ppm	4.08	3.38		
R-15	CO ppm	305.77	273.08		
R-15	HC ppm	7.61/15.37			

XEQ FF

XEQ SO2 F Factor _____

RESULTS:

				Avg this date	Avg of 5 Tests
MW = 46					
NO_x lb/hr	550.78	520.89		535.8	559.8
NO_x ppm @ 3% O_2	730.45	667.57		699	754 ppm @ 3%
NO_x lb/MMBtu					
NO_x lb/Bbl					
MW = 64.1					
SO_2 lb/hr	6.51	5.40			
SO_2 ppm @ 3% O_2	6.20	4.96			
SO_2 lb/MMBtu					
SO_2 lb/Bbl					
MW = 28					
CO lb/hr	213.20	190.41			
CO ppm @ 3% O_2	464.63	401.00			
CO lb/MMBtu					
CO lb/Bbl					
MW = 16					
HC lb/hr	3.03/6.12				
HC ppm @ 3% O_2	11.56/23.36				
HC lb/MMBtu					
HC lb/Bbl					

Pape & Steiner Environmental Services

TEST 1

LOCATION Kiln

CM SO_2, NO_x, HC, CO EMISSION RATE DATA 2/8/85

Standard Temperature, S_t 68 (XEQ 60 or 68); 29.92 inches Hg

7:30am - 12:00pm

ENTER	Test 1	Test 2	Test 3	Average
R-22 O_2%	8.96			
R-26 Q_s				
R-15 NO_x ppm	358.00			
R-15 SO_2 ppm	7.10			
R-15 CO ppm	575.00			
R-15 HC ppm				
XEQ FF				
XEQ SO2	F Factor			

RESULTS:

MW = 46					
NO_x lb/hr					Avg of 6 min
NO_x ppm @ 3% O_2	536.70			537	718
NO_x lb/MMBtu					
NO_x lb/Bbl					
MW = 64.1					
SO_2 lb/hr					
SO_2 ppm @ 3% O_2	10.64				
SO_2 lb/MMBtu					
SO_2 lb/Bbl					
MW = 28					
CO lb/hr					
CO ppm @ 3% O_2	862.02				
CO lb/MMBtu					
CO lb/Bbl					
MW = 16					
HC lb/hr					
HC ppm @ 3% O_2					
HC lb/MMBtu					
HC lb/Bbl					