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Final Report - Volume I of II

Lime Manufacturing Emissions Test Report

Chemical Lime Company (Formerly Eastern Ridge Lime Company) Ripplemead, Virginia

Office of Air Quality
Clean Air
OAQPS
Planning and Standards

LIME MANUFACTURING
EMISSION TEST REPORT
CHEMICAL LIME COMPANY
(FORMERLY APG LIME COMPANY)
RIPPLEMEAD, VIRGINIA

VOLUME I OF II
REPORT TEXT
APPENDICES A & B

EPA Contract No. 68D70069
Work Assignment No. 2-12

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DISCLAIMER

This document was prepared by Pacific Environmental Services, Inc. (PES) under EPA Contract No. 68D70069, Work Assignment No. 2-12. The field sampling, analyses, and draft report were completed under EPA Contract No. 68D20162, Work Assignment No. 4-01. This document has passed PES' internal quality assurance review and has been approved for distribution. The contents of this document do not necessarily reflect the views and policies of the U.S. EPA. Mention of trade names does not constitute endorsement by the EPA or PES.

TABLE OF CONTENTS

VOLUME I Page

1.0 INTRODUCTION 1-1

2.0 SUMMARY OF RESULTS 2-1

3.0 PROCESS DESCRIPTION 3-1

4.0 SAMPLING LOCATIONS 4-1

4.1 NO. 1 KILN 4-1
4.2 NO. 2 KILN COOLER STACK 4-1

5.0 SAMPLING AND ANALYTICAL PROCEDURES 5-1

5.1 LOCATION OF MEASUREMENT SITES AND SAMPLE/ VELOCITY TRAVERSE POINTS 5-1
5.2 DETERMINATION OF STACK GAS VOLUMETRIC FLOW RATE . . . 5-1
5.3 DETERMINATION OF DRY MOLECULAR WEIGHT AND EMISSION CORRECTION FACTORS 5-1
5.4 DETERMINATION OF STACK GAS MOISTURE CONTENT 5-2
5.5 DETERMINATION OF POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS 5-2
5.6 DETERMINATION OF TOTAL HYDROCARBONS 5-2
5.7 DETERMINATION OF PARTICULATE MATTER AND METALS 5-6
5.8 PULVERIZED COAL FEED SAMPLING 5-6
5.9 PULVERIZED COAL FEED RATE 5-6
5.10 VISIBLE EMISSIONS 5-12

6.0 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES AND RESULTS 6-1

6.1 CALIBRATION OF APPARATUS 6-1
6.2 ON-SITE MEASUREMENTS 6-4

APPENDICES A & B

VOLUME II APPENDICES C-F

LIST OF FIGURES

VOLUME I

		Page
Figure 1.1	Key Personnel and Responsibility for Testing at APG Lime Company, EPA Contract No. 68D20162, Work Assignment No. 4-01	1-2
Figure 1.2	Sampling/Monitoring Location, at APG Lime, Ripplemead, VA	1-3
Figure 4.1	APG Lime Kiln Baghouse Inlet Sampling Location	4-2
Figure 4.2	APG Lime Kiln Baghouse Outlet Sampling Location	4-3
Figure 4.3	APG Lime Cooler Stack Sampling Location	4-4
Figure 5.1	Method 23 CDD/CDF Outlet Sampling Train	5-3
Figure 5.1A	Method 23 CDD/CDF Inlet Sampling Train	5-4
Figure 5.2	Method 25A Measurement System for THC	5-5
Figure 5.3	Method 29 Particulate Matter/Metals Baghouse Outlet and Cooler Sampling Train	5-7
Figure 5.3A	Method 29 Particulate Matter/Metals Inlet Sampling Train	5-8
Figure 5.4	Method 29 Sample Recovery Scheme (Sample Fractions 1-4)	5-9
Figure 5.5	Method 29 Sample Recovery Scheme (Sample Fraction 5)	5-10
Figure 5.6	Method 29 Sample Preparation and Analysis Scheme	5-11

LIST OF TABLES

VOLUME I

		Page
Table 2.1	Emissions Test Log APG Lime Company - Ripplemead, VA	2-2
Table 2.2	CDD/CDF Emissions Sampling and Exhaust Gas Parameters Kiln No. 1 Baghouse Inlet, APG Lime Company - Ripplemead, VA	2-4
Table 2.3	CDD/CDF Exhaust Gas Concentrations and Emission Rates Kiln No. 1 Baghouse Inlet, APG Lime Company - Ripplemead, VA	2-5
Table 2.4	CDD/CDF Exhaust Gas Concentrations and 2378 Toxic Equivalent Stack Gas Concentrations Adjusted to 7 Percent Oxygen, Kiln No. 1 Baghouse Inlet, APG Lime Company - Ripplemead, VA	2-6
Table 2.5	CDD/CDF Emissions Sampling and Stack Gas Parameters Kiln No. 1 Baghouse Outlet, APG Lime Company - Ripplemead, VA	2-7
Table 2.6	CDD/CDF Stack Gas Concentrations and Emission Rates Kiln No. 1 Baghouse Outlet, APG Lime Company - Ripplemead, VA	2-8
Table 2.7	CDD/CDF Stack Gas Concentrations and 2378 Toxic Equivalent Stack Gas Concentrations Adjusted to 7 Percent Oxygen, Kiln No. 1 Baghouse Outlet, APG Lime Company - Ripplemead, VA	2-9
Table 2.8	Particulate/Metals Emissions Sampling and Exhaust Gas Parameters Kiln No. 1 Baghouse Inlet, APG Lime Company - Ripplemead, VA	2-11
Table 2.9	Particulate Matter Concentrations and Emission Rates, Kiln No. 1 Baghouse Inlet, APG Lime Company - Ripplemead, VA	2-12
Table 2.10	Exhaust Gas Metals Concentrations and Emission Rates, Kiln No. 1 Baghouse Inlet, APG Lime Company - Ripplemead, VA	2-13
Table 2.11	Particulate/Metals Emissions Sampling and Stack Gas Parameters Kiln No. 1 Baghouse Outlet, APG Lime Company - Ripplemead, VA	2-15
Table 2.12	Particulate Matter Concentrations and Emission Rates, Kiln No. 1 Baghouse Outlet, APG Lime Company - Ripplemead, VA	2-16
Table 2.13	Stack Gas Concentrations and Emission Rates, Kiln No. 1 Baghouse Outlet, APG Lime Company - Ripplemead, VA	2-17
Table 2.14	Summary of Total Hydrocarbon Emissions - Kiln No. 1 APG Lime Company - Ripplemead, VA	2-18

LIST OF TABLES (Concluded)

Page

Table 2.15 Particulate/Metals Emissions Sampling and Stack Gas Parameters Kiln No. 2 Cooler Exhaust Stack, APG Lime Company - Ripplemead, VA 2-19
Table 2.16 Particulate Matter Concentrations and Emission Rates, Kiln No. 2 Cooler Exhaust Stack, APG Lime Company - Ripplemead, VA 2-21
Table 2.17 Stack Gas Concentrations and Emission Rates, Kiln No. 2 Cooler Exhaust Stack, APG Lime Company - Ripplemead, VA 2-22

Table 5.1 Sources, Test Parameters, and Test Methods Summary APG Lime Company - Ripplemead, Virginia 5-2

Table 6.1 Summary of Temperature Sensor Calibration Data 6-2
Table 6.2 Summary of Pitot Tube Dimensional Data 6-3
Table 6.3 Summary of Dry Gas Meter and Orifice Calibration Data 6-5
Table 6.4 Summary of Orsat Analyzer Calibration Results 6-7
Table 6.5 Summary of Method 23/Proposed Method 29 Field Sampling QA/QC Data 6-8
Table 6.6 Summary of Calibration Gas Cylinders 6-9
Table 6.7 Summary of Method 23 Standards Recovery Efficiencies 6-10
Table 6.8 Summary of Method 29 Analysis QC Data 6-11

1.0 INTRODUCTION

The U.S. Environmental Protection Agency's (EPA) Emissions Standards Division, Minerals and Inorganic Chemicals Group (ESD/MICG) is investigating lime manufacturing processes to obtain air emissions data to support development of the lime manufacturing NESHAP. Because lime manufacturing is similar to portland cement manufacturing, it is believed that lime plants may have similar emissions. There are limited data on HAP emissions from lime manufacturing processes; therefore additional data are needed to identify which of the 189 HAPs listed in Section 112(b) of the Clean Air Act (CAA), as amended in 1990, are emitted from these sources.

As part of its investigation, the ESD/MICG requested that the EPA's Emissions, Monitoring and Analysis Division (EMAD) test two lime manufacturing facilities. EMAD issued a work assignment to Pacific Environmental Services, Inc. (PES) to plan and conduct the air emissions testing program to gather emissions data from lime manufacturing processes as specified in the ESD/MICG test request. The Eastern Ridge Lime Company in Ripplemead, Virginia was one of the host facilities selected by the EPA for testing. The testing program was conducted through EPA Contract No. 68D20162, Work Assignment No. 4-01.

The primary objective of the testing program was to obtain data on air emissions from Kiln No. 2. Measurements were made of total hydrocarbons (THC) at the common inlet to the two scrubber stacks, and dioxin/furan (CDD/CDF), particulate matter, metals, and THC at the separate outlets of the two scrubber stacks. A secondary objective of the testing program was to obtain data on the emissions of particulate matter and metals from the hydrator exhaust stack.

In addition, another EPA contractor assessed HAP emission concentrations at the Kiln No. 2 exhaust, the outlets of the two scrubbers, and the hydrator exhaust stack using Fourier transform infrared spectroscopy (FTIRS). These results were documented by the other contractor on a separate report to the EPA.

Figure 1.1 presents the test program organization and major lines of communication. Figure 1.2 shows the sampling/monitoring locations at Eastern Ridge Lime Company.

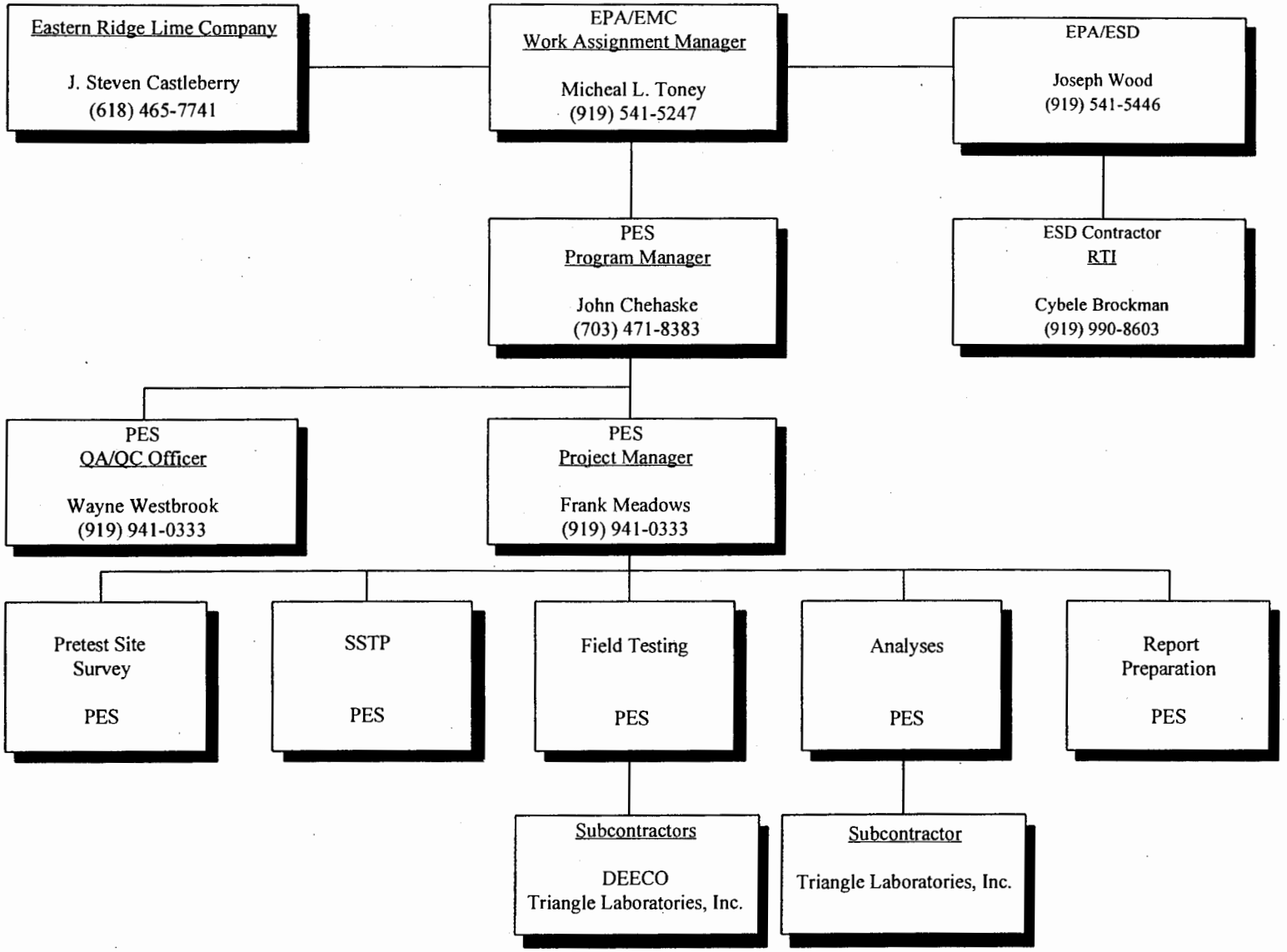


Figure 1.1 Key Personnel and Responsibility for Testing at Eastern Ridge Lime Company, EPA Contract No. 68D20162, WA No. 4-01.

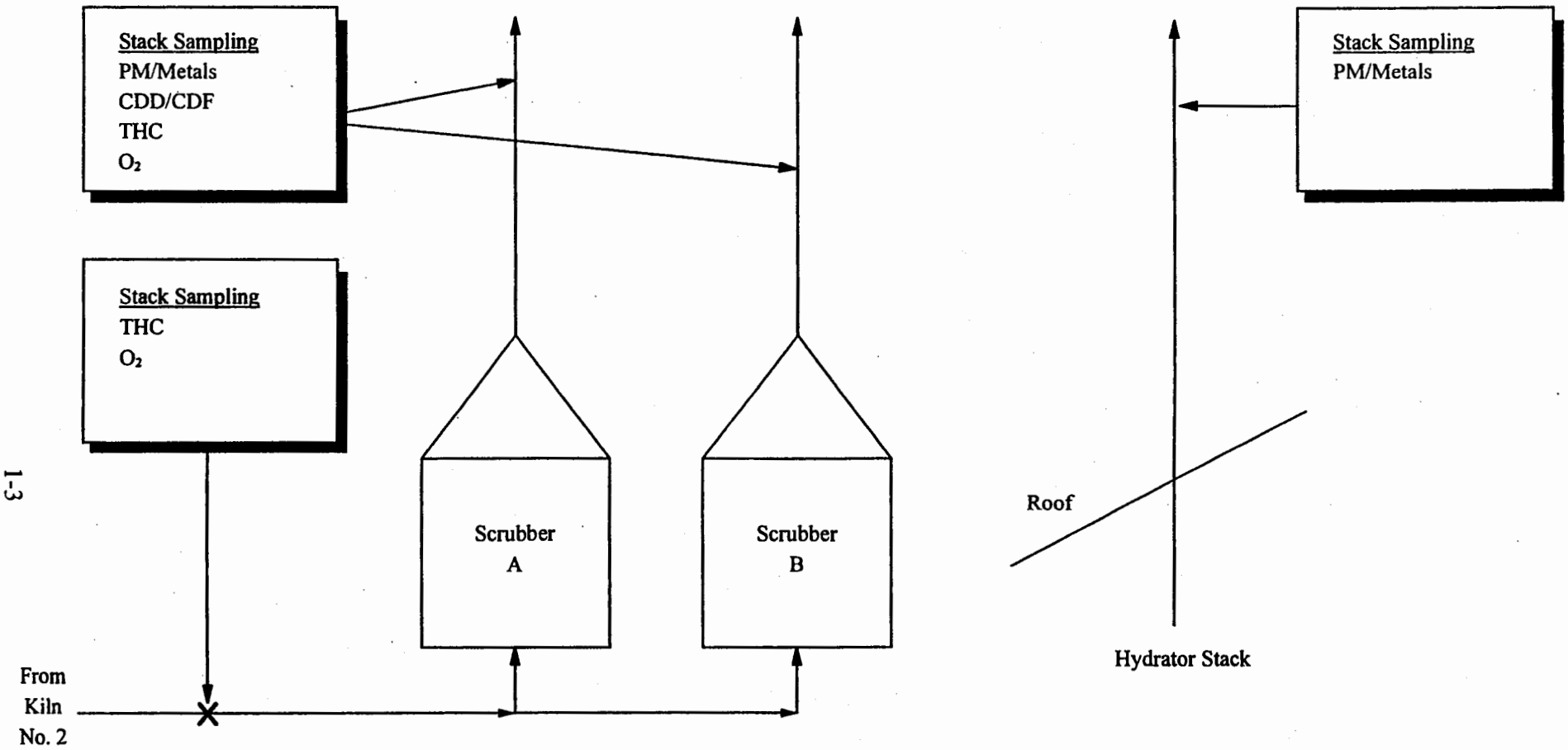


Figure 1.2 Sampling/Monitoring Locations at Eastern Ridge Lime Company, Ripplemead, VA.

2.0 SUMMARY OF RESULTS

This section provides summaries of the test results obtained from the testing program at the Eastern Ridge Lime Company. Included are the results of the tests conducted for THC, CDD/CDF, and particulate matter/metals on Kiln No. 2 and particulate matter/metals on the hydrator.

2.1 EMISSIONS TEST LOG

Sampling on Kiln No. 2 was conducted on three consecutive days from October 16, 1996 through October 18, 1996. Sampling on the hydrator was conducted on October 19 and 20, 1996. Table 2.1 summarizes the emissions test log. Presented are the run numbers, test dates, pollutants, run times and downtime for filter changes, port changes, and CEM calibrations.

2.2 KILN NO. 2

2.2.1 CDD/CDF

The Method 23 sample extracts were first analyzed using a DB-5 capillary column to determine the concentration of each isomer of CDD's and CDF's (tetra- through octa-). Tetra-chlorinated dibenzofurans were detected in this analysis; therefore, another aliquot of the sample was analyzed using a DB-225 capillary column to measure the 2,3,7,8 tetra-chloro dibenzofuran isomers.

The CDD/CDF test results are presented in actual concentrations and mass emission rates, concentrations adjusted to 7% oxygen (O_2), and concentrations adjusted to 7% O_2 in 2378 toxic equivalents. The concentrations, adjusted to 7% O_2, were adjusted by each congeners respective Toxic Equivalency Factor (TEF). The TEFs used are the international TEF values.

Scrubber "A"

Table 2.2 summarizes the CDD/CDF emissions sampling and stack gas parameters. The total sampling time for each run was 240 minutes. The average sample volume was 118.115 dry standard cubic feet (dscf) or 3.327 dry standard cubic meters (dscm). The average stack gas temperature was 136°F and contained 21.9 percent (%) carbon dioxide (CO_2), 6.1% oxygen (O_2), and 18.5% moisture (100% of saturation). The average stack gas volumetric flow rate was 26,249 actual cubic feet per minute (acfm) or 18,054 dry standard cubic feet per minute (dscfm) or 511 dry standard cubic meters per minute (dscmm).

TABLE 2.1

EMISSIONS TEST LOG
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VIRGINIA

Run No.	Date	Pollutant	Run Time	Downtime, minutes
Kiln Exhaust				
M25A-1	10/16/96	THC	1508-1721 1739-2005	
M25A-2	10/17/96	THC	1140-1330 1400-1536 1545-1630	
M25A-3	10/18/96	THC	1010-1200 1215-1400 1415-1605	
Scrubber "A"				
M25A-A-1	10/16/96	THC	1515-2000	159
M23A-1	10/16/96	CDD/CDF	1510-2038	88
M29A-1	10/16/96	PM/Metals	1510-2038	88
M25A-A-2	10/17/96	THC	1140-1615	150
M23A-2	10/17/96	CDD/CDF	1140-1630	50
M29A-2	10/17/96	PM/Metals	1140-1630	50
M25A-A-3	10/18/96	THC	1010-1430	140
M23A-3	10/18/96	CDD/CDF	1100-1543	43
M29A-3	10/18/96	PM/Metals	1100-1543	48
Scrubber "B"				
M25A-B-1	10/16/96	THC	1530-2015	165
M23B-1	10/16/96	CDD/CDF	1511-2027	76
M29B-1	10/16/96	PM/Metals	1514-2037	83
M25A-B-2	10/17/96	THC	1200-1630	135
M23B-2	10/17/96	CDD/CDF	1140-1630	50
M29B-2	10/17/96	PM/Metals	1140-1630	50
M25A-B-3	10/18/96	THC	1030-1615	120
M23B-3	10/18/96	CDD/CDF	1100-1540	40
M29B-3	10/18/96	PM/Metals	1100-1550	50
Hydrator				
M29-5	10/19/96	PM/Metals	1339-1541	2
M29-6	10/20/96	PM/Metals	1008-1213	5
M29-7	10/20/96	PM/Metals	1233-1436	3

TABLE 2.2

CDD/CDF EMISSIONS SAMPLING AND STACK GAS PARAMETERS
KILN NO. 2 SCRUBBER "A" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M23-A-1	M23-A-2	M23-A-3	Average
Date	10/16/96	10/17/96	10/19/96	
Total Sampling Time, min.	240	240	240	
Average Sampling Rate, dscfm[a]	0.531	0.462	0.484	0.492
Sample Volume:				
dscf[b]	127.343	110.767	116.234	118.115
dscm[c]	3.587	3.120	3.274	3.327
Average Stack Gas Temp., °F	138	135	135	136
O_2 Concentration, % by volume	6.6	5.0	6.7	6.1
CO_2 Concentration, % by volume	21.1	23.7	21.0	21.9
Moisture, % by volume	19.3	18.1	18.1	18.5
Stack Gas Volumeric Flow Rate:				
acfm[d]	26,779	24,919	27,049	26,249
dscfm[a]	18,276	17,273	18,613	18,054
dscmm[e]	517	489	527	511
Isokinetic Sampling Ratio, %	101.3	101.0	98.3	100.2

[a] Dry standard cubic feet per minute at 68°F and 1 atm
[b] Dry standard cubic feet at 68°F and 1 atm
[c] Dry standard cubic meters at 20°C and 1 atm.
[d] Actual cubic feet per minute at stack conditions.
[e] Dry standard cubic meters per minute at 20°C and 1 atm.

Table 2.3 presents the CDD/CDF stack gas concentrations and emission rates. The average concentration of total CDD was 0.31 nanograms per dry standard cubic meter (ng/dscm). The average concentration of total CDD/CDF was 0.76 ng/dscm. These values corresponded to average emission rates of 9.4 micrograms per hour (μg/hr) and 23 μg/hr, respectively.

Table 2.4 presents CDD/CDF concentrations adjusted to 7% O_2. The measured average stack gas O_2 concentration was 6.1 percent (%). Therefore, the adjusted CDD/CDF concentrations were about 6% lower than the actual concentrations. The average adjusted concentration of total CDD was 0.29 ng/dscm @ 7% O_2. The average adjusted concentration of total CDD/CDF was 0.71 ng/dscm @ 7% O_2.

Table 2.4 also presents the adjusted concentrations in 2378 toxic equivalents. The average TEF concentration for total CDD/CDF was 0.00523 ng/dscm @ 7% O_2.

Scrubber "B"

Table 2.5 summarizes the CDD/CDF emissions sampling and stack gas parameters. The total sampling time for each run was 240 minutes. The average sample volume was 140.196 dscf or 3.949 dscm. The average stack gas temperature was 133°F and contained 19.6% CO_2, 7.7% O_2, and 16.7% moisture (98% of saturation). The average stack gas volumetric flow rate was 16,783 acfm or 11,831 dscfm or 335 dscmm.

Table 2.6 presents the CDD/CDF stack gas concentrations and emission rates. The average concentration of total CDD was 0.20 ng/dscm. The average concentration of total CDD/CDF was 0.52 ng/dscm. These values corresponded to average emission rates of 4.0 μg/hr and 11 μg/hr, respectively.

Table 2.7 presents the CDD/CDF concentrations adjusted to 7% O_2. The measured stack gas O_2 concentration was 7.7%. Therefore, the adjusted CDD/CDF concentrations were about 5% greater than the actual concentrations. The average adjusted concentration of total CDD was 0.21 ng/dscm @ 7% O_2. The average adjusted concentration of total CDD/CDF was 0.55 ng/dscm @ 7% O_2.

Table 2.7 also presents the adjusted concentrations in 2378 toxic equivalents. The average TEF concentration for total CDD/CDF was 0.00359 ng/dscm @ 7% O_2.

2.2.2 Particulate Matter/Metals

Scrubber "A"

Table 2.8 summarizes the particulate matter/metals emissions sampling and stack gas parameters. The total sampling time for each test run was 240 minutes. The average sample volume was 131.593 dscf or 3.726 dscm. The average stack gas temperature was 128°F and

TABLE 2.3

CDD/CDF STACK GAS CONCENTRATIONS AND EMISSION RATES
KILN NO. 2 SCRUBBER "A" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

CONGENER	CONCENTRATION[a] ng/dscm, as measured				EMISSION RATE[b] μg/hr			
	M23-A-1	M23-A-2	M23-A-3	Average	M23-A-1	M23-A-2	M23-A-3	Average
Dioxins								
2378 TCDD	(0.0028)	(0.0032)	(0.0031)	0.00	(0.087)	(0.094)	(0.097)	0.00
Total TCDD	0.042	0.067	0.14	0.084	1.3	2.0	4.5	2.6
12378 PeCDD	(0.0056)	(0.0064)	(0.0061)	0.00	(0.17)	(0.19)	(0.19)	0.00
Total PeCDD	0.0084	0.019	0.092	0.04	0.26	0.56	2.9	1.2
123478 HxCDD	(0.0056)	(0.0064)	(0.0061)	0.00	(0.17)	(0.19)	(0.19)	0.00
123678 HxCDD	(0.0056)	(0.0064)	(0.0061)	0.00	(0.17)	(0.19)	(0.19)	0.00
123789 HxCDD	{0.0020}	(0.0064)	(0.0061)	0.00	{0.060}	(0.19)	(0.19)	0.00
Total HxCDD	0.056	0.038	0.049	0.048	1.7	1.1	1.5	1.5
1234678 HpCDD	0.011	0.058	0.0092	0.026	0.35	1.7	0.29	0.78
Total HpCDD	0.020	0.11	0.021	0.050	0.61	3.2	0.68	1.5
Octa CDD	0.025	0.20	0.040	0.088	0.78	5.8	1.3	2.6
Total CDD	0.15	0.43	0.35	0.31	4.7	13	11	9.4
Furans								
2378 TCDF	0.0084	0.0064	0.0092	0.0080	0.26	0.19	0.29	0.25
Total TCDF	0.28	0.13	0.34	0.25	8.6	3.8	11	7.7
12378 PeCDF	0.0028	(0.0032)	0.0061	0.0029	0.087	(0.094)	0.097	0.092
23478 PeCDF	0.0028	0.0032	0.0061	0.0040	0.087	0.094	0.19	0.12
Total PeCDF	0.061	0.013	0.082	0.052	1.9	0.38	2.6	1.6
123478 HxCDF	0.0084	0.016	{0.0061}	0.012	0.26	0.47	{0.19}	0.37
123678 HxCDF	0.0028	0.0064	0.0031	0.0041	0.087	0.19	0.097	0.12
234678 HxCDF	0.0028	0.016	0.0031	0.0073	0.087	0.47	0.97	0.22
123789 HxCDF	(0.0056)	(0.0064)	(0.0061)	0.00	(0.17)	(0.19)	(0.19)	0.00
Total HxCDF	0.028	0.054	0.015	0.033	0.87	1.6	0.48	0.98
1234678 HpCDF	0.011	0.064	0.0061	0.027	0.35	1.9	0.19	0.81
1234789 HpCDF	(0.0056)	0.019	(0.0061)	0.019	(0.17)	0.56	(0.19)	0.56
Total HpCDF	0.02	0.13	0.0061	0.052	0.52	4.0	0.19	1.6
Octa CDF	0.017	0.20	0.0092	0.074	0.52	5.7	0.29	2.2
Total CDF	0.40	0.51	0.45	0.45	12	15	14	14
Total CDD + CDF	0.55	0.95	0.79	0.76	17	28	25	23

[a] Nanogram per dry standard cubic meter at 20°C and 1 atm.
[b] Micrograms per hour.
( ) Non Detectable - Results are below target analyte detection limits. ND values are not counted in totals or averages.
{ } Estimated Maximum Possible Concentration. EMPC values are not counted in totals or averages.

TABLE 2.4

CDD/CDF STACK GAS CONCENTRATIONS AND 2378 TOXIC EQUIVALENT STACK GAS CONCENTRATIONS ADJUSTED TO 7 PERCENT OXYGEN
KILN NO. 2 SCRUBBER "A" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

CONGENER	CONCENTRATION[a] ng/dscm, adjusted to 7 percent O_2				2378-TCDD[b] Toxic Equiv. Factor	2378 TOXIC EQUIVALENCIES ng/dscm, adjusted to 7 percent O_2			
	M23-A-1	M23-A-2	M23-A-3	Average		M23-A-1	M23-A-2	M23-A-3	Averag
Dioxins									
2378 TCDD	(0.0027)	(0.0028)	(0.0030)	0.00	1.000	(0.0027)	(0.0028)	(0.0030)	0.00
Total TCDD	0.041	0.059	0.14	0.080					
12378 PeCDD	(0.0054)	(0.0056)	(0.0060)	0.00	0.500	(0.0027)	(0.0028)	(0.0030)	0.00
Total PeCDD	0.0081	0.017	0.090	0.038					
123478 HxCDD	(0.0054)	(0.0056)	(0.0060)	0.00	0.100	(0.00054)	(0.00056)	(0.00060)	0.00
123678 HxCDD	(0.0054)	(0.0056)	(0.0060)	0.00	0.100	(0.00054)	(0.00056)	(0.00060)	0.00
123789 HxCDD	{0.0019}	(0.0056)	(0.0060)	0.00					
Total HxCDD	0.054	0.034	0.048	0.045	0.100	{0.00019}	(0.00056)	(0.00060)	0.00
1234678 HpCDD	0.011	0.050	0.0090	0.023					
Total HpCDD	0.019	0.095	0.021	0.045	0.010	0.00011	0.00050	0.000090	0.00023
Octa CDD	0.024	0.17	0.039	0.079	0.001	0.000024	0.00017	0.000039	0.000079
Total CDD	0.15	0.38	0.34	0.29		0.00013	0.00067	0.00013	0.00031
Furans									
2378 TCDF	0.0081	0.0056	0.0090	0.0076	0.100	0.00081	0.00056	0.00090	0.00079
Total TCDF	0.27	0.11	0.33	0.24					
12378 PeCDF	0.0027	(0.0028)	0.0030	0.0028	0.050	0.00014	(0.00014)	0.00015	0.00014
23478 PeCDF	0.0027	0.0028	0.0060	0.0038	0.500	0.0014	0.0014	0.0030	0.0019
Total PeCDF	0.060	0.011	0.081	0.051					
123478 HxCDF	0.0081	0.014	{0.0060}	0.011	0.100	0.00081	0.0014	{0.00060}	0.0011
123678 HxCDF	0.0027	0.0056	0.0030	0.0038	0.100	0.00027	0.00056	0.00030	0.00038
234678 HxCDF	0.0027	0.014	0.0030	0.0066	0.100	0.00027	0.0014	0.00030	0.00066
123789 HxCDF	(0.0054)	(0.0056)	(0.0060)	0.00	0.100	(0.00054)	(0.00056)	(0.00060)	0.00
Total HxCDF	0.027	0.048	0.015	0.098					
1234678 HpCDF	0.011	0.056	0.0060	0.024	0.010	0.00011	0.00056	0.000060	0.00024
1234789 HpCDF	(0.0054)	0.017	(0.0060)	0.017	0.010	(0.000054)	0.00017	(0.000060)	0.00017
Total HpCDF	0.016	0.12	0.0060	0.047					
Octa CDF	0.016	0.17	0.0090	0.065	0.001	0.000016	0.00017	0.0000090	0.00006
Total CDF	0.39	0.45	0.44	0.43		0.00383	0.00622	0.00472	0.00492
Total CDD + CDF	0.53	0.83	0.78	0.71		0.00396	0.00689	0.00485	0.00523

[a] Nanogram per dry standard cubic meter adjusted to 7 percent oxygen at 20°C and 1 atm.

[b] North Atlantic Treaty Organization, Committee on the Challenges of Modern Society. Pilot study on International Information Exchange on Dioxins and Related Compounds: International Toxicity Equivalency Factor (I-TEF) Methods of Risk Assessment for Complex Mixtures of Dioxins and Related Compounds. Report No. 176, August 1988.

( ) Non Detectable - Results are below target analyte detection limits. ND values are not counted in totals or averages.

{ } Estimated Maximum Possible Concentration. EMPC values are not counted in totals or averages.

TABLE 2.5

CDD/CDF EMISSIONS SAMPLING AND STACK GAS PARAMETERS
KILN NO. 2 SCRUBBER "B" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M23-B-1	M23-B-2	M23-B-3	Average
Date	10/16/96	10/17/96	10/18/96	
Total Sampling Time, min.	240	240	240	
Average Sampling Rate, dscfm[a]	0.721	0.443	0.589	0.584
Sample Volume:				
dscf[b]	172.998	106.346	141.244	140.196
dscm[c]	4.873	2.996	3.979	3.949
Average Stack Gas Temp., °F	135	131	134	133
O_2 Concentration, % by Volume	7.8	7.7	7.6	7.7
CO_2 Concentration, % by Volume	19.0	20.0	19.7	19.6
Moisture, % by Volume	17.6	15.5	17.0	16.7
Stack Gas Volumetric Flow Rate:				
acfm[d]	16,653	14,168	19,530	16,783
dscfm[a]	11,667	10,192	13,633	11,831
dscmm[e]	330	289	386	335
Isokinetic Sampling Ratio %	101.3	104.3	103.5	103.0

[a] Dry standard cubic feet per minute at 68°F and 1 atm
[b] Dry standard cubic feet at 68°F and 1 atm
[c] Dry standard cubic meters at 20°C and 1 atm
[d] Actual cubic feet per minute at stack conditions
[e] Dry standard cubic meters per minute at 20°C and 1 atm

TABLE 2.6

CDD/CDF STACK GAS CONCENTRATIONS AND EMISSION RATES
KILN NO. 2 SCRUBBER "B" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

CONGENER	CONCENTRATION[a] ng/dscm, as measured				EMISSION RATE[b] μg/hr			
	M23-B-1	M23-B-2	M23-B-3	Average	M23-B-1	M23-B-2	M23-B-3	Average
Dioxins								
2378 TCDD	(0.0021)	(0.0033)	(0.0025)	(0.00)	(0.041)	(0.058)	(0.058)	0.00
Total TCDD	0.041	0.090	0.15	0.095	0.81	1.6	3.6	2.0
12378 PeCDD	(0.0041)	(0.0067)	(0.0020)	0.00	(0.081)	(0.12)	(0.050)	0.00
Total PeCDD	0.016	0.030	0.030	0.026	0.33	0.52	0.70	0.51
123478 HxCDD	(0.0041)	(0.0067)	(0.0075)	0.00	(0.081)	(0.12)	(0.17)	0.00
123678 HxCDD	(0.0041)	(0.0067)	(0.0050)	0.00	(0.081)	(0.12)	(0.12)	0.00
123789 HxCDD	(0.0041)	(0.0067)	(0.0050)	0.00	(0.081)	(0.12)	(0.12)	0.00
Total HxCDD	0.041	0.040	0.033	0.038	0.81	0.69	0.76	0.75
1234678 HpCDD	0.010	0.010	0.010	0.010	0.20	0.17	0.23	0.20
Total HpCDD	0.018	0.017	0.010	0.015	0.37	0.29	0.23	0.30
Octa CDD	0.070	{0.030}	{0.085}	0.070	1.4	{0.52}	{2.0}	1.4
Total CDD	0.19	0.18	0.23	0.20	3.7	3.1	5.2	4.0
Furans								
2378 TCDF	0.0082	0.0067	0.010	0.0083	0.16	0.12	0.23	0.17
Total TCDF	0.29	0.12	0.30	0.24	5.7	2.1	7.0	4.9
12378 PeCDF	0.0041	(0.0033)	(0.0025)	0.0041	0.081	(0.058)	(0.058)	0.081
23478 PeCDF	0.0062	(0.0033)	(0.0025)	0.0062	0.12	(0.058)	(0.058)	0.12
Total PeCDF	0.088	0.020	0.065	0.058	1.7	0.35	1.5	1.2
123478 HxCDF	0.0082	0.0067	0.0075	0.075	0.16	0.12	0.17	0.15
123678 HxCDF	0.0041	0.0020	0.0020	0.0027	0.081	0.035	0.047	0.054
234678 HxCDF	0.0041	(0.0033)	{0.0025}	0.0041	0.081	(0.058)	{0.058}	0.081
123789 HxCDF	(0.0041)	(0.0067)	(0.0050)	0.00	(0.081)	(0.12)	(0.12)	0.00
Total HxCDF	0.033	0.020	0.013	0.022	0.65	0.35	0.29	0.43
1234678 HpCDF	0.014	{0.0067}	0.0075	0.011	0.28	{0.12}	0.17	0.23
1234789 HpCDF	0.0021	(0.0067)	(0.0075)	0.0021	0.041	(0.12)	(0.17)	0.041
Total HpCDF	0.016	{0.0067}	0.0075	0.012	0.33	{0.12}	0.17	0.25
Octa CDF	0.12	{0.0067}	0.015	0.014	0.24	{0.12}	0.35	0.30
Total CDF	0.42	0.16	0.39	0.33	8.3	2.8	9.1	6.8
Total CDD + CDF	0.61	0.34	0.62	0.52	12	5.9	14	11

[a] Nanogram per dry standard cubic meter at 20°C and 1 atm.
[b] Micrograms per hour.
( ) Non Detectable - Results are below target analyte detection limits. ND values are not counted in totals or averages.
{ } Estimated Maximum Possible Concentration. EMPC values are not counted in totals or averages.

TABLE 2.7

CDD/CDF STACK GAS CONCENTRATIONS AND 2378 TOXIC EQUIVALENT STACK GAS CONCENTRATIONS ADJUSTED TO 7 PERCENT OXYGEN
KILN NO. 2 SCRUBBER "B" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

CONGENER	CONCENTRATION[a] ng/dscm, adjusted to 7 percent O_2				2378-TCDD[b] Toxic Equiv. Factor	2378 TOXIC EQUIVALENCIES ng/dscm, adjusted to 7 percent O_2			
	M23-B-1	M23-B-2	M23-B-3	Average		M23-B-1	M23-B-2	M23-B-3	Average
Dioxins									
2378 TCDD	(0.0022)	(0.0035)	(0.0026)	0.00	1.000	(0.0022)	(0.004)	(0.003)	0.00
Total TCDD	0.044	0.095	0.160	0.10					
12378 PeCDD	(0.0044)	(0.0070)	(0.0021)	0.00	0.500	(0.0022)	(0.004)	(0.0011)	0.00
Total PeCDD	0.017	0.032	0.032	0.027					
123478 HxCDD	(0.0044)	(0.0070)	(0.0079)	0.00	0.100	(0.00044)	(0.00070)	(0.00079)	0.00
123678 HxCDD	(0.0044)	(0.0070)	(0.0053)	0.00	0.100	(0.00044)	(0.00070)	(0.00053)	0.00
123789 HxCDD	(0.0044)	(0.0070)	(0.0053)	0.00	0.100	(0.00044)	(0.00070)	(0.00053)	0.00
Total HxCDD	0.044	0.042	0.034	0.04					
1234678 HpCDD	0.011	0.011	0.011	0.011	0.010	0.00011	0.00011	0.00011	0.00011
Total HpCDD	0.020	0.018	0.011	0.016					
Octa CDD	0.074	{0.032}	{0.089}	0.074	0.001	0.000074	{0.000032}	{0.000089}	0.000074
Total CDD	0.20	0.19	0.24	0.21		0.00018	0.00011	0.00011	0.00013
Furans									
2378 TCDF	0.0087	0.0070	0.011	0.0087	0.100	0.00087	0.00070	0.0011	0.00087
Total TCDF	0.30	0.13	0.32	0.25					
12378 PeCDF	0.0044	(0.0035)	(0.0026)	0.0044	0.050	0.00022	(0.00018)	(0.00013)	0.0022
23478 PeCDF	0.0065	(0.0035)	(0.0026)	0.0065	0.500	0.0033	(0.0018)	(0.0013)	0.0033
Total PeCDF	0.094	0.021	0.068	0.061					
123478 HxCDF	0.0087	0.0070	0.0079	0.0079	0.100	0.00087	0.00070	0.00079	0.00079
123678 HxCDF	0.0044	0.0021	0.0021	0.0029	0.100	0.00044	0.00021	0.00021	0.00029
234678 HxCDF	0.0044	(0.0035)	0.0026	0.0035	0.100	0.00044	(0.00035)	0.00026	0.00035
123789 HxCDF	(0.0044)	(0.0070)	(0.0053)	0.00	0.100	(0.00044)	(0.00070)	(0.00053)	0.00
Total HxCDF	0.035	0.021	0.013	0.023					
1234678 HpCDF	0.014	{0.0067}	0.0075	0.011	0.010	0.00014	{0.000067}	0.000075	0.00011
1234789 HpCDF	0.0022	(0.0070)	(0.0079)	0.0022	0.010	0.000022	(0.000070)	(0.000079)	0.000022
Total HpCDF	0.017	{0.0070}	0.0079	0.013					
Octa CDF	0.013	{0.0070}	0.016	0.014	0.001	0.000013	{0.0000070}	0.000016	0.000014
Total CDF	0.45	0.17	0.41	0.34		0.00632	0.00161	0.00245	0.00156
Total CDD + CDF	0.64	0.36	0.65	0.55		0.00650	0.00172	0.00256	0.00359

[a] Nanogram per dry standard cubic meter adjusted to 7 percent oxygen at 20°C and 1 atm.

[b] North Atlantic Treaty Organization, Committee on the Challenges of Modern Society. Pilot study on International Information Exchange on Dioxins and Related Compounds: International Toxicity Equivalency Factor (I-TEF) Methods of Risk Assessment for Complex Mixtures of Dioxins and Related Compounds. Report No. 176, August 1988.

( )Non Detectable - Results are below target analyte detection limits. ND values are not counted in totals or averages.

{ }Estimated Maximum Possible Concentration. EMPC values are not counted in totals or averages.

TABLE 2.8

PARTICULATE/METALS EMISSIONS SAMPLING AND STACK GAS PARAMETERS
KILN NO. 2 SCRUBBER "A" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M29-A-1	M29-A-2	M29-A-3	Average
Date	10/16/96	10/17/96	10/18/96	
Total Sampling Time, min.	240	240	240	
Average Sampling Rate, dscfm[a]	0.539	0.548	0.558	0.548
Sample Volume:				
dscf[b]	129.347	131.430	134.001	131.593
dscm[c]	3.663	3.772	3.794	3.726
Average Stack Gas Temp., °F	128	126	129	128
O_2 Concentration, % by Volume	6.6	5.0	6.7	6.1
CO_2 Concentration, % by Volume	21.1	23.7	21.0	21.9
Moisture, % by Volume	15.0	14.2	15.4	14.9
Stack Gas Volumetric Flow Rate:				
acfm[d]	25,740	25,454	28,226	26,473
dscfm[a]	18,799	18,754	20,250	19,268
dscmm[e]	532	531	573	546
Isokinetic Sampling Ratio, %	102.4	100.3	101.7	101.5

[a] Dry standard cubic feet per minute at 68°F and 1 atm.
[b] Dry standard cubic feet at 68°F and 1 atm.
[c] Dry standard cubic meters at 20°C and 1 atm.
[d] Actual cubic feet per minute at stack conditions.
[e] Dry standard cubic meters per minute at 20°C and 1 atm.

contained 21.9% CO_2, 6.1% O_2, and 14.9% moisture (100% of saturation). The average stack gas volumetric flow rate was 26,473 acfm or 19,268 dscfm or 546 dscmm.

Table 2.9 summarizes the stack gas particulate matter concentrations and emission rates. The average concentration was 5.38 E-02 grains per dry standard cubic foot (gr/dscf) or 1.23 E-01 grams per dry standard cubic meter (g/dscm). The concentrations are also shown adjusted to 7% O_2. The average mass emission rate was 8.86 pounds per hour (lb/hr) or 4.02 kilograms per hour (kg/hr).

Table 2.10 summarizes the stack gas metals concentrations and emission rates. All of the target metals were found to be present in all three samples. Average concentrations ranged from 1.93 micrograms per dry standard cubic meter (µg/dscm) for arsenic to 33.7 µg/dscm for selenium.

Scrubber "B"

Table 2.11 summarizes the particulate matter/metals emissions sampling and stack gas parameters. The total sampling time for each test run was 240 minutes. The average sample volume was 131.312 dscf or 3.718 dscm. The average stack gas temperature was 133°F and contained 19.6% CO_2, 7.7% O_2, and 16.6% moisture (97% of saturation). The average stack gas volumetric flow rate was 15,795 acfm or 11,153 dscfm or 316 dscmm.

Table 2.12 summarizes the stack gas particulate matter concentrations and emission rates. The average concentration was 4.14 E-02 gr/dscf or 9.48 E-02 g/dscm. The concentrations are also shown adjusted to 7% O_2. The average emission rate was 3.90 lb/hr or 1.77 kg/hr.

Table 2.13 summarizes the stack gas metals concentrations and emission rates. All of the target metals were found to be present in all three samples. Average concentrations ranged from 1.54 µg/dscm for arsenic to 36.9 µg/dscm for selenium.

2.2.3 Total Hydrocarbons

Total hydrocarbons (THC) were measured using a flame ionization analyzer (FIA) calibrated with propane-in-air gases. Two FIAs were used, one for the Kiln No. 2 exhaust and one for the outlets of Scrubbers "A" and "B". The outlet FIA was used to alternately sample the outlet stacks of scrubber A or B at approximately 15-minute intervals. The FIAs were operated on a 0-100 parts per million by volume (ppmv) range. The instrument sensitivity was ±2% of span or 2 ppmv. The sample lines, pump, and detector were heated; therefore the THC concentrations were measured on a wet basis. The measured moisture contents in each stack were used to correct the measured concentrations on a wet basis to concentrations on a dry basis. At the scrubber outlets the average moistures obtained for each run from the Method 23 and Method 29 moisture determinations were used.

TABLE 2.9

PARTICULATE MATTER CONCENTRATIONS AND EMISSION RATES
KILN NO. 2 SCRUBBER "A" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M29-A-1	M29-A-2	M29-A-3	Average
Date	10/16/96	10/17/96	10/18/96	
Clock Time, 24-hr clock	1510-2038	1140-1630	1100-1548	
Concentration:				
gr/dscf[a]	0.0454	0.0687	0.0474	0.0538
gr/dscf @ 7% O_2[b]	0.0301	0.0455	0.0314	0.0356
g/dscm[c]	0.104	0.157	0.108	0.123
g/dscm @ 7% O_2[d]	0.0688	0.104	0.072	0.0815
Emission Rate:				
lb/hr[e]	7.31	11.0	8.22	8.86
kg/hr[f]	3.32	5.01	3.73	4.02

[a] Grains per dry standard cubic foot at 68°F and 1 atm.
[b] Grains per dry standard cubic foot at 68°F and 1 atm adjusted to 7 percent O_2.
[c] Grams per dry standard cubic meter at 20°C and 1 atm.
[d] Grams per dry standard cubic meter at 20°C and 1 atm adjusted to 7 percent O_2.
[e] Pounds per hour.
[f] Kilograms per hour.

TABLE 2.10

STACK GAS METALS CONCENTRATIONS AND EMISSION RATES
KILN NO. 2 SCRUBBER "A" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M29-A-1	1M29-A-2	M29-A-3	Average
Date	10/16/96	10/17/96	10/18/96	
Clock Time, 24-hr Clock	1510-2038	1140-1630	1100-1548	
Antimony (Sb)				
μg/dscm[a]	6.42	4.65	3.00	4.69
μg/dscm @ 7% O_2[b]	6.24	4.06	2.94	4.41
g/hr[c]	0.205	0.148	0.103	0.152
Arsenic (As)				
μg/dscm[a]	2.50	2.02	1.26	1.93
μg/dscm @ 7% O_2[b]	2.43	1.77	1.23	1.81
g/hr[c]	0.0800	0.0645	0.0432	0.0626
Beryllium (Be)				
μg/dscm[a]	10.4	20.6	16.7	15.9
μg/dscm @ 7% O_2[b]	10.1	18.0	16.3	14.8
g/hr[c]	0.332	0.656	0.573	0.520
Cadmium (Cd)				
μg/dscm[a]	1.03	5.21	1.53	2.59
μg/dscm @ 7% O_2[b]	1.01	4.56	1.50	2.35
g/hr[c]	0.0330	0.166	0.0528	0.0840
Total Chromium (Cr)				
μg/dscm[a]	15.3	14.5	7.35	12.4
μg/dscm @ 7% O_2[b]	14.9	12.7	7.20	11.6
g/hr[c]	0.490	0.461	0.253	0.402
Cobalt (Co)				
μg/dscm[a]	10.5	15.2	16.8	14.1
μg/dscm @ 7% O_2[b]	10.2	13.2	16.4	13.3
g/hr[c]	0.335	0.483	0.577	0.465
Lead (Pb)				
μg/dscm[a]	20.3	42.5	11.7	24.8
μg/dscm @ 7% O_2[b]	19.7	37.1	11.5	22.8
g/hr[c]	0.647	1.35	0.403	0.801
Manganese (Mn)				
μg/dscm[a]	21.4	53.5	20.1	31.6
μg/dscm @ 7% O_2[b]	20.8	46.7	19.6	29.1
g/hr[c]	0.684	1.70	0.690	1.03
Mercury (Hg)				
μg/dscm[a]	2.78	1.69	1.84	2.10
μg/dscm @ 7% O_2[b]	2.71	1.48	1.80	2.00
g/hr[c]	0.0889	0.0538	0.0634	0.0687
Nickel (Ni)				
μg/dscm[a]	26.2	23.0	17.9	22.4
μg/dscm @ 7% O_2[b]	25.5	20.1	17.5	21.0
g/hr[c]	0.836	0.734	0.616	0.729
Selenium (Se)				
μg/dscm[a]	53.0	28.5	19.5	33.7
μg/dscm @ 7% O_2[b]	51.5	24.9	19.1	31.8
g/hr[c]	1.69	0.908	0.672	1.09

[a] Micrograms per dry standard cubic meter @ 20° C and 1 atm.
[b] Micrograms per dry standard cubic meter @ 20°C and 1 atm, adjusted to 7% O_2.
[c] Grams per hour.

TABLE 2.11

PARTICULATE/METALS EMISSIONS SAMPLING AND STACK GAS PARAMETERS
KILN NO. 2 SCRUBBER "B" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M29-B-1	M29-B-2	M29-B-3	Average
Date	10/16/96	10/17/96	10/18/96	
Total Sampling Time, min.	240	240	240	
Average Sampling Rate, dscfm[a]	0.717	0.416	0.509	0.547
Sample Volume:				
dscf[b]	172.068	99.783	122.085	131.312
dscm[c]	4.872	2.826	3.457	3.718
Average Stack Gas Temp., °F	135	130	133	133
O_2 Concentration, % by volume	7.8	7.7	7.6	7.7
CO_2 Concentration, % by volume	19.0	20.0	19.7	19.6
Moisture, % by volume	17.5	15.6	16.7	16.6
Volumetric Flow Rate:				
acfm[d]	16,444	13,754	17,185	15,795
dscfm[a]	11,510	9,907	12,044	11,153
dscmm[e]	326	281	341	316
Isokinetic Sampling Ratio, %	100.5	100.7	101.3	100.8

[a] Dry standard cubic feet per minute at 68°F and 1 atm.
[b] Dry standard cubic feet at 68°F and 1 atm.
[c] Dry standard cubic meters at 20°C and 1 atm.
[d] Actual cubic feet per minute at stack conditions.
[e] Dry standard cubic meters per minute at 20°C and 1 atm.

TABLE 2.12

PARTICULATE MATTER CONCENTRATIONS AND EMISSION RATES
KILN NO. 2 SCRUBBER "B" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M29-B-1	M29-B-2	M29-B-3	Average
Date	10/16/96	10/17/96	10/18/96	
Clock Time, 24-hr clock	1514-2037	1140-1630	1100-1550	
Concentration:				
gr/dscf[a]	0.0325	0.0540	0.0378	0.0414
gr/dscf @ 7% O_2[b]	0.0215	0.0360	0.0253	0.0276
g/dscm[c]	0.0743	0.124	0.0864	0.0948
g/dscm @ 7% O_2[d]	0.0493	0.0824	0.0578	0.0631
Emission Rate:				
lb/hr[e]	3.20	4.58	3.90	3.90
kg/hr[f]	1.45	2.08	1.77	1.77

[a] Grains per dry standard cubic foot at 68°F and 1 atm.
[b] Grains per dry standard cubic foot at 68°F and 1 atm adjusted to 7 percent O_2.
[c] Grams per dry standard cubic meter at 20°C and 1 atm.
[d] Grams per dry standard cubic meter at 20°C and 1 atm adjusted to 7 percent O_2.
[e] Pounds per hour.
[f] Kilograms per hour.

TABLE 2.13

STACK GAS METALS CONCENTRATIONS AND EMISSION RATES
KILN NO.2 SCRUBBER "B" OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M29-B-1	M29-B-2	M29-B-3	Average
Date	10/16/96	10/17/96	10/18/96	
Clock Time, 24-hr Clock	1514-2037	1140-1630	1100-1550	
Antimony (Sb)				
μg/dscm[a]	3.69	5.91	3.12	4.24
μg/dscm @ 7% O_2[b]	3.92	6.22	3.26	4.47
g/hr[c]	0.0722	0.0995	0.0639	0.0785
Arsenic (As)				
μg/dscm[a]	1.51	2.09	1.03	1.54
μg/dscm @ 7% O_2[b]	1.60	2.20	1.08	1.63
g/hr[c]	0.0295	0.0351	0.0211	0.0286
Beryllium (Be)				
μg/dscm[a]	11.1	16.6	16.8	14.8
μg/dscm @ 7% O_2[b]	11.8	17.4	17.6	15.6
g/hr[c]	0.218	0.279	0.344	0.280
Cadmium (Cd)				
μg/dscm[a]	1.98	4.71	1.37	2.69
μg/dscm @ 7% O_2[b]	2.11	4.96	1.43	2.83
g/hr[c]	0.0388	0.0792	0.0281	0.0487
Total Chromium (Cr)				
μg/dscm[a]	7.78	16.7	7.00	10.5
μg/dscm @ 7% O_2[b]	8.25	17.6	7.32	11.1
g/hr[c]	0.152	0.282	0.143	0.192
Cobalt (Co)				
μg/dscm[a]	14.7	16.0	16.4	15.7
μg/dscm @ 7% O_2[b]	15.6	16.8	17.1	16.5
g/hr[c]	0.287	0.269	0.336	0.297
Lead (Pb)				
μg/dscm[a]	14.2	52.7	13.6	26.9
μg/dscm @ 7% O_2[b]	15.1	55.5	14.2	28.3
g/hr[c]	0.278	0.888	0.279	0.482
Manganese (Mn)				
μg/dscm[a]	9.05	61.6	21.3	30.6
μg/dscm @ 7% O_2[b]	9.60	64.8	22.3	32.2
g/hr[c]	0.177	1.04	0.436	0.550
Mercury (Hg)				
μg/dscm[a]	2.79	2.25	1.99	2.34
μg/dscm @ 7% O_2[b]	2.96	2.37	2.08	2.47
g/hr[c]	0.0546	0.0379	0.0407	0.0444
Nickel (Ni)				
μg/dscm[a]	16.0	26.9	18.9	20.6
μg/dscm @ 7% O_2[b]	17.0	28.3	19.7	21.7
g/hr[c]	0.313	0.453	0.386	0.384
Selenium (Se)				
μg/dscm[a]	46.6	38.9	25.3	36.9
μg/dscm @ 7% O_2[b]	49.4	41.0	26.4	39.0
g/hr[c]	0.911	0.655	0.517	0.695

[a] Micrograms per dry standard cubic meter @ 20° C and 1 atm.
[b] Micrograms per dry standard cubic meter @ 20°C and 1 atm, adjusted to 7% O_2.
[c] Grams per hour.

At the kiln exhaust, it was not possible to measure stack gas velocity. In order to determine the kiln exhaust volumetric flow rate, it was necessary to calculate this value based on the measured flow rates at the scrubber outlets and accounting for dilution air. Also, at the kiln exhaust, measurements were made of stack gas CO_2, O_2, and moisture content so that corrections could be made for dilution air and wet-to-dry THC concentrations. On average 20% dilution air entered the duct between the kiln exhaust and scrubber outlet.

Kiln No. 2

Table 2.14 summarizes the exhaust gas conditions at the Kiln No. 2 exhaust. The average exhaust gas temperature was 926°F and contained 25.1% CO_2, 4.0% O_2, and 9.9% moisture. The average exhaust gas volumetric flow rate was 78,038 acfm or 25,203 dscfm or 714 dscmm.

Table 2.15 summarizes the THC emissions from Kiln No. 2. In all cases the THC concentrations were very low, being only about 3 ppmv above the instrument detection of 2 ppmv. At the kiln exhaust the average THC concentration was 4.6 ppmv, dry basis, or 3.8 ppmv adjusted to 7% O_2. The average emission rate was 0.80 lb/hr. At the outlet of scrubber "A" the average THC concentration was 5.7 ppmv or 5.3 ppmv adjusted to 7% O_2. The average emissions rate was 0.73 lb/hr. At the outlet of scrubber "B" the average THC concentration was 5.2 ppmv or 5.5 ppmv at 7% O_2. The combined THC emission rate from both scrubbers was 1.13 lb/hr.

2.3 HYDRATOR

Table 2.16 summarizes the particulate matter/metals emissions sampling and stack gas parameters. The total sampling time for each test run was 120 minutes. The average sample volume was 48.307 dscf or 1.368 dscm. The average stack gas temperature was 185°F and contained 57.9% moisture. The stack gas composition (on a dry basis) was assumed to be 20.9% O_2 and no CO_2. The average stack gas volumetric flow rate was 3,278 acfm or 1,065 dscfm or 30.2 dscmm.

Table 2.17 summarizes the stack gas particulate matter concentrations and emission rates. The average concentration was 4.16 E-02 gr/dscf or 9.53 E-02 g/dscf. The concentrations are also shown adjusted to 7% O_2. The average emission rate was 3.79 E-02 lb/hr or 1.72 E-01 kg/hr.

Table 2.18 summarizes the stack gas metals concentrations and emission rates. All of the target metals except beryllium and mercury were found to be present in all three samples. Average concentrations of those metals detected ranged from 0.879 μg/dscm for cadmium to 22.9 μg/dscm for manganese.

TABLE 2.14

SUMMARY OF STACK GAS CONDITIONS
KILN NO. 2 EXHAUST
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	1	2	3	Average
Date	10-16-96	10-17-96	10-18-96	
Average Stack Gas Temp., °F	924	905	950	926
O_2 Concentrations, % by volume	3.5	2.7	5.4	4.0
CO_2 Concentration, % by volume	25.0	27.4	23.0	25.1
Moisture, % by volume	11.0	10.3	8.4	9.9
Stack Gas Volumetric Flow Rate:				
acfm[a,b]	73,534	72,171	88,409	78,038
dscfm[a,c]	23,901	22,975	28,732	25,203
dscmm[a,d]	677	651	814	714

[a] Calculated using combined outlet volumetric flow rates from scrubbers "A" and "B" and adjustments for dilution air.
[b] Actual cubic feet per minute at stack conditions.
[c] Dry standard cubic feet per minute at 68°F and 1 atm.
[d] Dry standard cubic meters per minute at 20°C and 1 atm.

TABLE 2.15

SUMMARY OF TOTAL HYDROCARBON EMISSIONS - KILN NO. 2
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	25A-1	25A-2	25A-3	Average
Date	10-16-96	10-17-96	10-18-96	
Kiln No. 2 Exhaust				
Flow Rate, dscfm[a,b]	23,901	22,975	28,732	25,203
Oxygen, %	3.5	2.7	5.4	3.9
THC Concentration				
ppmvd[c]	2.3	6.9	4.7	4.6
ppmvd @ 7% O_2[d]	1.8	5.3	4.2	3.8
THC Emission Rate				
lb/hr[e]	0.38	1.1	0.93	0.80
Scrubber "A" Outlet				
Flow Rate, dscfm[a]	18,548	18,014	19,432	18,665
Oxygen, %	6.6	5.0	6.7	6.1
THC Concentration				
ppmvd[c]	3.4	7.6	6.1	5.7
ppmvd @ 7% O_2[d]	3.3	6.7	6.0	5.3
THC Emission Rate				
lb/hr[e]	0.43	0.94	0.81	0.73
Scrubber "B" Outlet				
Flow Rate, dscfm[a]	11,589	10,050	12,839	11,493
Oxygen, %	7.8	7.7	7.6	7.7
THC Concentration				
ppmvd[c]	5.0	6.0	4.7	5.2
ppmvd @ 7% O_2[d]	5.3	6.3	4.9	5.5
THC Emission Rate				
lb/hr[e]	0.40	0.41	0.41	0.41
Scrubbers Outlet Total				
Flow Rate, dscfm[a]	30,137	28,064	32,271	30,158
Oxygen, %	7.1	6.0	7.1	6.7
THC Concentration				
ppmvd[c]	4.0	7.0	5.5	5.5
ppmvd @ 7% O_2[d]	4.0	6.6	5.6	5.4
THC Emission Rate				
lb/hr[e]	0.83	1.35	1.22	1.13

[a] Dry standard cubic feet per minute at 68°F and 29.92" Hg.
[b] Calculated from combined outlet flow rate corrected for dilution air.
[c] Parts per million by volume, as propane, dry basis.
[d] Parts per million by volume, as propane, dry basis, adjusted to 7 % oxygen.
[e] Pounds per hour.

TABLE 2.16

PARTICULATE/METALS EMISSIONS SAMPLING AND STACK GAS PARAMETERS
HYDRATOR EXHAUST STACK
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M29-5	M29-6	M29-7	Average
Date	10/19/96	10/20/96	10/20/96	
Total Sampling Time, min.	120	120	120	
Average Sampling Rate, dscfm[a]	0.443	0.352	0.413	0.403
Sample Volume:				
dscf[b]	53.142	42.234	49.544	48.307
dscm[c]	1.505	1.196	1.403	1.368
Average Stack Gas Temp., °F	185	185	186	185
O_2 Concentration, % by volume	20.9	20.9	20.9	20.9
CO_2 Concentration, % by volume	0	0	0	0
Moisture, % by volume	58.6	56.3	58.7	57.9
Stack Gas Volumetric Flow Rate:				
acfm[d]	3,403	3,002	3,428	3,278
dscfm[a]	1,088	1,015	1,094	1,065
dscmm[e]	30.8	28.7	31.0	30.2
Isokinetic Sampling Ratio, %	107.0	92.0	99.2	99.4

[a] Dry standard cubic feet per minute at 68°F and 1 atm.
[b] Dry standard cubic feet at 68°F and 1 atm.
[c] Dry standard cubic meters at 20°C and 1 atm.
[d] Actual cubic feet per minute at stack conditions.
[e] Dry standard cubic meters per minute at 20°C and 1 atm.

TABLE 2.17

PARTICULATE MATTER CONCENTRATIONS AND EMISSION RATES
HYDRATOR EXHAUST STACK
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M29-5	M29-6	M29-7	Average
Date	10/19/96	10/20/96	10/20/96	
Clock Time, 24-hr Clock	1339-1541	1008-1213	1233-1436	
Concentration:				
gr/dscf[a]	0.0361	0.0460	0.0428	0.0416
g/dscm[b]	0.0825	0.105	0.0980	0.0953
Emission Rate:				
lb/hr[c]	0.336	0.400	0.402	0.379
kg/hr[d]	0.153	0.182	0.182	0.172

[a] Grains per dry standard cubic foot at 68°F and 1 atm.
[b] Grams per dry standard cubic meter at 20°C and 1 atm.
[c] Pounds per hour.
[d] Kilograms per hour.

TABLE 2.18

STACK GAS METALS CONCENTRATIONS AND EMISSION RATES
KILN NO.2 HYDRATOR OUTLET
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	M29-5	M29-6	M29-7	Average
Date	10/19/96	10/20/96	10/20/96	
Clock Time, 24-hr Clock	1339-1541	1008-1213	1233-1436	
Antimony (Sb)				
μg/dscm[a]	13.0	4.26	5.89	7.73
g/hr[c]	0.0241	0.00735	0.0110	0.0141
Arsenic (As)				
μg/dscm[a]	3.28	2.30	0.948	2.17
g/hr[c]	0.00605	0.00396	0.00176	0.00393
Beryllium (Be)				
μg/dscm[a]	0.00	0.00	0.00	0.00
g/hr[c]	0.00	0.00	0.00	0.00
Cadmium (Cd)				
μg/dscm[a]	0.970	0.853	0.813	0.879
g/hr[c]	0.00179	0.00147	0.00151	0.00159
Total Chromium (Cr)				
μg/dscm[a]	25.5	27.3	13.7	22.2
g/hr[c]	0.0472	0.0470	0.0254	0.0399
Cobalt (Co)				
μg/dscm[a]	5.95	6.31	3.07	5.11
g/hr[c]	0.0110	0.0109	0.00571	0.00919
Lead (Pb)				
μg/dscm[a]	4.35	8.20	6.21	6.25
g/hr[c]	0.00803	0.0141	0.0115	0.0112
Manganese (Mn)				
μg/dscm[a]	31.3	23.9	13.5	22.9
g/hr[c]	0.0578	0.0412	0.0250	0.0414
Mercury (Hg)				
μg/dscm[a]	0.00	0.00	0.00	0.00
g/hr[c]	0.00	0.00	0.00	0.00
Nickel (Ni)				
μg/dscm[a]	17.5	9.45	14.0	13.7
g/hr[c]	0.0324	0.0163	0.0261	0.0249
Selenium (Se)				
μg/dscm[a]	12.5	3.71	5.77	7.33
g/hr[c]	0.0231	0.00640	0.0107	0.0134

[a] Micrograms per dry standard cubic meter @ 20° C and 1 atm.
[b] Micrograms per dry standard cubic meter @ 20°C and 1 atm, adjusted to 7% O_2.
[c] Grams per hour.

3.0 PROCESS DESCRIPTION

The Eastern Ridge Lime Company is located in Ripplemead, Virginia. The facility has three coal-fired rotary kilns. The emissions from each kiln are controlled by two parallel Ducon wet scrubbers. Kiln No. 2 is rated at 350 tons per day.

In addition to the kilns, the facility also operates a hydrator where lime is converted to hydrated lime. The hydrator operates continuously. Water sprays are used as an integrated part of the hydrating process to prevent product loss.

During this testing program, Research Triangle Institute (RTI), under contract to the ESD/MICG, was responsible for monitoring and documenting all process and emission control system operational parameters, and development of a detailed process section for the report. Contained in this section is a condensed narrative and process conditions. RTI's complete process description and detailed process conditions are contained in Appendix A.

3.1 PROCESS DESCRIPTION FOR EASTERN RIDGE PLANT

Lime (CaO) is typically produced in the U.S. by crushing and then heating limestone ($CaCO_3$) in an inclined, rotating kiln. The limestone is heated to temperatures of around 2000 degrees Fahrenheit (°F) which cause it to breakdown chemically into lime and CO_2. At Eastern Ridge, most of the lime is sold as CaO; a small amount (ten percent of production) is converted into hydrated lime ($Ca(OH)_2$).

Limestone at the Eastern Ridge plant is surface-mined from a quarry located at the plant. The quarried limestone is crushed and screened into several sizes and then transferred to a storage area. Prior to entering the kiln, the sized stone is washed with water to remove dirt.

Kiln No. 2 is an inclined rotating kiln with a design capacity of 350 tons of lime per day (115,150 tons per year). The kiln is 392 feet long with a tapered diameter (11 feet in diameter at the front end of the kiln and 10 feet in diameter the remaining length of the kiln). The incline of the kiln is ½ inch per foot. Limestone enters the kiln at its back end (the highest point of incline) and tumbles through the kiln via gravity and the rotating motion of the kiln (typical rotating rates are 55 to 65 revolutions per hour). The residence time of the feed material in the kiln is four hours. Approximately two tons of limestone are required to produce a ton of lime.

The combustion of fuel, which consists of pulverized coal suspended in air, occurs at the front end of the kiln (the origin and chemical composition of the coal at the time of testing are unknown). The coal is pulverized to the consistency of powder in a bowl mill (the bowl mill is exclusive to the number two kiln). Air from the firing hood, located directly above the combustion end of the kiln, is pulled into the bowl mill. The air preheats and dries the coal. A fan on the mill blows the air and dry pulverized coal from the mill into the kiln. Typically a quarter to a third of a ton of coal is consumed per ton of lime.

As the lime exits the kiln, it drops into one of ten satellite coolers that are attached to the exterior of the kiln. The coolers are long cylindrical tubes (30 feet long by 8 feet wide in diameter) filled with chains. As the coolers rotate with the kiln, the lime tumbles through the chains which conduct heat away from the lime. Lime drops from the cooler tubes onto a conveyor belt. The lime is conveyed to a screen, separated by particle size, and stored. Fines from product screening are collected, stored, and used in hydrate production.

Approximately ten percent of the lime produced at Eastern Ridge is chemically reacted with water to form a hydrated product. The chemical reaction for hydration is as follows:

$$CaO + H_2O \rightleftharpoons Ca(OH)_2 + \text{heat}$$

Lime Hydrate

At Eastern Ridge, the hydration process is carried out in seven steps. In step one, lime fines are mixed with water in a pug mill to form a partially hydrated product. The pug mill is a horizontal cylinder that contains a shaft fitted with short, heavy paddles that push and mix the materials through the mill. The source of water to the pug mill is effluent from the wet scrubber that treats exhaust from steps two through seven (the scrubber is discussed further under Hydrator Emissions Control). In steps two through seven, the partially hydrated product passes through a series of six mixing barrels which allow the mixture to fully react (the transfer time through all six mixing barrels is approximately thirty minutes). After the lime is hydrated, it is transferred to a storage bin, milled, and separated from impurities (such as unreacted lime and limestone) with a whizzer separator (similar to a cylone). Approximately 28,000 tons of hydrate are typically produced annually.

3.2 EMISSIONS CONTROL

3.2.1 Kiln Emissions Control

Exhaust from Kiln No. 2 is routed to two, parallel spray towers. The spray towers/scrubbers were manufactured by Ducon and were installed at the plant in the 1970's. Each scrubber is equipped with a fan which draws the kiln exhaust up through the tower. Water is sprayed into the tower at various points upstream of the fan and into the fan itself. The exhaust from the fan exits through a stack. Effluent from the scrubbers is directed to a

series of four settling ponds where solids are removed. Clarified water is recycled back to the scrubbers.

3.2.2 Hydrator Emissions Control

The hydration process is exothermic, and part of the water in the hydrate mixture is vaporized. Gases from the hydrator, containing water and lime particles, are pulled by fan to a Ducon scrubber, scrubbed with 10 gallons per minute (gpm) of water (typical), and then vented to the atmosphere. (The flow rate of scrubbing water varies somewhat with the moisture content of the lime fines in step one of the hydration process. For example, newly processed lime fines have less moisture than fines which have been kept in storage; thus, the former may require more than 10 gpm while the latter may require less than 10 gpm.) Effluent from the scrubber is added to the lime fines in step one. The Ducon scrubber is the same type of spray tower used to control the kiln exhaust.

Refer to Figure 1 in Appendix A for a diagram of the kiln, hydrator and associated emissions control. The diagram indicates the relative locations for each unit operation, direction of flow for material and gas, input and output of materials and gas, and approximate locations where process parameters were measured.

3.3 PROCESS OPERATION DURING TESTS

Data indicating the operation of the kiln, the scrubbers treating the kiln exhaust, and the scrubber treating the hydrator exhaust are presented in this section. All process data for the kiln were manually recorded by RTI every 15 minutes during the emissions testing and taken from computer screens in the kiln control room; the recorded data were measured with instruments already in place and used by the plant for process control of the kiln.

Table 3.1 summarizes the kiln operating conditions during each of the three test runs. The average feed rates for coal and limestone were 3.65 and 26.39 tons per hour (t/hr), respectively. The average temperatures at the kiln front and back were 1817°F and 992°F, respectively. The average oxygen content at the kiln back was 0.9 percent (%).

Three different sizes of calcitic limestone were fed to the number two kiln during testing; the stone sizes were referred to as "twos", "threes", and "fours". The sizes of these stones are based on mesh size. "Twos" are stones that pass through a 1 and 3/8 inch mesh and are retained on a 7/8 inch mesh. "Threes" are stones that pass through a 7/8 inch mesh and are retained on a 3/8 inch mesh. "Fours" are stones that pass through a 3/8 inch mesh and are retained on a 3/16 inch mesh. During testing, the size two stone was fed to the kiln separately while the size three and four stones were combined and fed to the kiln as one feed. The decision to use a stone size during the testing was dictated by the existing supply of the stone. Neither size two stone nor sizes three and four stones were available in a large enough supply to feed the number two kiln the same stone size during the entire three days of testing.

TABLE 3.1

SUMMARY OF KILN NO. 2 OPERATING CONDITIONS
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

	Kiln Operating Conditions				
			Kiln Temperature °F		
Run No.	Coal Feed t/hr[a]	Limestone Feed t/hr[a]	Front End	Back End	Oxygen Content at Back End of Kiln, %
1	3.69	25.21	1741	1010	1.2
2	3.65	28.16	1869	945	0.3
3	3.61	25.81	1840	1020	1.3
Average	3.65	26.39	1817	992	0.9

[a] Tons per hour.

For the scrubbers treating the kiln exhaust, PES measured the pressure drop across each of the scrubbers and measured/calculated the volumetric flow rates of water entering and exiting each of the scrubbers. To measure pressure drop, PES drilled pressure taps upstream of each scrubber tower and at the end of each exhaust stack. The pressure drop across the upstream tap and exhaust tap of each scrubber was measured using a U-tube manometer. The pressure drop across each scrubber was measured and recorded once during each run, just prior to testing.

PES measured the volumetric flow rate of water exiting the bottom of the each scrubber by placing a container of known volume below the water outlet and recording the time to fill the container. The opening of the container was slightly smaller than the water outlet, thus, the container only collected approximately 80 percent of the exiting water. PES took two measurements of the water flow rate exiting the bottom of each scrubber; the measurements were taken back-to-back during run 2 of the kiln 2 scrubber tests.

PES measured the temperature, gas flow, and moisture content of the kiln exhaust just prior to each scrubber tower and exiting each scrubber stack; based on these measurements, PES calculated the volumetric flow rates of water vapor entering and exiting each scrubber. These calculated flow rates, along with the measured flow rate of water exiting each scrubber, were entered into a mass balance of water across the system to calculate the flow rate of water injected into each scrubber (see Figure 2 in Appendix A for a mass balance of water of the scrubber system).

Table 3.2 summarizes the scrubbers operating conditions during each of the three test runs. The pressure drop across each scrubber was very erratic. On scrubber A the average pressure drop was 3.9 inches of water (in. H_2O) ranging from 2.9 to 4.9. On scrubber B the average pressure drop was 2.3 in. H_2O ranging from 0.9 to 4.9. The average water flow rate into each scrubber was estimated to be 261 and 165 gallons per minute (gpm) in scrubbers A and B, respectively.

During emissions testing, RTI manually recorded the water flow rate to the scrubber treating the hydrator. The water flow rate was measured by an instrument already in place and used by the plant for control of the hydrator. The water flow rate was initially recorded every 15 minutes; however, after no change was noted during the first hour, and after the operator of the hydrator stated that the flow rate would remain fairly constant, the readings were recorded less frequently. The average water flow rate to the scrubber was 9.5 gpm.

TABLE 3.2

SUMMARY OF SCRUBBERS A AND B OPERATING CONDITIONS
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Run No.	Pressure Drop in. H_2O[a]		Water Flow Rate, gpm[b]	
	A	B	A	B
1	2.9	1.0	—	—
2	4.9	0.9	261	165
3	3.8	4.9	—	—
Average	3.9	2.3	261	165

[a] Inches of water.
[b] Gallons per minute, estimated.

4.0 SAMPLING LOCATIONS

4.1 NO. 2 KILN

4.1.1 Kiln Exhaust

The common inlet to the two Ducon scrubbers was located in a tapered (large-to-small) rectangular duct that was oriented at a 45° angle to horizontal. This section of duct was six feet wide by four feet high at the kiln discharge and five feet wide by four feet high at the point where the duct split for discharge to the two scrubbers. The site was accessible via stairs and a permanent platform. This location did not meet EPA Method 1 criteria for location of a measurement site for velocity or sample traverses. Therefore, sampling at this location was limited to gas composition (carbon dioxide and oxygen), moisture content, and total hydrocarbons (THC). Sampling of these parameters was accomplished through a six-inch inside diameter (ID) sample port located on the top of the duct. Figure 4.1 shows a simplified schematic of the kiln exhaust measurement site.

4.1.2 Kiln No. 2 Scrubbers A and B

The two scrubbers were of similar design/operation and each had its own dedicated exhaust stack. The measurement site at each scrubber outlet was located in a 48-inch ID round vertical stack, 142 inches (2.95 equivalent stack diameters) downstream of the scrubber outlet and 98 inches (2.04 equivalent stack diameters) upstream of the atmosphere. According to EPA Method 1 criteria this location required 24 sample traverse points, 12 along each of two perpendicular diameters.

Figure 4.2 shows a simplified schematic of the scrubbers outlet stacks measurement sites. Access to the scrubber stacks was provided by a contractor who erected temporary scaffold. Each stack was checked for the presence of cyclonic or non-parallel flow. The results indicated cyclonic or non-parallel flow was present to the extent that modifications to the stacks would be required. The average angle of rotation was about 35°, ranging from 24 to 45°. This condition was corrected by re-installing flow straightening vanes that the facility had used in the past. After installation of the straightening vanes the average angle of rotation was reduced to 4°.

4.2 HYDRATOR

The measurement site for the hydrator stack was located in a 23.5-inch ID round vertical stack 144 inches (6.12 equivalent stack diameters) downstream of the hydrator and

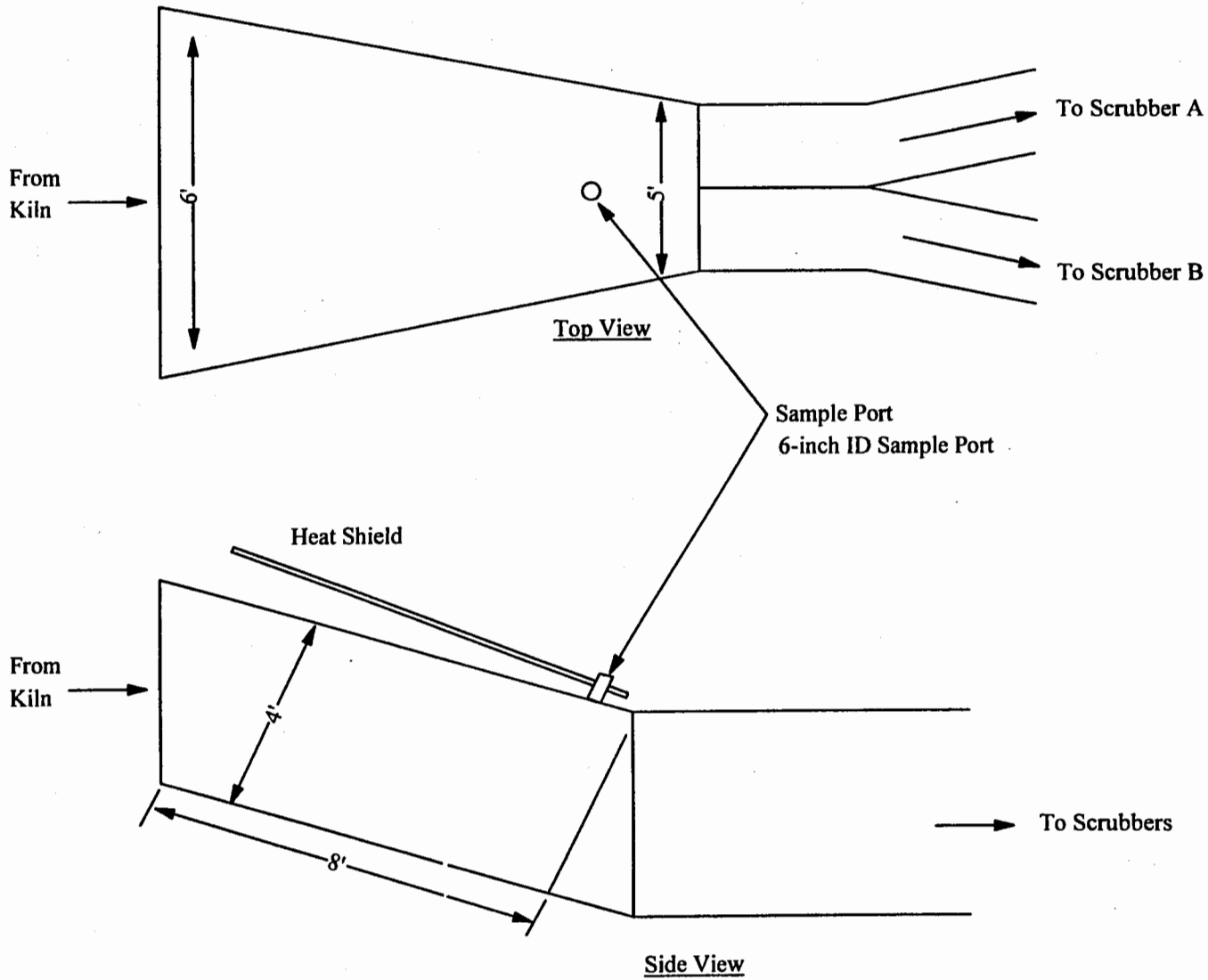
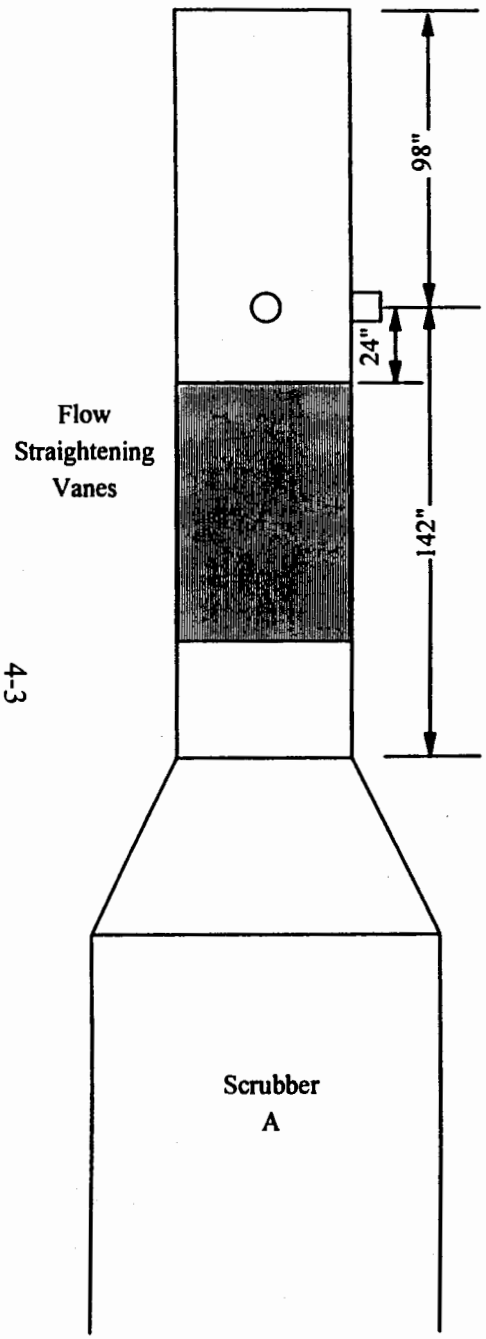
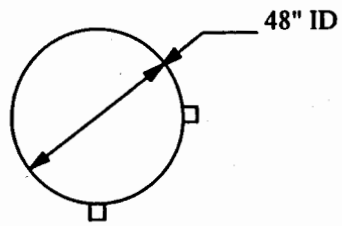


Figure 4.1 Eastern Ridge Lime Kiln No. 2 Kiln Exhaust Sampling Location.





Cross-Section

SAMPLE TRAVERSE POINT LOCATIONS

Point Number	Fraction of Stack ID	Distance Inches	Port Depth Inches	Port Location Inches
1	.021	1.00	3.25	4.25
2	.067	3.19	3.25	6.44
3	.118	5.69	3.25	8.94
4	.177	8.50	3.25	11.75
5	.250	12.00	3.25	15.25
6	.356	17.06	3.25	20.31
7	.644	30.94	3.25	34.19
8	.750	36.00	3.25	39.25
9	.823	39.50	3.25	42.75
10	.882	42.31	3.25	45.56
11	.933	44.81	3.25	48.06
12	.979	47.00	3.25	50.25

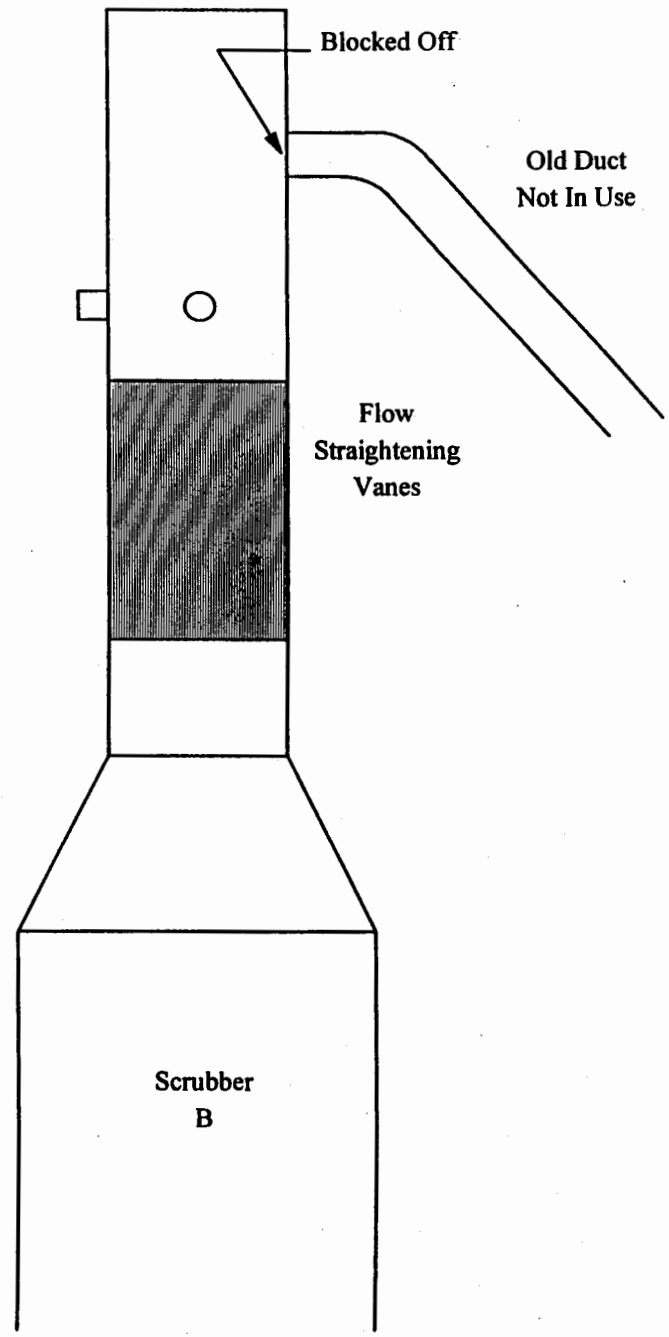
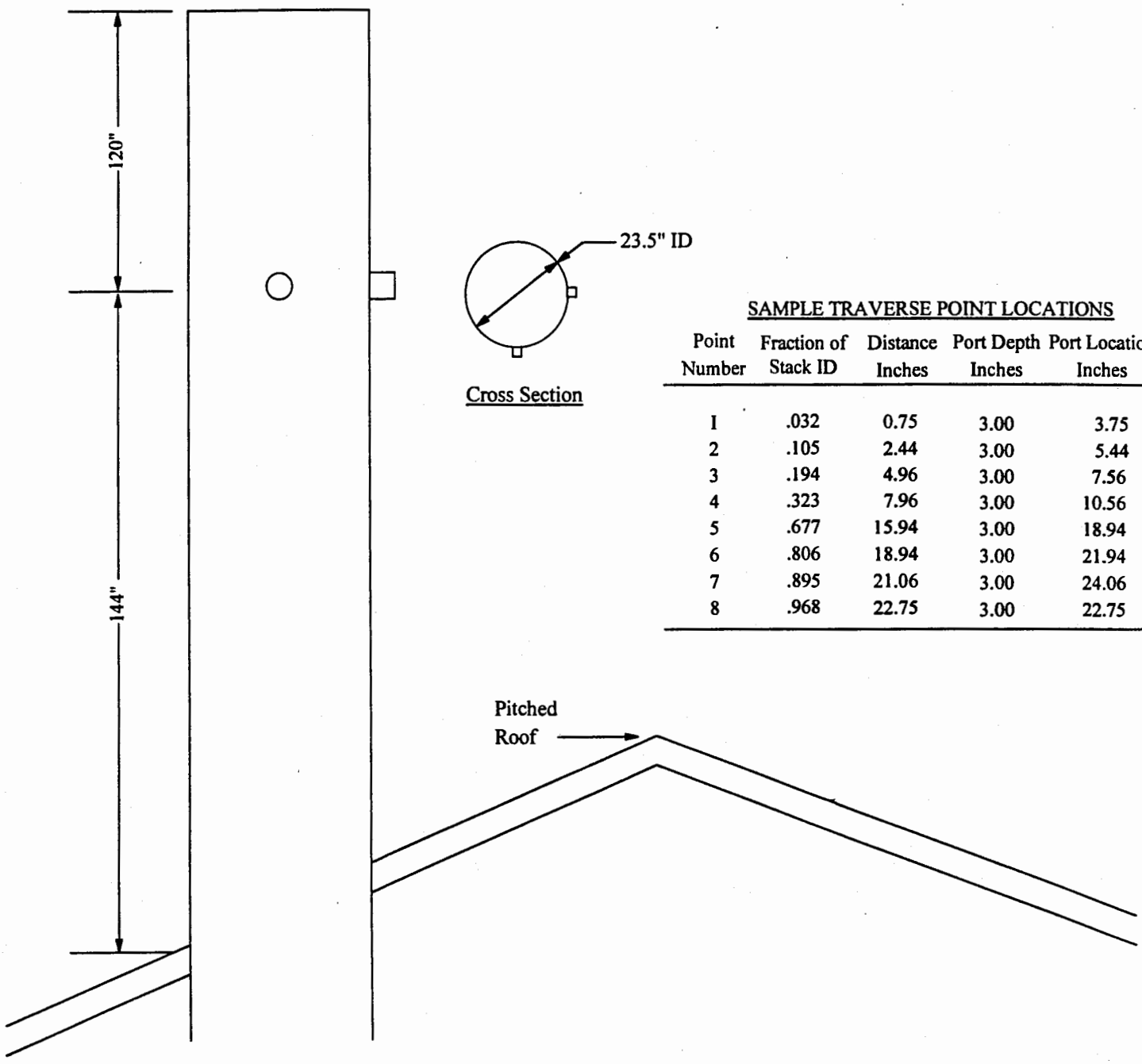


Figure 4.2 Eastern Ridge Lime No. 2 Kiln Scrubbers A and B Outlet Sampling Locations.

120 inches (5.10 equivalent stack diameters) upstream of the atmosphere. According to EPA Method 1 criteria, this location required 16 sample traverse points, eight along each of two perpendicular diameters. Figure 4.3 shows a simplified schematic of the hydrator stack sampling location and sample traverse points. The stack was accessible via stairs to the roof and temporary scaffold.



SAMPLE TRAVERSE POINT LOCATIONS

Point Number	Fraction of Stack ID	Distance Inches	Port Depth Inches	Port Location Inches
1	.032	0.75	3.00	3.75
2	.105	2.44	3.00	5.44
3	.194	4.96	3.00	7.56
4	.323	7.96	3.00	10.56
5	.677	15.94	3.00	18.94
6	.806	18.94	3.00	21.94
7	.895	21.06	3.00	24.06
8	.968	22.75	3.00	22.75

Figure 4.3 Eastern Ridge Lime Hydrator Stack Sampling Location.

5.0 SAMPLING AND ANALYTICAL PROCEDURES

Table 5.1 summarizes the sources, test parameters, test methods, number of tests, and planned duration of each event. Sampling of both scrubber exhausts was conducted simultaneously for CDD/CDF, THC, and PM/Metals. Sampling for THC at the kiln exhaust was conducted simultaneously with the outlet sampling. Brief descriptions of each method follow:

5.1 LOCATION OF MEASUREMENT SITES AND SAMPLE/VELOCITY TRAVERSE POINTS

EPA Method 1, "Sample and Velocity Traverses for Stationary Sources," was used to select the measurement sites and to establish velocity and sample traverse point locations. The measurement sites are discussed in Section 4.0.

5.2 DETERMINATION OF STACK GAS VOLUMETRIC FLOW RATE

EPA Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to determine stack gas volumetric flow rate at the scrubber outlets and hydrator stack. A Type S pitot tube, constructed according to Method 2 criteria and having an assigned coefficient of 0.84 and connected to an inclined-vertical manometer was used to measure velocity pressure. A calibrated Type K thermocouple attached directly to the pitot tube was used to measure stack gas temperature. The average stack gas velocity was calculated from the average square roots of the velocity pressure, average stack gas temperature, stack gas molecular weight, and absolute stack pressure. The volumetric flow rate is the product of velocity and the stack cross-sectional area.

At the scrubber inlet it was not possible to determine volumetric flow rate by direct measurement. Instead the volumetric flow rate was calculated from the combined outlet flow rates corrected for dilution air. No correction for moisture was necessary since the scrubber outlet flow rates were on a dry basis. The following equation was used:

$$Q_{STDi} = Q_{STDo} \frac{20.9 - \%O_{2i}}{20.9 - \%O_{2o}}$$

where: Q_{STDi} = volumetric flow rate at the kiln exhaust, dscfm.
Q_{STDo} = combined volumetric flow rate at the scrubbers outlets, dscfm.
O_{2i} = % oxygen at the kiln exhaust
O_{2o} = % oxygen (flow-weighted) at the scrubbers outlets.

TABLE 5.1

SOURCES, TEST PARAMETERS, AND TEST METHODS SUMMARY
EASTERN RIDGE LIME COMPANY - RIPPLEMEAD, VA

Source	Parameter	EPA Test Methods	No. Of Tests	Time per Test, Minutes
Scrubber Inlet	CO_2/O_2	3B	3	240
	Moisture	4	3	240
	THC	25A	3	240
Scrubber Outlets (A&B)	Flow Rate	1&2	3	240
	CO_2/O_2	3B	3	240
	Moisture	4	3	240
	CDD/CDF	23	3	240
	THC	25A	3	240
	PM/Metals	29	3	240
Hydrator Stack	Flow Rate	1&2	3	120
	Moisture	4	3	120
	PM/Metals	29	3	120

5.3 DETERMINATION OF DRY MOLECULAR WEIGHT AND EMISSION CORRECTION FACTORS

EPA Method 3B, "Gas Analysis for the Determination of Emission Rate Correction Factor or Excess Air," was used to measure carbon dioxide and oxygen content of the stack gases. Gas samples were extracted from each stack using the integrated, single-point bag sampling technique. The bag contents were analyzed onsite within six hours after sample collection using an Orsat® analyzer to determine percent concentrations of carbon dioxide and oxygen. The Orsat analyzer had 0.1 percent subdivisions.

5.4 DETERMINATION OF STACK GAS MOISTURE CONTENT

EPA Method 4, "Determination of Moisture Content in Stack Gases," was used to determine stack gas moisture content. The quantity of condensed water was determined gravimetrically and then compared to the total volume of gas sampled to determine the volume percent moisture content.

At the scrubber outlets there was potential for the presence of water droplets in the gas streams. Therefore, a second determination of the moisture content was made simultaneously with the reference method by measuring the stack temperature at each sample traverse point and assuming that the gas streams were saturated at that temperature. The moisture content was then calculated using vapor pressure tables. If the results were found to be lower than those obtained using the reference method then the gas streams contained water droplets. The lower of the two results were used in all calculations.

5.5 DETERMINATION OF POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS

EPA Method 23, "Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans From Stationary Sources" was used to determine polychlorinated dibenzo-p-dioxins (CDD's) and polychlorinated dibenzofurans (CDF's). Samples were withdrawn from the gas stream isokinetically and collected in the sample probe, on a glass fiber filter, and on a packed column of XAD®-2 adsorbent material. The CDD's and CDF's were extracted from the samples, separated by high resolution gas chromatography, and measured by high resolution mass spectrometry. Triangle Laboratories, Inc., Research Triangle Park, North Carolina prepared the filters and adsorbent traps, and performed the required analyses. A schematic of the Method 23 sampling apparatus is shown in Figure 5.1.

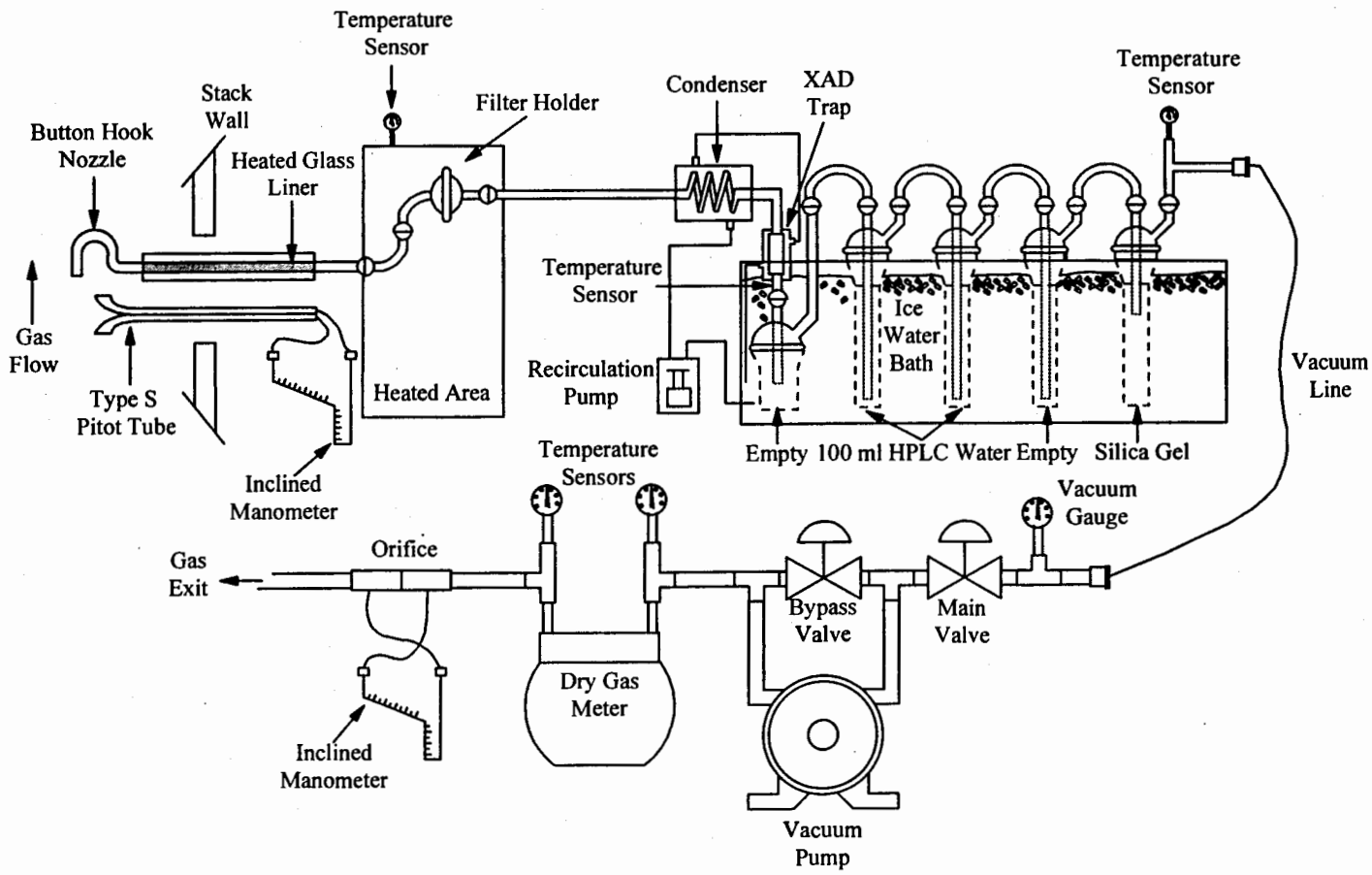


Figure 5.1 Method 23 CDD/CDFSampling Train.

5.6 DETERMINATION OF TOTAL HYDROCARBONS

EPA Method 25A, "Determination of Total Gaseous Organic Concentrations Using a Flame Ionization Analyzer" was used to measure total hydrocarbon (THC) concentrations at the kiln exhaust and scrubber outlets. Two flame ionization analyzers (FIAs) were used, one for the inlet and one for the outlets. The outlet FIA alternately sampled each outlet stack for 15 minute periods. Heated sample lines and FIAs were used due to the high moisture content in the stack gases. THC concentrations were expected to be less than 25 parts per million by volume (ppmv) as propane. Therefore, both FIAs were operated on a 100 ppmv range. Span gases consisting of propane-in-air, prepared according to EPA Protocol, were used.

Figure 5.2 is a schematic of the FIA sampling system. The two FIAs were equipped with a strip chart recorder and a data logger. Prior to beginning the testing program, the two FIA systems were assembled and a bias check and a response time test was conducted. Acceptability criteria for the bias check is a difference of not more than five percent between the value measured by direct injection of calibration gas at the analyzer and the value obtained by injection of the calibration gas at the calibration gas valve. (Details of the bias check are presented in EPA Method 6C).

Prior to testing, PES performed the bias checks, response time tests, and calibration error tests. Calibration drift checks were performed hourly and at the conclusion of each measurement run.

5.7 DETERMINATION OF PARTICULATE MATTER AND METALS

EPA Method 29, "Determination of Metals Emissions From Stationary Sources," was used to determine filterable particulate matter and metals. The target metals included: Antimony (Sb), Arsenic (As), Beryllium (Be), Cadmium (Cd), Chromium (Cr), Cobalt (Co), Lead (Pb), Manganese (Mn), Mercury (Hg), Nickel (Ni), and Selenium (Se). Samples were withdrawn from the gas stream isokinetically and collected in the sample probe, on a tared quartz-fiber filter and in a series of impingers containing acidic hydrogen peroxide solution followed by acidified potassium permanganate. The probe and filter fractions were analyzed gravimetrically in the PES laboratory to determine filterable particulate matter. Upon completion of the particulate matter analyses, the particulate fractions and aqueous fractions were submitted to the laboratory for metals analyses. Triangle Laboratories, Inc. performed the metals analyses.

A schematic of Method 29 sampling train is shown in Figure 5.3. The sample recovery scheme for metals is shown in Figure 5.4. The sample recovery scheme for the additional Hg fraction is shown in Figure 5.5. The sample preparation and analysis scheme is shown in Figure 5.6. Metals other than Hg were be analyzed by inductively coupled argon plasma (ICP) emission spectroscopy. Hg was analyzed by cold vapor atomic absorption spectroscopy (CVAAS).

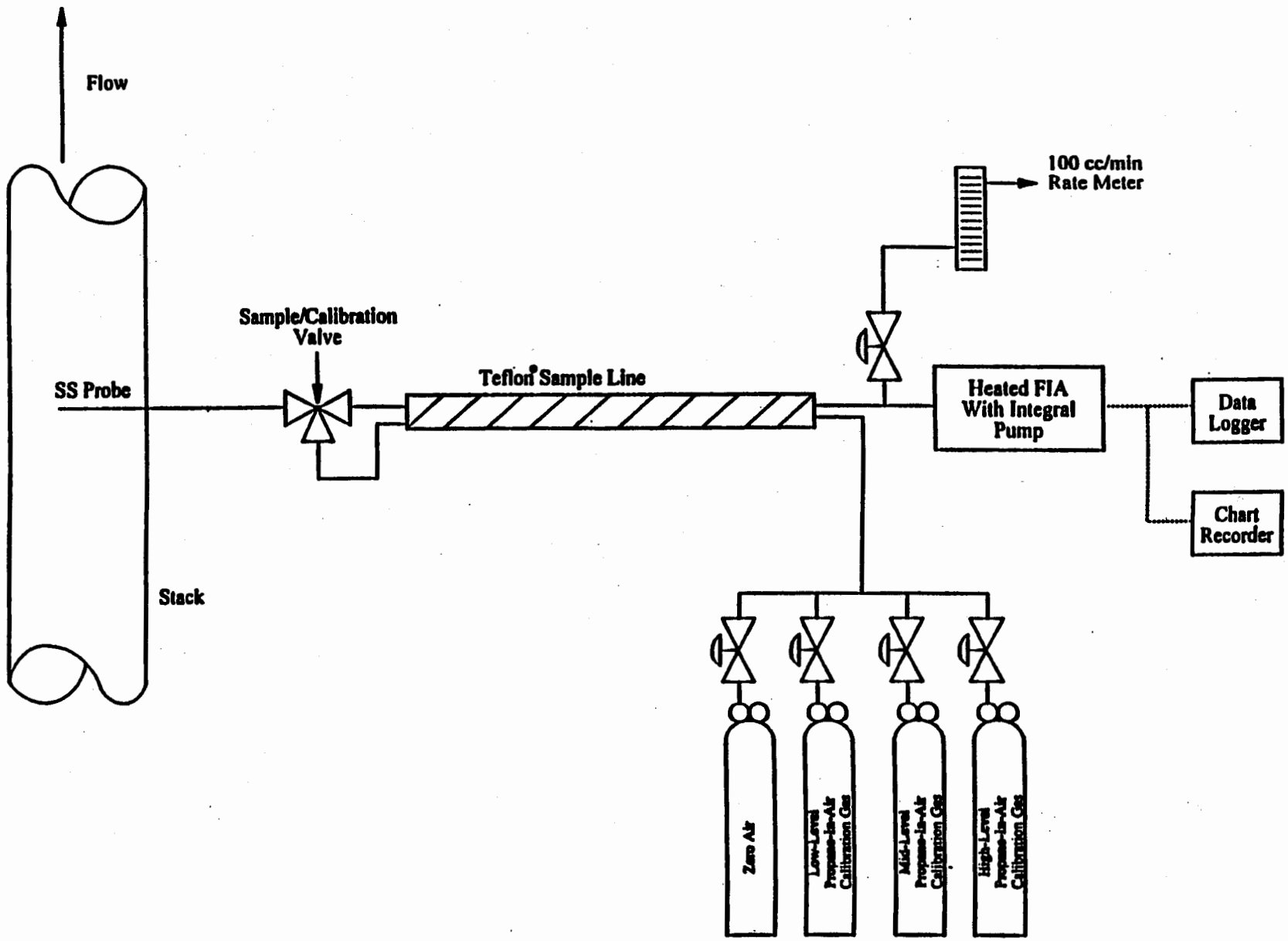


Figure 5.2 Method 25A Measurement System for THC.

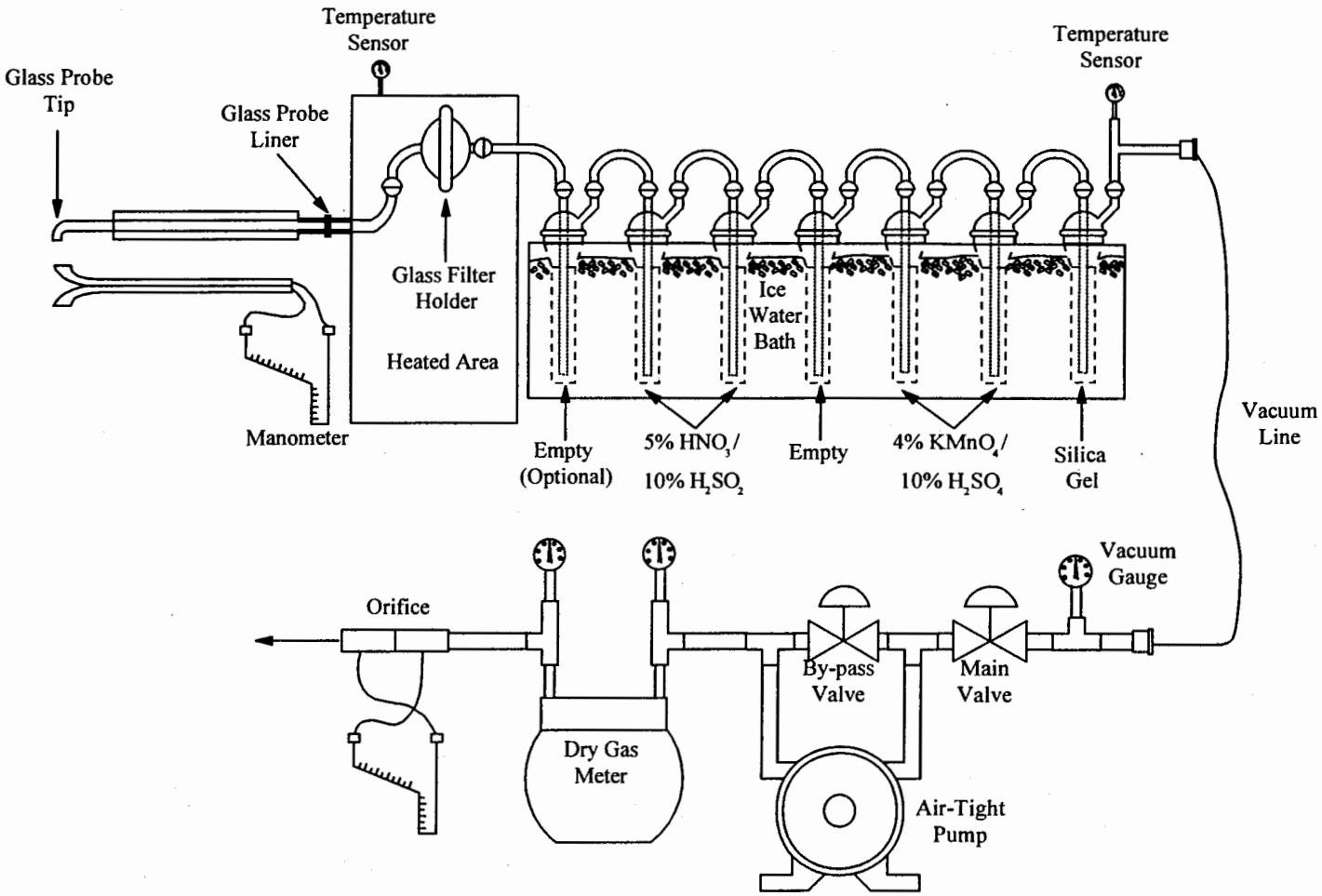
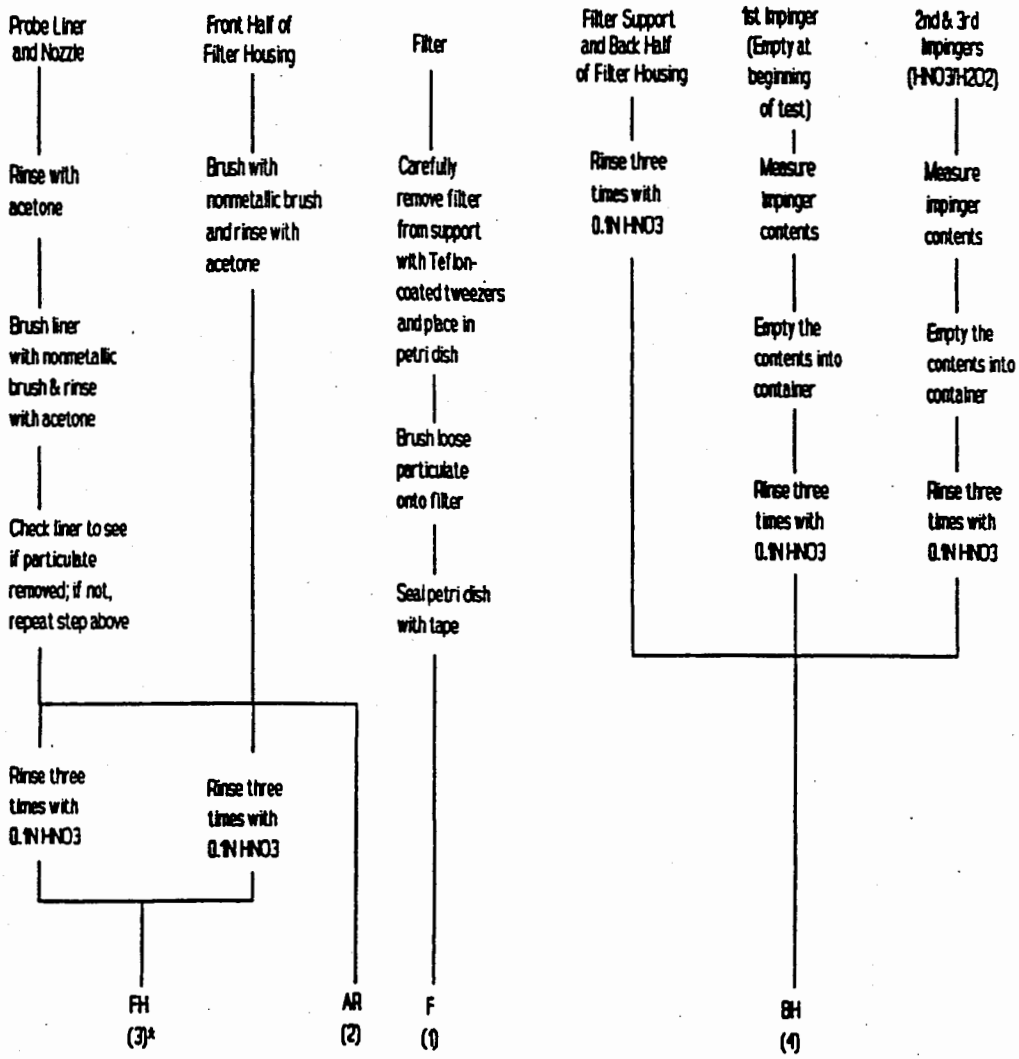


Figure 5.3 Method 29 Particulate Matter/Metals Sampling Train.



* Number in parentheses indicates container number

Figure 5.4 Method 29 Sample Recovery Scheme (Sample Fractions 1-4).

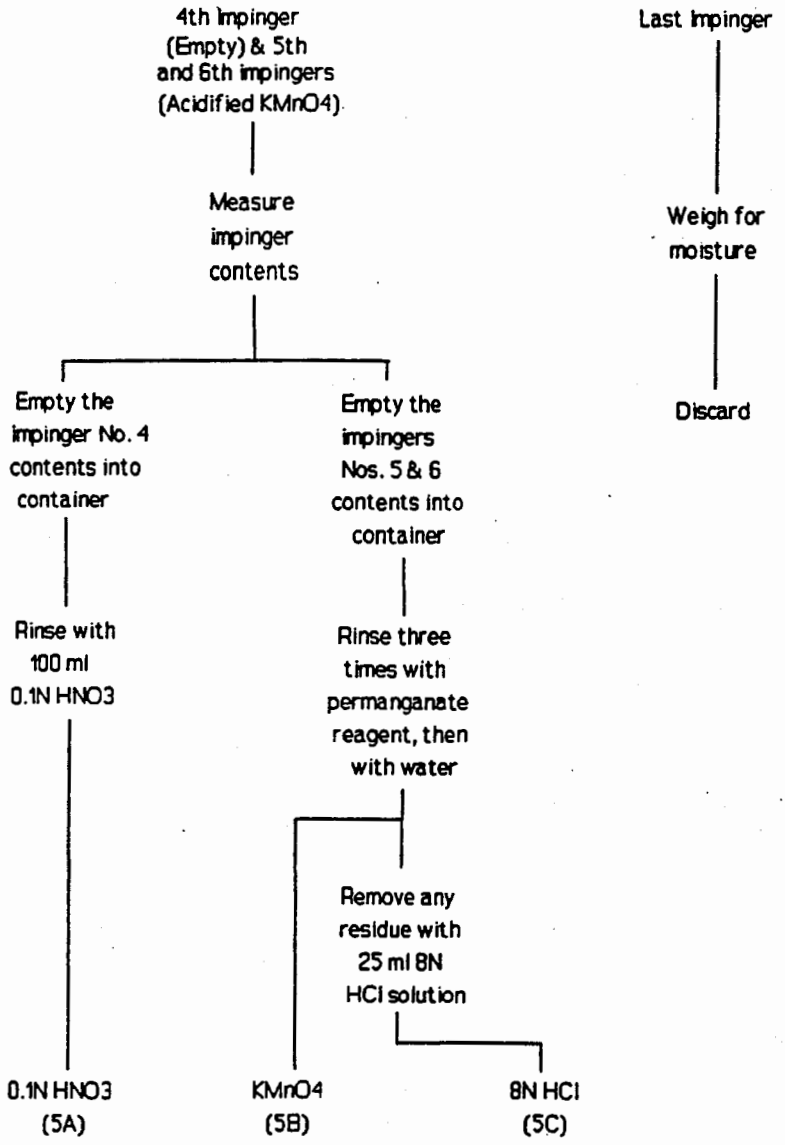
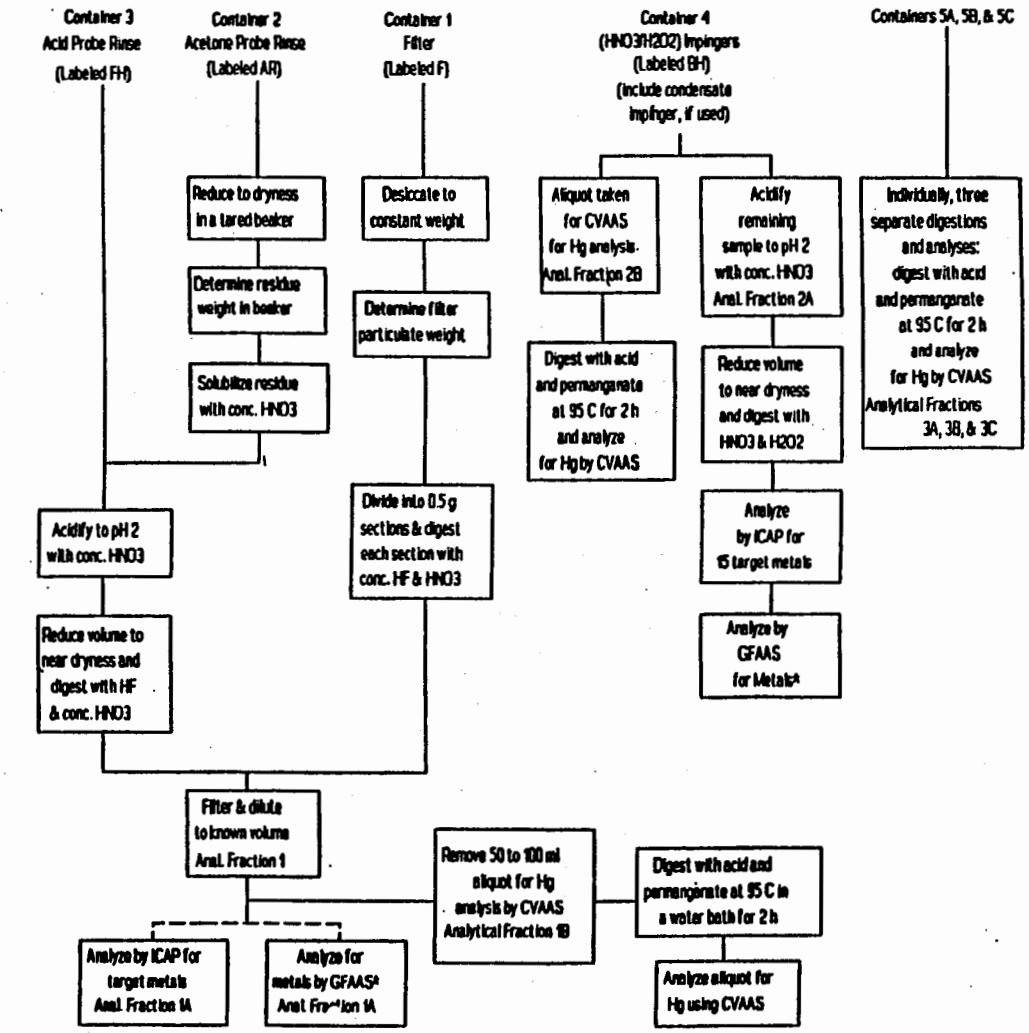


Figure 5.5 Method 29 Sample Recovery Scheme (Sample Fraction 5).



[a]Analysis by AAS for metals found (~ less than 2 ug/ml in digestate solution, if desired. Or analyze for each metal by AAS, if desired.

Figure 5.6 Method 29 Sample Preparation and Analysis Scheme.

5.8 DETERMINATION OF SCRUBBER WATER FLOW RATE

There were no scrubber water flow rate indicators on either scrubber. In order to estimate the water flow rate to each scrubber, PES placed a 33 gallon container under the water discharge of each scrubber and measured the time required to fill the containers. Due to the cross-sectional area of the discharge being larger than the container, PES assumed that 80% of the water was collected. Two measurement were made on each scrubber. The results were calculated in gallons per minute. PES then calculated the amount of water entering each scrubber by difference using the following equation:

$$Q_{wi} = Q_{wof} + Q_{ws} - Q_{wk}$$

where: Q_{wi} = Water flow rate into the scrubber, gpm
Q_{wof} = Water flow rate from scrubber outfall, gpm
Q_{ws} = Water discharged from outlet stack, gpm
Q_{wk} = Water discharged from kiln exhaust, gpm

6.0 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES AND RESULTS

This section describes the specific QA/QC procedures employed by PES in performing this series of tests. The procedures contained in the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods," EPA-600/77-027B, and in the reference test methods served as the basis for performance for all testing and related work activities in this project.

6.1 CALIBRATION OF APPARATUS

The preparation and calibration of source sampling equipment is essential in maintaining data quality. Brief descriptions of the calibration procedures used by PES follow.

6.1.1 Barometers

PES used aneroid barometers which are calibrated against a station pressure value reported by a nearby National Weather Service Station corrected for elevation.

6.1.2 Temperature Sensors

Bimetallic dial thermometers and Type K thermocouples were calibrated using the procedure described in Section 3.4.2 of the Quality Assurance Handbook. Each temperature sensor was calibrated over the expected range of use against an ASTM 3C or 3F thermometer. Table 6.1 summarizes the type of calibrations performed, the acceptable levels of variance, and the results. Digital thermometers were calibrated using a thermocouple simulator having a range of 0-2400°F.

6.1.3 Pitot Tubes

PES used Type S pitot tubes which are constructed to EPA Method 2 specifications. Pitot tubes meeting these specifications are assigned to a baseline coefficient to 0.84 and need not be calibrated. The dimensional criteria and results for each pitot tube used are summarized in Table 6.2.

TABLE 6.1

SUMMARY OF TEMPERATURE SENSOR CALIBRATION DATA

Temp. Sensor I.D.	Usage	Temperature, °F		Temp. Difference %	EPA Criteria %
		Reference	Sensor		
5A	Stack Gas	85	84	0.2	<±1.5
		32	37	-1.0	<±1.5
		190	188	0.3	<±1.5
5C	Stack Gas	36	38	-0.4	<±1.5
		82	83	-0.2	<±1.5
		199	198	0.2	<±1.5
		284	280	0.5	<±1.5
5E	Stack Gas	33	33	0.0	<±1.5
		73	74	-0.2	<±1.5
		242	244	-0.3	<±1.5
4B	Stack Gas	67	71	-0.8	<±1.5
		32	33	-0.2	<±1.5
		196	201	-0.8	<±1.5
		366	373	-1.1	<±1.5
4C	Stack Gas	71	70	0.2	<±1.5
		33	34	-0.2	<±1.5
		209	208	-0.2	<±1.5
		383	386	-0.4	<±1.5
SH-1	Impinger	64	64	0.0	<±1.5
	Outlet	34	34	0.0	<±1.5
SH-2	Impinger	63	63	0.0	<±1.5
	Outlet	33	33	0.0	<±1.5
SH-3	Impinger	64	66	-0.2	<±1.5
	Outlet	34	34	0.0	<±1.5

TABLE 6.2

SUMMARY OF PITOT TUBE DIMENSIONAL DATA

Measurement	Criteria	RESULTS					
		Pitot Tube Identification					
		5A	5C	5E	4B	4C	4D
$\alpha 1$	<10°	1	1	2	0	0	0
$\alpha 2$	<10°	0	1	1	0	0	1
$\beta 1$	<5°	1	0	0	0	0	0
$\beta 2$	<5°	0	0	0	1	0	0
γ	-	1	1	0	0	0	0
θ	-	1	0	0	0	1	0
A	-	1.012	1.004	1.000	0.945	0.973	0.938
Z	≤ 0.125 in.	0.018	0.018	0.0	0.0	0.0	0.0
W	≤ 0.03125 in.	0.018	0.0	0.0	0.0	0.017	0.0
D_t	0.1875" ≤ D_t ≤ 0.375"	0.375	0.375	0.374	0.375	0.375	0.375
$A/2D_t$	1.05 D_t ≤ A ≤ 1.50 D_t	1.35	1.34	1.34	1.26	1.30	1.25
	Acceptable	Yes	Yes	Yes	Yes	Yes	Yes
	Assigned Coefficient	0.84	0.84	0.84	0.84	0.84	0.84

6.1.4 Differential Pressure Gauges

PES uses Dwyer inclined/vertical manometers to measure differential pressures. These include velocity pressure, static pressure, and meter orifice pressure. Manometers are selected with sufficient sensitivity to accurately measure pressures over the entire range of expected values. Manometers are primary standards and require no calibration.

6.1.5 Method 23 and Method 29 Dry Gas Meter and Orifice

The Method 23 and 29 dry gas meters and orifices were calibrated in accordance with Section 3.3.2 of the Quality Assurance Handbook. This procedure involves direct comparison of the dry gas meter to a reference dry test meter. The reference dry test meter is routinely calibrated using a wet test meter or a liquid displacement technique. Before its initial use in the field, the metering system was calibrated over the entire range of operation. After field use, the metering system was calibrated at a single intermediate setting based on the previous field test. Acceptable tolerances for the initial and final dry gas meter factors and orifice calibration factors are ± 0.05 and ± 0.20 from average, respectively. The results for the gas meter and orifice used in this test program are summarized in Table 6.3.

6.2 ON-SITE MEASUREMENTS

The on-site QA/QC activities include:

6.2.1 Measurement Sites

Prior to sampling, the stack was checked dimensionally to determine measurement site locations, location of velocity and sample test ports, inside stack dimensions, and sample traverse point locations. Inside stack dimensions were checked through both test ports to ensure uniformity of the stack inside diameter. The inside stack dimensions, wall thickness, and sample port depths were measured to the nearest 0.1 inch.

6.2.2 Velocity Measurements

All velocity measurement apparatus were assembled, leveled, zeroed, and leak-checked prior to use and at the end of each determination. The static pressure was determined at a single point near the center of the stack cross-section.

6.2.3 Flue Gas Sampling

Integrated flue gas samples were collected in Tedlar® gas bags from the kiln exhaust and scrubber outlets. Prior to use the bags were leak checked and purged with nitrogen to ensure cleanliness. Prior to and after completion of each sampling run the entire sampling system was leak checked from the tip of the probe.

TABLE 6.3

SUMMARY OF DRY GAS METER AND ORIFICE CALIBRATION DATA

Meter No.	Gamma				Orifice Coefficient		
	Pre-test	Post-test	% Diff.	EPA Criteria	Average	Range	EPA Criteria
MB-13	0.985	0.976	0.90	± 5%	1.66	1.56-1.74	1.66± 0.20
MB-14	1.003	1.008	-0.50	± 5%	1.77	1.68-1.84	1.77± 0.20
MB-15	1.004	1.010	-0.60	± 5%	1.68	1.66-1.71	1.68± 0.20
M5-6	0.990	0.999	-0.90	± 5%	1.84	1.72-1.94	1.84± 0.20
M5-9	1.009	1.023	-1.39	± 5%	1.88	1.82-2.02	1.88± 0.20

The bag samples were analyzed on-site using an Orsat® analyzer. Prior to use the Orsat analyzer was assembled and replenished with fresh reagents and leak checked as per the manufacturer's procedures. Known concentrations of EPA Protocol carbon dioxide and oxygen in nitrogen were then analyzed to confirm proper operation of the Orsat analyzer. These results are shown in Table 6.4.

6.2.4 Moisture

During sampling, the exit gas of the last impinger was maintained below 68°F to ensure complete condensation of stack gas water vapor. The total moisture was determined gravimetrically using a digital reading top-loading electronic balance. At the scrubber outlets there was potential for the presence of water droplets in the gas streams. Therefore, a second moisture determination was made simultaneously with the reference method by measuring the stack gas temperature at each sample traverse point and assuming that the gas streams were saturated at that average temperature. The moisture content was then calculated using vapor pressure tables. The lower moisture value obtained using the reference method and saturation method was subsequently used in all Method 23 and Method 29 calculations.

6.2.5 Method 23/Method 29

The field sampling QA/QC for Method 23 and method 29 were similar. Table 6.5 summarizes the critical measurements made and the EPA's acceptability criteria. All pre- and post-test sample train leaks met the acceptance criteria. The isokinetic sampling rates deviated by no more than 8% thereby meeting each method criteria of 90-110%.

Method 23 and Method 29 field blanks were collected near the sampling locations to check for any sample contamination at the sites. Sample trains were assembled and pre- and post-test leak checks were conducted. The sample trains were recovered in the same manner as the actual sample runs.

An acetone blank and quartz fiber filter were taken as control samples for the particulate analysis and subsequent analysis for the target metals. Blanks were taken of the metals absorbing and recovery reagents.

6.2.6 Method 25A

The field QA/QC activities for Method 25A included the use of EPA Protocol calibration gases; pretest calibration error tests, system bias checks, and response time tests; and post-test zero and calibration drift determinations. Table 6.6 lists the calibration gas cylinder numbers, concentrations, and expiration dates. Calibration error tests, system bias checks, calibration drift checks, and response time checks are shown in Appendix B.1.4.

TABLE 6.4

SUMMARY OF ORSAT ANALYZER CALIBRATION RESULTS

Cylinder No.	Contents	Expiration Date	Analysis				
			1	2	3	Avg.	Absolute Diff., %
ALMO58589	16.1% CO_2 in N_2	07/26/98	16.1	16.1	16.0	16.1	0.0
ALMO57024	9.85% CO_2 in N_2	05/20/99	9.9	9.9	9.8	9.9	0.0
	13.1% O_2 in N_2		13.1	13.1	13.0	13.1	0.0

TABLE 6.5

SUMMARY OF METHOD 23/METHOD 29 FIELD SAMPLING QA/QC DATA

Date	Site	Run No.	Pre-Test Leak Rate acfm	Post-Test Leak Rate acfm	EPA Criteria	Percent Isokinetic	EPA Criteria
10/16/96	Scrubber "A"	M23	0.010 @ 16" Hg	0.002 @ 18" Hg	0.02	103.1	90-110%
		M29	0.002 @ 15" Hg	0.002 @ 13" Hg	0.02	102.4	90-110%
	Scrubber "B"	M23	0.006 @ 15" Hg	0.004 @ 16" Hg	0.02	101.3	90-110%
		M29	0.012 @ 15" Hg	0.005 @ 17" Hg	0.02	100.5	90-110%
10/17/96	Scrubber "A"	M23	0.018 @ 18" Hg	0.015 @ 19" Hg	0.02	102.8	90-110%
		M29	0.000 @ 15" Hg	0.000 @ 14" Hg	0.02	101.1	90-110%
	Scrubber "B"	M23	0.008 @ 15" Hg	0.004 @ 16" Hg	0.02	104.3	90-110%
		M29	0.010 @ 15" Hg	0.008 @ 12" Hg	0.02	100.7	90-110%
10/18/96	Scrubber "A"	M23	0.006 @ 18" Hg	0.002 @ 20" Hg	0.02	100.1	90-110%
		M29	0.006 @ 15" Hg	0.002 @ 13" Hg	0.02	101.7	90-110%
	Scrubber "B"	M23	0.005 @ 15" Hg	0.004 @ 16" Hg	0.02	103.5	90-110%
		M29	0.010 @ 16" Hg	0.005 @ 14" Hg	0.02	101.3	90-110%
10/19/96	Hydrator	M29	0.005 @ 15" Hg	0.002 @ 9" Hg	0.02	105.2	90-110%
10/20/96	Hydrator	M29	0.003 @ 15" Hg	0.004 @ 10" Hg	0.02	92.0	90-110%
		M29	0.002 @ 15" Hg	0.003 @ 10" Hg	0.02	99.3	90-110%

TABLE 6.6

SUMMARY OF CALIBRATION GAS CYLINDERS

Cylinder Number	Contents	Expiration Date
AAL2583	Hydrocarbon Free Air	-
ALM012950	30.04 ppm C_3H_8 in air	03-17-98
ALM-029561	49.72 ppm C_3H_8 in air	04-18-98
ALM060903	87.86 ppm C_3H_8 in air	05-15-99

6.3 ANALYSIS

6.3.1 Particulate Matter

Particulate matter analysis consisted of front half acetone sample rinses and quartz fiber filters. Prior to the field testing program, the filters were tared in the PES laboratory, stored in petri dishes, and sealed with Teflon® tape. Several beakers were also cleaned and tared for subsequent use in evaporating the acetone rinses. Upon receipt in the PES laboratory, the acetone rinses were placed in the tared beakers and evaporated to dryness at room temperature. The filters and beakers were desiccated and weighed to a constant weight. All weighings were within the method requirements of 0.5 milligrams between two consecutive weighings taken at least six hours apart.

6.3.2 Method 23 CDD/CDF

Prior to the field testing program, TLI prepared PES' XAD®-2 absorbent modules and precleaned the glass fiber filters. TLI's laboratory QA/QC program consisted of adding isotopically labeled standards to each sample at various stages of the project to determine recovery efficiencies. The following types of standards were used:

Internal Standards were spiked in the TLI laboratory after the field sampling program and prior to sample extraction. Recovery efficiencies for these compounds are used in quantifying the actual CDD/CDF isomers measured in the samples.

Surrogate Standards were spiked in the TLI laboratory on the XAD®-2 absorbent prior to the field sampling program. Recovery efficiencies for these compounds provide for sample collection efficiency and analytical matrix effects.

Alternate Standards were spiked in the TLI laboratory after the field sampling program and prior to sample extraction. Recovery for these compounds provides for extraction efficiencies.

Recovery Standards were added in the laboratory after extraction just prior to GC/MS analysis.

Table 6.7 summarizes the recovery efficiencies for the various standards and the respective quality control limits. The recovery efficiencies for the XAD® blank, field blank, and samples were all within the method QC limits.

TABLE 6.7

SUMMARY OF METHOD 23 STANDARDS RECOVERY EFFICIENCIES

	Percent Recovery								QC Limits
	TLI XAD-2 Blank	23FB-4 Field Blank	M23A-1	M23A-2	M23A-3	M23B-1	M23B-2	M23B-3	
FULL SCREEN ANALYSIS									
Internal Standards									
2,3,7,8-TCDF	81.3	81.2	85.0	66.8	78.4	73.0	76.5	64.6	40-130%
2,3,7,8-TCDD	78.2	86.5	88.5	69.2	82.4	76.8	78.0	63.0	40-130%
1,2,3,7,8-PeCDF	66.9	77.7	83.1	62.7	75.7	72.4	74.4	56.5	40-130%
1,2,3,7,8-PeCDD	63.8	72.2	75.6	57.8	70.2	66.1	68.8	56.6	40-130%
1,2,3,6,7,8-HxCDF	82.5	95.1	89.2	64.0	81.4	74.0	78.9	72.0	40-130%
1,2,3,6,7,8-HxCDD	86.8	99.5	102	75.3	90.8	83.0	86.1	70.6	40-130%
1,2,3,4,6,7,8-HpCDF	72.1	96.3	101	73.5	89.1	81.6	82.1	67.0	25-130%
1,2,3,4,6,7,8-HpCDD	75.3	94.8	102	76.0	89.1	84.3	82.0	71.2	25-130%
1,2,3,4,6,7,8,9-OCDD	49.6	71.4	103	71.7	80.7	69.1	58.8	51.1	25-130%
Surrogate Standards									
2,3,7,8-TCDD	111	96.3	105	111	107	112	107	133	70-140%
2,3,4,7,8-PeCDF	103	93.0	106	111	107	110	101	123	70-140%
1,2,3,4,7,8-HxCDF	117	103	113	123	117	121	119	139	70-140%
1,2,3,4,7,8-HxCDD	104	97.3	104	107	108	110	110	124	70-140%
1,2,3,4,7,8,9-HpCDF	68.9	95.8	105	126	117	110	106	128	70-140%
Alternate Standards									
1,2,3,7,8,9-HxCDF	82.1	104	109	84.6	103	100	93.9	104	40-130%
2,3,4,6,7,8-HxCDF	99.3	93.5	109	80.6	100	95.9	91.6	94.4	40-130%
CONFIRMATION ANALYSIS									
Internal Standards									
2,3,7,8-TCDF			93	75.1	86.0	82.4	82.3	71.1	40-130%

6.3.3 Method 29

Method 29 samples consisting of nine stack gas samples, one field blank and reagent blanks were analyzed for antimony (Sb), arsenic (As), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), and selenium (Se). Metals other than Hg were analyzed either by graphite furnace atomic absorption (GFAA) or by inductively coupled plasma emission spectroscopy (ICP). Specific TLI QA/QC activities for GFAA and ICP analyses consisted of laboratory control spikes, post-digestion matrix spikes of one sample set, duplicate analysis of one sample set, serial dilution and analysis of one sample set, analysis of a method blank, and analysis of field and reagent blanks. Hg was analyzed by cold vapor atomic absorption spectroscopy (CVAAS). Specific TLI AQ/AC activities for CVAAS analyses consisted of analysis of a method blank and analysis of field and reagent blanks. The results of these QA/QC activities are summarized in Table 6.8. Complete QA/QC data are contained in Appendix C.3.

TABLE 6.8

SUMMARY OF METHOD 29 ANALYSIS QC DATA

Lab Control Spikes

Analyte	Spike Amt μg	LCS Recovery	LCS 2 Recovery	Recovery Limits
As	50	89%	92%	80-120%
Be	50	108%	101%	80-120%
Cd	50	98%	93%	80-120%
Co	50	84%	94%	80-120%
Cr	50	96%	96%	80-120%
Mn	50	97%	95%	80-120%
Ni	50	94%	91%	80-120%
Pb	50	94%	96%	80-120%
Sb	50	98%	98%	80-120%
Se	50	88%	90%	80-120%

Matrix Spikes (Post-Digestion), Run No. M29-1-B

Analyte	Spike Amt μg	Recovery *	Recovery Limits
As	50	62%	75-125%
Be	2.5	94%	75-125%
Cd	2.5	100%	75-125%
Co	25	78%	75-125%
Cr	50	63%	75-125%
Mn	50	LS	75-125%
Ni	50	LS	75-125%
Pb	50	LS	75-125%
Sb	50	58%	75-125%
Se	50	LS	75-125%

* LS - Low spike; % Recovery is not considered valid when spike amount is less than 20% of recovered amount

TABLE 6.8 (Continued)

Duplicate, Run No. M29-2-A

Analyte	Sample μg	Duplicate μg	RPD	RPD Limits
As	7.53	75.3	0.0%	± 20%
Cr	53.9	54.3	0.7%	± 20%
Mn	199	200	0.5%	± 20%
Ni	85.7	86.3	0.7%	± 20%
Pb	158	160	1.3%	± 20%
Sb	17.3	17.9	3.4%	± 20%
Se	106	106	0.0%	± 20%

Note: Duplicate analysis not reported for elements analyzed by GFAA. Be, Cd, and Co were analyzed by GFAA

Serial Dilution, Run M29-1-A

Analyte	Sample μg	Serial Dilution μg	RPD *	RPD Limits
As	9.17	11.7	< 10 RDL	± 10%
Be	38.1	45.8	< 5 RDL	± 10%
Cd	3.79	4.17	< 5 RDL	± 10%
Co	38.4	44.9	15.6%	± 10%
Cr	56.2	76.9	31.0%	± 10%
Mn	78.4	85.1	8.20%	± 10%
Ni	95.9	112	15.5%	± 10%
Pb	74.2	91.1	20.4%	± 10%
Sb	23.5	26.9	< 10 RDL	± 10%
Se	194	232	17.8%	± 10%

* < 10 RDL / 5 RDL - Serial dilution analyte results are not considered valid when the concentration in the analyte is less than 10 times the Reported Detection Limit (RDL) for ICP analysis and 5 times the RDL for GFAA analysis. RPD = Relative percent deviation.

TABLE 6.8 (Continued)

Method Blank*

Analyte	Detection Limit μg/L	MB Recovered Amount μg/L	MB 1 Recovered Amount μg/L
As	5	-2.37	-2.62
Be	1	0.01	0.04
Cd	1	0.00	-0.67
Co	1.5	0.00	-0.83
Cr	2	-0.02	-0.06
Mn	2	0.49	0.94
Ni	3	-1.26	-2.70
Pb	2	-0.40	0.76
Sb	4	2.02	0.40
Se	3	-3.06	-0.26

* Method Blank considered "Pass" when recovered amount is less than the detection limit

Field Blank and Reagent Blank

Analyte	Field Blank μg	1A Reagent Blank μg	2A Reagent Blank μg
As	< 0.500	1.24	<0.500
Be	< 0.100	< 0.100	<0.100
Cd	0.380	0.430	<0.100
Co	0.170	0.490	<0.150
Cr	6.31	14.7	0.392
Mn	4.95	1.38	1.40
Ni	3.26	8.70	0.300
Pb	1.37	2.24	0.983
Sb	2.79	7.35	0.883
Se	2.14	6.82	0.300

TABLE 6.8 (Continued)

Lab Control Spikes - Mercury Summary Report

Sample ID	Spike Amt μg	Recovery	Recovery Limits
LCS 1	5	102%	80-120%
LCS 1 Dup	5	103%	80-120%
LCS 2	5	94%	80-120%
LCS 2 Dup	5	98%	80-120%
LCS 3	5	87%	80-120%
LCS 3 Dup	5	90%	80-120%
LCS 4	5	95%	80-120%
LCS 4 Dup	5	95%	80-120%
LCS	5	98%	80-120%
LCS Dup	5	103%	80-120%

Matrix Spikes (Pre-Digestion) - Mercury Summary Report

Sample ID	Spike Amt μg	Recovery	Recovery Limits
M29-1-A	5	104%	75-125%
M29-1-A Dup	5	101%	75-125%
M29-1-B	5	105%	75-125%
M29-1-B Dup	5	107%	75-125%
M29-2-A	5	114%	75-125%
M29-2-A Dup	5	109%	75-125%
M29-2-B	5	107%	75-125%
M29-2-B Dup	5	111%	75-125%
M29-3-A	5	98%	75-125%
M29-3-A Dup	5	98%	75-125%
M29-3-B	5	97%	75-125%
M29-3-B Dup	5	97%	75-125%
M29-5	5	92%	75-125%
M29-5 Dup	5	92%	75-125%
M29-6	5	55%	75-125%
M29-6 Dup	5	68%	75-125%
M29-7	5	84%	75-125%
M29-7 Dup	5	84%	75-125%

TABLE 6.8 (Concluded)

Method Blank - Mercury Summary Report

Sample ID	Detection Limit μg/L	Recovered Amount μg/L
MB-1	0.2	0.026
MB-1 Dup	0.2	0.033
MB-2	0.2	0.003
MB-2 Dup	0.2	0.003
MB-3	0.2	-0.006
MB-3 Dup	0.2	-0.008
MB-4	0.2	0.025
MB-4 Dup	0.2	0.020
MB	0.2	-0.026
MB Dup	0.2	-0.026

Field Blank and Reagent Blank - Mercury Summary Report

Sample ID	Field Blank μg	Reagent Blank μg
FH	< 0.40	< 0.40
FH - Dup	<0.40	<0.40
BH	< 0.60	< 1.20
BH- Dup	<0.60	<1.20
HNO3	< 0.21	< 0.40
HNO3 - Dup	<0.21	<0.40
KMnO4	< 1.52	< 1.60
KmnO4 - Dup	<1.52	<1.60
HCL	< 0.96	< 0.92
HCL - Dup	<0.96	<0.92

APPENDIX A

PROCESS DATA

ESEARCH TRIANGLE INSTITUTE

RTI

nter for Environmental Analysis

MEMORANDUM

TO: Joseph Wood, ESD/MICG (MD-13)
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

FROM: Cybele Brockmann, RTI

DATE: July 31, 1997

SUBJECT: Process Description for Eastern Ridge Lime

REFERENCE: Information Gathering and Analysis for the Lime Manufacturing Industry NESHAP
EPA Contract 68-D1-0118
ESD Project 95/06
RTI Project 6750-017

Attached is the description of processes at Eastern Ridge; processes were monitored during testing at the plant October 16-19, 1997.

040 Cornwallis Road • Post Office Box 12194 • Research Triangle Park, North Carolina 27709-2194 USA
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I. Process Description for Eastern Ridge Plant

Lime (CaO) is typically produced in the U.S. by crushing and then heating limestone ($CaCO_3$) in an inclined, rotating kiln. The limestone is heated to temperatures of around 2000 degrees Fahrenheit (deg F) which cause it to breakdown chemically into lime and CO_2. At Eastern Ridge, most of the lime is sold as CaO; a small amount (ten percent of production) is converted into hydrated lime ($Ca(OH)_2$.[1]

Limestone at the Eastern Ridge plant is surface-mined from a quarry located at the plant. The quarried limestone is crushed and screened into several sizes and then transferred to a storage area. Prior to entering the kiln, the sized stone is washed with water to remove dirt.

The number two kiln is an inclined rotating kiln with a design capacity of 350 tons of lime per day (115,150 tons per year).[2] The kiln is 392 feet long with a tapered diameter (11 feet in diameter at the front end of the kiln and 10 feet in diameter the remaining length of the kiln).[3] The incline of the kiln is 1/2 inch per foot.[4] Limestone enters the kiln at its back end (the highest point of incline) and tumbles through the kiln via gravity and the rotating motion of the kiln (typical rotating rates are 55 to 65 revolutions per hour). The residence time of the feed material in the kiln is four hours. Approximately two tons of limestone are required to produce a ton of lime.[5]

The combustion of fuel, which consists of pulverized coal suspended in air, occurs at the front end of the kiln (the origin and chemical composition of the coal at the time of testing are unknown). The coal is pulverized to the consistency of powder in a bowl mill (the bowl mill is exclusive to the number two kiln). Air from the firing hood, located directly above the combustion end of the kiln, is pulled into the bowl mill. The air preheats and dries the coal. A fan on the mill blows the air and dry pulverized coal from the mill into the kiln. Typically a quarter to a third of a ton of coal is consumed per ton of lime.[6]

As the lime exits the kiln, it drops into one of ten satellite coolers that are attached to the exterior of the kiln. The coolers are long cylindrical tubes (30 feet long by 8 feet wide in diameter) filled with chains. As the coolers rotate with the kiln, the lime tumbles through the chains which conduct heat away from the lime.[7] Lime drops from the cooler tubes onto a conveyor belt. The lime is conveyed to a screen, separated by particle size, and stored. Fines from product screening are collected, stored, and used in hydrate production.

Approximately ten percent of the lime produced at Eastern Ridge is chemically reacted with water to form a hydrated product.[8] The chemical reaction for hydration is as follows:

$$CaO + H_2O = Ca(OH)_2 + heat$$

Lime Hydrate

At Eastern Ridge, the hydration process is carried out in seven steps. In step one, lime fines are mixed with water in a pug mill to form a partially hydrated product. The pug mill is a horizontal cylinder that contains a shaft fitted with short, heavy paddles that push and mix the materials through the mill. The source of water to the pug mill is effluent from the wet scrubber that treats exhaust from steps two through seven (the scrubber is discussed further under Hydrator Emissions Control).[9] In steps two through seven, the partially hydrated product passes through a series of six mixing barrels which allow the mixture to fully react (the transfer time through all six mixing barrels is approximately thirty minutes). After the lime is hydrated, it is transferred to a storage bin, milled, and separated from impurities (such as unreacted lime and limestone) with a whizzer separator (similar to a cylone). Approximately 28,000 tons of hydrate are typically produced annually.[10]

II. Emissions Control

Kiln Emissions Control

Exhaust from the number two kiln is routed to two, parallel spray towers. The spray towers/scrubbers were manufactured by Ducon and were installed at the plant in the 1970's. Each scrubber is equipped with a fan which draws the kiln exhaust up through the tower. Water is sprayed into the tower at various points upstream of the fan and into the fan itself.[11] The exhaust from the fan exits through a stack. Effluent from the scrubbers is directed to a series of four settling ponds where solids are removed. Clarified water is recycled back to the scrubbers.

Hydrator Emissions Control

The hydration process is exothermic, and part of the water in the hydrate mixture is vaporized. Gases from the hydrator, containing water and lime particles, are pulled by fan to a Ducon scrubber, scrubbed with 10 gallons per minute (gpm) of water (typical), and then vented to the atmosphere.[12] (The flow rate of scrubbing water varies somewhat with the moisture content of

the lime fines in step one of the hydration process. For example, newly processed lime fines have less moisture than fines which have been kept in storage; thus, the former may require more than 10 gpm while the latter may require less than 10 gpm.)[13] Effluent from the scrubber is added to the lime fines in step one. The Ducon scrubber is the same type of spray tower used to control the kiln exhaust.

Refer to Figure 1 for a diagram of the kiln, hydrator and associated emissions control. The diagram indicates the relative locations for each unit operation, direction of flow for material and gas, input and output of materials and gas, and approximate locations where process parameters were measured.

III. Process Operation

Data indicating the operation of the kiln, the scrubbers treating the kiln exhaust, and the scrubber treating the hydrator exhaust are presented in this section. All process data for the kiln were manually recorded by RTI every 15 minutes during the emissions testing and taken from computer screens in the kiln control room; the recorded data were measured with instruments already in place and used by the plant for process control of the kiln.

For the scrubbers treating the kiln exhaust, PES measured the pressure drop across each of the scrubbers and measured/calculated the volumetric flow rates of water entering and exiting each of the scrubbers. To measure pressure drop, PES drilled pressure taps upstream of each scrubber tower and at the end of each exhaust stack. The pressure drop across the upstream tap and exhaust tap of each scrubber was measured using a U-tube manometer. The pressure drop across each scrubber was measured and recorded once during each run, just prior to testing.

PES measured the volumetric flow rate of water exiting the bottom of the each scrubber by placing a container of known volume below the water outlet and recording the time to fill the container. The opening of the container was slightly smaller than the water outlet, thus, the container only collected approximately 80 percent of the exiting water. PES took two measurements of the water flow rate exiting the bottom of each scrubber; the measurements were taken back-to-back during run 2 of the kiln 2 scrubber tests.

PES measured the temperature, gas flow, and moisture content of the kiln exhaust just prior to each scrubber tower and exiting each scrubber stack; based on these measurements, PES calculated

the volumetric flow rates of water vapor entering and exiting each scrubber. These calculated flow rates, along with the measured flow rate of water exiting each scrubber, were entered into a mass balance of water across the system to calculate the flow rate of water injected into each scrubber (see Figure 2 for a mass balance of water of the scrubber system).

During emissions testing, RTI manually recorded the water flow rate to the scrubber treating the hydrator. The water flow rate was measured by an instrument already in place and used by the plant for control of the hydrator. The water flow rate was initially recorded every 15 minutes; however, after no change was noted during the first hour, and after the operator of the hydrator stated that the flow rate would remain fairly constant, the readings were recorded less frequently.

Table 1 is a statistical summary of the process data collected during testing. Tables 2a, 2b, and 2c display all of process data collected during testing.

Table 3 is a comparison of the values of the process parameters recorded during testing to previously cited values of these parameters. Previously cited values were extracted from emission test reports provided by the plant (private testing was comissioned in 1989 and 1995);[14] a trip survey of the plant written by Research Triangle Institute in 1995;[15] a questionnaire filled out by the plant for EPA in 1995;[16] and standard operating procedures (SOP) of Eastern Ridge Lime plant.[17] Values cited by the kiln operator during testing are also included in Table 3.

Notes Pertaining to Test Data

Coal feed rate, limestone feed rate, kiln speed

Table 4 compares calculated coal feed rates with the average coal feed rates recorded during testing. Coal feed rates were calculated using previously cited values for tons of coal per ton of lime and tons of lime per ton of limestone and using the average limestone rates recorded during testing. Using the questionnaire values for tons of coal per ton of lime and tons of lime per ton of limestone, the calculated coal feed rates were 1.85, 2.06, and 1.89 tons of coal per hour. Using the value for tons of coal per ton of lime cited by the kiln operator and the 1995 test data, and using the questionnaire value for tons of lime per ton of limestone, the calculated coal feed rates were 4.36, 4.46, and 4.87 tons of coal per hour. The recorded average coal feed rates were 3.69, 3.65 and 3.61 tons of coal per hour (Table 4).

Front end temperature, back end temperature, excess air

As shown in Table 3, the average back end temperatures during testing were below both ranges of temperature specified in the SOP. The front end temperature fell within the operating range specified by the SOP. The percentage of oxygen in the kiln exhaust exceeded the SOP ranges on two of the test days.

Despite the fact that the back end temperature and the oxygen level were not within the ranges specified by the SOP, all of the kiln operators stated that they were operating the kiln under normal conditions during testing. They also stated that the operation of the kiln varies on a day to day basis depending on the weather, the size of the limestone, the moisture content of the coal, the BTU value of the coal, and other factors. These factors may explain why the average oxygen content in the kiln exhaust varied between days 10/17 and 10/18. According to the kiln operator, the process was operating under normal conditions on both of these days.

Stone size

Three different sizes of calcitic limestone were fed to the number two kiln during testing; the stone sizes were referred to as "twos", "threes", and "fours". The sizes of these stones are based on mesh size. "Twos" are stones that pass through a 1 and 3/8 inch mesh and are retained on a 7/8 inch mesh. "Threes" are stones that pass through a 7/8 inch mesh and are retained on a 3/8 inch mesh. "Fours" are stones that pass through a 3/8 inch mesh and are retained on a 3/16 inch mesh.[18] During testing, the size two stone was fed to the kiln separately while the size three and four stones were combined and fed to the kiln as one feed. The process data in Tables 2a through 2e indicate the times when the different stone sizes were fed to the kiln. The decision to use a stone size during the testing was dictated by the existing supply of the stone. Neither size two stone nor sizes three and four stones were available in a large enough supply to feed the number two kiln the same stone size during the entire three days of testing.

Table 1. Statistical Summary of Process Data Collected at Eastern Ridge Lime Company

Run 1 of Kiln 2 Scrubber Tests
10/16/96; data recorded from 3:04 pm to 8:40 pm

Parameters for Kiln 2	mean	std. dev.	min.	max.	# recordings
Tons of coal per hour	3.69	0.1	3.55	3.78	21
Tons of limestone per hour	25.21	2.0	21.65	27.64	20
Front end temperature (deg F)	1741	48.1	1600	1826	21
Back end temperature (deg F)	1010.3	14.4	979.4	1038.1	21
Kiln revolutions per hour	59	4.8	50	64	21
Percent oxygen at back end kiln	1.2	0.8	0.1	4.1	21

Run 2 of Kiln 2 Scrubber Tests
10/17/96; data recorded from 11:42 am to 4:21 pm

Parameters for Kiln 2	mean	std. dev.	min.	max.	# recordings
Tons of coal per hour	3.65	0.1	3.53	3.85	14
Tons of limestone per hour	28.16	0.8	26.66	29.04	14
Front end temperature (deg F)	1869	19.1	1840.00	1900	14
Back end temperature (deg F)	945.0	8.4	931.2	965.0	14
Kiln revolutions per hour	66	2.1	62	68	14
Percent oxygen at back end kiln	0.3	0.2	0	0.7	14

Run 3 of Kiln 2 Scrubber Tests
10/18/96; data recorded from 11:05 am to 3:47 pm

Parameters for Kiln 2	mean	std. dev.	min.	max.	# recordings
Tons of coal per hour	3.61	0.0	3.54	3.71	15
Tons of limestone per hour	25.81	1.4	23.73	29.34	15
Front end temperature (deg F)	1840	15.6	1800.00	1858	15
Back end temperature (deg F)	1020.1	17.6	1003.6	1054.9	15
Kiln revolutions per hour	60	3.4	55	68	15
Percent oxygen at back end kiln	1.3	0.4	0.8	2.5	15

Run 1 of Hydrator Tests
Sat 10/19/96; data recorded from 10:00 am to 3:35 pm

Parameters for Hydrator	mean	std. dev.	min.	max.	# recordings
Water flow rate (gal/min)	9.6	0.1	9.4	9.6	11

Runs 2 & 3 of Hydrator Tests
Sun 10/20/96; data recorded from 8:00 am to 3:00 pm

Parameters for Hydrator	mean	std. dev.	min.	max.	# recordings
Water flow rate (gal/min)	9.5	0.1	9.4	9.6	8

Table 2a. Process Data

10/16/96; Run 1 of Kiln 2 Scrubber Tests
Day kiln operator = Tony
Night kiln operator = James

KILN PARAMETERS

Time	CFR	LSFR	FET	BET	RPH	% O2
2:50 PM Kiln burners turned off for approximately 5 minutes to allow sampling probes to be inserted upstream of scrubbers; the burners were turned off to reduce the heat of the exhaust where the probes were being inserted.						
currently burning small stone						
3:04 PM	3.71	21.65	1668	979.4	50	1.9
3:19 PM	3.77	21.74	1731	1002.7	50	1.4
3:34 PM	3.68	25.68	1800	1014.5	60	1.1
3:49 PM	3.74	27.08	1750	1013.3	64	1
4:04 PM	3.7	27.61	1734	1007.5	63	1.1
4:19 PM	3.74	27.48	1734	1007.5	63	1.1
4:34 PM	3.78	27.24	1757	998	64	0.1
4:49 PM	3.66	26.95	1719	1001.6	63	0.7
5:04 PM	3.75	27.03	1319	989.5	63	16.5*
(*oxygen high because coal grate clogged up; coal feed turned off for a few minutes to unclog)						
5:12 PM	3.73	27.19	1600	979.8	63	4.1
Break for filter change for Method 23						
5:40 PM	3.72	24.22	1728	1004.7	56	1.1
5:55 PM	3.72	24.35	1709	1012.9	56	1.5
new operator came; changed to large size stone around 6:00						
6:10 PM	3.64	24.35	1733	1012.7	56	1.1
6:25 PM	3.72	24.59	1705	1017.4	56	1
6:40 PM	3.59	24.39	1732	1020.6	56	0.7
6:59 PM	3.62		1780	1028.2	56	1.5
Stopped for testing change; resumed around 7:20						
7:30 PM	3.7	24.58	1760	1009.5	64	0.6
7:45 PM	3.7	27.64	1793	1008.9	64	0.9
8:00 PM	3.7	27.01	1763	1009.7	63	0.6
8:15 PM	3.71	23.37	1780	1014.3	54	0.7
8:30 PM	3.55	23.33	1755	1035.2	54	1.6
8:40 PM	3.67	23.67	1826	1038.1	54	1.4

SCRUBBER PARAMETERS
Pressure drop of exhaust

Scrubber A	Scrubber B
2.9 in. H_2O	1.0 in. H_2O

CFR = coal feed rate (tons per hour)
LSFR = limestone feed rate (tons per hour)
FET = front end temperature of kiln (deg F)
BET = back end temperature of kiln (deg F)
RPH = kiln revolutions per hour
% O2 = percent oxygen at back end kiln

Table 2b. Process Data

10/17/96; Run 2 of Kiln 2 Scrubber Tests
Day kiln operator = Chuck

KILN PARAMETERS

Time	CFR	LSFR	FET	BET	RPH	% O2
11:42 AM	3.7	26.66	1860	965	62	0.5
12:15 PM	3.85	27.57	1889	953.2	64	0.1
12:30 PM	3.7	27.35	1860	952.9	64	0.3
12:51 PM	3.7	27.67	1850	948.2	64	0.2
1:06 PM	3.63	27.61	1900	949.1	64	0.6
1:27 PM	3.66	27.58	1840	940.2	64	0.1
stone size change						
1:43 PM	3.67	28.19	1880	942.3	66	0.2
2:00 PM	3.8	28.22	1880	931.2	66	0
2:17 PM	3.6	28.95	1850	936.8	68	0.1
3:06 PM	3.54	28.95	1850	939.8	68	0.4
3:21 PM	3.53	28.85	1900	938.7	68	0.7
3:49 PM	3.55	28.85	1870	945.6	68	0.5
4:04 PM	3.62	29.04	1860	944.1	68	0.3
4:21 PM	3.55	28.81	1870	942.8	68	0.3

SCRUBBER PARAMETERS

Pressure drop		Water Effluent	
Scrubber A	Scrubber B	Scrubber A	Scrubber B
4.9 in. H_2O	0.9 in. H_2O	33 gal /9 se	33 gal /15 sec
		33 gal /10 s	33 gal /15 sec

CFR = coal feed rate (tons per hour)
LSFR = limestone feed rate (tons per hour)
FET = front end temperature of kiln (deg F)
BET = back end temperature of kiln (deg F)
RPH = kiln revolutions per hour
% O2 = percent oxygen at back end kiln

Table 2c. Process Data

10/18/96; Run 3 of Kiln 2 Scrubber Tests
Day kiln operator = Chuck

KILN PARAMETERS

Time	CFR	LSFR	FET	BET	RPH	% O2
11:05 AM	3.58	29.34	1855	1005.1	68	1.2
11:20 AM	1:55 PM	27.48	1841	1003.6	64	0.9
11:40 AM	3.6	26.43	1847	1008.5	62	0.8
11:57 AM	3.69	25.94	1850	1006.1	60	1
12:15 PM	3.62	25.77	1845	1007.2	60	1.9
12:36 PM	3.54	26.12	1840	1011.8	60	2.5
12:56 PM	2:38 PM	25.71	1821	1015.3	60	1.2
port changes; resumed around 1:35						
1:37 PM	3.6	26.22	1840	1015.8	60	1.3
1:53 PM	3.59	25.68	1831	1017.2	60	0.9
2:15 PM	3.62	23.99	1824	1015.4	55	1.3
2:35 PM	3.55	23.94	1857	1018.3	55	1.5
2:59 PM	3.59	23.73	1800	1019.6	55	1.2
3:17 PM	3.71	26.06	1850	1054.9	60	1.3
3:39 PM	3.58	25.43	1858	1052.7	60	1.5
3:47 PM	3.62	25.34	1840	1050.5	60	1.3

SCRUBBER PARAMETERS
Pressure drop

Scrubber A	Scrubber B
3.8 in. H_2O	4.9 in. H_2O

CFR = coal feed rate (tons per hour)
LSFR = limestone feed rate (tons per hour)
FET = front end temperature of kiln (deg F)
BET = back end temperature of kiln (deg F)
RPH = kiln revolutions per hour
% O2 = percent oxygen at back end kiln

Table 2d. Process Data

10/19/96; Runs 1 & 2 on Hydrator*
operator = Shockey

Time	H_20 flow rate to scrubber
10:00 AM	9.6
10:35 AM	9.6
10:50 AM	9.6
11:50 AM	9.6
12:03 PM	9.6
12:20 PM	9.6
12:45 PM	9.6
1:15 PM	9.6
1:27 PM	9.6
3:22 PM	9.6
3:35 PM	9.4

*Run 1 test data was discarded due to non isokinetic conditions

Table 2e. Process Data

10/20/96; Runs 3&4 on Hydrator
Operator = Dave

Time	H_20 flow rate to scrubber
8:00 AM	9.6
9:00 AM	9.6
10:00 AM	9.6
11:00 AM	9.6
12:00 PM	9.4
1:00 PM	9.4
2:00 PM	9.4
3:00 PM	9.4

Table 3. Comparison of Values of Operating Parameters Recorded During Testing to Values of Parameters Cited from Other Sources

Operating Parameters	Average values recorded during testing	Values from standard operating and procedures manual for Eastern Ridge Lime	Values from questionnaire[1]	Values from kiln operator	Values from 1995 site survey[2]	Values from 1995 test data[3]	Values from 1989 test data[4]
Tons per hour of coal	3.69; 3.65; 3.61		2.04[5]	3.9 - 4	3.96	4	4
Tons per hour of limestone	25.21; 28.16; 25.81		27.85[6]	Max 27			19
Tons limestone/ton lime			1.91				
Tons coal/ton of lime			0.14	0.33	0.25 - 0.33		
Kiln speed (revolutions per hour)	59; 66; 60			55 to 65		65	
Back end temp. of kiln (deg F)	1010; 945; 1020	1050 to 1150 (operating range) 1100 to 1120 (desired range)		1050 - 1200		1100	928
Front end temp. of kiln (deg F)	1741; 1869; 1840	1200 to 1950 (operating range) 1700 to 1850 (desired range)		Avg 1800		1620	1863
% O_2 in exhaust	1.2; 0.3; 1.3	0.1 to 1 (operating range) 0.1 - 0.3 (desired range)					4.5
Water flow rate to hydrator scrubber (gpm)	9.6; 9.5		10				

[1]Ref 2.
[2]Ref 1.
[3]Ref 2
[4]Ref 2
[5]Value not specified directly in questionnaire; value calculated from reported tons coal/ton of lime (0.14) and reported tons of lime per day (350).
[6]Value not specified directly in questionnaire; value calculated from reported tons of limestone/ton of lime (1.91), and reported tons of lime per day (350).

Table 4. Comparison of Calculated and Recorded Coal Feed Rates

	Calculated coal rate (tons/hr) based on 0.14 tons coal/ton of lime[1]	Calculated coal rate (tons per hour) based on 0.33 tons coal/ton of lime[2]	Recorded average coal rate (tons per hour) during testing
Run 1 of kiln 2 scrubber tests	1.85	4.36	3.69
Run 2 of kiln 2 scrubber tests	2.06	4.87	3.65
Run 3 of kiln 2 scrubber tests	1.89	4.46	3.61

[1]Equation for calculating coal feed rates based on 0.14 tons of coal / ton of lime

$$\text{calculated coal feed rate} = \frac{0.14 \text{ tons coal}}{\text{ton lime}} \text{ (questionnaire data)} \frac{\text{ton of lime}}{1.91 \text{ tons limestone}} \text{ (questionnaire data)} \frac{\text{average tons of limestone}}{\text{hr}} \text{ (recorded data)}$$

$$\text{calculated coal feed rate from run 1 of kiln 2 scrubber tests} = 0.14 * \frac{1}{1.91} * 25.21 = 1.85 \text{ tons coal per hour}$$

$$\text{calculated coal feed rate from run 2 of kiln 2 scrubber tests} = 0.14 * \frac{1}{1.91} * 28.16 = 2.06 \text{ tons coal per hour}$$

$$\text{calculated coal feed rate from run 3 of kiln 2 scrubber tests} = 0.14 * \frac{1}{1.91} * 25.81 = 1.89 \text{ tons coal per hour}$$

[2]Equation for calculating coal feed rates based on 0.33 tons of coal / ton of lime:

$$\text{calculated coal feed rate} = \frac{0.33 \text{ tons coal}}{\text{ton lime}} \text{ (kiln operator and 1995 test data)} \frac{\text{ton of lime}}{1.91 \text{ tons limestone}} \text{ (questionnaire data)} \frac{\text{average tons of limestone}}{\text{hr}} \text{ (recorded data)}$$

$$\text{calculated coal feed rate from run 1 of kiln 2 scrubber tests} = 0.33 * \frac{1}{1.91} * 25.21 = 4.36 \text{ tons coal per hour}$$

$$\text{calculated coal feed rate from run 2 of kiln 2 scrubber tests} = 0.33 * \frac{1}{1.91} * 28.16 = 4.87 \text{ tons coal per hour}$$

$$\text{calculated coal feed rate from run 3 of kiln 2 scrubber tests} = 0.33 * \frac{1}{1.91} * 25.81 = 4.46 \text{ tons coal per hour}$$

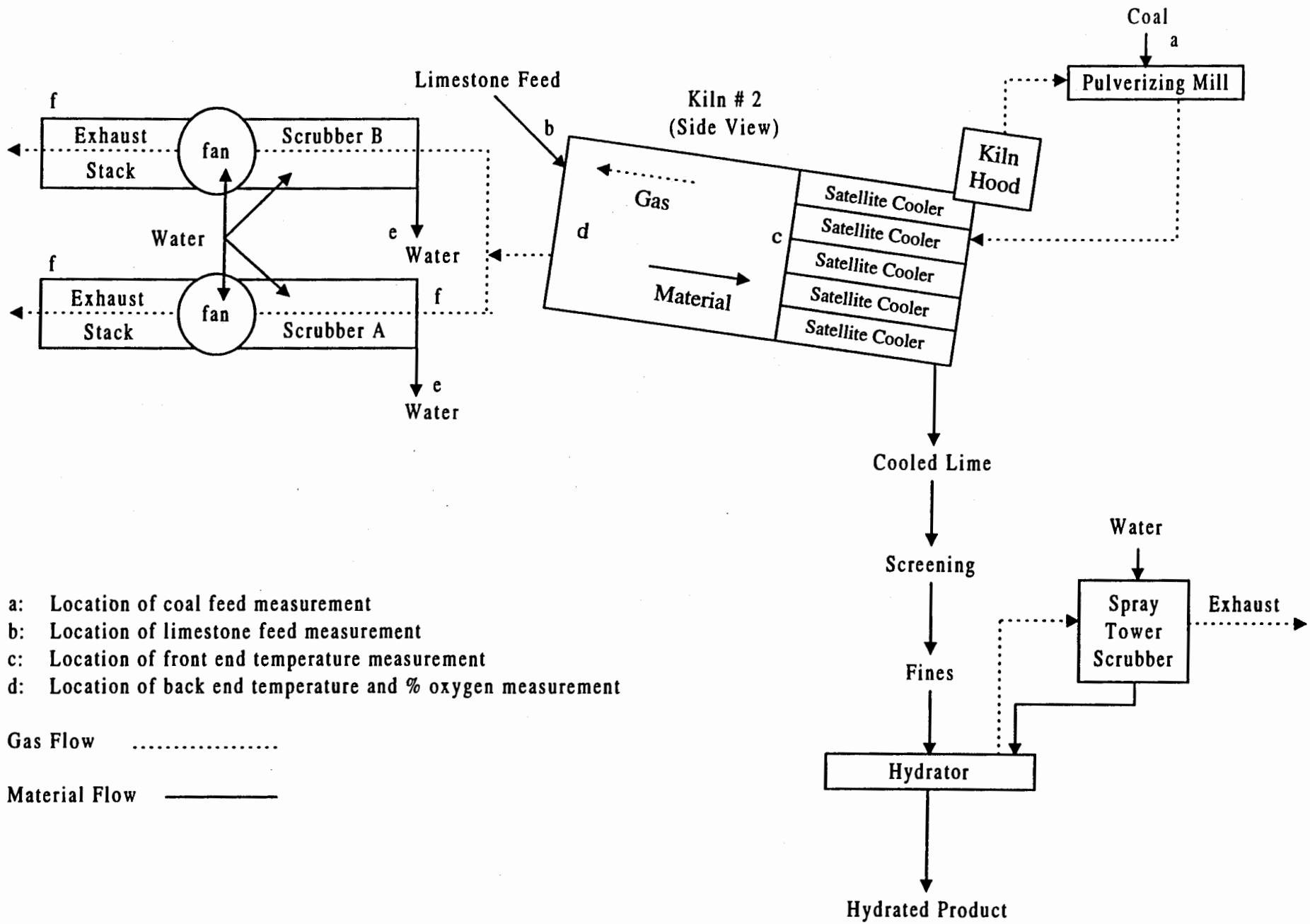
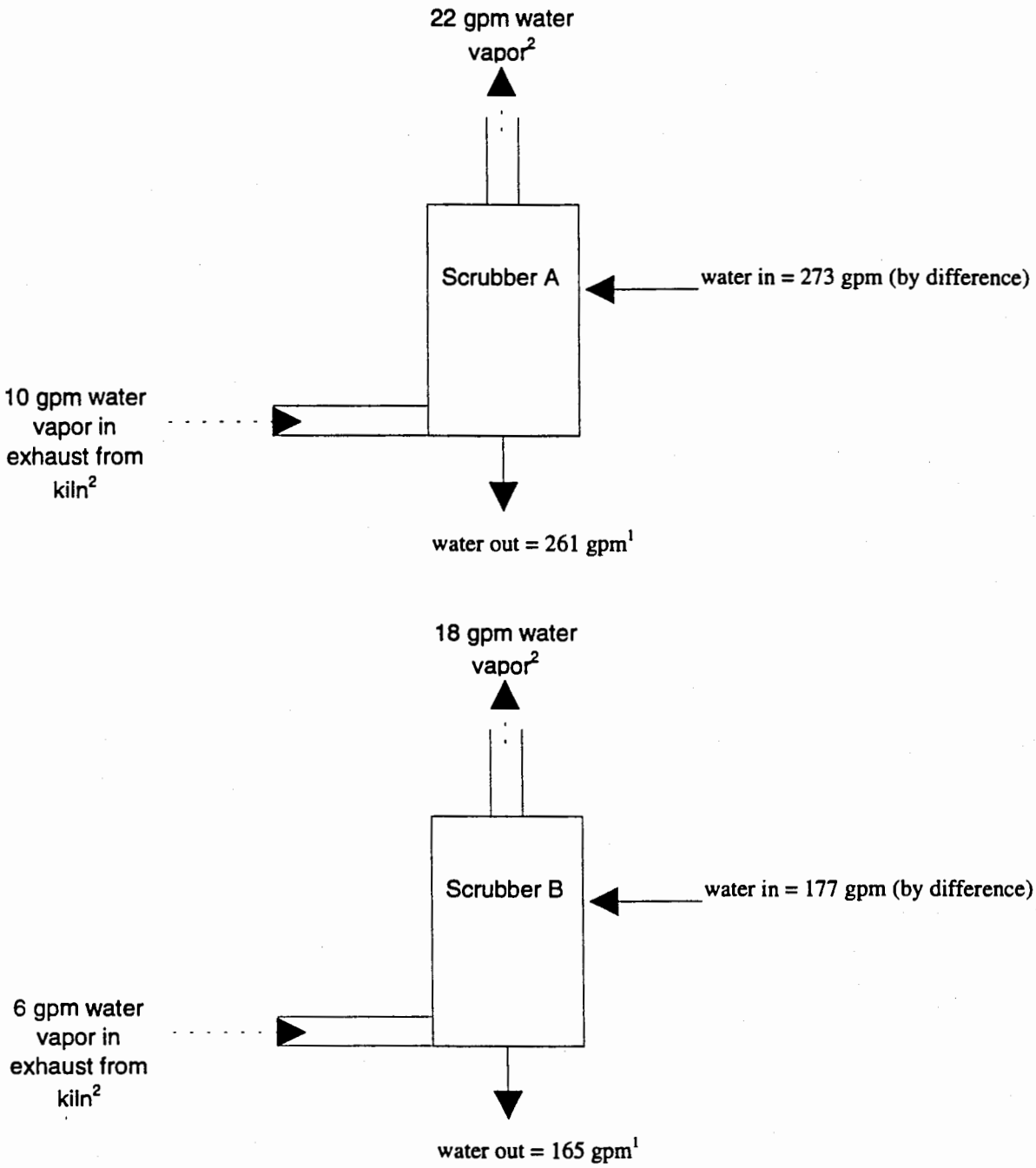


Figure 1. Process Diagram of Kiln # 2, Hydrator, and Associated Emission Control System at Eastern Ridge Lime.



[1]Average of two measurements taken during run 2 of kiln 2 scrubber tests
[2]Calcuated from air flow, temperature, and moisture measurements at this location during run 2 of kiln 2 scrubber tests

Figure 2. Mass Balance of Water Across Kiln 2 Scrubbers

REFERENCES

1. Heath, Elizabeth, Research Triangle Institute. "Site Survey of Eastern Ridge Lime, Inc., Ripplemead, Virginia." February 1, 1996.

2. Eastern Ridge response to questionnaire sent out in 1995 by the National Lime Association as part of a voluntary effort with the Environmental Protection Agency to obtain data/information for the MACT program.

3. Ref 1

4. Ref 1

5. Ref 2

6. Ref 1

7. Telecommunication between Cybele Brockmann of Research Triangle Institute and John Collins, Safety & Enviornmental director of Eastern Ridge Lime, November 21, 1996.

8. Ref 1

9. Ref 7

11. Ref 1

12. Ref 7

13. Ref 2

14. Ref 7

15. Ref 2

16. Ref 1

17. Standard Operating and Procedures Manual of Eastern Ridge Lime Plant

18. Ref 7

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page	of
S401	1	1

Client: EPA/EMC

Location: EASTERN RIDGE LIME CO.

Prepared By	Date	Checked By	Date	Sheet Title
[signature]	11/20/96			SCRUBBERS A & B PRESS. DROP & WATER RATE

RUN NO.	SCRUBBER "A"	Scrubber "B"
1	2.9" H_2O	1.0" H_2O
2	4.9" H_2O	0.9" H_2O
3	3.8" H_2O	4.9" H_2O

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page
5401.003	1 of 1

Client: EASTERN RIDGE LIME CO.

Location: RIPPLEMEAD, VA

Prepared By	Date	Checked By	Date	Sheet Title
F. Meadows	10/16/96			KILN NO. 2 SCRUBBERS A & B ΔP

RUN 1

Scrubber ΔP, in. H_2O Time	A ΔP, "H_2O	B ΔP, "H_2O	Ts °F
1524	3.3	1.0	945
1633	3.1	0.9	
1655	3.4	1.0	
1715	3.1	1.0	
1741	3.0	1.0	916
1853	2.0	1.0	916
2030	2.0	1.0	917

RUN 2 10/17/96

1143	5.4	0.85	914
1310	5.4	0.90	914
1345	4.8	0.90	901
1435	4.2	0.90	901
1611	5.1	0.90	901
1630	4.7	0.90	901

RUN 3 10/18/96

	3.8	4.90	954
1100			
1200	3.3	4.7	936
1253	4.1	5.1	964
1340	4.0	4.9	952
1428	3.9	4.8	943
1512	3.9	5.0	949

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page	of
5401.003	1	1

Client: ERL

Location:

Prepared By	Date	Checked By	Date	Sheet Title
F. MEADOWS	10/16/96			

Scrubber A — 10 sec, 9 sec — assume we can get 80% of H2O

B — 15 sec, 15 sec — "

33 gal can

$\frac{33}{.8} \times \frac{9.5 \text{ sec/min}}{60 \text{ sec}}$

A $\frac{33 \text{ gallons} \times \cancel{0.80} \times}{0.80 \times 9.5 \text{ seconds}} \times \frac{60 \text{ seconds}}{\text{minute}} = \cancel{167}\ 261$ GPM

B $\frac{33 \text{ gallons} \times 60}{.80 \times 15} = 165$ GPM

APPENDIX B

RAW FIELD DATA

Appendix B.1

Raw Field Data

Kiln No. 2

Appendix B.1.1

Raw Field Data

Kiln No. 2 Exhaust

GAS ANALYSIS DATA FORM

PLANT EAST

DATE 10-16-96 TEST NO 3-1

SAMPLING TIME (24-hr CLOCK)

SAMPLING LOCATION KILN NO. 2 EXHAUST

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 70°F

OPERATOR [illegible]

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	25.0	25.0	25.0	25.0	25.0	25.0	25.0	44/100	11.000
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	28.4	3.4	28.5	3.5	28.5	~~28.5~~ 3.5	3.5	32/100	1.120
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)		—		—		—	—	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		71.6		71.5		71.5	71.5	28/100	20.020
								TOTAL	32.14

FIELD DATA SHEET

4-1

Plant: Ridge Lime Comp.
Sampling Location Scrubber Inlet
4-1 Run Number: Inlet Run 1 Date: 10-16-96
Pretest Leak Rate: .005 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ____ Orsat: ____

Sample Type: M-4 Operator: ____
Pbar: 28.65 Ps: ____
CO2: 20 O2: 8
Probe Length/Type: 4' SS Pitot #: ____
Stack Diameter: ____ As: ____

Nozzle ID: ____ Thermocouple #: ____
Assumed Bws: ____ Filter #: ____
Meter Box #: 13 Y: .985 ΔH@: 1.656
Post-Test Leak Rate: ____ cfm @ ____ in. Hg.
Post-Test Leak Check: Pitot: ____ Orsat: ____

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Orifice Pressure Differential (ΔH) in H2O Actual	Stack Temp. (Ts)	Temperature °F Probe	Temperature °F Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Dry Gas Meter Temp. Outlet (Tm out °F)	Pump Vacuum (in. Hg)
	0	1314	144.028										
		1326	149.5			.5	NA ~~135~~				93	93	4
		1335	153.4			.5	~~135~~				95	95	4
		1343	156.5			.5	~~137~~				93	92	5
106.790	57.7		106.790			.5					93	91	7
167.442	62.0		169.4			.5					94	92	1
	70	1723	173.3			.5					99	94	2
	83.0	1735	179.0			.5					102	96	1
	92.0	1745	182.9			.5					102	96	2
	125	1818	197.7			.5					101	96	3
	135	1828	202.0			.5					100	99	3
	145	1838	206.0			.5					98	94	4
	154	1847	209.8			.5					97	94	4
	165	1858	214.5			.5					97	93	5
	185	1918	223.7			.5					96	92	6
	200	1932	230.2			.5					93	88	7
	217	1950	237.3			.5					93	89	5
	240	2013	246.290			.5					91	88	8
			102.262										
			.652										

ΔVm= 101.610 $\overline{\sqrt{\Delta p}}$= ____ $\overline{\Delta H}$= .5 $\overline{Ts}$= ____ $\overline{Tm}$= 95°F

SAMPLE RECOVERY DATA

Plant: EASTERN RIDGE LIME CO. Run No.: 4-1

Date: 10-16-96 Sample Box No.: _____ Job No.: 5401.003

Sample Location: KILN NO. 2 EXHAUST

Sample Type: MOISTURE Filter No.: —

Sample Recovery Person: _____

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ Sealed: _____

Description of Filter: _____

Samples Stored and Locked: _____

BACK HALF/MOISTURE

Container No.: _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
condenser 1	MT		1987.0	2195.0	208.0
2	Silica Gel		862.7	895.4	32.7
3					
4					
5					
6					
TOTAL					240.7

Description of Impinger Catch: _____

GAS ANALYSIS DATA FORM

PLANT EASTERN RIDGE LIME CO.

DATE 10-17-96 TEST NO 3-2

SAMPLING TIME (24-hr CLOCK)

SAMPLING LOCATION KILN NO.2 EXHAUST (SCRUBBERS INLET

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) INTEGRATED BAG

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 70°F

OPERATOR [illegible]

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	27.4	27.4	27.4	27.4	27.4	27.4	27.4	44/100	12.056
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	30.1	2.7	30.1	2.7	30.1	2.7	2.7	32/100	0.864
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)		0		0		0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		69.9		69.9		69.9	69.9	28/100	19.572
								TOTAL	32.492

FIELD DATA SHEET

Plant: EPA Ridge Lime
Sampling Location: Scrubber Inlet
4-2 Run Number: 4-B-2 Date: 10-17-96
Pretest Leak Rate: .002 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ____ Orsat: ____

Sample Type: M-4 Operator: TA
Pbar: 28.54 Ps: ____
CO2: ____ O2: ____
Probe Length/Type: 4' SS Pitot #: ____
Stack Diameter: ____ As: ____

Nozzle ID: ____ Thermocouple #: ____
Assumed Bws: .12 Filter #: NA
Meter Box #: 13 Y: .985 ΔH@: 1.656
Post-Test Leak Rate: .004 cfm @ 15 in. Hg.
Post-Test Leak Check: Pitot: ____ Orsat: ____

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Orifice Pressure Differential (ΔH) in H2O Actual	Stack Temp. (Ts)	Temperature °F Probe	Temperature °F Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Dry Gas Meter Temp. Outlet (Tm out °F)	Pump Vacuum (in. Hg)
	0	1140	246.661										
	20	1200	255.5			.5					76	74	2
	40	1220	263.6								94	84	3
Down to	60	1240	271.8								91	83	6
sampling probe	103	1340	290.4								94	87	11
	120	1358	297.8								97	93	1
83.238	150	1428	310.8								98	93	1
83.920	180	1520	325.0								96	94	2
	200	1538	333.5								93	90	2
	220	1602	344.4								94	90	2
	240	1619	350.410								95	91	2
											96	91	2

ΔVm= ____ $\overline{\sqrt{\Delta p}}$= ____ $\overline{\Delta H}$= ____ $\overline{Ts}$= ____ $\overline{Tm}$= 91

SAMPLE RECOVERY DATA

Plant: Eastern Ridge Lime Run No.: 4-2

Date: 10-17-96 Sample Box No.: _____ Job No.: _____

Sample Location: Kiln No. 2 Exhaust

Sample Type: M-4 Moisture Filter No.: —

Sample Recovery Person: CLR

Comments: SS Condenser

Experienced 30 psi pressure; removed some silica gel and reweighed. Center tube was plugged!

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ Sealed: _____

Description of Filter: _____

Samples Stored and Locked: _____

BACK HALF/MOISTURE

Container No.: _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
SG 1	silica gel		897.1	911.6	14.5
2					
SG 3	reweighed silica gel		850.0	873.2	23.2
4					
SS Condenser 5	empty		1994.0	2182.0	188.0
6					
TOTAL					225.7

Description of Impinger Catch: dirty

GAS ANALYSIS DATA FORM

PLANT EASTERN RIDGE LIME CO.

DATE 10-18-96 TEST NO 3-3

SAMPLING TIME (24-hr CLOCK)

SAMPLING LOCATION KILN NO. 2 EXHAUST (SCRUBBERS INLET)

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) INTEGRATED BAG

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 70°F

OPERATOR [illegible]

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	23.0	23.0	23.0	23.0	23.0	23.0	23.0	44/100	10.120
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	28.4	5.4	28.4	5.4	28.4	5.4	5.4	32/100	1.728
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)		0		0		0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		71.6		71.6		71.6	71.6	28/100	20.048
								TOTAL	31.896

FIELD DATA SHEET

Plant: PPA Eastern Ridge Lime Corp. Sample Type: M-4 Operator: TA/FM Nozzle ID: _____ Thermocouple #: _____

Sampling Location Scrubber Inlet Pbar: 28.30 Ps: _____ Assumed Bws: 12 Filter #: _____

4-3 Run Number: ~~4-1-3~~ 3-3 Date: 10-18-96 CO2: _____ O2: _____ Meter Box #: 13 Y: .985 ΔH@: 1.656

Pretest Leak Rate: .004 cfm @ 15 in. Hg. Probe Length/Type: 4'55 Pitot #: _____ Post-Test Leak Rate: .002 cfm @ 13 in. Hg.

Pretest Leak Check: Pitot: ____ Orsat: _____ Stack Diameter: _____ As: _____ Post-Test Leak Check: Pitot: ____ Orsat: ____

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)	
	0	1100	350.600										
	20	1120	359.5			.5					74	73	2
	40	1140	368.5								79	76	2
	60	1200	377.8								83	77	5
	80	1220	387.3								86	79	5
	100	1240	396.0								87	81	5
	120	1300	405.3								88	82	5
	140	1320	413.2								89	83	5
	160	1355	421.7								88	83	5
	180	1415	430.3								88	83	5
	200	1435	438.9								88	83	5
	240	1540	456.240								88	84	6

ΔVm= 105.640 $\sqrt{\Delta p}$= — $\overline{\Delta H}$= .5 $\overline{Ts}$= — $\overline{Tm}$= 83

SAMPLE RECOVERY DATA

Plant: EASTERN RIDGE LIME Run No.: ~~3-3~~ 4-3

Date: 10/18/96 Sample Box No.: _____ Job No.: S401.003

Sample Location: KILN No. 2 EXHAUST (SCRUBBERS INLET)

Sample Type: MOISTURE EPA 4 Filter No.: —

Sample Recovery Person: Riley

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ Sealed: _____

Description of Filter: _____

Samples Stored and Locked: _____

BACK HALF/MOISTURE

Container No.: _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	Condenser		1996.0	2144.0	148.0
2	Silica Gel		868.0	~~21~~ 906.0	38.0
3					
4					
5					
6					
TOTAL					186.0

Description of Impinger Catch: _____

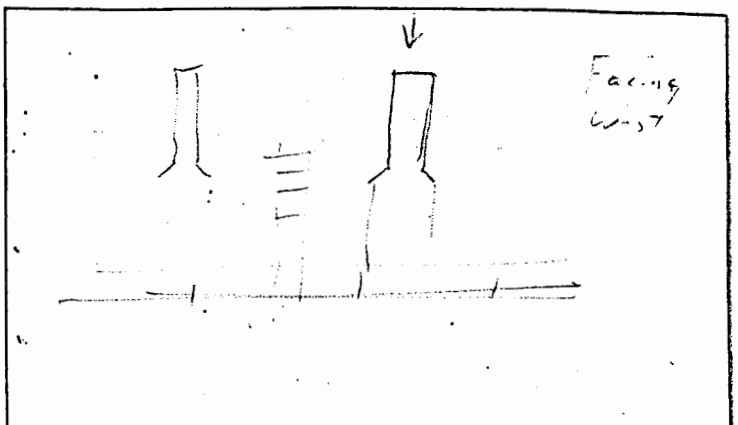
Appendix B.1.2

Raw Field Data

Kiln No. 2 - Scrubber "A"

EPA METHOD 1
TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT EASTERN RIDGE LIME CO.
CITY RIPPLEMEAD STATE VA
SAMPLING LOCATION Scrubber Outlet
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 51 1/4
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 3 1/4
NEAREST UPSTREAM DISTURBANCE
DISTURBANCE ~2 Diam
NEAREST DOWNSTREAM DISTURBANCE
DISTURBANCE ~ Diam
SAMPLER MH AB DATE



SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8-INCH)	DISTANCE B	TRAVERSE DISTANCE FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	0.021	48"	1"	3 1/4	4 1/4
2	0.067		3 1/4"		6 1/2
3	0.118		5 5/8		8 7/8"
4	0.177		8 1/2		11 3/4"
5	0.250		12"		15 1/4"
6	0.356		17 1/8"		20 3/8"
7	0.644		30 7/8"		34 1/8"
8	0.750		36"		39 1/4"
9	0.823		39 1/2		42 3/4"
10	0.882		42 3/8"		45 5/8"
11	0.933		44 3/4"		48"
12	0.979		47"		50 1/4

GAS ANALYSIS DATA FORM

PLANT EASTERN RIDGE LIME CO.

DATE 10-16-96 TEST NO 3A-1

SAMPLING TIME (24-hr CLOCK)

SAMPLING LOCATION KILN NO. 2 SCRUBBER A OUTLET

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) INTEGRATED BAG

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 70°F

OPERATOR

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	21.1	21.1	21.1	21.1	21.0	21.0	21.1	44/100	9.284
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	27.7	6.6	27.7	6.6	27.7	6.7	6.6	32/100	2.112
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)		0		0		0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		72.3		72.3		72.3	72.3	28/100	20.244
								TOTAL	31.640

GAS ANALYSIS DATA FORM

PLANT EASTER RIDGE LIME CO.
DATE 10-17-96 TEST NO 3A-2
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION KILN NO. 2 SCRUBBER A OUTLET
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) INTEGRATED BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 70°F
OPERATOR L Meadows

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	23.8	23.8	23.7	23.7	23.7	23.7	23.7	44/100	10.428
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	28.8	5.0	28.7	5.0	28.7	5.0	5.0	32/100	1.600
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)		0		0		0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		71.2		71.3		71.3	71.3	28/100	19.964
								TOTAL	31.992

GAS ANALYSIS DATA FORM

PLANT EASTERN RIDGE LIME CO.

DATE 10-18-96 TEST NO 3A-3

SAMPLING TIME (24-hr CLOCK)

SAMPLING LOCATION KILN NO. 2 SCRUBBER "A" OUTLET

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) INTEGRATED BAG

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 70°F

OPERATOR J Meadows

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	21.0	21.0	21.0	21.0	21.0	21.0	21.0	44/100	9.240
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	27.7	6.7	27.8	6.8	27.7	6.7	6.7	32/100	2.144
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)		0		0		0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		72.3	~~72~~	72.2		72.3	72.3	28/100	20.244
								TOTAL	31.628

METHOD 5 TESTING FIELD DATA SHEET

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Eastern Ridge Ripplemead VA	10/16/	DEEGO Scrubber A	M23	M23A-1 1

OPERATOR	AMBIENT PRESS (in. Hg)	STATIC PRESS (in. Hg)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (in.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
MH	~~29.54~~ 28.65	-0.07	66	—	48	0.84	6' Glass	Field Cal	0.257 0.256, 0.257, 0.257

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
19.9	M5-6	1.816	1.008	5A	5A	PES Orsat	0.0 @ 16"	0.001 @ 18"	~7	~22	~~2.978~~ 5.0

TRAV. POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (in. H2O)	delta H ORIFICE (in. H2O)	STACK TEMP (deg. F)	PROBE TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	SIL GEL IMPINGER TEMP (deg. F)	DGM IN/OUT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)	Aux Temp
B 1	0	15:10	381.433	0.44	1.32	137	248	254	~~86~~ 67	86	6.5	37
	5		384.71	0.45	1.35	137	248	252	66	87	6.7	37
2	10		387.96	0.43	1.29	137	249	253	58	90	6.9	36
	15		391.22	0.43	1.29	138	249	253	55	91	7.0	36
3	20		394.47	0.40	1.2	137	243	253	55	93	7.0	36
	25		397.55	0.39	1.17	138	244	247	54	93	7.01	37
4	30		400.68	0.47	1.41	138	245	249	55	95	8.1	39
	35		404.00	0.46	1.38	138	247	252	54	96	8.6	39
5	40		407.34	0.52	1.56	137	239	249	54	96	9.8	39
	45		410.87	0.52	1.56	137	247	253	54	97	10.2	39
6	50		414.41	0.31	0.93	138	245	252	66	88	8.1	44
	55		417.19	0.31	0.93	137	251	251	64	89	8.2	43
7	60		419.9	0.17	0.51	137	248	250	60	91	6.0	38
	TOTAL TIME		DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.				AVE. TEMP.		

13 Readings

	$\sqrt{\Delta P}$	ΔH	T_s	T_m
Avg ⇒ (This Page)	0.633	1.227	137.4	91.7

☆ Stop @ 4:00 PM
Resume @ 4:27
C. 1 R Filter Change

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Eastern Ridge Ripplemead VA	10/16	DEECO Scrubber A	~~Dioxin~~ Dioxin/Furan	1

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
	65		421.98	0.17	0.51	137	242	253	58	92	37	6.0
8	70		424.00	0.15	0.48	138	248	251	59	94	39	6.0
	75		426.01	0.15	0.48	139	252	252	61	94	41	6.0
9	80		428.00	0.16	0.51	137	249	250	59	93	41	6.3
	85		430.09	0.17	0.54	134	251	253	59	94	44	6.8
10	90		432.32	0.26	0.83	136	254	253	60	94	45	9.0
	95		435.00	0.26	0.83	137	250	254	62	93	41	9.0
11	100★		437.637	0.52	1.66	139	246	255	66	85	45	14.6
	105		441.25	0.52	1.66	138	239	251	65	85	39	15.0
12	110		444.89	0.58	1.86	139	237	252	60	84	38	17.0
	115		448.71	0.58	1.86	139	250	254	58	85	38	18.0
B 12	120*	~~17:52~~ 18:25	~~452.523~~ 453.086	0.43	1.38	138	247	256	66	78	36	12.0
	125		456.49	0.43	1.38	139	247	255	60	79	37	12.2
~~2~~ 11	130		459.75	0.44	1.41	138	248	257	55	80	41	13.6
	135		463.04	0.44	1.32	138	247	252	55	80	42	14.0
~~3~~ 10	140		466.29	0.46	1.38	138	257	254	57	80	43	15.0
	145		469.60	0.45	1.35	138	247	252	58	80	43	15.0
~~4~~ 9	150		472.84	0.47	1.41	138	250	253	58	80	44	15.7
	155		476.17	0.47	1.41	138	244	253	59	79	44	16.1
~~5~~ 8	160 +		479.481	0.33	0.99	138	246	250	60	75	45	12.1
Page Totals	TOTAL TIME	This Page Only →	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	20 Readings			AVG DGM F		
				0.596	1.157	137.8				85.2		

Change K factor to 3.2 to reflect lower Stack Temp than Expected

Change K factor to reflect Lower DGM Temp K = 3.0

+ Stop 19:05 Scrub B ★ Stop @ 5:17 PM Scrub B ✱ –

Sheet Checked By: _____ Date _____

0.012 @ 21" Hg

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Eastern Ridge Ripley, WV	10/16/96	DEECO Scrubber A	M23 Dioxin/Furan	1

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
	165		482.27	0.34	1.02	138	252	252	62	75	43	13.1
gmk 67	170		485.08	0.32	0.96	138	253	254	59	77	44	13.5
	175		487.87	0.34	1.02	137	248	252	56	77	44	13.8
gmk 76	180		490.65	0.33	0.99	137	246	250	58	77	46	14.0
	185		493.44	0.33	0.99	138	249	254	60	78	47	14.2
gmk 85	190		496.23	0.24	0.72	138	247	254	61	77	48	12.2
	195		498.59	0.24	0.72	138	250	253	62	78	50	12.4
gmk 94	200		500.99	0.20	0.60	137	248	254	63	78	51	11.8
	205		503.16	0.22	0.66	137	245	251	62	77	48	12.1
gmk 103	210		505.44	0.21	0.63	137	241	250	61	78	48	12.2
	215		507.67	0.23	0.69	137	237	249	61	77	47	12.8
gmk 112	220		510.00	0.27	0.81	137	241	252	61	77	48	13.9
	225		512.52	0.27	0.81	139	244	251	60	77	49	14.3
gmk 121	230		515.06	0.27	0.81	139	246	255	61	77	51	14.6
	235		517.55	0.29	0.87	139	248	253	62	77	53	15.4
	240	20:38	520.184									

Page Totals	TOTAL TIME	Total for Run 1 →	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	AVG DGM F
	240		138.188	0.583	1.070	137.7	84.4

This page (15 Readings)

$\overline{\sqrt{\Delta P}}$	$\overline{\Delta H}$	$\overline{STKT}$	$\overline{DGMT}$
0.524	0.820	137.73	77.13

Sheet Checked By: _____ Date _____

METHOD 23 CDD/CDF SAMPLE RECOVERY DATA

Plant: Eastern Ridge Lim		Run No. 23A Run 1
Sample Date: 10-15-96	Filter No.(s): NA	Job No.: 5-401
Sample Location: No. 2 Kiln Outlet "A"		
Recovery Date: 10-15-96	XAD-2 Trap No.(s): Run 1A	
Sample Recovery Person: C. E. Riley / M M		

Moisture Data

Impingers	XAD - 2 Trap	1 (knockout)	2 (100 ml H2O) (untipped)	3 (100 ml H2O) (tipped)	4 (knockout) (untipped)	Silica gel (untipped)	
Final wt.	314.2	1014.4	584.9	587.7	482.6	941.9	g
Initial wt.	307.8	403.6	588.4	587.6	479.3	905.7	g
Net wt.	6.4	610.8	-3.5	0.1	3.3	36.2	g
						653.3	

Description

Train System: M-23

Probe: 4 ft

Filter: Color - grey Loading - medium to heavy (changed filters)

Impinger Contents: clear

Silica Gel: @Grams Used - 500 Color - blue/white % Spent - 80 to 70%

Condensate Observed In Front Half: some condensate drops

Recovered Sample Fractions

Filter Container No.	marked/sealed: ✓
XAD Module Container No.:	marked/sealed: ✓
Probe (FH) & Back Half Rinse (Acetone) Container No.:	Liquid level marked/sealed: ✓
Probe (FH) & Back Half Rinse (Toluene) Container No.:	Liquid level marked/sealed: ✓
Impinger Contents Container No.:	Liquid level marked/sealed:
Impinger Rinse (Acetone/MeCl2) Container No.:	Liquid level marked/sealed:

FH fraction - FH/BH rinsing (acetone/toluene) & filter

XAD fraction - XAD trap

METHOD 5 TESTING FIELD DATA SHEET

Assumed
$T_M = 80$
$T_s = 137.5$
$\%M = 19\%$

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Eastern Ridge Rippleme VA	10/17/96	Scrubber A	M23 Dioxin/Furan	2

OPERATOR	AMBIENT PRESS (in. Hg)	STATIC PRESS (in. Hg)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (in.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
MH	28.54	-0.07		—	48	0.84	6' Glass	Field Cal (~~See back~~)	~~0.257~~ 0.247

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
20	M56	1.816	1.008	5A	5A	PES	0.018 @ 18"	0.015 @ 19"	~7	~25	~~3.05~~ 2.60

TRAV. POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (in. H2O)	delta H ORIFICE (in. H2O)	STACK TEMP (deg. F)	PROBE TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	SIL GEL IMPINGER TEMP (deg. F)	DGM IN/OUT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)	Aux Temp
A 12	0	11:40	~~520.883~~ 521.621	0.41	1.07	134	253	255	65	75	6.0	44
	5		524.54	0.41	1.07	134	254	253	63	78	7.0	39
11	10		527.39	0.40	1.04	134	252	255	61	81	7.0	38
	15		530.26	0.40	1.04	133	253	253	57	83	7.5	38
10	20		533.08	0.39	1.01	134	257	252	56	85	7.9	38
	25		535.96	0.42	1.09	133	251	253	55	86	8.41	36
9	30		538.81	0.44	1.14	134	251	251	56	87	9.0	37
	35		541.78	0.44	1.14	134	249	252	56	88	9.6	37
8	40		544.73	0.33	0.86	134	248	253	58	89	8.7	38
8	45		547.38	0.33	0.86	135	246	253	59	90	9.0	38
7	50		550.02	0.33	0.86	134	244	250	60	91	9.2	38
	55		552.67	0.33	0.88	134	245	252	61	91	9.5	38
6	60		555.32	0.12	0.32	134	246	251	63	92	5.8	42
	TOTAL TIME	This page only	DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.				AVE. TEMP.		
				0.599	0.952	133.9				85.8		

(13 Readings)

Change K Factor 2.67 DGM Temp Higher

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
~~Ripple~~ Eastern Ridge Ripplemead VA	10/17/96	Scrubber A	M23 Dioxin/Furan	2

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
	65		557.03	0.12	0.32	134	246	252	64	92	39	5.8
5	70		558.69	0.24	0.64	134	246	249	65	91	37	8.0
	75		561.00	0.27	0.72	134	247	250	61	91	38	9.0
4	80		563.43	0.21	0.56	134	247	251	59	92	39	8.0
	85		565.61	0.23	0.61	134	248	250	60	93	39	8.6
3	90		567.86	0.19	0.51	135	249	251	60	93	39	8.2
	95		569.94	0.19	0.51	135	249	252	61	93	40	8.2
2	100		572.03	0.23	0.61	134	250	252	62	94	40	8.8
	105		574.29	0.24	0.64	135	249	251	62	93	38	9.0
1	110		567.59	0.26	0.69	134	249	251	60	94	37	9.5
	115		578.99	0.26	0.69	134	247	248	60	94	38	10.1
B 1	120 +	13:40 / 13:55	581.376 / 581.728	0.41	1.09	135	250	254	66	90	39	15.6
	125		584.76	0.41	1.09	135	249	250	63	91	38	15.6
2	130		587.71	0.39	1.04	136	244	245	60	91	37	15.5
	135		590.61	0.38	1.01	137	244	252	59	93	37	15.5
3	140		593.47	0.41	1.09	137	247	251	56	92	36	16.0
	145		596.42	0.42	1.12	137	245	249	55	92	36	16.3
4	150		599.43	0.50	1.34	137	245	249	56	92	36	18.5
	155 ★	14:30 / 15:05	602.632	0.45	1.20	136	245	255	65	86	43	18.0
5	160		605.79	0.46	1.23	137	252	253	63	87	38	18.3

Page Totals	TOTAL TIME	This page only →	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	(20 Readings)	AVG DGM F
				0.551	0.84	135.2		~~8~~ 91.7

★ Stop 14:30 + Intermediate Probe 0.011 @ 12 "Hg

Sheet Checked By: _____ Date _____

PLANT AND CITY				DATE	SAMPLING LOCATION			SAMPLE TYPE		RUN NUMBER			
Eastern Ridge Ripplemead VA				10/17/96	Scrubber A			M23 Dioxin/Furan		2			
TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
	165		608.94	0.46	1.23	136	248	253	57	86	36	18.3
6	170		612.04	0.24	0.64	136	248	251	53	86	35	13.0
	175		614.39	0.24	0.64	137	250	254	58	89	37	13.0
7	180		616.68	0.11	0.29	136	248	250	59	90	36	7.9
	185		618.92	0.11	0.29	136	246	250	61	91	37	8.0
8	190		619.87	0.09	0.24	136	246	249	61	92	37	7.4
	195		621.35	0.09	0.24	136	245	252	62	93	38	7.5
9	200		622.83	0.16	0.43	136	246	252	62	93	38	9.5
	205		624.74	0.16	0.43	136	248	252	61	94	38	9.8
10	210		626.68	0.37	0.99	135	244	257	61	95	39	17.0
	215		629.51	0.37	0.99	135	248	257	56	94	38	17.3
11	220		632.38	0.42	1.12	135	244	248	53	93	34	18.5
	225		635.26	0.41	1.09	135	243	257	52	93	33	18.2
12	230		638.14	0.37	0.99	135	243	257	52	92	33	18.0
	235		641.02	0.37	0.99	135	246	250	53	92	34	18.2
	240	16:30	643.964									

	TOTAL TIME		DGM VOLUME	AVG SQRT P	AVG H	AVG STK F		AVG DGM F
Page Totals	240	This Page only →	~~121.991~~ 9nW	~~0.564~~ 0.496	0.707	135.6		91.5
		Total →	121.991	0.547	0.829	135.0	Sheet Checked By:	90.0 Date

13:25
SG
911.6
850.0 - new

METHOD 23 CDD/CDF SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plus

Plant: Eastern Redy Lime		Run No.: 23A Run 2
Sample Date: 10-17-96	Filter No.(s): NA	Job No.: S401
Sample Location: No. 2 Kiln Outlet A		
Recovery Date: 10-17-96	XAD-2 Trap No.(s): M23 Run 2 A	
Sample Recovery Person: CCR		

Moisture Data

Impingers	XAD - 2 Trap	1 (knockout)	2 (100 ml H2O) (untipped)	3 (100 ml H2O) ~~(tipped)~~	4 (knockout) (untipped)	Silica gel (untipped)	
Final wt.	319.1	977.8	584.9	581.7	477.4	911.5	g
Initial wt.	~~316.0~~	405.6	584.7	587.6	472.3	880.6	g
Net wt.	315.3	572.2	0.0.2	-5.9	5.1	30.9	g
	3.8					606.3	

Description

Train System:	M-23
Probe:	4ft
Filter: Color - blue/gray	Loading - heavy (changed filter)
Impinger Contents:	clear
Silica Gel: @Grams Used - 400	Color - good % Spent - 60
Condensate Observed In Front Half:	several drops

Recovered Sample Fractions

Filter Container No.	marked/sealed: ✓
XAD Module Container No.:	marked/sealed: ✓
Probe (FH) & Back Half Rinse (Acetone) Container No.:	Liquid level marked/sealed: ✓
Probe (FH) & Back Half Rinse (Toluene) Container No.:	Liquid level marked/sealed: ✓
Impinger Contents Container No.:	Liquid level marked/sealed:
Impinger Rinse (Acetone/MeCl2) Container No.:	Liquid level marked/sealed:

Nozzle check: .246 .248 .246 .247
FH fraction - FH/BH acetone, toluene rinsing to filter
XAD fraction - XAD module

METHOD 5 TESTING FIELD DATA SHEET

$T_s = 135$

$\%H_2O = 18.2$ (Sat)

$85 = T_m$

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Eastern Ridge Ripplemead VA	10/18/96	Scrubber A	M23 Dioxin/Furan	23A-3 3

OPERATOR	AMBIENT PRESS (In. Hg)	STATIC PRESS (in. Hg)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (In.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
MH AB	28.32	-0.07	65	—	48	0.84	6' Glass		0.247

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
18.2	M5-6	1.816	1.008	5A	5A	PES	0.006 @ 18"	0.002 @ 19.5"	~7	~25	2.68

TRAV. POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	STACK TEMP (deg. F)	PROBE TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	SIL GEL IMPINGER TEMP (deg. F)	DGM IN/OUT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)	Aux Temp
B 1	0	~~10:50~~ 11:00	646.915	0.48	1.29	134	256	252	68	76	5.0	38
	5		650.18	0.49	1.31	134	251	253	55	77	5.0	37
2	10		653.38	0.51	1.37	134	251	250	51	80	5.3	37
	15		656.62	0.50	1.34	134	252	251	48	81	5.8	37
3	20		659.88	0.50	1.34	134	251	249	47	83	6.0	37
	25		663.11	0.52	1.39	134	251	252	48	84	6.7	38
4	30		666.38	0.61	1.63	133	249	249	47	84	8.0	38
	35		669.96	0.61	1.63	133	243	250	47	85	8.3	39
5	40		673.55	0.67	1.80	134	248	249	47	85	9.8	38
	45		677.39	0.68	1.82	135	248	251	49	86	10.0	40
6	50		681.07	0.17	0.45	135	250	251	50	86	4.8	41
	55		683.14	0.17	0.45	135	250	251	54	84	4.8	40
7	60		685.04	0.13	0.35	135	254	251	55	85	4.2	41
	TOTAL TIME		DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.				AVE. TEMP.		

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Eastern Ridge Ripplemead VA	10/18/96	Scrubber A	M23 Dioxin/Furan	23A-3 3

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
	65		686.75	0.11	0.29	134	254	252	55	84	40	3.9
8	70		688.32	0.17	0.46	134	255	253	57	84	40	4.8
	75		690.28	0.16	0.43	135	253	250	55	84	41	4.7
9	80		692.16	0.21	0.56	135	252	252	55	84	41	5.5
	85		694.31	0.19	0.51	134	252	252	55	85	40	5.4
10	90		696.37	0.39	1.05	135	252	250	54	84	40	8.3
	95		699.26	0.39	1.05	135	250	249	53	85	40	8.5
11	100		702.17	0.42	1.13	135	252	248	52	86	40	9.2
	105		705.18	0.41	1.10	136	253	250	53	86	41	9.2
12	110		708.14	0.42	1.13	135	251	252	52	86	42	9.8
	115		711.15	0.42	1.13	135	251	251	53	86	41	9.8
A 12	120+	13:00 / 13:35	714.171 / 714.494	0.24	0.64	135	251	250	65	80	33	8.5
	125		716.83	0.24	0.64	135	250	251	53	81	34	8.5
11	130		719.12	0.22	0.59	135	249	251	50	82	34	8.0
	135		721.36	0.23	0.62	135	252	250	49	83	35	8.2
10	140		723.58	0.23	0.62	135	251	251	48	83	36	8.4
	145		725.84	0.21	0.56	135	252	250	45	83	36	8.2
9	150		728.00	0.24	0.64	136	251	252	44	84	36	8.8
	155		730.30	0.22	0.59	135	250	251	44	83	36	8.5
8	160		732.50	0.25	0.67	136	252	254	44	83	36	9.1

Page Totals	TOTAL TIME	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	AVG DGM F

+ Intermediate Leak check

Sheet Checked By: _____ Date _____

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Eastern Ridge Riverlemeay VA	10/8/96	Scrubber A	M23 Dioxin/Furan	23 A-3 3

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
	165		734.83	0.23	0.62	134	250	253	44	83	36	9.1
9	170		737.08	0.10	0.27	134	253	250	44	83	36	6.0
	175		738.61	0.10	0.27	136	253	252	46	83	35	6.0
6	180		740.10	0.42	1.13	135	252	251	47	83	34	13.1
	185		743.09	0.40	1.07	135	254	252	46	83	35	12.9
5	190		746.07	0.61	1.63	135	254	249	44	83	34	18.1
	195		749.63	0.59	1.58	135	251	257	44	82	35	18.3
4	200		753.17	0.45	1.21	133	245	248	45	81	34	15.0
	205		756.25	0.45	1.21	135	241	246	45	72	37	14.0
3	210		759.32	0.41	1.10	135	233	244	44	72	35	13.5
	215		762.28	0.41	1.10	135	234	244	44	72	35	13.5
2	220		765.19	0.49	1.31	135	242	246	44	71	35	15.0
	225		768.38	0.49	1.31	134	248	245	44	71	36	15.1
1	230		771.51	0.53	1.42	134	234	248	45	71	35	17.0
	235		774.80	0.53	1.42	134	233	248	45	69	36	17.0
	240	1543	778.079									

Page Totals	TOTAL TIME	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	AVG DGM F
	240		0.5885	0.984	135	81.5

Sheet Checked By: _____ Date _____

Stopped @ 14:57
Resumed 15:10 Lost Power
Sudden rain storm

METHOD 23 CDD/CDF SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plus

Plant: Eastern Ridge Lime		Run No.: 23A Run 3
Sample Date: 10-18-96	Filter No.(s): NA	Job No.: S401
Sample Location: No. 2 Kiln Outlet A		
Recovery Date: 10-18-96	XAD-2 Trap No.(s): Run ~~3A~~ 3A	
Sample Recovery Person: C & R		

Moisture Data

Impingers	XAD - 2 Trap	1 (knockout)	2 (100 ml H2O) (untipped)	3 (100 ml H2O) (tipped)	4 (knockout) (untipped)	Silica gel (untipped)	
Final wt.	322.2	999.5	582.5	581.6	482.0	894.1	g
Initial wt.	316.0	482.9	584.9	581.7	477.4	863.0	g
Net wt.	6.2	516.6	-2.4	-0.1	4.6	31.1	g
						556.0	

Description

Train System: M-23

Probe: 4 ft

Filter: Color - blue/gray Loading - heavy mold (changed filter)

Impinger Contents: clear

Silica Gel: @Grams Used - 450 Color - good % Spent - 60

Condensate Observed In Front Half: no

Recovered Sample Fractions

Filter Container No.	marked/sealed: ✓
XAD Module Container No.:	marked/sealed: ✓
Probe (FH) & Back Half Rinse (Acetone) Container No.:	Liquid level marked/sealed: ✓
Probe (FH) & Back Half Rinse (Toluene) Container No.:	Liquid level marked/sealed: ✓
Impinger Contents Container No.:	Liquid level marked/sealed:
Impinger Rinse (Acetone/MeCl2) Container No.:	Liquid level marked/sealed:

FH fraction - FH/BH acetone, toluene rinsings & filter

XAD fraction - XAD trap

METHOD 5 TESTING FIELD DATA SHEET

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
EASTERN RIDGE LIME CO. RIPPLEMEAD, VA.	10-16-96	#2A LIME KILN STACK	MMTL	M29A-1

OPERATOR	AMBIENT PRESS (in. Hg)	STATIC PRESS (in. Hg)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (in.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
BDR	28.65	-0.07	73°	~~NA~~ 301663	48"	0.84	5 FT. GLASS	FIELD CAL	0.254

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
20-	M5-9	1.883	1.009	5E	5E	PES	0.002	0.002	7	22	~~2.946~~ 2.937 (140) 3.273 (132) 3.467 (127)

TRAV. POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24 HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (in. H2O)	delta H ORIFICE (in. H2O)	STACK TEMP (deg. F)	PROBE TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	SIL GEL IMPINGER TEMP (deg. F)	DGM IN/OUT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
A-12	0/0	~~1510~~ 0/0	920.568	0.41	1.20	132	252	260	67	79	2
	5	1515	923.96	0.42	1.38	127	250	258	66	80	2
10	10	1520	927.32	0.43	1.49	127	245	255	65	81	3
	15	1525	930.33	0.43	1.49	127	244	256	62	81	3
10	20	1530	933.76	0.47	1.63	127	247	256	60	81	3
	25	1535	937.27	0.47	1.63	127	246	255	59	82	3
9	30	1540	940.71	0.46	1.60	126	246	256	60	84	3
	35	1545	944.05	0.46	1.60	127	249	254	61	84	3.4
8	40	1550	947.43	0.35	1.21	128	250	255	61	85	4
	45	1555	950.52	0.35	1.21	128	249	255	61	85	4
7	50	1627	952.97	0.24	0.83	130	245	264	67	79	3
	55	1632	955.44	0.28	0.97	129	242	256	66	80	4
6	60	1637	958.16	0.24	0.79	133	240	261	63	81	3
	TOTAL TIME		DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.				AVE. TEMP.	

Filter #s 301633 and 301666

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
EASTERN RIDGE LIME-RIPPLEMEAD, VA	10-16-96	#2A STACK	MMTL	M29A-1

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
A-6	65	1642	960.57	0.28	0.94	130	242	265	64	82	NA	4
5	70	1647	963.20	0.23	0.77	130	244	265	60	82	–	4
	75	1652	965.63	0.25	0.84	130	247	260	61	82	–	5
4	80	1657	968.06	0.21	0.73	127	248	265	61	82	–	4
	85	1702	970.48	0.20	0.72	124	250	265	61	82	–	4
3	90	1707	972.86	0.23	0.83	125	251	267	60	82	–	6
	95	1712	975.35	0.20	0.69	126	252	260	62	82	–	5
2	100	1717/1732	977.68	0.24	0.83	129	247	261	68	76	–	4
	105	1737	980.03	0.24	0.80	129	244	267	66	76	–	7
1	110	1742	982.49	0.25	0.83	131	242	265	65	76	–	13
	115	1747	985.00	0.25	0.83	131	240	264	62	75	–	9
B-1	120/0	1825	987.462 / 988.690 (233)	0.40	1.32	128	256	266	67	70	–	2
2	125/5	1830	991.32	0.39	1.31	128	250	262	64	70	–	2
2H	130/10	1835	994.31	0.36	1.21	128	248	262	60	70	–	2
	135/15	1840	997.22	0.35	1.17	127	244	263	56	70	–	6
3	20	1845	999.99	0.41	1.37	127	244	270	54	70	–	9
	25	1850	3.62	0.41	1.37	127	242	262	54	71	–	3
4	30	1855	6.43	0.46	1.54	127	240	264	54	71	–	7
	35	1900	9.78	0.46	1.54	127	243	263	54	71	–	8
5	40	~~1905~~	12.91	0.46	1.54	127	240	269	63	67	–	8
Page Totals	TOTAL TIME	1918	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F				AVG DGM F		

3.38 (130)
3.273 (13
3.62 (12

L.L. @ 13"
0.002
3.35 (72°, 128°

Sheet Checked By: _____ Date _____

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
E. RIDGE LIME CO.-RIPPLEMEAD, VA.	10-16-96	#2A STACK	MMTL	M29A-1

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)	
	45	1923	16.13	0.46	1.54	126	246	265	58	68	—	5	
6	50	1928	19.32	0.30	1.00	125	246	266	53	68	—	13	3.35 (70 127)
	55	1933	21.96	0.30	1.04	125	243	267	54	68	—	7	3.34
67	60	1938	24.71	0.30	1.04	127	242	266	55	68	—	7	3.45
	65	1943	27.16	0.18	0.62	127	240	266	55	67	—	13	
8	70	1948	29.58	0.15	0.51	129	241	266	57	67	—	4	
	75	1953	31.61	0.15	0.49	129	240	266	58	67	—	4	3.29
9	80	1958	33.42	0.18	0.59	129	242	266	58	67	—	5	
	85	2003	35.55	0.18	0.59	129	240	266	58	67	—	5	
10	90	2008	37.56	0.34	1.12	129	244	265	58	67	—	7	
	95	2013	40.46	0.34	1.12	129	245	265	56	67	—	7	
11	100	2018	43.24	0.46	1.51	129	247	265	55	67	—	8	
	105	2023	46.48	0.49	1.61	130	248	264	55	67	—	10	
12	110	2028	49.84	0.47	1.55	130	244	267	56	67	—	10	
	115	2033	53.02	0.47	1.55	133	240	266	56	67	—	10	
	120 off	2038	56.537										

Page Totals	TOTAL TIME	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	AVG DGM F
	240 MN		0.5706	1.127	128	71

Sheet Checked By: _____ Date _____

[redacted]

MULTI-METALS SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Eastern Ridge Lime Co.		Run No.: 29-A-I
Date: 10/16/96	Sample Box No.: 29-A-1	Job No.: S-40L-003
Sample Location: Kiln #2 Scrubber Outlet "A"		
Sample Type: Method 29		
Sample Recovery Person: MDM, B. CER		

Container	Description	Volume, ml	Sealed/Level Marked
Front Half			
1	Filter No.(s) 361633/301666		F1 ✓
2	Acetone Rinse		AR2 ✓
3	Nitric Rinse		FH3 ✓
Back Half			
4	Nitric Rinse - Imp. 1,2,3, + Back 1/2 Filter		BH4 ✓
5A	Nitric Rinse - Impinger No. 4		5A ✓
5B	KMNO4/H2O Rinse - Impingers 5 & 6		5B ✓
5C	HCl Rinse - Impingers 5 & 6		5C ✓

Moisture Data

Impinger No.	Contents	Initial Volume, ml	Weight, grams Initial	Final	Net
1	MT	0	710.4	1194	483.6
2	5% HNO_3/10% H_2O_2	100	638.7	738.8	100.1
3	"	100	727.5	743.3	15.8
4	MT	0	516.4	519.5	3.1
5	4% $KMnO_4$/10% H_2SO_4	100	642.8 [sic]	642.2	-0.6
6	"	100	642.8 [sic]	641.6	-1.2
7	Si gel	—	943.5	975.3	31.8
Total					632.6

Comments: Filter loading heavy! 2 filters

METHOD 5 TESTING FIELD DATA SHEET

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
E. RIDGE LIME-RIPPLEMEAD, VA.	10-17-96	#2A LIME KILN STACK	MMTL	M29A-2

OPERATOR	AMBIENT PRESS (in. Hg)	STATIC PRESS (in. Hg)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (in.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
BDR	28.54	-0.10	68	301664 301663	48"	0.84	5FT. GLASS	27-G	0.259

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
SATURATED	M5-9	1.883	1.009	5C	5C	PES	0.000	0.000	7	25	~~3.006~~ 3.344

TM = 55 70
TS = 135
3.596

TRAV. POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (in. H2O)	delta H ORIFICE (in. H2O)	STACK TEMP (deg. F)	PROBE TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	SIL GEL IMPINGER TEMP (deg. F)	DGM IN/OUT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
B-1	0/0	1140	58.342	0.41	1.37	129	235	270	51	74	2
	5	1145	61.34	0.40	1.44	128	235	270	46	76	3
2	10	1150	64.66	0.41	1.47	128	232	270	45	77	3
	15	1155	67.83	0.41	1.47	128	228	267	44	78	3
3	20	1200	70.99	0.48	1.74	128	227	266	44	79	4
	25	1205	74.56	0.56	2.03	128	227	265	45	80	5
4	30	1210	78.42	0.57	2.06	124	232	265	46	82	6
	35	1215	82.27	0.63	2.65	115	236	265	48	83	7
5	40	1220	86.52	0.23	0.94	117	234	261	51	84	5
	45	1225	89.25	0.21	0.78	125	233	265	53	85	4
6	50	1230	91.64	0.23	0.85	125	228	268	55	85	5
	55	1235	94.22	0.23	0.85	125	236	261	55	86	5
7	60	1240	96.71	0.28	1.04	123	240	256	57	86	6
	TOTAL TIME		DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.				AVE. TEMP.	

3.616
3.77 (124)
4.21 (113)
4.07
3.23

Filter #5 301663
301664

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
E. RIDGE LIME CO.-RIPPLEMEAD, VA.	10-17-96	#2A STACK	MMTL	M29A-2

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (In. H2O)	H ORIFICE (In. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (In. Hg)
	65	1245	99.37	0.24	0.90	125	235	265	57	87	—	6
B-8	70	1250	102.10	~~0.08~~	~~1.06~~ 0.36	128	239	263	60	87	—	4
	75	1255	103.74	0.08	0.29	128	246	262	63	87	—	4
9	80	1300	105.26	0.15	0.55	129	249	260	53	87	—	5
	85	1305	107.26	0.15	0.55	128	249	261	49	88	—	5
10	90	1310	109.38	0.34	1.24	123	251	261	45	88	—	7
	95	1315	112.40	0.36	1.32	127	250	261	42	89	—	8
11	100	1320	115.44	0.44	1.61	126	252	263	41	90	—	9
	105	1325	118.90	0.44	1.61	126	255	260	41	90	—	11
12	110	1330	122.36	0.44	1.62	126	249	261	41	90	—	11
	115	1335	125.80	0.44	1.62	125	240	255	43	89	—	11
* A-12	120/0	1355	129.245/129.480	0.42	1.55	127	250	261	65	85	—	11
	5	1410	132.78	0.44	1.61	127	252	257	45	85	—	12
11	10	1415	136.18	0.41	1.50	130	245	260	42	86	—	12
	15	1420	139.55	0.41	1.45	131	244	259	42	85	—	12
10	20	1425	142.76	0.44	1.56	131	238	254	43	85	—	13
	25	1430	146.07	0.44	1.56	131	233	260	44	85	—	14
⊕ 9	30	1435	149.42	0.46	1.62	131	231	259	46	85	—	14
	35	1440/1505	152.79/154.308	0.45	1.59	130	238	226	64	84	—	3
8	40	1510	157.73	0.36	1.27	131	237	266	49	85	—	3

3.73
3.77

3.66
3.68

3.538
3.525

Page Totals	TOTAL TIME	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	AVG DGM F

Sheet Checked By: _____ Date _____

* L.C. @ 12" H_2O ⊕ L.C. @ 15"

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
E. RIDGE LIME CO. - RIPPLEMEAD, VA.	10-17-96	#2A STACK	MMTL	M29A-2

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
	45	1515	160.77	0.38	1.36	130	235	270	48	86	—	3
7	50	1520	163.94	0.25	0.90	130	236	264	48	87	—	3
	55	1525	166.51	0.22	0.79	130	236	266	50	87	—	3
6	60	1530	168.90	0.29	1.04	130	243	266	51	88	—	4
	65	1535	171.63	0.29	1.04	130	246	265	49	88	—	4
5	70	1540	174.48	0.25	0.90	130	250	263	48	88	—	3
	75	1545	177.07	0.25	0.90	130	255	263	49	88	—	3
4	80	1550	179.74	0.28	1.00	130	259	265	50	88	—	4
	85	1555	182.40	0.30	1.08	130	259	266	50	88	—	4
3	90	1600	185.22	0.30	1.08	130	261	265	51	89	—	5
	95	1605	187.96	0.30	1.08	130	260	264	50	89	—	5
2	100	1610	190.78	0.24	0.86	130	263	259	43	89	—	5
	105	1615	193.38	0.24	0.86	130	260	265	42	89	—	5
1	110	1620	195.90	0.25	0.90	129	260	264	41	89	—	5
	115	1625	198.50	0.20	0.72	129	260	263	41	89	—	5
	120/OFF	1630	200.845									

3.5

Page Totals	TOTAL TIME	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	AVG DGM F
	240 MIN.					86

Sheet Checked By: _____ Date _____

[redacted]

PACIFIC ENVIRONMENTAL SERVICES, INC.

MULTI-METALS SAMPLE RECOVERY DATA

Plant: Eastern Ridge Lime Co.		Run No.: 79-A-2
Date: 10/17/96	Sample Box No.: 79-A-2	Job No.: S-461
Sample Location: Kiln No 2 Outlet A		
Sample Type: Method 29		
Sample Recovery Person: MDM		

Container	Description	Volume, ml	Sealed/Level Marked
Front Half			
1	Filter No.(s) 301664/301663		F1 ✓
2	Acetone Rinse		AR2 ✓
3	Nitric Rinse		F#3 ✓
Back Half			
4	Nitric Rinse - Imp. 1,2,3, + Back 1/2 Filter		BH4 ✓
5A	Nitric Rinse - Impinger No. 4		5A ✓
5B	KMNO4/H2O Rinse - Impingers 5 & 6		5B ✓
5C	HCl Rinse - Impingers 5 & 6		5C ✓

Moisture Data

Impinger No.	Contents	Initial Volume, ml	Weight, grams Initial	Final	Net
1	MT	0	726.9	1178.7	451.8
2	5% HNO_3/10% H_2O_2	100	587.1	699.5	112.4
3	"	100	573.5	603.4	29.9
4	MT	0	486.6	492.5	5.9
5	4% KMnO4/10% H_2SO_4	100	649.0	650.9	1.9
6	"	100	591.7	592.9	1.2
7	Si gel.	–	901.6	930.8	29.2
Total					632.3

Comments: heavy loading; 2 filters

METHOD 5 TESTING FIELD DATA SHEET

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
E. RIDGE LIME: RIPPLEMEAD, VA.	10-18-96	#2A KILN STACK	MMTL	M29A-3

OPERATOR	AMBIENT PRESS (In. Hg)	STATIC PRESS (in. Hg)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (In.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
BDR	28.32	-0.10	62	301670	48	0.84	5 FT. GLASS	~~27-G~~ FIELDCAL	0.250

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
SATURATED		1.883	1.009	5C	5C	PES	0.006	0.002	7	25	3.048 .095 .186

TRAV. POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft) 438	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	STACK TEMP (deg. F)	PROBE TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	SIL GEL IMPINGER TEMP (deg. F)	DGM IN/OUT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
A-12	0	1100	201.~~278~~	0.18	0.55	129	257	260	60	74	3
	5	1105	203.45	0.23	0.70	129	251	256	59	76	3
11	10	1110	205.62	0.26	0.79	129	242	257	56	76	4
	15	1115	207.97	0.29	0.88	128	238	261	53	76	4
10	20	1120	210.50	~~0.40~~ 0.35	1.07	128	238	261	49	77	5
	25	1125	213.28	0.33	1.02	128	235	259	48	78	5
9	30	1130	216.06	0.31	0.96	128	236	254	48	79	5
	35	1135	218.73	0.29	0.90	1.28	237	252	49	79	5
8	40	1140	221.30	0.22	0.68	128	239	248	49	80	4
	45	1145	223.52	0.26	0.81	128	236	249	51	79	5
7	50	1150	225.99	0.21	0.65	129	236	249	51	80	4
	55	1155	228.42	0.41	1.27	129	240	251	51	79	7
6	60	1200	231.27	0.58	1.80	129	240	257	~~50~~ 50	80	8
	TOTAL TIME		DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.				AVE. TEMP.	

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
E. RIDGE LIME-RIPPLEMEAD, VA.	11-18-96	#2A STACK	MMTL	M29A-3

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
	65	1205	234.92	0.63	1.96	128	231	256	49	79	—	10
A-5	70	1210	238.71	0.80	2.49	128	241	258	50	79	—	13
	75	1215	242.97	0.74	2.30	128	241	261	50	79	—	13
4	80	1220	247.22	0.58	1.80	129	230	256	50	79	—	11
	85	1225	250.84	0.61	1.90	128	231	254	52	79	—	11
3	90	1230	254.61	0.45	1.40	128	237	260	52	79	—	10
	95	1235	257.84	0.43	1.34	128	241	255	52	80	—	10
2	100	1240	260.98	0.43	1.34	128	245	258	53	79	—	10
	105	1245	264.16	0.43	1.34	129	246	262	53	79	—	11
1	110	1250	267.29	0.40	1.24	129	244	258	53	79	—	11
	115	1255	270.36	0.45	1.40	129	245	257	53	80	—	12
* B-1	120	1335	273.620 / 274.022	0.52	1.62	129	239	240	60	77	—	5
	125	1340	277.46	0.52	1.62	129	233	264	55	77	—	6
2	130	1345	280.98	0.55	1.68	130	233	270	50	77	—	6
	135	1350	284.51	0.53	1.62	129	233	267	45	77	—	6
3	140	1355	287.86	0.56	1.71	129	233	269	39	77	—	7
	145	1400	291.42	0.56	1.71	129	234	269	39	79	—	7
4	150	1405	294.95	0.57	1.74	129	239	269	40	79	—	8
	155	1410	298.56	0.59	1.81	129	238	261	40	79	—	9
5	160	1445	302.22	0.65	2.00	129	241	260	40	79	—	10

3.0~~00~~

	TOTAL TIME	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	AVG DGM F
Page Totals						

Sheet Checked By: _____ Date _____

* L.A. @ 12" RATES ND

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
E. RIDGE LIME-RIPPLEMEAD, VA.	10-18-96	#2A STACK	MMTL	M29A-3

TRAV. POINT NO.	ELAPSED TEST TIME (min)	CLOCK TIME (24-hr)	GAS METER READING Vm (ft3)	P VELOCITY HEAD (in. H2O)	H ORIFICE (in. H2O)	STACK TEMP (F)	PROBE TEMP (F)	FILTER OVEN TEMP (F)	SIL GEL IMPINGER TEMP (F)	DGM IN/OUT TEMP (F)	AUX. TEMP. (F)	SAMPLE TRAIN ACUU (in. Hg)
B-~~6~~	165	1420	306.16	0.67	2.05	129	245	260	40	79	–	10
6	170	1425	309.99	0.73	2.24	129	242	261	41	79	–	12
~~7~~	175	1430	314.16	0.73	2.24	129	243	261	41	79	–	13
7	180	1435	318.23	0.10	0.31	129	239	258	44	78	–	5
~~8~~	185	1440	319.87	0.10	0.31	129	244	261	47	78	–	5
8	190	1445	321.31	0.10	0.31	129	247	258	46	78	–	5
~~9~~	195	1450	322.83	0.10	0.31	129	242	260	45	78	–	5
9	200	1455	324.46	0.15	0.46	129	240	250	46	77	–	5
~~10~~	205	1513	326.11	0.15	0.45	130	230	239	40	70	–	5
10	210	1518	328.06	0.26	0.79	130	229	235	38	69	–	7
~~11~~	215	1523	330.45	0.26	0.79	130	228	235	37	69	–	7
11	220	1528	332.88	0.34	1.03	129	229	237	37	68	–	9
~~12~~	225	1533	335.62	0.40	1.20	129	232	241	36	67	–	10
12	230	1538	338.61	0.35	1.05	129	234	244	36	67	–	9
	235	1543	341.42	0.35	1.05	128	236	241	36	66	–	9
	240/OFF	1548	344.081									

Page Totals	TOTAL TIME	DGM VOLUME	AVG SQRT P	AVG H	AVG STK F	AVG DGM F
			0.6210	1.26		

Sheet Checked By: _____ Date _____

[redacted]

MULTI-METALS SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Eastern Ridge Lime Co.		Run No.: 29-A-3
Date: 10/18/96	Sample Box No.: 29A3	Job No.: 5401
Sample Location: No 2 Kiln Outlet "A"		
Sample Type: Method 29		
Sample Recovery Person: MDM, CLL		

Container	Description	Volume, ml	Sealed/Level Marked
Front Half			
1	Filter No.(s) 301670/301677		F1 ✓
2	Acetone Rinse		AR2 ✓
3	Nitric Rinse		FH3 ✓
Back Half			
4	Nitric Rinse - Imp. 1,2,3, + Back 1/2 Filter		BH4 ✓
5A	Nitric Rinse - Impinger No. 4		5A ✓
5B	KMNO4/H2O Rinse - Impingers 5 & 6		5B ✓
5C	HCl Rinse - Impingers 5 & 6		5C ✓

Moisture Data

Impinger No.	Contents	Initial Volume, ml	Weight, grams Initial	Final	Net
1	MT	0 ~~100~~	729.1	1204.9	475.8
2	5% HNO_3/10% H_2O_2	100 ~~100~~	588.6	682.0	93.4
3	"	100 0	575.2	589.7	14.5
4	MT	0 ~~100~~	487.9	489.9	2.0
5	4% $KMnO_4$/10% H_2O_2	100 ~~100~~	593.7	594.4	0.7
6	"	100 ~~0~~	648.3	648.3	0
7	Si gel	–	880.8	909.6	28.8
Total					615.2

Comments: Heavy loading; 2 filters

Appendix B.1.3

Raw Field Data

Kiln No. 2 - Scrubber "B"

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: Lima Date: 10-14-96
Sampling Location: wet scrubber west stack Clock Time: 1342
Run #: Preliminary Operators: TA/BF
Barometric Pressure, in. Hg: 29.5 Static Pressure, in. H_2O: -.10
Moisture, %: 15 Molecular wt., Dry: ~~29.5~~ Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: 48" Side 2:
Wet Bulb, °F: 129 Dry Bulb, °F: 134

Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F
1	.20	134
2	.24	134
3	.29	134
4	.30	134
5	.25	136
6	.26	138
7	.10	135
8	.05	134
9	.04	134
10	.04	134
11	.04	134
12	.04	134
1	.17	133
2	.21	137
3	.20	134
4	.19	134
5	.20	134
6	.25	134
7	.20	134
8	.10	134
9	.07	137
10	.07	134
11	.07	134
12	.07	133
	$\overline{\sqrt{\Delta P}}$ = .03707	$\overline{Ts}$ = 134

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times 14) + (0.32 \times 10) + (0.28 \times 76)$ 6.16 3.2 21.08 30.64

$Md = 30.64$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (30.64) \times (1 - \frac{15}{100}) + 18 (\frac{15}{100})$

$Ms = 28.74$

$\overline{Ts} = 134$ °F = 594 °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps = 29.49$ in. Hg

$\overline{\sqrt{\Delta P}} = 0.3707$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\ (°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (.84) \times (\quad) \times \sqrt{\quad}$

$Vs = 22.29$ ft/s

$As = 12.57$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs = 12.57 \times 22.29 \times 60$

$Qs = 16,805$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} = 12,506$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: EPA Ridge Lime Date: 10-15-96
Sampling Location: Scrubber Outlet B Clock Time: _____
Run #: Cyclonic Flow Operators: TH/BF
Barometric Pressure, in. Hg: 28.54 Static Pressure, in. H_2O: _____
Moisture, %: 15 Molecular wt., Dry: _____ Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: 48" Side 2: _____
Wet Bulb, °F: _____ Dry Bulb, °F: _____

Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F
1	3°	
2	3°	
3	0°	
4	0°	
5	7°	
6	6°	
7	5°	
8	7°	
9	5°	
10	3°	
11	1°	
12	1°	
1	0°	
2	5°	
3	5°	
4	5°	
5	7°	
6	3°	
7	0°	
8	1°	
9	1°	
10	2°	
11	4°	
12	5°	
	$\overline{\sqrt{\Delta P}}$ =	$\overline{Ts}$ =

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\% H_2O}{100}) + 18 (\frac{\% H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$

$\overline{Ts} =$ °F = °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps =$ in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\ (°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs =$ ft/s

$As =$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs =$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\% H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} =$ dscfm

Metals K = 15.868
Organ K = 16.099

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: EPA Lime Scrubber Date: 10-16-96
Sampling Location: Scrubber #~~2~~ Stack B Clock Time: 1005
Run #: Prelim Operators: TA / BF
Barometric Pressure, in. Hg: 28.42 Static Pressure, in. H_2O: -.10
Moisture, %: 15 Molecular wt., Dry: _____ Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: 48" Side 2: _____
Wet Bulb, °F: 129 Dry Bulb, °F: 133

29 - .378
23

Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F
1	.10	132
2	.09	132
3	.07	134
4	.05	133
5	.05	133
6	.07	134
7	.08	132
8	.12	132
9	.18	132
10	.20	132
11	.22	133
12	.21	133
1	.21	132
2	.20	132
3	.18	132
4	.11	132
5	.07	133
6	.05	133
7	.07	134
8	.22	134
9	.20	132
10	.17	132
11	.17	132
12	.16	130
	$\sqrt{\overline{\Delta P}}$ = 0.3573	$\overline{Ts}$ = 133

$\overline{\Delta P}$ = .1354 593 °K

DN = .372

DN = .369

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times 21) + (0.32 \times 8) + (0.28 \times \quad)$

$Md = 31.68$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{15}{100}) + 18 (\frac{15}{100})$

$Ms = 29.63$

$\overline{Ts} = \quad °F = \quad °R \ (°F + 460)$

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps = 28.41$ in. Hg

$\sqrt{\overline{\Delta P}} =$

$Vs = 85.49 \times Cp \times \sqrt{\overline{\Delta P}} \times \sqrt{\frac{Ts\ (°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs = 21.53$ ft/s

$As = 12.57$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs = 16,231$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{15}{100})$

$Qs_{std} = 11,675$ dscfm

Metals. 0.378
Organ. 0.375

S.C.

GAS ANALYSIS DATA FORM

PLANT EASTERN RIDGE LIME CO.

DATE 10-16-96 TEST NO 3B-1

SAMPLING TIME (24-hr CLOCK)

SAMPLING LOCATION KILN NO. 2 SCRUBBER B OUTLET

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) INTEGRATED BAG

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 70°F

OPERATOR [illegible]

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	19.0	19.0	19.0	19.0	18.9	18.9	19.0	44/100	8.360
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	26.7	7.7	26.8	7.8	26.7	7.8	7.8	32/100	2.496
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)		0		0		0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		73.3		73.2		73.3	73.3	28/100	20.524
								TOTAL	31.380

FIELD DATA SHEET

Plant: EASTERN RIDGE LIME CO. | Sample Type: M 23 | Operator: [illegible] | Nozzle ID: 0.375 | Thermocouple #: 46

Sampling Location: Scrubber Outlet B | Pbar: 28.65 | Ps: | Assumed Bws: 15% | Filter #:

Run Number: 23-B-1 | Date: 10/16/96 | CO2: 20% | O2: 8.0 | Meter Box #: [illegible] | Y: 1.003 | ΔH@: 1.765

Pretest Leak Rate: .006 cfm @ 15 in. Hg. | Probe Length/Type: 4'/Glass | Pitot #: 46 | Post-Test Leak Rate: .004 cfm @ 16 in. Hg.

Pretest Leak Check: Pitot: ✓ Orsat: | Stack Diameter: 48" | As: 12.57 ft² | Post-Test Leak Check: Pitot: Orsat:

Leak Check 11.270 11.475

Leak check 233.116 233.20

Leak

Region @ 1627.

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Actual	Stack Temp. (Ts)	Temperature °F Probe	Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Outlet (Tm out °F)	Pump Vacuum (in. Hg)
	0	1511*	129.848										
B 1	10	1521	138.0	0.17	2.76	2.76	133	245	256	30	92	93	4
B 2	20	1531	148.6	0.25	4.02	4.02	133	248	254	32	17/94	95	6
B 3	30	1541	159.4	0.25	4.02	4.02	125	248	258	32	101	96	9
B 4	40	1551	170.5	0.25	4.02	4.02	137	254	255	22	100	95	11
B 5	50	1601	181.270.	0.25	4.02	4.02	137	252	244	28	100	96	12
B 6	60	1629/1639	187.6	0.14	2.25	2.28	136	248	252	26	98	98	5
B 7	70	1649	193.6	0.05	0.81	0.81	137	248	259	23	101	97	2
B 8	80	1659	199.6	0.05	0.81	0.81	134	252	255	30	102	97	3
B 9	90	1709	204.8	0.05	0.81	0.81	131	247	256	34	100	97	2
B 10	100	1717/1722	214.5	0.18	2.9	2.9	135	249	255	41	101	97	3
B 11	110	1742	223.6	0.18	2.9	2.9	136	248	256	19	99	97	7
B 12	120	1752	233.116	0.18	2.9	2.9	135	254	255	17	103	97	9
A 1	130	1824	240.0	0.10	1.6	1.6	133	250	256	55	93	93	4
A 2	140	1834	246.7	0.10	1.6	1.6	135	247	255	54	96	93	4
A 3	150	1844	253.2	0.08	1.3	1.3	137	245	255	55	96	92	4
A 4	160	1854	258.0	0.05	0.81	0.81	134	248	253	57	95	91	3
A 5	170	19[illegible]	258.446 @ 101.	0.03	0.48	0.48	135	247	255	56	93	90	2
A 6	180	19[illegible]	262.37	.10	1.6	1.6	135	252	254	55	89	87	6
A 7	190	19[illegible]	268.6	0.08	1.3	1.3	137	250	254	57	91	86	6
A 8	200	19[illegible]	281.6	0.10	1.6	1.6	135	249	255	58	91	86	5
A 9	210	19[illegible]	289.7	0.18	2.9	2.9	136	242	254	58	91	85	7
A 10	220	19[illegible]	299.4	0.20	3.2	3.2	135	246	254	59	91	85	9
A 11	230	2017	309.1	0.20	3.2	3.2	135	249	253	59	89	85	13
A 12	240	2027	318.110	0.20	3.2	3.2	136	247	253	59	87	83	14

ΔVm= | $\overline{\sqrt{\Delta p}}$= | $\overline{\Delta H}$= 2.29 | $\overline{Ts}$= 135 | $\overline{Tm}$= 93.9

* Clock times [illegible]

77.6
76.5
.1

METHOD 23 CDD/CDF SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Eastern Rice Lime		Run No.: M23-No26-1 (Yellow ~~Blue~~ 23B Run 1)
Sample Date: 10-16-96	Filter No.(s): NA	Job No.: S-401
Sample Location: No 2 Kiln - Outlet "B"		
Recovery Date:	XAD-2 Trap No.(s): Run 1B	
Sample Recovery Person: MDM & GR		

Moisture Data

Impingers	XAD - 2 Trap	1 (knockout)	2 (100 ml H2O) (untipped)	3 (100 ml H2O) (tipped)	4 (knockout) (untipped)	Silica gel (untipped)	
Final wt.	323.5	1144.1	645.3	576.5	480.2	910.9	g
Initial wt.	317.1	480.5	586.2	577.6	476.1	860.0	g
Net wt.	6.4	663.6	59.1	-1.1	4.1	50.9	g
						783.0	

Description

Train System: M-23	
Probe: 4 ft	
Filter: Color - blue/grey	Loading - heavy (changed filters)
Impinger Contents: clear	
Silica Gel: @Grams Used - 500	Color - blue/white % Spent - 80
Condensate Observed In Front Half: some condensate drops	

Recovered Sample Fractions

Filter Container No.	marked/sealed: ✓
XAD Module Container No.:	marked/sealed: ✓
Probe (FH) & Back Half Rinse (Acetone) Container No.:	Liquid level marked/sealed: ✓
Probe (FH) & Back Half Rinse (Toluene) Container No.:	Liquid level marked/sealed: ✓
Impinger Contents Container No.:	Liquid level marked/sealed:
Impinger Rinse (Acetone/MeCl2) Container No.:	Liquid level marked/sealed:

FH fraction – FH/BH aceton, toluene rinsings + filter
XAD fraction – XAD module

GAS ANALYSIS DATA FORM

PLANT EASTERN RIDGE LIME CO.
DATE 10-17-96 TEST NO 3B-Z
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION KILN NO. 2 SCRUBBER B OUTLET
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) INTEGRATED BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 70°F
OPERATOR [illegible]

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	20.0	20.0	20.1	20.1	20.0	20.0	20.0	44/100	8.800
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	27.7	7.7	27.8	7.7	27.8	7.8	~~7.8~~ ~~7.7~~ 7.7	32/100	2.464
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)		0		0		0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		72.3		72.2		72.2	72.3	28/100	20.244
								TOTAL	31.508

K = 7.518

FIELD DATA SHEET

Plant: ~~EPA~~ EARTHEN Ridge Lime
Sampling Location: No 2 Kiln Scrubber Outlet "B"
Run Number: 23-B-2 Date: 10-17-96
Pretest Leak Rate: 0.008 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ____ Orsat: ____

Sample Type: M-23 Operator: MDM
Pbar: 28.54 Ps: +.05
CO2: 23 O2: 8
Probe Length/Type: 4' "w GL Pitot #: 413
Stack Diameter: 48" As: ____

Nozzle ID: .310 Thermocouple #: 413
Assumed Bws: .15 Filter #: NA
Meter Box #: MB-14 Y: 1.003 ΔH@: 1.765
Post-Test Leak Rate: .004 cfm @ 16 in. Hg.
Post-Test Leak Check: Pitot: ____ Orsat: ____

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Actual	Stack Temp. (Ts)	Temperature °F Probe	Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Outlet (Tm out °F)	Pump Vacuum (in. Hg)	Trap Temp °F
0	0	1140	318.516											
1	10	1150	324.6	0.17	1.29	1.29	130	252	256	69	80	76	5.5	41
2	20	1200	330.9	0.17	1.29	1.29	131	253	255	61	86	78	6	41
3	30	1210	337.0	0.18	1.37	1.37	131	250	255	55	91	82	6	45
4	40	1220	343.4	0.18	1.37	1.37	130	252	256	54	94	84	7	43
5	50	1230	349.9	0.18	1.37	1.37	131	250	256	54	97	87	8.5	38
6	60	1240	~~350~~ 356.6	0.19	1.43	1.43	131	249	258	57	95	89	9	37
7	70	1250	~~356.6~~ 363.4	0.20	1.50	1.50	131	247	258	56	99	91	10	39
8	80	1300	~~363.4~~ 366.3	.03	0.22	0.22	131	246	256	58	99	93	4	40
9	90	1310	370.1	0.06	0.45	0.45	131	247	258	60	99	93	4	41
10	100	1320	375.5	0.12	0.90	0.90	131	254	257	58	102	96	6	43
11	110	1330	381.2	0.13	0.98	0.98	131	253	256	55	105	98	10	48
12	120	1340	386.884	0.13	0.98	0.98	130	247	255	52	~~54~~ 104	99	10	54
		1345	386.884											
1	130	1405	391.3	0.07	0.53	0.53	131	250	257	~~58~~ 67	99	98	8	59
2	140	1415	395.5	0.07	0.53	0.53	132	251	257	63	103	99	8	56
3	150	1420 ~~1425~~	398.8	0.04	0.30	0.30	132	248	254	57	102	98	6	55
4	160	~~1430~~ 1510	402.1	0.04	0.30	0.30	131	249	253	59	98	96	6.5	53
5	170	1520	405.3	0.04	0.30	0.30	132	253	255	66	92	92	7	53
6	180	1530	407.5	0.01	0.08	0.08	132	247	258	61	95	93	7	51
7	190	1540	410.6	0.04	0.30	0.30	132	249	257	65	97	94	5	52
8	200	1550	413.9	0.04	0.30	0.30	132	252	256	59	98	95	7	53
9	210	1600	419.2	0.12	0.90	0.90	132	250	255	56	98	95	7	54
10	220	1610	424.4	0.12	0.90	0.90	132	249	256	51	101	97	13	53
11	230	1620	~~424.4~~ 429.8	0.12	0.90	0.90	131	249	254	49	101	97	13	54
12	240	1630	435.265	0.12	0.90	0.90	131	252	254	48	102	98	14	52

Leak check 386.884 - 387.012

ΔVm= 116.621 $\sqrt{\Delta p}$= ____ $\overline{\Delta H}$= 0.81 $\overline{Ts}$= 131 $\overline{Tm}$= 91°F

METHOD 23 CDD/CDF SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

yellow

Plant: Eastern Ridge Lim		Run No.: 23B Run 2
Sample Date: 10-17-96	Filter No.(s): NA	Job No.: 5401
Sample Location: No. 2 Kiln Outlet "B"		
Recovery Date: 10-17-96	XAD-2 Trap No.(s): Run 2B	
Sample Recovery Person: CEA		

Moisture Data

Impingers	XAD - 2 Trap	1 (knockout)	2 (100 ml H2O) (untipped)	3 (100 ml H2O) (tipped)	4 (knockout) (untipped)	Silica gel (untipped)	
Final wt.	328.3	792.5	587.7	575.3	482.0	914.4	g
Initial wt.	322.8	409.2	588.8	576.4	480.0	887.6	g
Net wt.	5.5	383.3	-1.1	-1.1	2.0	26.8	g
						415.4	

Description

Train System: M-23

Probe: 4 ft

Filter: Color - blue/grey Loading - heavy (changed filter)

Impinger Contents: clear

Silica Gel: @Grams Used - 450 Color - good % Spent - 30

Condensate Observed In Front Half: no

Recovered Sample Fractions

Filter Container No.	marked/sealed: ✓
XAD Module Container No.:	marked/sealed: ✓
Probe (FH) & Back Half Rinse (Acetone) Container No.:	Liquid level marked/sealed: ✓
Probe (FH) & Back Half Rinse (Toluene) Container No.:	Liquid level marked/sealed: ✓
Impinger Contents Container No.:	Liquid level marked/sealed:
Impinger Rinse (Acetone/MeCl2) Container No.:	Liquid level marked/sealed:

FH fraction - FH/BH acetone, toluene rinses & filter

XAD fraction - XAD trap

GAS ANALYSIS DATA FORM

PLANT EASTERN RIDGE LIME CO.

DATE 10-18-96 TEST NO 3B-3

SAMPLING TIME (24-hr CLOCK)

SAMPLING LOCATION KILN NO. 2 SCRUBBER "B" OUTLET

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) INTEGRATED BAG

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 70°F

OPERATOR J Meadem

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	19.7	19.7	19.8	19.8	19.7	19.7	19.7	44/100	8.668
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	27.3	7.6	27.3	7.5	27.3	7.6	7.6	32/100	2.432
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)		0		0		0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		72.7		72.7		72.7	72.7	28/100	20.356
								TOTAL	31.456

FIELD DATA SHEET

K = 7.518

Plant: EPA Ridge Lime Company
Sampling Location: Scrubber Outlet B
Run Number: 23-B-3 Date: 10-18-96
Pretest Leak Rate: 0.005 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ____ Orsat: ____

Sample Type: M-23 Operator: MM/BF
Pbar: 28.30 Ps: 0.12
CO2: 20.0 O2: 9.0
Probe Length/Type: 4' Glass Pitot #: 4B
Stack Diameter: 48" As: ____

Nozzle ID: .310 Thermocouple #: 4B
Assumed Bws: .15 Filter #: NA
Meter Box #: 14 Y: 1.003 ΔH@: 1.765
Post-Test Leak Rate: .004 cfm @ 16 in. Hg.
Post-Test Leak Check: Pitot: ____ Orsat: ____

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Orifice Pressure Differential (ΔH) in H2O Actual	Stack Temp. (Ts)	Temperature °F Probe	Temperature °F Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Dry Gas Meter Temp. Outlet (Tm out °F)	Pump Vacuum (in. Hg)	XAD TRAP °F
0	0	1100	435.673											
1	10	1110	440.5	0.11	0.83	0.83	133	245	255	62	71	70	4	42
2	20	1120	445.6	0.11	0.83	0.83	133	249	254	52	74	71	4	45
3	30	1130	450.6	0.11	0.83	0.83	134	246	253	46	76	72	4	45
4	40	1140	455.6	0.12	0.90	0.90	133	242	253	46	79	73	4	48
5	50	1150	461.1	0.12	0.90	0.90	134	249	253	46	81	74	5	52
6	60	1200	466.4	0.12	0.90	0.90	134	249	254	46	82	76	5	52
7	70	1210	474.6	0.30	2.26	2.26	134	246	254	49	84	77	5.5	51
8	80	1220	482.5	0.30	2.26	2.26	134	245	254	48	86	78	11	53
9	90	1230	489.3	0.20	1.50	1.50	134	251	253	52	87	80	12	54
10	100	1240	496.3	0.23	1.73	1.73	134	249	253	52	87	80	10	51
11	110	1250	503.6	0.26	1.95	1.95	134	247	254	53	88	81	12	51
12	120	1300	511.237	0.26	1.95	1.95	134	251	254	53	88	82	12	52
1	130	1335/13	519.6	.30	2.26	2.26	135	255	256	55	85	83	8	55
2	140	1345	527.8	0.31	2.33	2.33	135	251	254	46	90	83	9	55
3	150	1355	536.6	0.34	2.56	2.56	135	246	255	47	92	84	10	56
4	160	1405	545.1	0.30	2.26	2.26	135	245	254	50	91	84	12	56
5	170	1415	554.1	0.36	2.71	2.71	135	246	254	50	91	84	12	58
6	180	1425	562.5	0.38	2.86	2.86	134	246	253	51	89	84	14	59
7	190	1435	567.8	0.11	0.83	0.83	134	248	253	53	88	84	14	58
8	200	1445	–	0.10	0.75	0.75	135	248	254	54	88	84	7	59
9	210	1455	577.3	0.10	0.75	0.75	135	248	254	[illegible]	77	78	1	53
10	220	1510	581.2	0.05	0.38	0.38	131	241	251	43	76	75	6	54
11	230	1520	584.5	0.06	0.45	0.45	130	245	250	45	72	73	5	55
12	240	1540	587.880	0.06	0.45	0.45	132	243	253	45	71	71	5	56

leak check
511.237
511.340

511.340
511.500

ΔVm= ____ √Δp= ____ ΔH= 1.48 Ts= 134 Tm= 81

METHOD 23 CDD/CDF SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Eastern Ridge Lime		Run No.: 23B Run 3 (yellow)
Sample Date: 10-18-96	Filter No.(s): NA	Job No.: 5401
Sample Location: No. 2 Kiln Outlet B		
Recovery Date: 10-18-96	XAD-2 Trap No.(s): Run 3B	
Sample Recovery Person: CER		

Moisture Data

Impingers	XAD - 2 Trap	1 (knockout)	2 (100 ml H2O) (untipped)	3 (100 ml H2O) (tipped)	4 (knockout) (untipped)	Silica gel (untipped)	
Final wt.	326.8	979.3	586.4	576.6	485.1	947.0	g
Initial wt.	322.3	405.1	587.7	575.3	482.0	914.4	g
Net wt.	4.5	574.2	-1.3	1.3	3.1	32.6	g
						614.4	

Description

Train System: M-23	
Probe: 4 ft	
Filter: Color - blue/grey	Loading - heavy (damaged filter)
Impinger Contents: clear	
Silica Gel: @Grams Used - 450	Color - good % Spent - 75
Condensate Observed In Front Half: no	

Recovered Sample Fractions

Filter Container No.	marked/sealed: ✓
XAD Module Container No.:	marked/sealed: ✓
Probe (FH) & Back Half Rinse (Acetone) Container No.:	Liquid level marked/sealed: ✓
Probe (FH) & Back Half Rinse (Toluene) Container No.:	Liquid level marked/sealed: ✓
~~Impinger Contents Container No.:~~	Liquid level marked/sealed:
~~Impinger Rinse (Acetone/MeCl2) Container No.:~~	Liquid level marked/sealed:

FH fraction - FH/BH acetone, toluene rinsings + filter

XAD fraction - XAD trap

FIELD DATA SHEET

301680

Plant: Eastern Ridge Lime Co. | Sample Type: M29 | Operator: TA | Nozzle ID: 0.378 | Thermocouple #: 40

Sampling Location: Scrubber Outlet B | Pbar: 28.65 | Ps: -.06 | Assumed Bws: 15% | Filter #: 301655; 301661

Run Number: 29B-1 | Date: 10/16/96 | CO2: 20 | O2: 8 | Meter Box #: 15 | Y: 1.003 | ΔH@: 1.685

Pretest Leak Rate: .012 cfm @ 15 in. Hg. | Probe Length/Type: 4'/6'/SS | Pitot #: 40 | Post-Test Leak Rate: .005 cfm @ 17 in. Hg.

Pretest Leak Check: Pitot: ✓ Orsat: ✓ | Stack Diameter: 48" | As: 12.57 ft² | Post-Test Leak Check: Pitot: ____ Orsat: ____

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Actual	Stack Temp. (Ts)	Temperature °F Probe	Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Outlet (Tm out °F)	Pump Vacuum (in. Hg)
	0	1514	24.402										
B 1	10	1524	34.1	.20	2.98	3.30	135	247	248	60	95	95	9
2	20	1534	43.3	.18	2.7	2.7	135	244	249	53	95	95	9
3	30	1543	50.4	.11	1.6	1.6	136	248	253	56	99	94	7
4	40	1554	57.4	.11	1.6	1.6	137	248	250	62	99	94	7
5	50			.10	1.5	1.5	137	243	250	58	99	94	7
6	60	1637	71.3	.11	1.6	1.6	136	253	248	58	103	96	8
7	70	1647	78.3	.10	1.5	1.5	137	253	248	58	99	96	8
8	80	1657	84.6	.08	1.2	1.2	137	254	250	61	99	96	8
9	90	1707	94.2	.18	2.7	2.7	136	249	248	60	100	97	16
10	100	1717	103.588	.18	2.7	2.7	132	247	250	60	99	98	16
11	110	1731	113.8	.20	3.0	3.0	136	239	246	60	100	96	9
12	120	1751	123.1	.18	2.7	2.7	135	252	248	49	103	95	9
		1824											
1	130	1834	132.0	.16	2.4	2.4	133	255	248	53	94	93	8
2	140	1844	140.6	.16	2.4	2.4	135	248	250	58	95	93	9
3	150	1854	149.8	.18	2.7	2.7	136	252	251	49	94	91	12
4	160	1904	[illegible]	.16	2.4	2.4	136	251	250	51	94	91	12
5	170	1527	169.7	.25	3.7	3.7	135	241	258	52	94	90	10
6	180	1937	174.8	.05	0.74	0.74	135	251	254	55	93	89	4
7	190	1947	179.2	.04	0.58	0.58	136	249	245	54	94	87	4
8	200	1957	183.7	.04	0.58	0.58	135	244	249	54	92	89	4
9	210	2007	189.4	.07	1.0	1.0	135	245	249	55	91	87	6
10	220	2017	196.8	.12	1.8	1.8	135	250	253	56	92	86	8
11	230	2027	204.0	.14	2.0	2.0	135	249	246	57	92	85	10
12	240	2037	212.306	.14	2.0	2.0	135	251	249	59	92	85	10

1627 Restart

ok
leaks
D 3.588
3.967

23.113
23.282 PX

159.634
159.862

ΔVm= 187.128 √Δp= .3587 ΔH= 2.0 Ts= 135 Tm= 94

MULTI-METALS SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Eastern Ridge Lime Co.		Run No.: 29-B-1
Date: 10/16/96	Sample Box No.:	Job No.: S-401
Sample Location: Kiln #2 Scrubber Outlet "B"		
Sample Type: Method 29		
Sample Recovery Person: MDM, CLL		

Container	Description	Volume, ml	Sealed/Level Marked
Front Half			
1 (3)	Filter No.(s) 301655/301680/301669	—	F1 ✓
2	Acetone Rinse		AR2 ✓
3	Nitric Rinse		FH3 ✓
Back Half			
4	Nitric Rinse - Imp. 1,2,3, + Back 1/2 Filter		BH4 ✓
5A	Nitric Rinse - Impinger No. 4		5A ✓
5B	KMNO4/H2O Rinse - Impingers 5 & 6		5B ✓
5C	HCl Rinse - Impingers 5 & 6		5C ✓

Moisture Data

Impinger No.	Contents	Initial Volume, ml	Weight, grams Initial	Final	Net
1	MT	0	740.7	1342.2	601.5
2	5% HNO_3/10% H_2O_2	100	677.2	790.7	113.5
3	"	100	633.2	657.6	24.4
4	MT	0	559.1	562.2	3.1
5	4% $KMnO_4$/10% H_2SO_4	100	653.6	653.4	-0.2
6	"	100	642.7	641.6	-1.1
7	Sil gel	—	830.2	865.9	35.7
Total					776.9

Comments: Heavy Part. loading; 3 filters

FIELD DATA SHEET

* Downsized from previous day

Plant: EPA Ridge Line
Sampling Location: Scrubber Outlet "B"
Run Number: 29-B-2 Date: 10-17-96
Pretest Leak Rate: .010 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: ✓

Sample Type: M-29 Operator: TA
Pbar: 28.54 Ps: +.05
CO2: 23 O2: 8
Probe Length/Type: 4' Glass Pitot #: 4D
Stack Diameter: 48" As:

Nozzle ID: .310 Thermocouple #: 4D
Assumed Bws: .15 Filter #: 301668
Meter Box #: 15 Y: 1.003 ΔH@: 1.685
Post-Test Leak Rate: .009 cfm @ 12 in. Hg.
Post-Test Leak Check: Pitot: ____ Orsat: ____

	Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Orifice Pressure Differential (ΔH) in H2O Actual	Stack Temp. (Ts)	Temperature °F Probe	Temperature °F Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Dry Gas Meter Temp. Outlet (Tm out °F)	Pump Vacuum (in. Hg)
A	0	0	1140	212.687										
	1	10	1150	216.8	.07	.46	.46	129	249	249	58	78	75	2
	2	20	1200	220.8	.07	.46	.46	131	249	244	54	89	79	2
	3	30	1210	224.7	.07	.46	.46	130	246	249	53	93	82	2
	4	40	1220	228.1	.05	.34	.34	130	249	244	54	97	85	2
	5	50	1230	230.7	.03	.20	.20	130	249	250	56	100	88	1
	6	60	1240	233.3	.03	.20	.20	130	249	250	57	98	90	1
	7	70	1250	236.7	.05	.34	.34	130	249	247	60	100	92	2
	8	80	1300	240.8	.07	.46	.46	130	249	253	54	101	94	4
	9	90	1310	246.1	.13	.88	.88	130	252	249	49	103	95	7
	10	100	1320	252.0	.15	1.0	1.0	130	249	245	48	106	98	7
	11	110	1330	257.9	.15	1.0	1.0	130	247	249	47	107	99	7
	12	120	1340	263.758	.15	1.0	1.0	129	250	246	48	108	101	8
			1355 Start											
B	1	130	1405	269.7	.15	1.0	1.0	129	250	250	60	103	98	8
	2	140	1415	275.1	.13	.88	.88	131	246	249	48	106	100	7
	3	150	1425	280.6	.13	.88	.88	131	242	248	47	106	101	8
	4	160	1510	286.8	.17	1.2	1.2	131	250	248	47	107	102	10
	5	170	1520	293.3	.20	1.4	1.4	130	248	246	47	102	92	10
	6	180	1530	298.8	.13	.88	.88	131	249	249	44	99	93	9
	7	190	1540	301.8	.03	.20	.20	131	253	251	48	100	93	5
	8	200	1550	304.5	.03	.20	.20	131	248	248	55	99	95	5
	9	210	1600	308.2	.05	.34	.34	132	248	253	54	99	95	6
	10	220	1610	312.4	.11	.74	.74	131	248	250	50	102	97	8
	11	230	1620	317.9	.11	.74	.74	131	250	249	46	102	97	10
	12	240	1630	322.651	.11	.74	.74	130	248	250	46	104	98	10

Leak check
263.758
63.885

ΔVm= ____ $\overline{\sqrt{\Delta p}}$= ____ $\overline{\Delta H}$= ____ $\overline{Ts}$= ____ $\overline{Tm}$= ____

B Run 2

MULTI-METALS SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Fairbank Ridge Lime Co.		Run No.: 79-B-2
Date: 10/17/96	Sample Box No.: 79-B-2	Job No.: S-401
Sample Location: No 2 Kiln Outlet B		
Sample Type: Method 29		
Sample Recovery Person: MDM, CLR		

Container	Description	Volume, ml	Sealed/Level Marked
Front Half			
1	Filter No.(s) 301668		F1 ✓
2	Acetone Rinse		AB2 ✓
3	Nitric Rinse		FH3 ✓
Back Half			
4	Nitric Rinse - Imp. 1,2,3, + Back 1/2 Filter		BH4 ✓
5A	Nitric Rinse - Impinger No. 4		5A ✓
5B	KMNO4/H2O Rinse - Impingers 5 & 6		5B ✓
5C	HCl Rinse - Impingers 5 & 6		5C ✓

Moisture Data

Impinger No.	Contents	Initial Volume, ml	Weight, grams Initial	Final	Net
1	MT	0	742.4	1040.1	297.7
2	5% HNO_3 / 10% H_2O_2	100	678.8	740.2	61.4
3	"	100	632.8	642.8	10.0
4	MT	0	559.6	560.7	9.1
5	4% $KMnO_4$ / 10% H_2SO_4	100	651.7	652.4	0.7
6	"	100	641.7	641.4	-0.3
7	Silica Gel ~~MT~~	–	809.1	828.9	19.8
Total					390.4

Comments: Heavy loading

FIELD DATA SHEET

K = 1.176

Plant: EPA Ridge Lime
Sampling Location: Scrubber Outlet B
Run Number: 29-B-3 Date: 10-18-96
Pretest Leak Rate: .010 cfm @ 16 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: ✓

Sample Type: M-29 Operator: TA/BE
Pbar: 28.30 Ps: + .12
CO2: 20 O2: 9
Probe Length/Type: 4' Glass Pitot #: 4D
Stack Diameter: 48" As:

Nozzle ID: .310 Thermocouple #: 4D
Assumed Bws: .15 Filter #: 301681
Meter Box #: 15 Y: 1.003 ΔH@: 1.685
Post-Test Leak Rate: .005 cfm @ 14 in. Hg.
Post-Test Leak Check: Pitot: ____ Orsat: ____

	Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Orifice Pressure Differential (ΔH) in H2O Actual	Stack Temp. (Ts)	Temperature °F Probe	Temperature °F Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Dry Gas Meter Temp. Outlet (Tm out °F)	Pump Vacuum (in. Hg)
A	0	0	1100	322.998										
	1	10	1110	330.0	.26	1.7	1.7	132	249	252	50	72	71	4
	2	20	1120	337.4	.26	1.7	1.7	133	246	245	49	84	74	4
	3	30	1130	~~339.5~~ 344.1	.26	1.7	1.7	133	251	250	45	89	76	4
	4	40	1140	352.2	.29	1.9	1.9	133	243	248	47	92	80	6
	5	50	1150	359.6	.26	1.7	1.7	133	249	249	48	93	81	6
	6	60	1200	367.5	.32	2.1	2.1	134	249	243	49	93	83	7
	7	70	1210	371.6	.07	0.47	0.47	134	248	244	51	95	84	3
	8	80	1220	375.6	.07	0.47	0.47	134	249	247	54	91	84	4
	9	90	1230	378.6	.03	0.20	0.20	134	249	247	50	93	84	2
	10	100	1240	381.5	.03	0.20	0.20	133	250	244	53	88	84	2
	11	110	1250	383.8	.03	0.20	0.20	134	247	250	53	88	84	2
	12	120	1300	387.264	0.05	0.36	0.36	134	254	250	57	88	85	4
			1335											
B	1	130	1345	392.3	.10	.67	.67	135	248	250	59	86	84	5
	2	140	1355	396.4	.07	0.47	0.47	134	244	249	42	87	84	5
	3	150	1405	400.6	.07	0.47	0.47	135	249	246	45	89	85	5
	4	160	1415	404.7	.07	0.47	0.47	134	249	246	45	89	84	5
	5	170	1425	409.3	.10	0.67	0.67	134	248	244	45	89	84	5
	6	180	1435	414.0	.10	0.67	0.67	134	251	249	45	90	84	7
	7	190	1445	422.0	.31	2.1	2.1	134	252	248	45	91	84	12
	8	200	1455	429.5	.26	1.7	1.7	134	249	247	43	93	85	12
	9	210	1520	436.5	.20	1.3	1.3	134	248	248	46	93	85	10
	10	220	1530	442.9	.16	1.1	1.1	131	250	249	40	78	77	10
	11	230	1540	448.9	.20	1.3	1.3	131	248	243	42	78	75	10
	12	240	1550	455.640	.22	1.4	1.4	131	248	246	42	78	75	10

Leak check
87.264
87.421

ΔVm= ____ $\overline{\sqrt{\Delta p}}$= 0.3745 $\overline{\Delta H}$= 1.04 $\overline{Ts}$= 133 $\overline{Tm}$= 85

B Run 3

MULTI-METALS SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Eastern Ridge Lime Co.		Run No.: 29-B-3
Date: 10/18/96	Sample Box No.: 29-B-3	Job No.: S-401
Sample Location: No. 2 Kiln Outlet B		
Sample Type: Method 29		
Sample Recovery Person: MDM		

Container	Description	Volume, ml	Sealed/Level Marked
Front Half			
1	Filter No.(s) 361681		F1 ✓
2	Acetone Rinse		AR2 ✓
3	Nitric Rinse		AH3 ✓
Back Half			
4	Nitric Rinse - Imp. 1,2,3, + Back 1/2 Filter		BH4 ✓
5A	Nitric Rinse - Impinger No. 4		5A ✓
5B	KMNO4/H2O Rinse - Impingers 5 & 6		5B ✓
5C	HCl Rinse - Impingers 5 & 6		5C ✓

Moisture Data

Impinger No.	Contents	Initial Volume, ml	Weight, grams Initial	Final	Net
1	8% H_2O_2	0 ~~100~~	742.8	1179.6	436.8
2	8% HNO_3 / 10% H_2O_2	100	678.6	736.8	58.2
3	" ~~MT~~ "	100	632.8	640.2	7.4
4	4% $KMnO_4$ Final 5	0 ~~100~~	558.6	558.4	-0.2
5	4% $KMnO_4$ / 10% H_2SO_4	100	646.7	646.7	0
6	" ~~MT~~ "	100	651.1	650.1	-1.0
7	Gel	–	883.0	902.5	19.5
Total					520.7

Comments: Heavy loading

Appendix B.1.4

Raw Field Data

Kiln No. 2 - Total Hydrocarbons

30.04 0

87.86 49.72

SYSTEM CALIBRATION

13:15

12:20

5m40cm

10 9 8 7 6 5 4 3 2 1 0

9:10

40 seconds

87.86 0

40 seconds

40 seconds 9:00 0

30.04

49.72

87.86

0

0 1 2 3 4 5 6 7 8 9 10

SYSTEM CALIBRATION

0

8:40 30.04

49.72

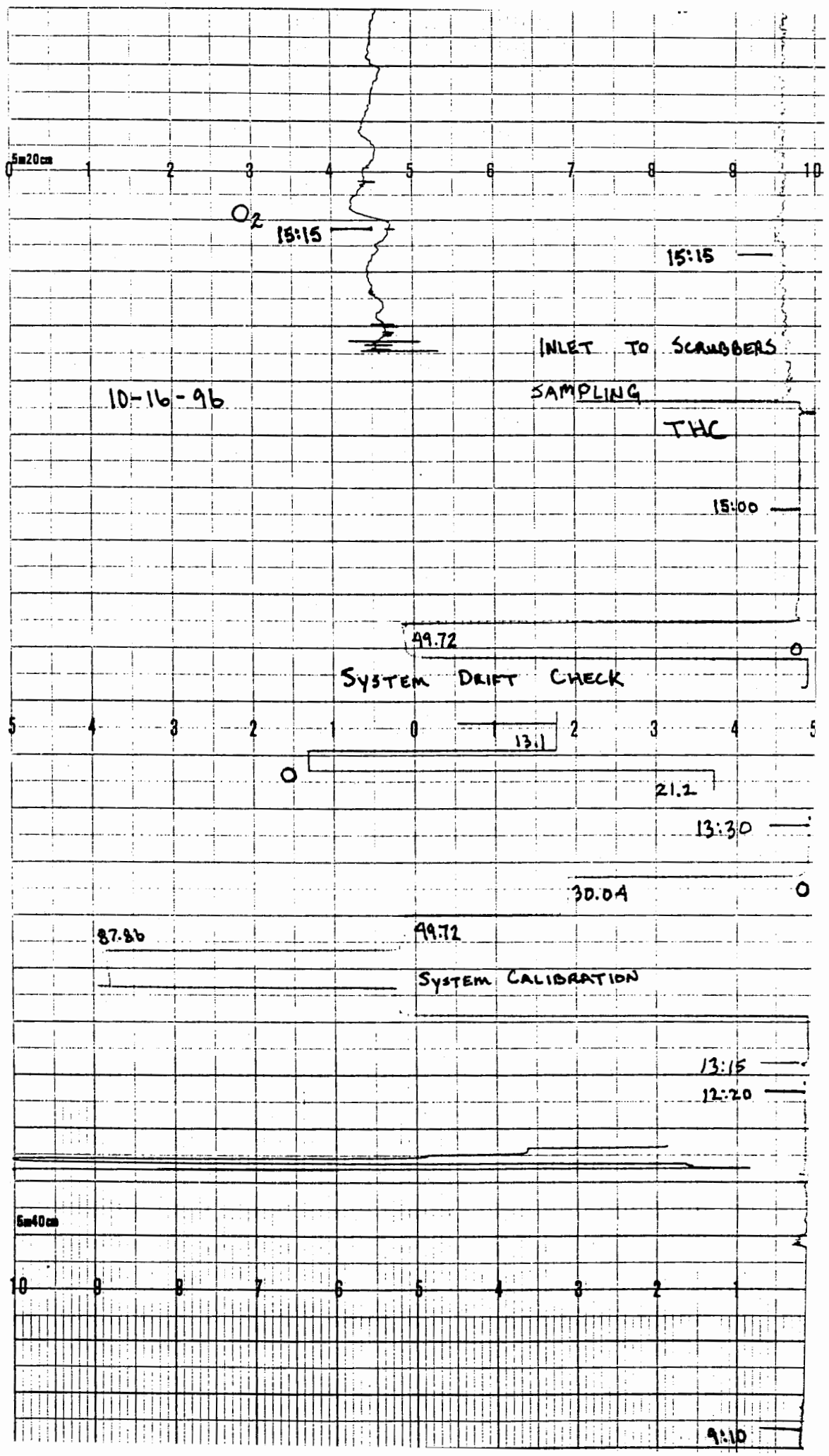
87.86

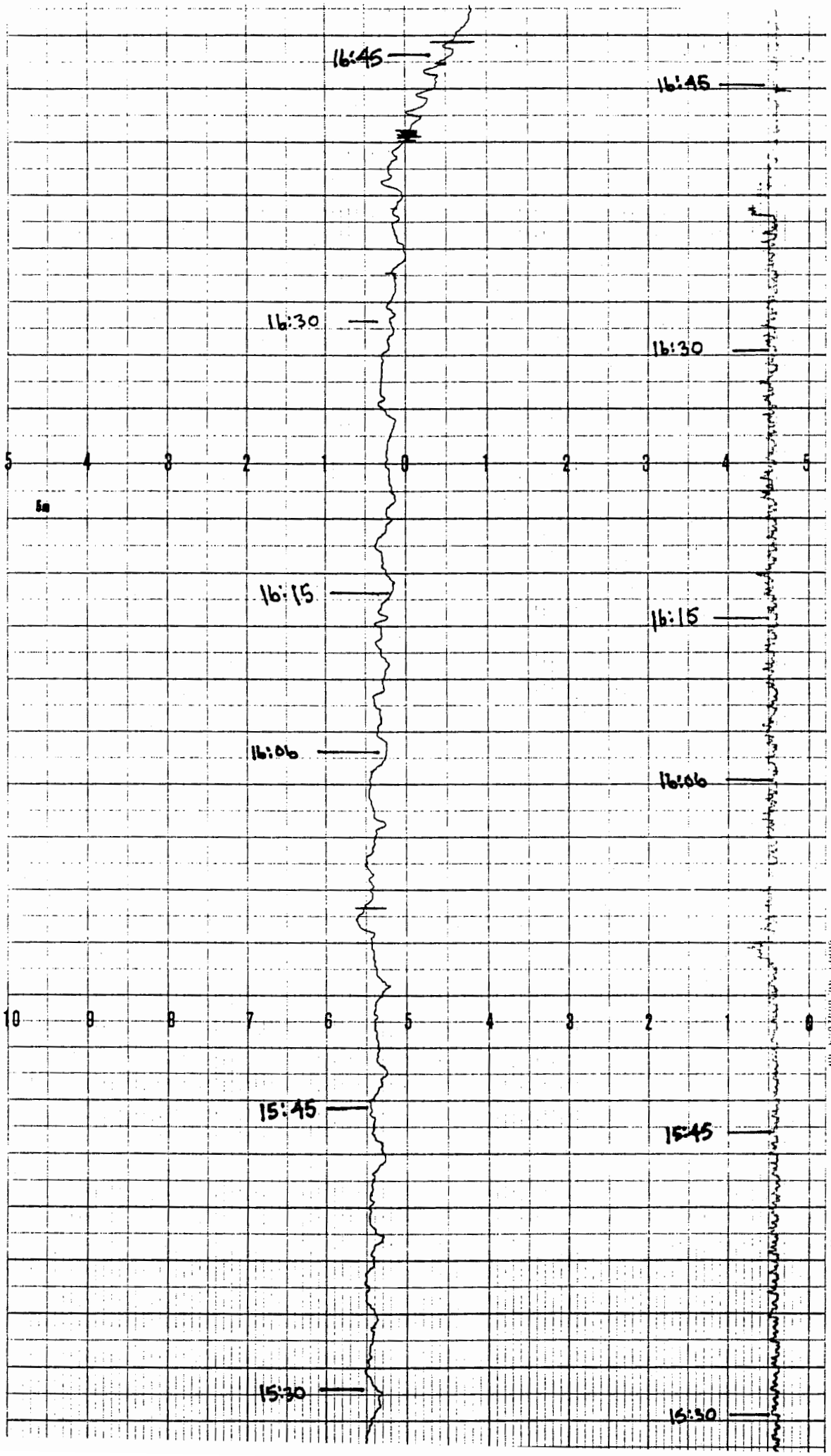
DIRECT CALIBRATION

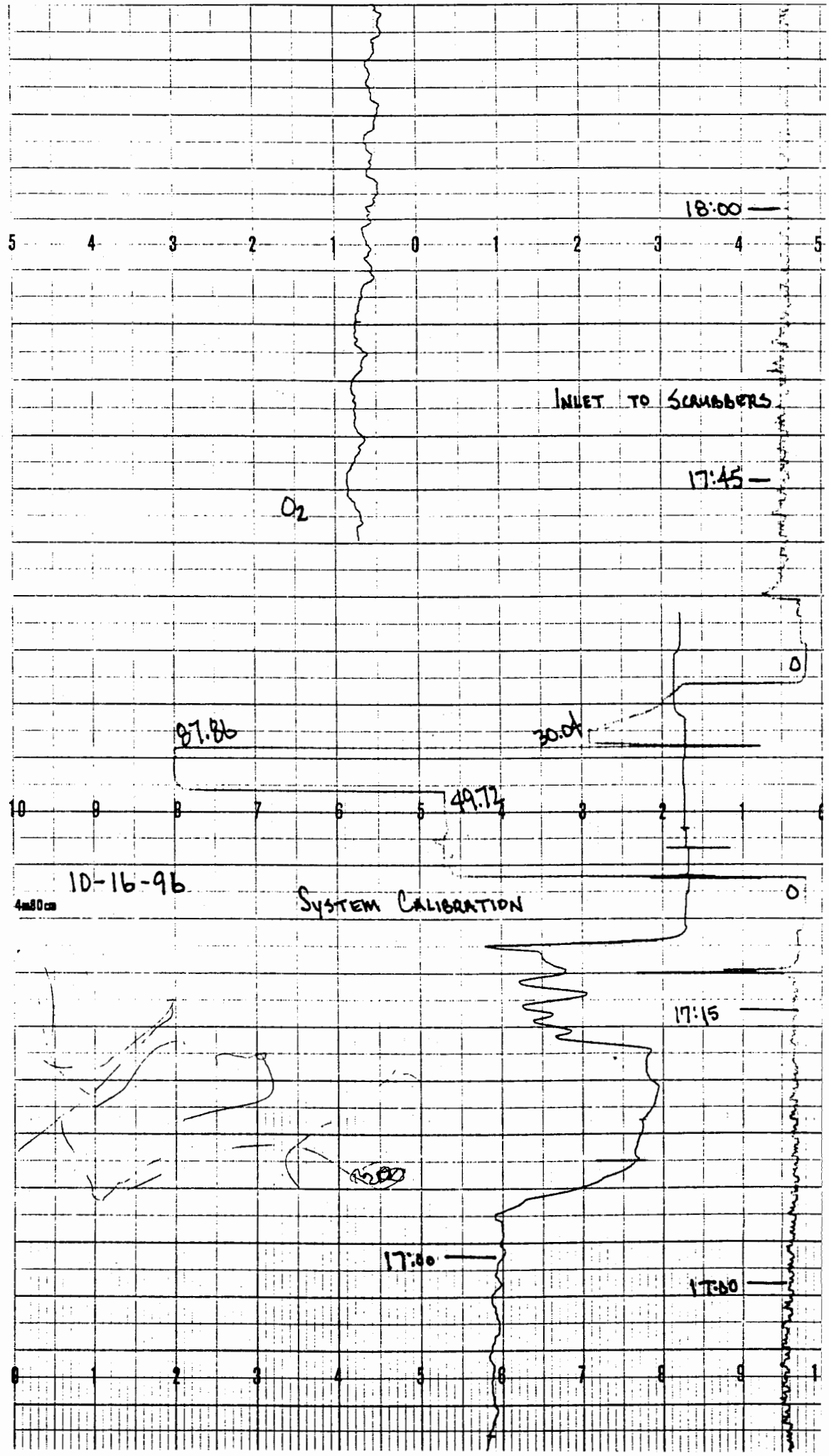
0

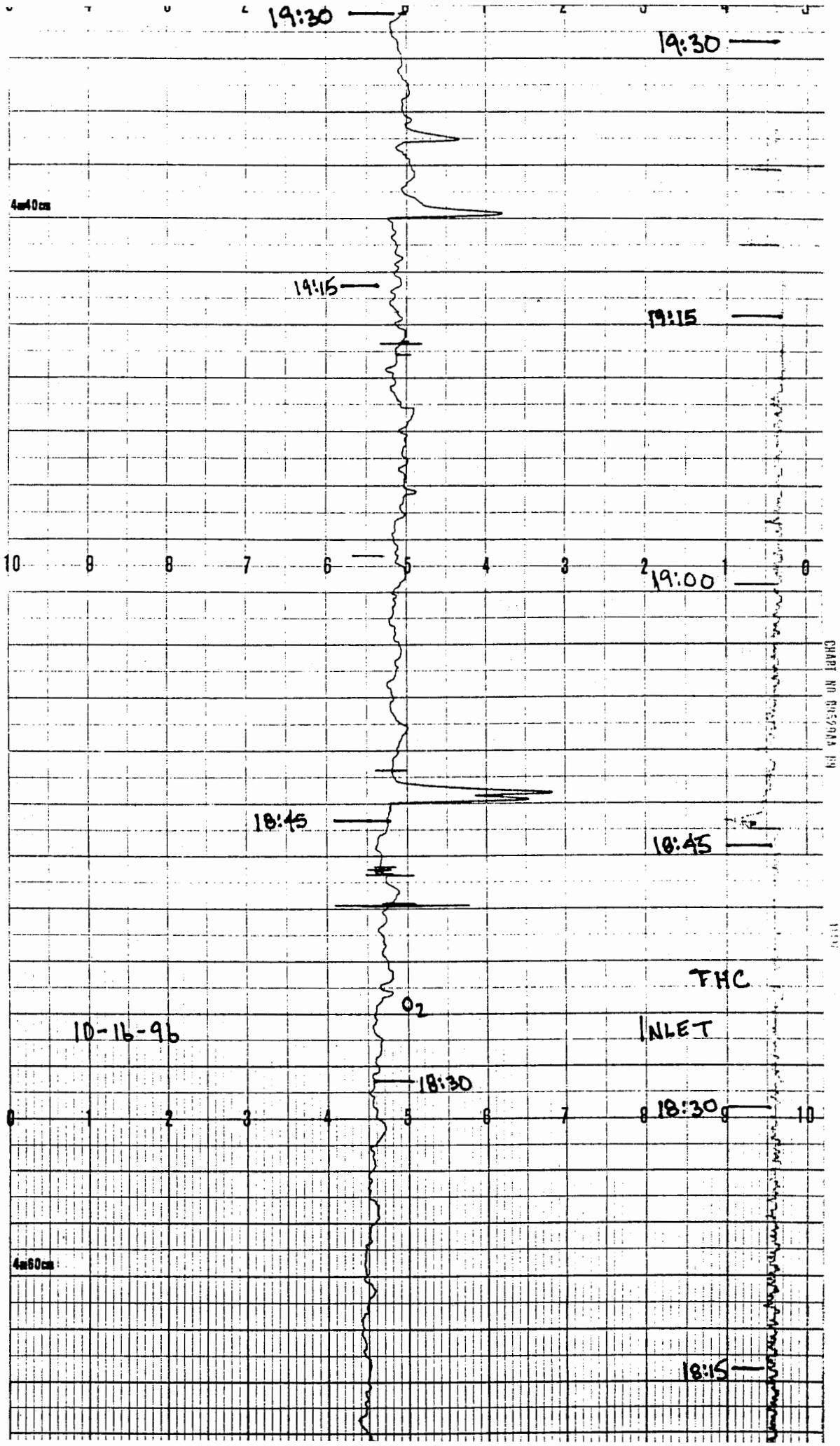
10-16-96 EASTERN RIDGE LIME COMPANY, RIPPLEMEAD, VA

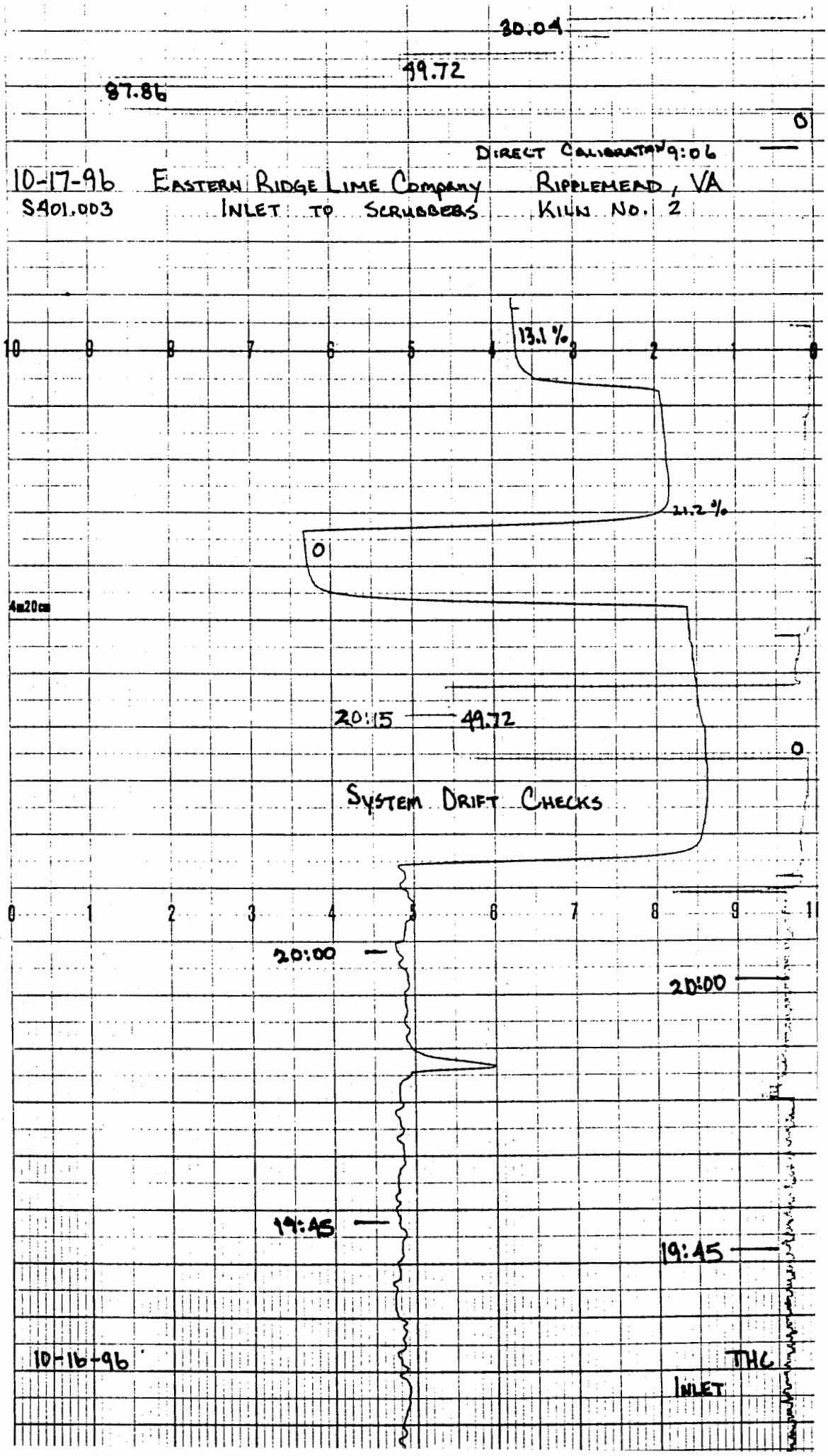
5401.003 INLET TO SCRUBBERS KILN No 2

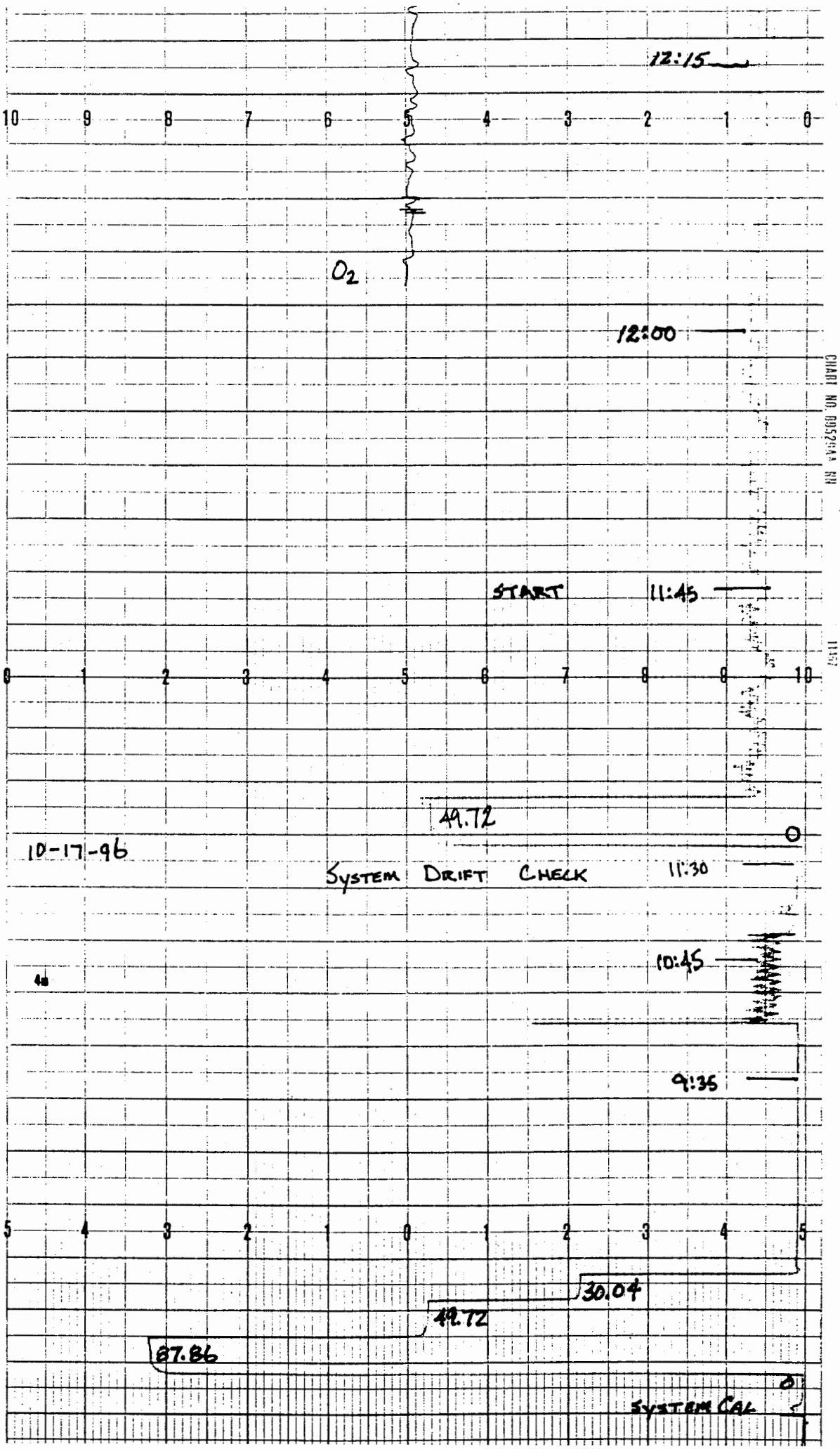

5m20cm
0 1 2 3 4 5 6 7 8 9 10
O2
15:15
15:15
INLET TO SCRUBBERS
10-16-96
SAMPLING
THC
15:00
49.72
0
SYSTEM DRIFT CHECK
5 4 3 2 1 0 1 2 3 4 5
13.1
0
21.2
13:30
30.04
0
87.86
49.72
SYSTEM CALIBRATION
13:15
12:20
5m40cm
10 9 8 7 6 5 4 3 2 1
9:10

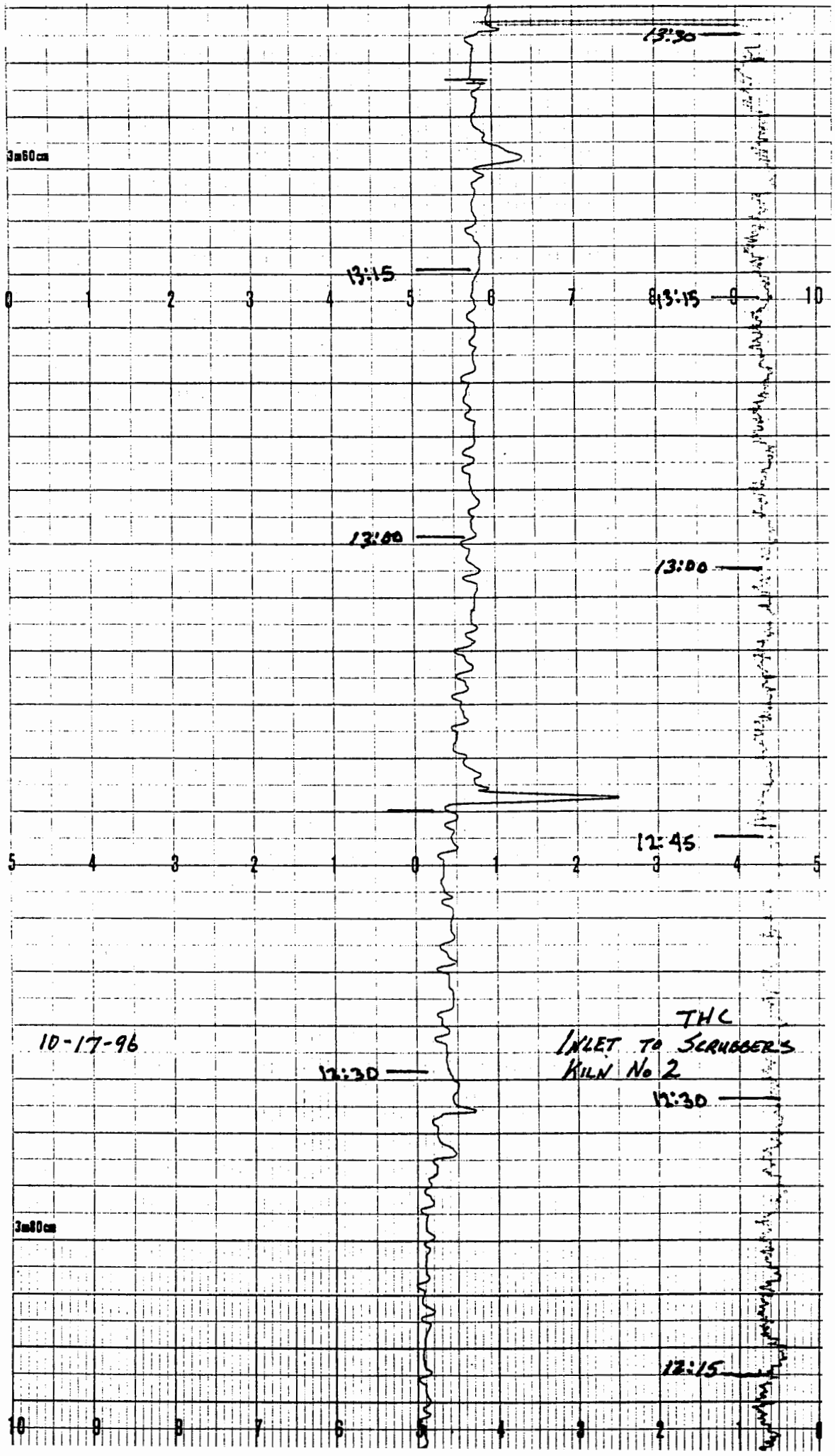

16:45
16:45
16:30
16:30
5 4 3 2 1 0 1 2 3 4 5
16:15
16:15
16:06
16:06
10 9 8 7 6 5 4 3 2 1 0
15:45
15:45
15:30
15:30

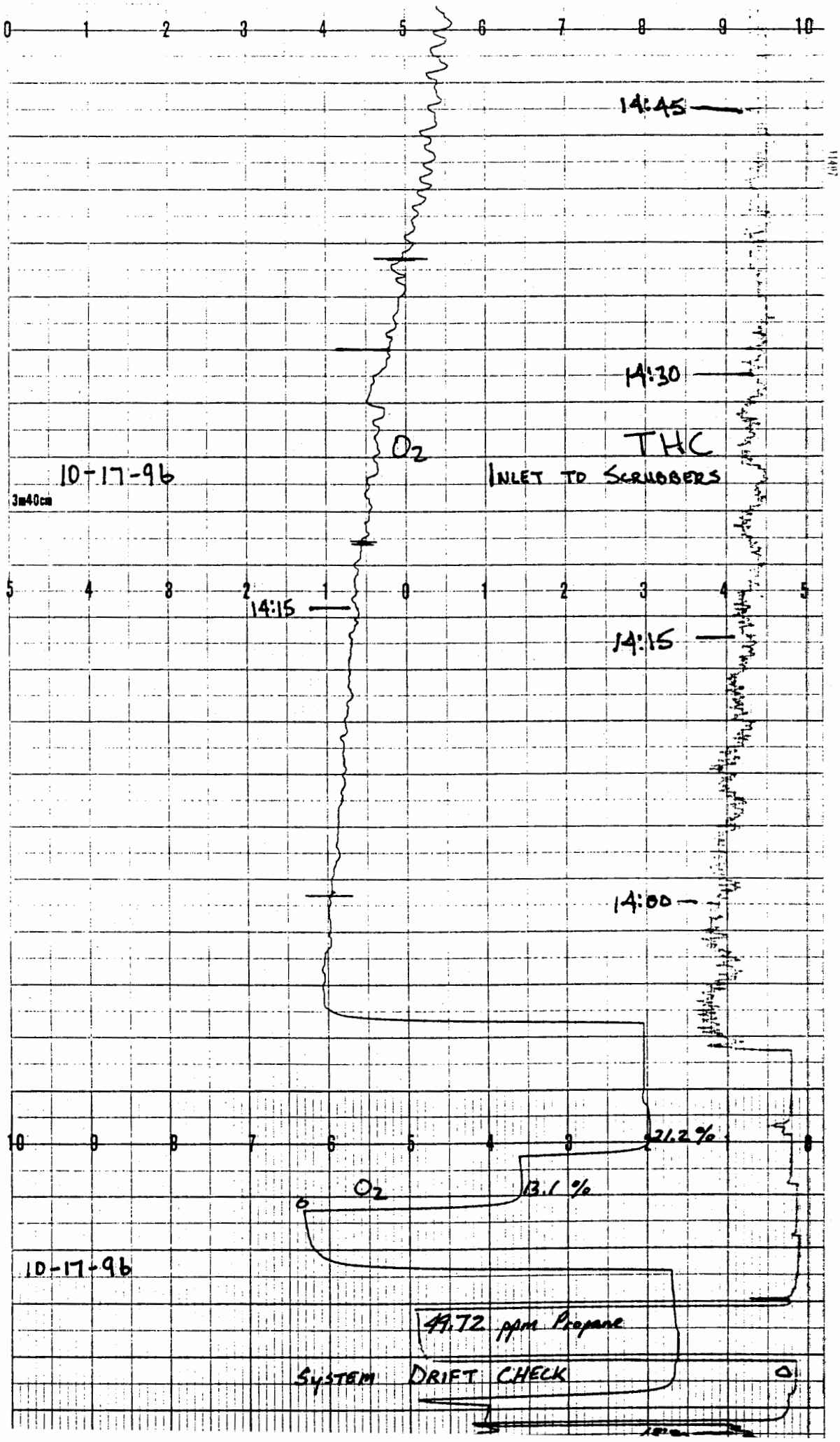

18:00
5 4 3 2 1 0 1 2 3 4 5
INLET TO SCRUBBERS
17:45
O2
0
87.86
30.04
49.72
10 9 8 7 6 5 4 3 2 1 0
10-16-96
SYSTEM CALIBRATION
0
17:15
17:00
17:00
0 1 2 3 4 5 6 7 8 9 1

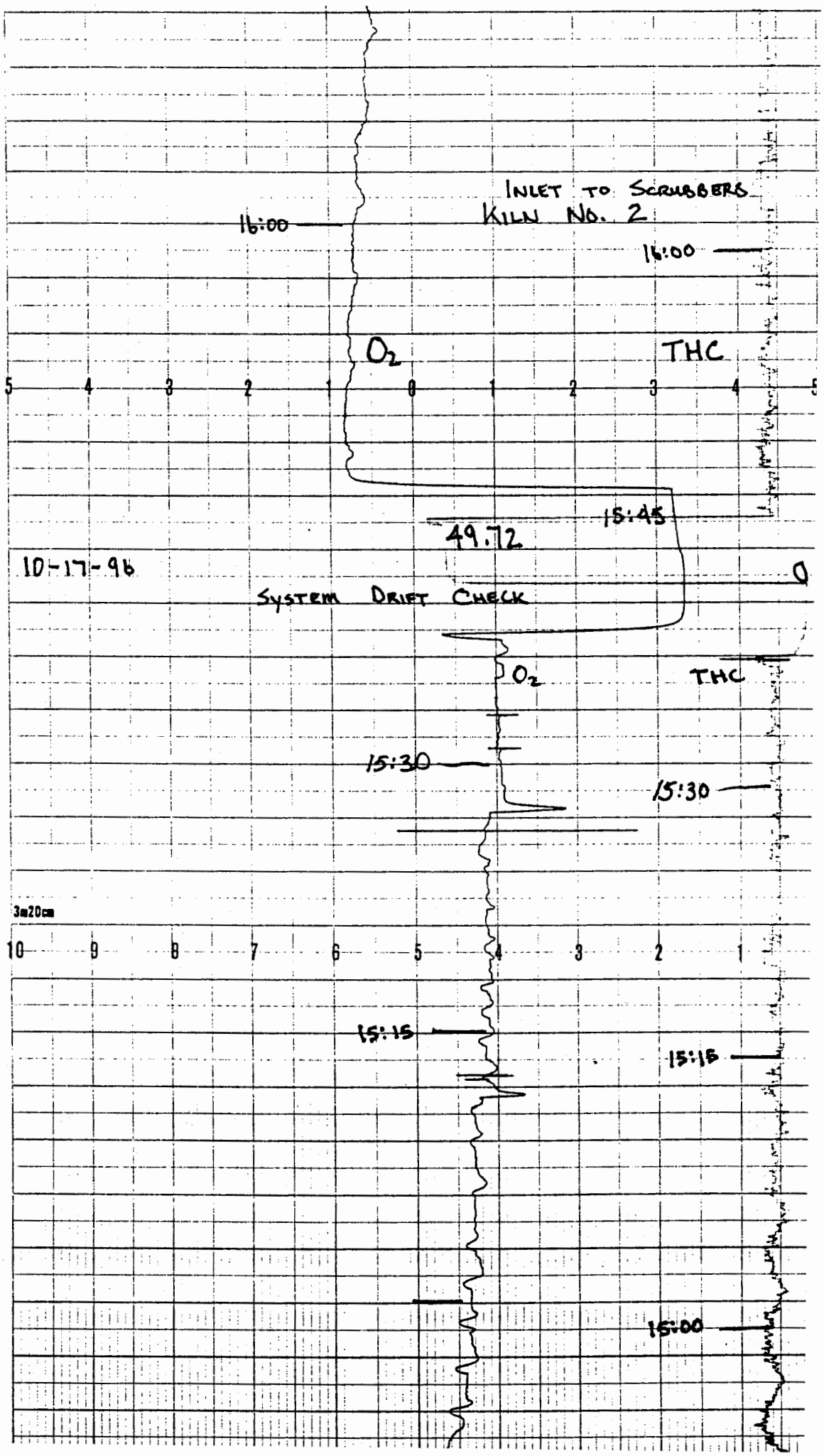

19:30
19:30
4m40cm
19:15
19:15
10 9 8 7 6 5 4 3 2 1 0
19:00
18:45
18:45
THC
O_2
10-16-96
INLET
18:30
18:30
0 1 2 3 4 5 6 7 8 9 10
4m60cm
18:15

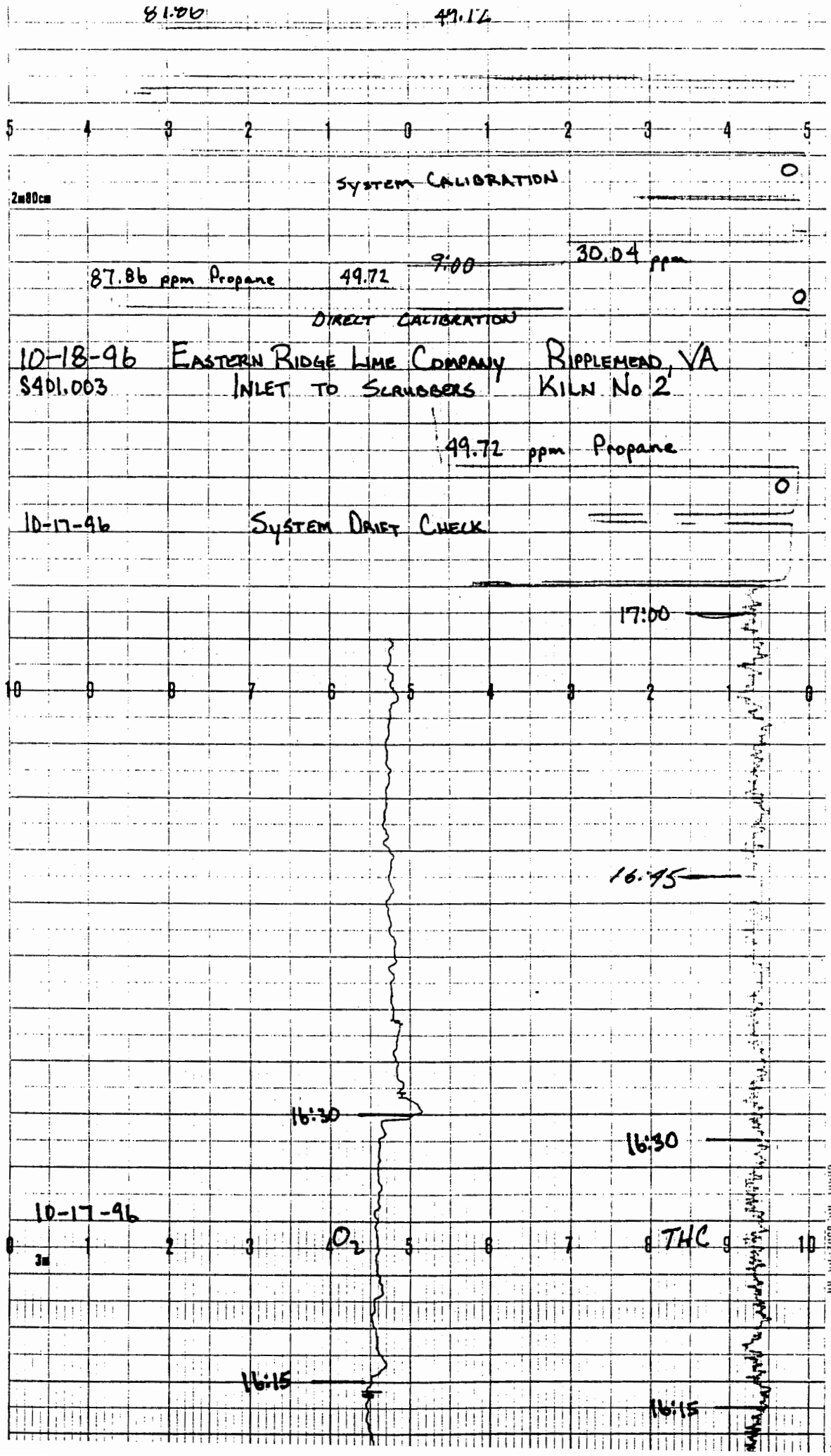

30.04
49.72
87.86
0
DIRECT CALIBRATION 9:06
10-17-96 EASTERN RIDGE LIME COMPANY RIPPLEMEAD, VA
S401.003 INLET TO SCRUBBERS KILN NO. 2
10 9 8 7 6 5 4 3 2 1 0
13.1 %
21.2 %
0
4m20cm
20:15
49.72
0
SYSTEM DRIFT CHECKS
0 1 2 3 4 5 6 7 8 9 10
20:00
20:00
19:45
19:45
10-16-96
THC
INLET


12:15
10 9 8 7 6 5 4 3 2 1 0
O_2
12:00
START
11:45
0 1 2 3 4 5 6 7 8 9 10
49.72
10-17-96
SYSTEM DRIFT CHECK
11:30
10:45
9:35
5 4 3 2 1 0 1 2 3 4 5
30.04
49.72
87.86
SYSTEM CAL


13:30
3m60cm
13:15
0 1 2 3 4 5 6 7 8 9 10
13:15
13:00
13:00
12:45
5 4 3 2 1 0 1 2 3 4 5
10-17-96
THC
INLET TO SCRUBBER'S
KILN No 2
12:30
12:30
3m80cm
12:15
10 9 8 7 6 5 4 3 2 1 0


0 1 2 3 4 5 6 7 8 9 10
14:45
14:30
THC
O2
10-17-96
INLET TO SCRUBBERS
3m40cm
5 4 3 2 1 0 1 2 3 4 5
14:15
14:15
14:00
10 9 8 7 6 5 4 3 2 1 0
21.2 %
O2
13.1 %
0
10-17-96
49.72 ppm Propane
SYSTEM DRIFT CHECK
0


INLET TO SCRUBBERS
KILN NO. 2
16:00
16:00
O2
THC
5 4 3 2 1 0 1 2 3 4 5
15:45
49.72
10-17-96
0
SYSTEM DRIFT CHECK
O2
THC
15:30
15:30
3m20cm
10 9 8 7 6 5 4 3 2 1
15:15
15:15
15:00


81.86
49.72
5 4 3 2 1 0 1 2 3 4 5
System Calibration
0
2m80cm
30.04 ppm
87.86 ppm Propane
49.72
9:00
0
Direct Calibration
10-18-96 Eastern Ridge Lime Company Ripplemead, VA
S401.003 Inlet to Scrubbers Kiln No 2
49.72 ppm Propane
0
10-17-96 System Drift Check
17:00
10 9 8 7 6 5 4 3 2 1 0
16:45
16:30
16:30
10-17-96
0 1 2 3 4 5 6 7 8 9 10
3m
O2
THC
16:15
16:15
CHART NO. 8952AA NN

10:45

10 9 8 7 6 5 4 3 2 1

10:30

2m60cm

10:15

THC

10-18-96

KILN No. 2

INLET TO SCRUBBERS 10:10

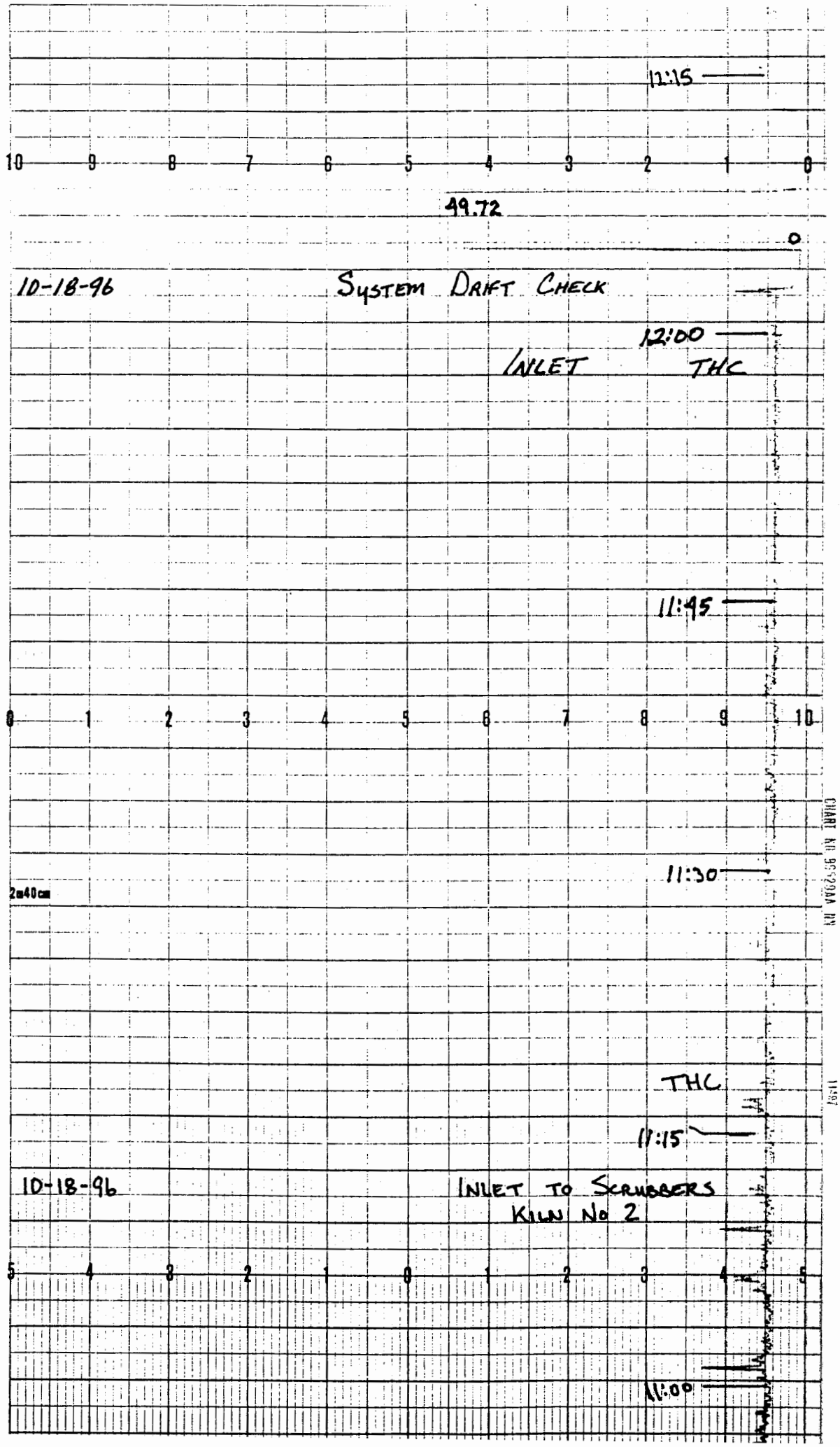
0 1 2 3 4 5 6 7 8 9

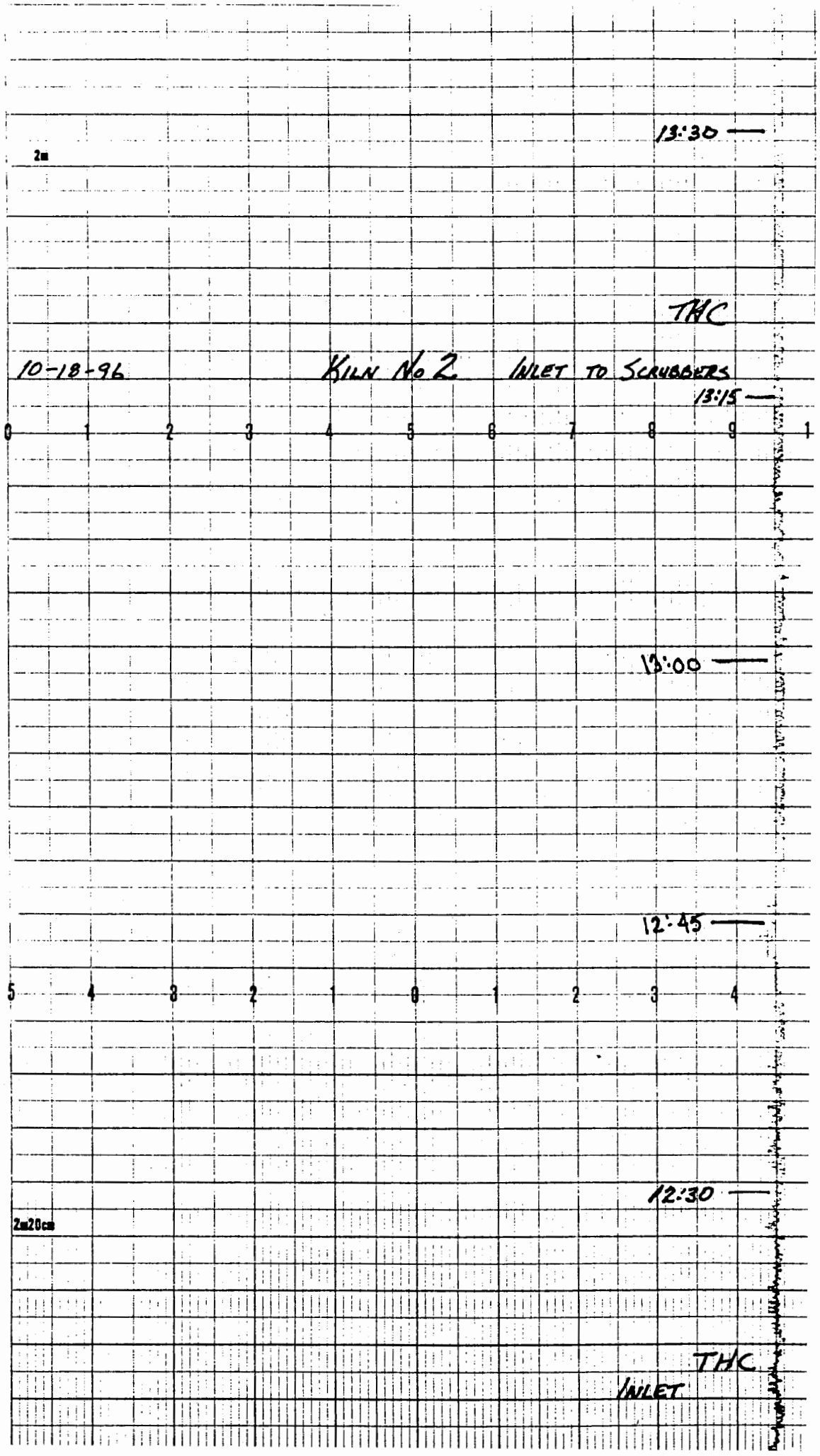
0

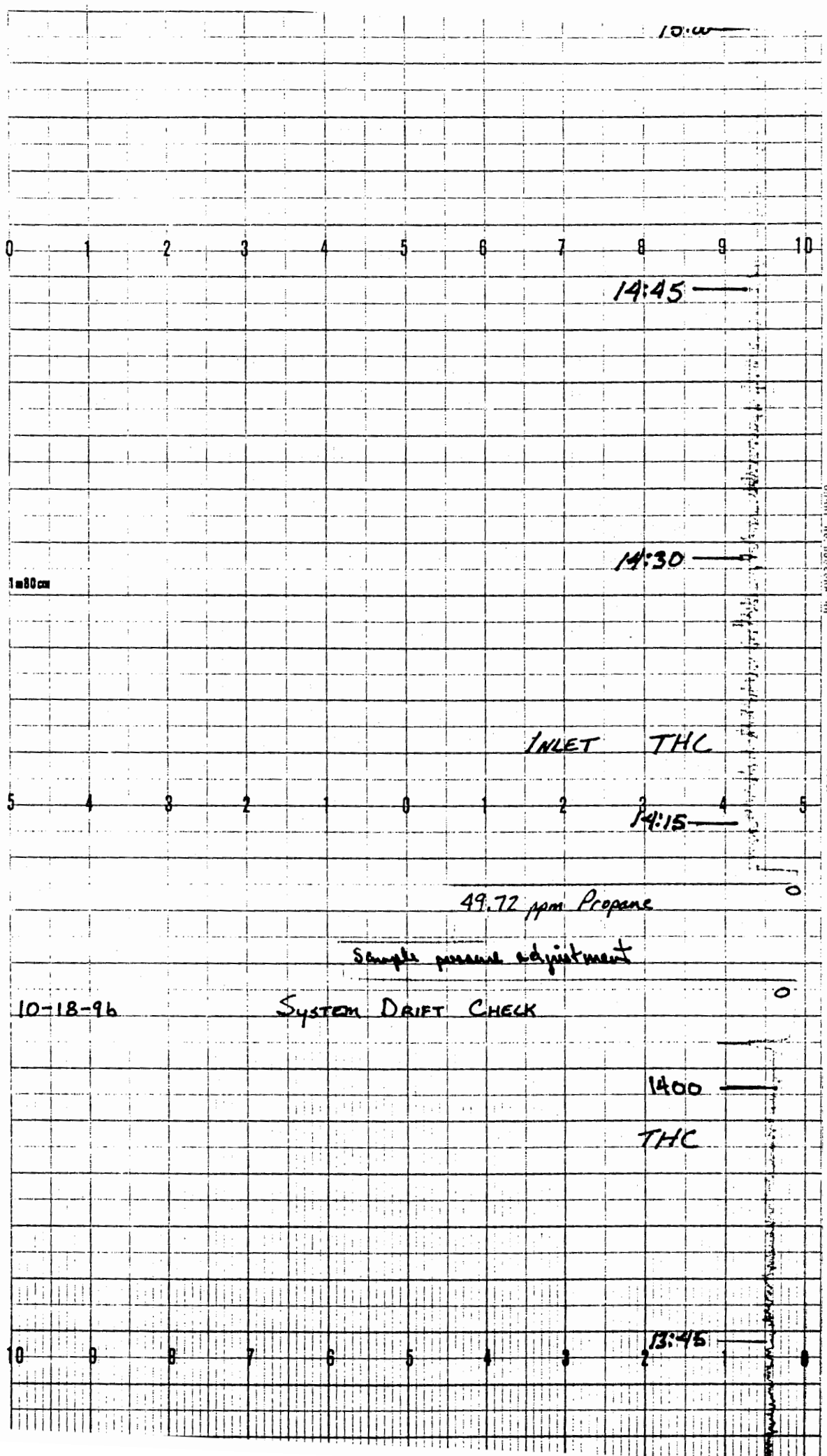
30.04

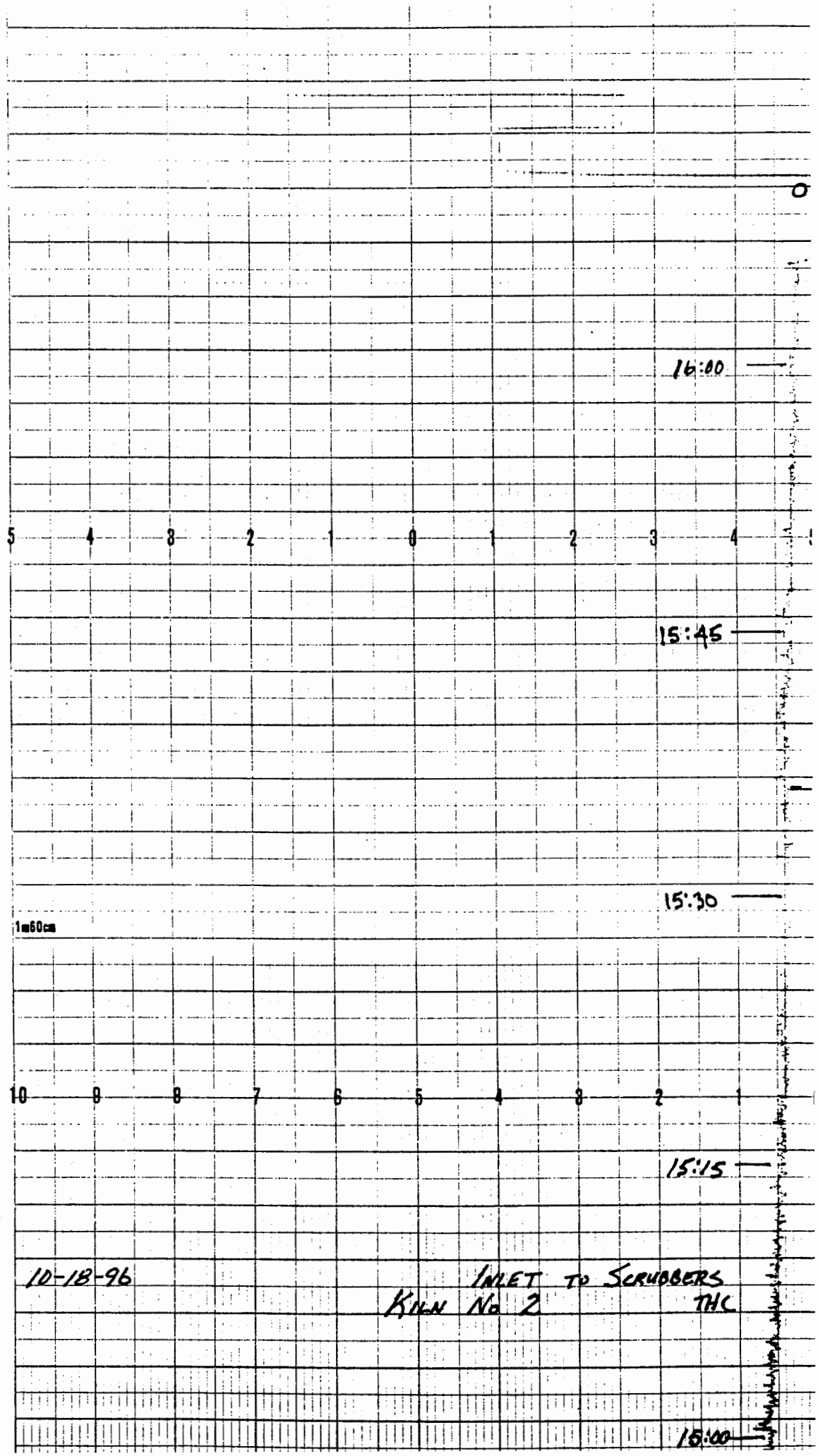
87.86

49.72


12:15
10 9 8 7 6 5 4 3 2 1 0
49.72
0
10-18-96
System Drift Check
12:00
Inlet THC
11:45
0 1 2 3 4 5 6 7 8 9 10
11:30
2a40cm
THC
11:15
10-18-96
Inlet to Scrubbers
Kiln No 2
5 4 3 2 1 0 1 2 3 4 5
11:00


13:30
2m
THC
10-18-96
KILN No 2
INLET TO SCRUBBERS
13:15
0 1 2 3 4 5 6 7 8 9 1
13:00
12:45
5 4 3 2 1 0 1 2 3 4
12:30
2m20cm
THC
INLET


10:00
0 1 2 3 4 5 6 7 8 9 10
14:45
14:30
1m80cm
INLET THC
5 4 3 2 1 0 1 2 3 4 5
14:15
0
49.72 ppm Propane
Sample pressure adjustment
0
10-18-96
SYSTEM DRIFT CHECK
1400
THC
13:45
10 9 8 7 6 5 4 3 2 1 0
CHART NO. B9529AA MM
11497


0
16:00
5 4 3 2 1 0 1 2 3 4
15:45
15:30
1m60cm
10 9 8 7 6 5 4 3 2 1
15:15
10-18-96
INLET TO SCRUBBERS
KILN No 2
THC
15:00

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME CO.
Location: KILN NO 2 INLET
Date: 10-16-96

Parameter: SO_2, CO_2, O_2, NO_X*, THC, CO
Operator: P. SIEGEL
Project #: S401.003

$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division - b})}{\text{m}} = \frac{(\text{CD} - 1.214)}{(0.9936)}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	15:15-15:30	4.0	2.8	100' of heated
	-15:45	4.2	3.0	sample line
	-16:00	4.5	3.3	
	-16:15	4.5	3.3	
	-16:30	4.7	3.5	
	-16:45	4.7	3.5	
	-17:00	4.3	3.1	
	-17:15	3.5	2.3	
				Second Calibration
	17:45-18:00	4.5	3.3	2.5
	-18:15	4.3	3.1	2.3
	-18:30	4.3	3.1	2.3
	-18:45	4.0	2.8	1.9
	-19:00	4.5	3.3	2.5
	-19:15	3.4		1.3
	-19:30	3.7		1.6
	-19:45	3.7		1.6
	-20:00	3.8		1.7

* For NO_X Indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated By: Paul T. Siegel Date: 10-16-96
Checked By: [illegible] Date: 12-19-96

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME CO.
Location: KILN NO. 2 INLET
Date: 10-17-96

Parameter: SO_2, CO_2, O_2, NO_X*, THC, CO
Operator: P. SIEGEL
Project #: S401.003

$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division - b})}{\text{m}} = \frac{(\text{CD} - 0.532)}{(0.9317)}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	11:45 - 12:00	6.5	6.4	
	- 12:15	6.5	6.4	
	- 12:30	6.0	5.9	
	- 12:45	6.0	5.9	
	- 13:00	6.7	6.6	
	- 13:15	6.8	6.7	
	- 13:30	7.3	7.3	
	14:00 - 14:15	9.5	9.6	
	- 14:30	7.0	6.9	
	- 14:45	6.3	6.2	
	- 15:00	6.0	5.9	
	- 15:15	5.5	5.3	
	- 15:30	5.5	5.3	
	15:45 - 16:00	6.1	6.0	
	- 16:15	6.5	6.4	
	- 16:30	6.7	6.6	
	- 16:45	6.8	6.7	
	- 17:00	7.0	6.9	

* For NO_X Indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated By: Paul T. Siegel Date: 10-17-96
Checked By: [illegible] Date: 12-19-96

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME Co.
Location: KILN No. 2 INLET
Date: 10-18-96

Parameter: SO_2, CO_2, O_2, NO_X*, (THC), CO
Operator: P. SIEGEL
Project #: S401.003

$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division} - b)}{m} = \frac{(CD - 0.923)}{(0.9158)}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	10:10 - 10:30	6.2	5.8	
	- 10:45	6.0	5.5	
	- 11:00	5.5	5.0	
	- 11:15	5.0	4.5	
	- 11:30	4.8	4.2	
	- 11:45	4.3	3.7	
	- 12:00	4.0	3.4	
	12:15 - 12:30	5.0	4.5	
	- 12:45	5.0	4.5	
	- 13:00	4.5	3.9	
	- 13:15	4.5	3.9	
	- 13:30	4.5	3.9	
	- 13:45	4.5	3.9	
	- 14:00	4.3	3.7	

* For NO_X Indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated By: Paul T. Siegel Date: 10-18-96
Checked By: [illegible] Date: 11-19-96

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME CO.
Location: KILN NO. 2 INLET
Date: 10-18-96

Parameter: SO_2, CO_2, O_2, NO_X*, (HC) CO
Operator: P. SIEGEL
Project #: S401.003

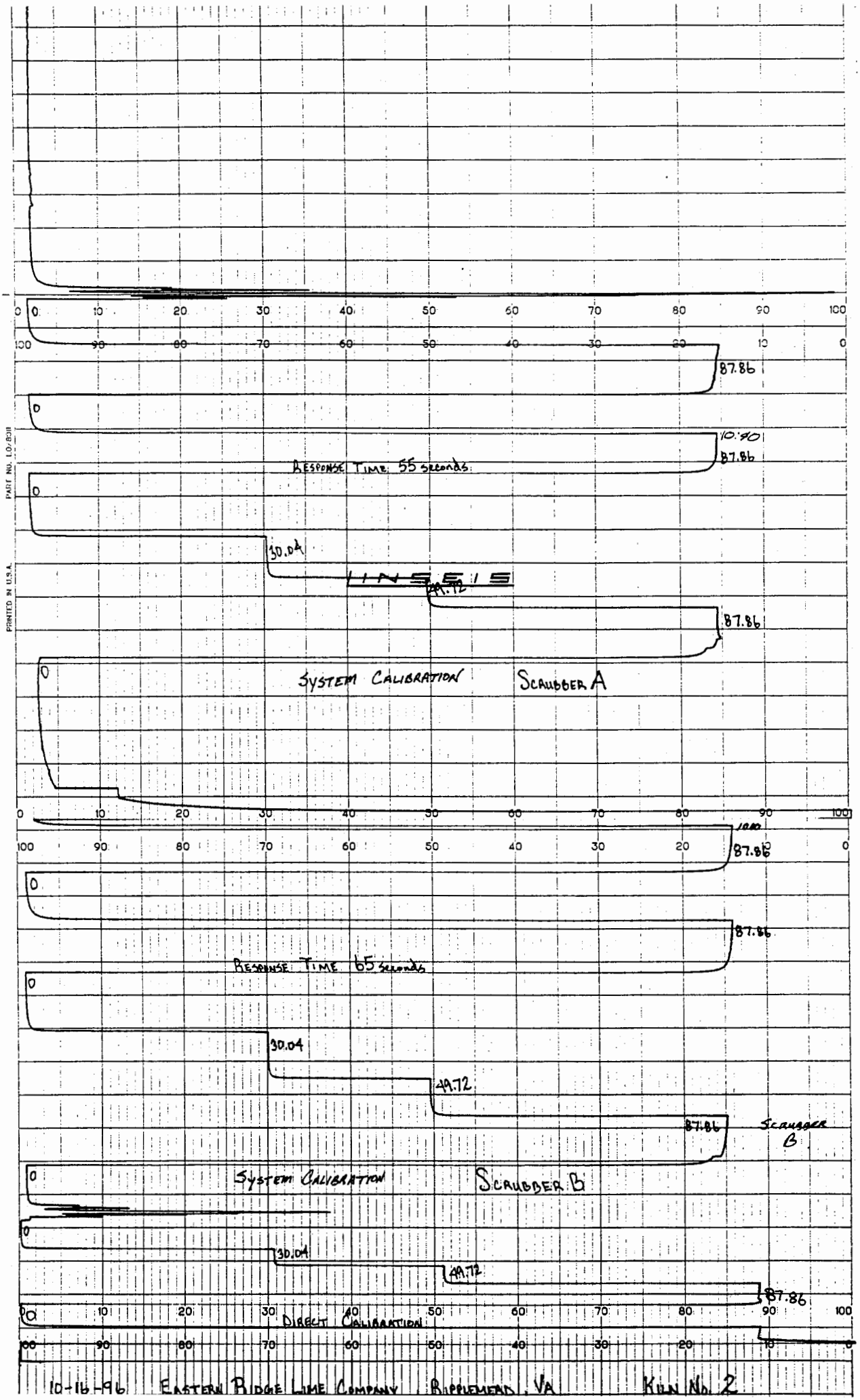
$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division} - b)}{m} = \frac{(CD - 0.923)}{(0.9158)}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	14:15-14:30	7.0	6.6	
	-14:45	6.5	6.1	
	-15:00	6.0	5.5	
	-15:15	5.3	4.8	
	-15:30	4.3	3.7	
	-15:45	4.0	3.4	
	-16:00	3.0	2.3	

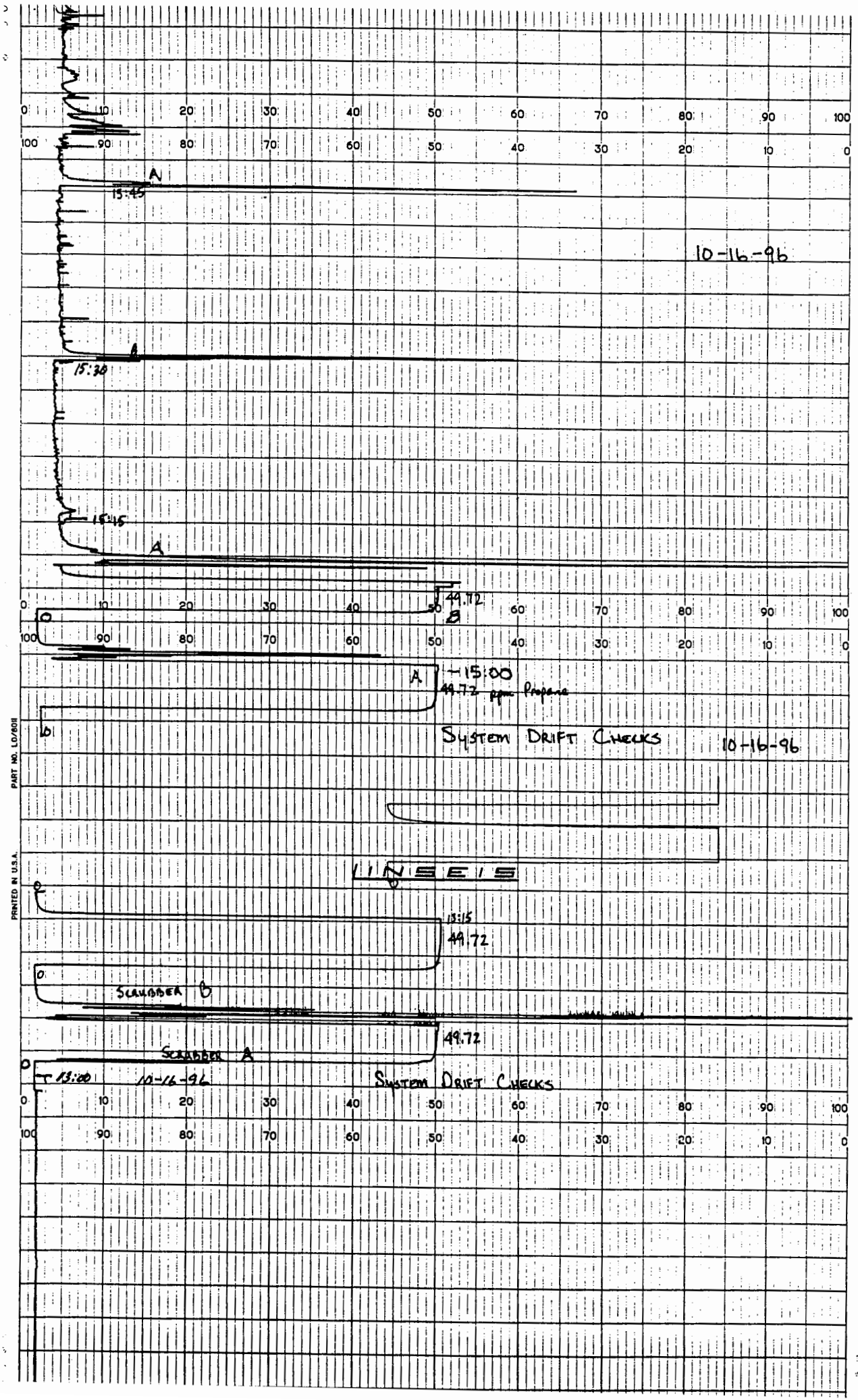
* For NO_X indicate whether NO, NO + NO_2, or NO_2 for specific interval.

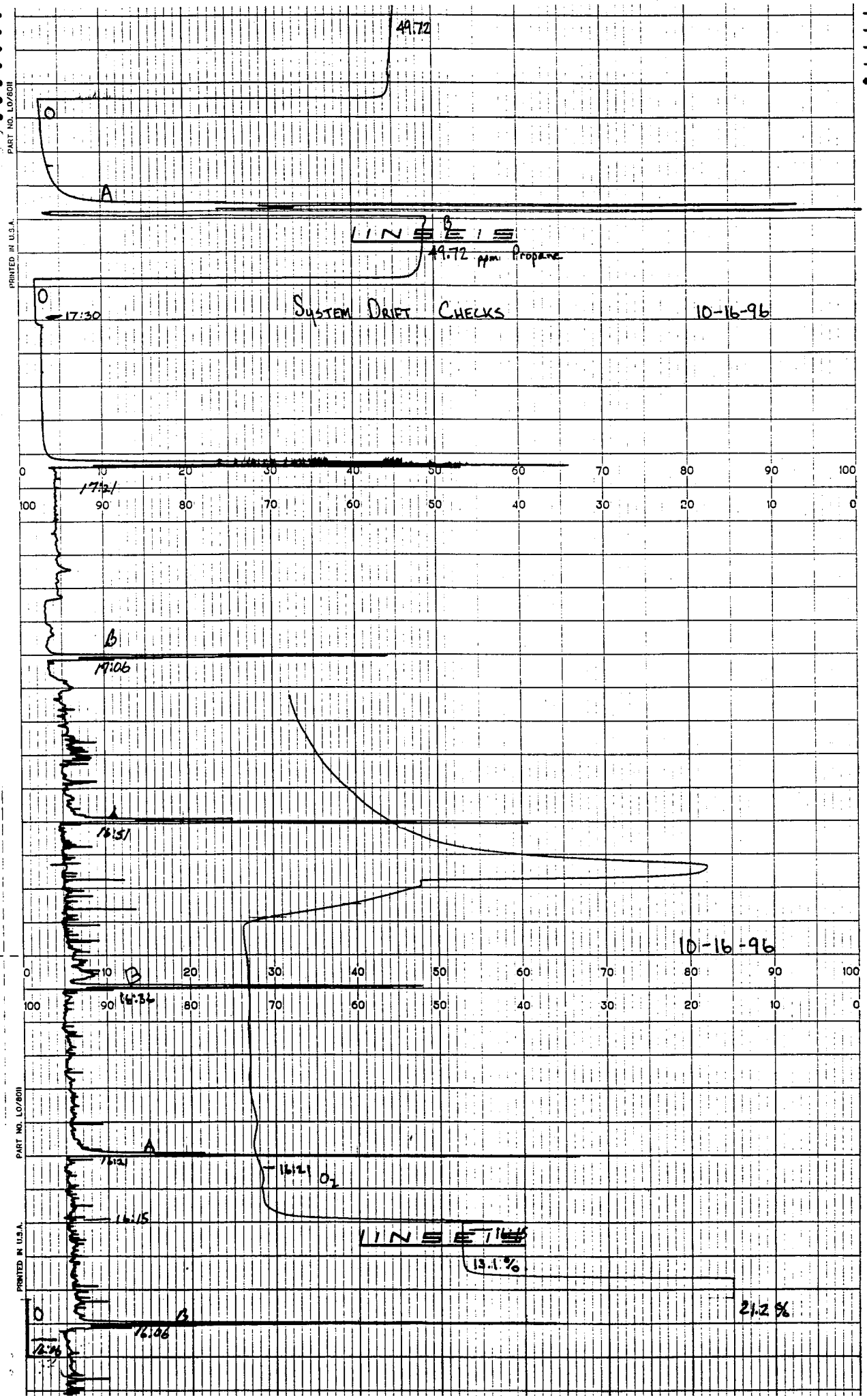
** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

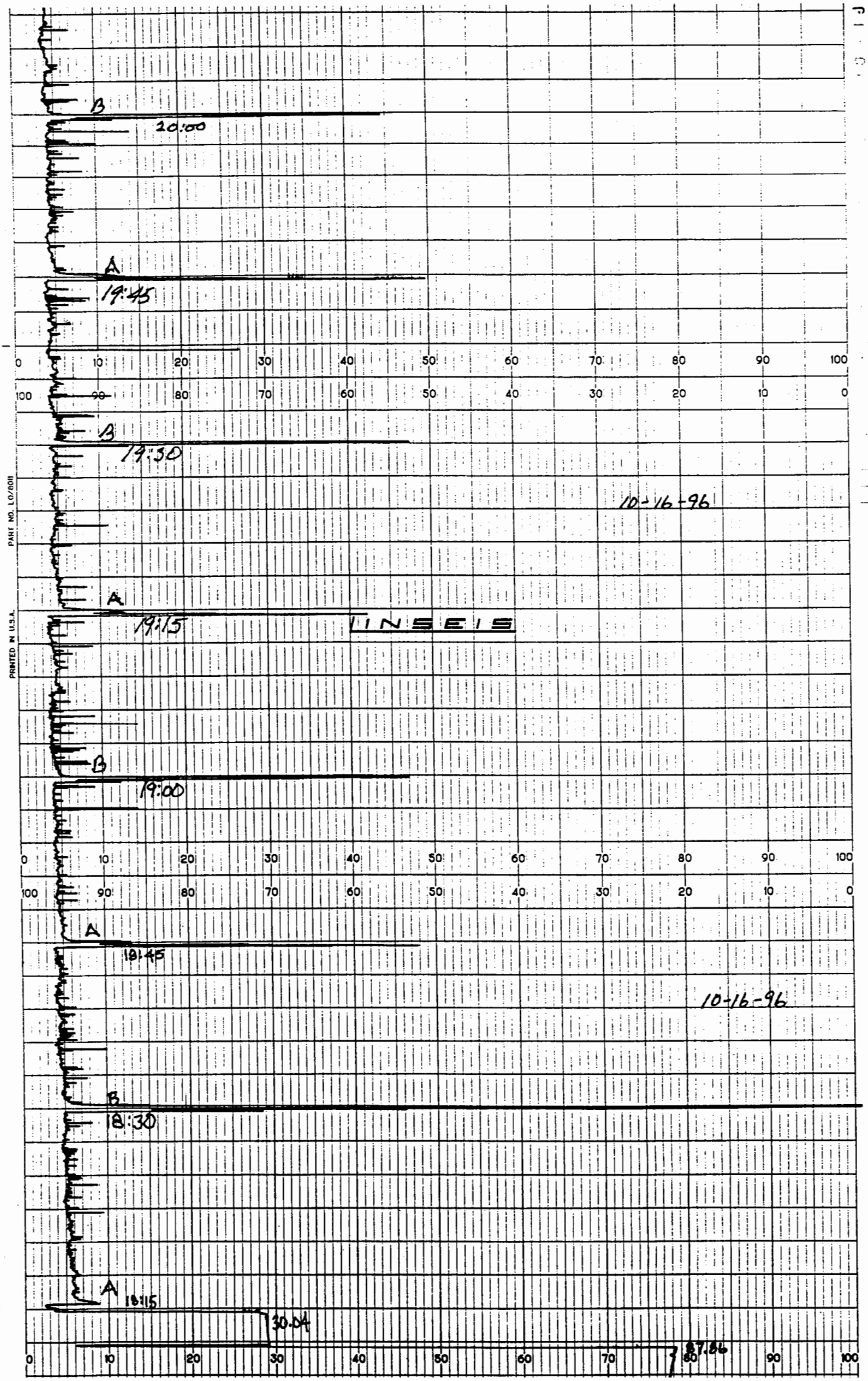
Calculated By: Paul T. Siegel Date: 10-18-96



10-16-96 Eastern Ridge Lime Company Riverhead, VA Kiln No. 2


A
15:45
10-16-96
A
15:30
15:15
A
49.72
B
A
15:00
49.72 ppm Propane
B
System Drift Checks
10-16-96
LINSEIS
13:15
49.72
Scrubber B
49.72
Scrubber A
13:00
10-16-96
System Drift Checks
PART NO. LD/8011
PRINTED IN U.S.A.


49.72
0
A
LINE 1
B
49.72 ppm Propane
0
17:30
System Drift Checks
10-16-96
0 10 20 30 40 50 60 70 80 90 100
17:21
100 90 80 70 60 50 40 30 20 10 0
B
17:06
16:51
10-16-96
0 10 20 30 40 50 60 70 80 90 100
B
16:36
100 90 80 70 60 50 40 30 20 10 0
A
16:21
16:21 O2
16:15
LINE 1
13.1 %
21.2 %
0
B
16:06
15:46
PART NO. LO/8011
PRINTED IN U.S.A.


B
20:00
A
19:45
0 10 20 30 40 50 60 70 80 90 100
100 90 80 70 60 50 40 30 20 10 0
B
19:30
10-16-96
A
19:15
LINSEIS
B
19:00
0 10 20 30 40 50 60 70 80 90 100
100 90 80 70 60 50 40 30 20 10 0
A
18:45
10-16-96
B
18:30
A
18:15
30.04
87.86
0 10 20 30 40 50 60 70 80 90 100
PART NO. L0/0011
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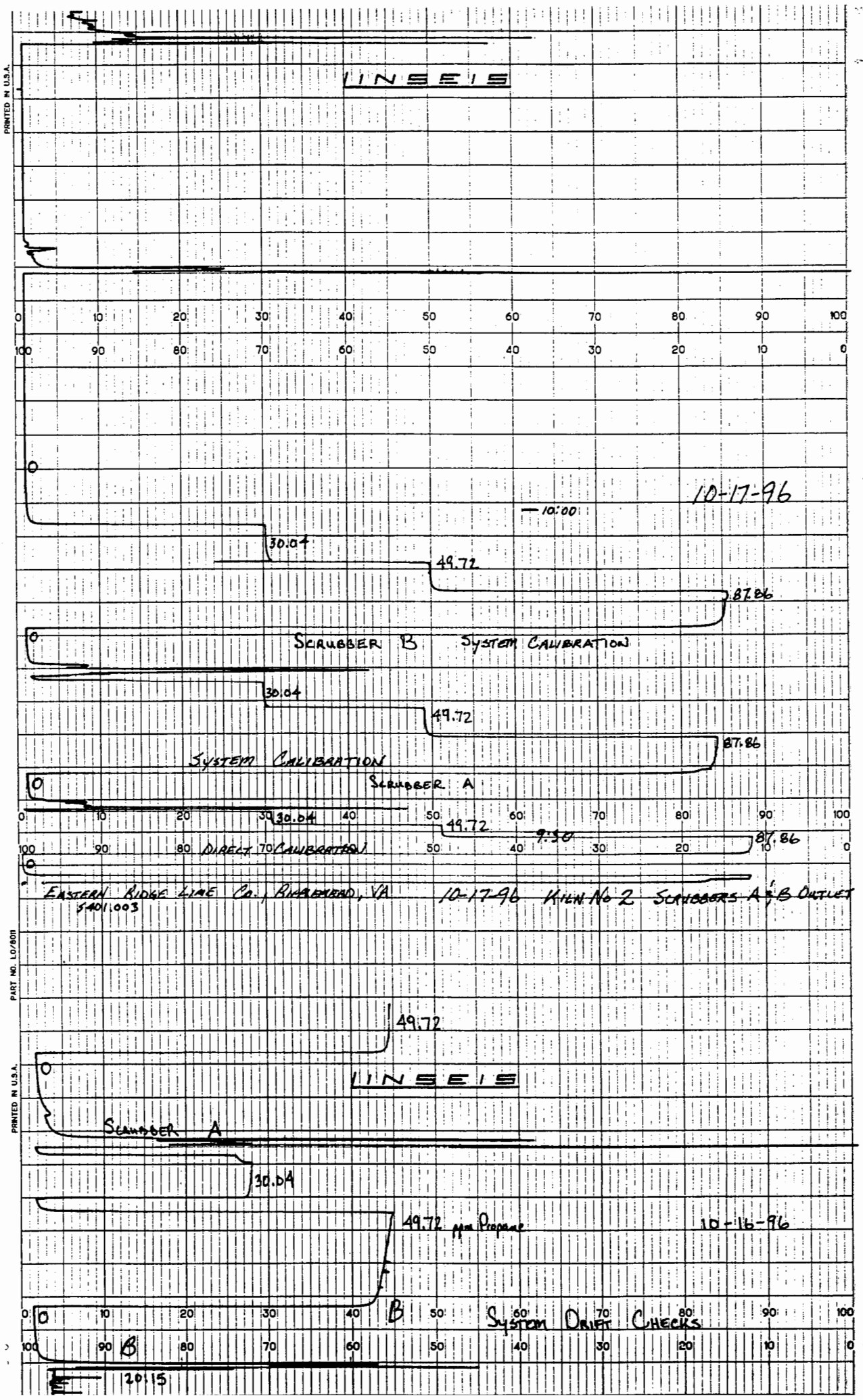
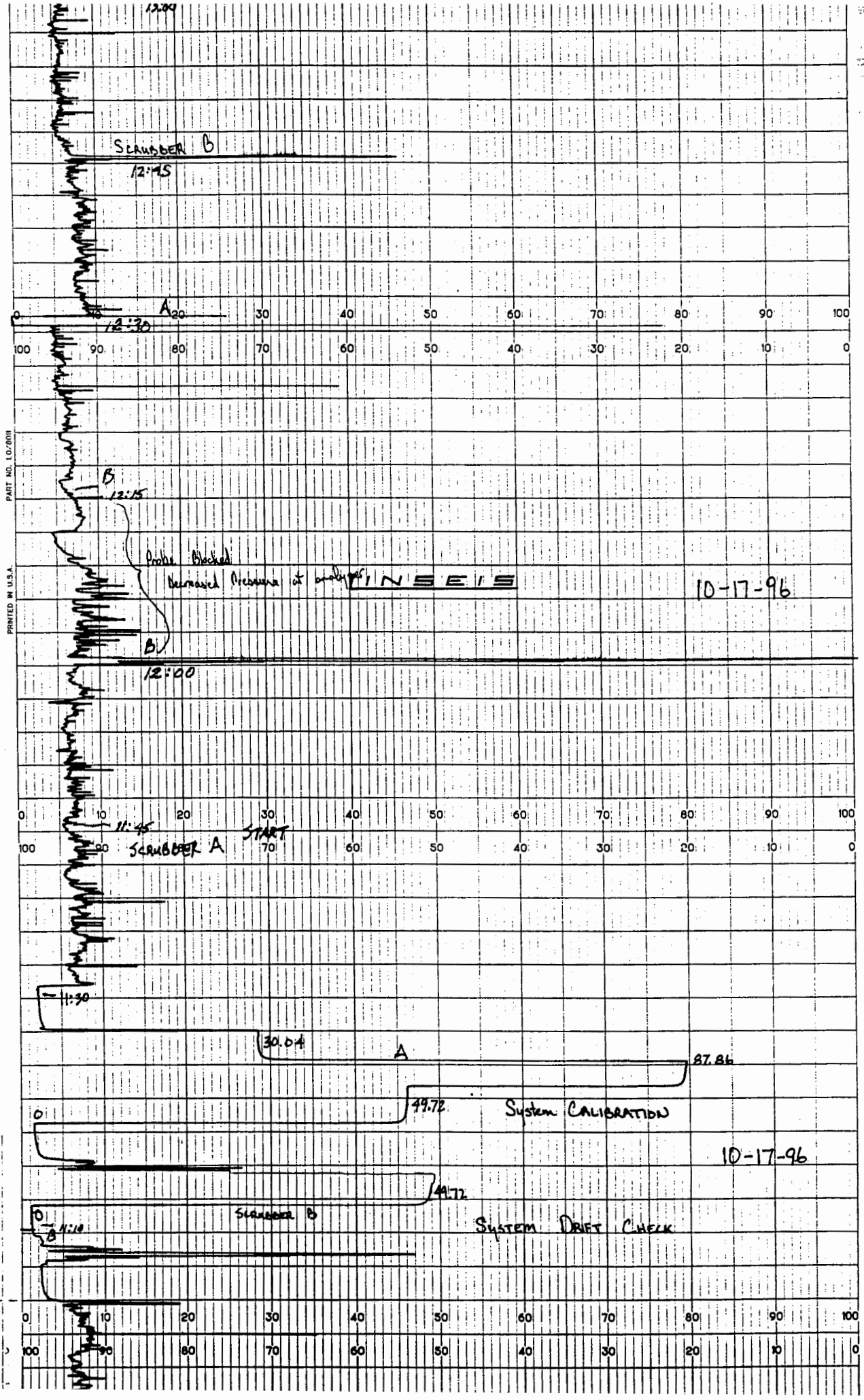
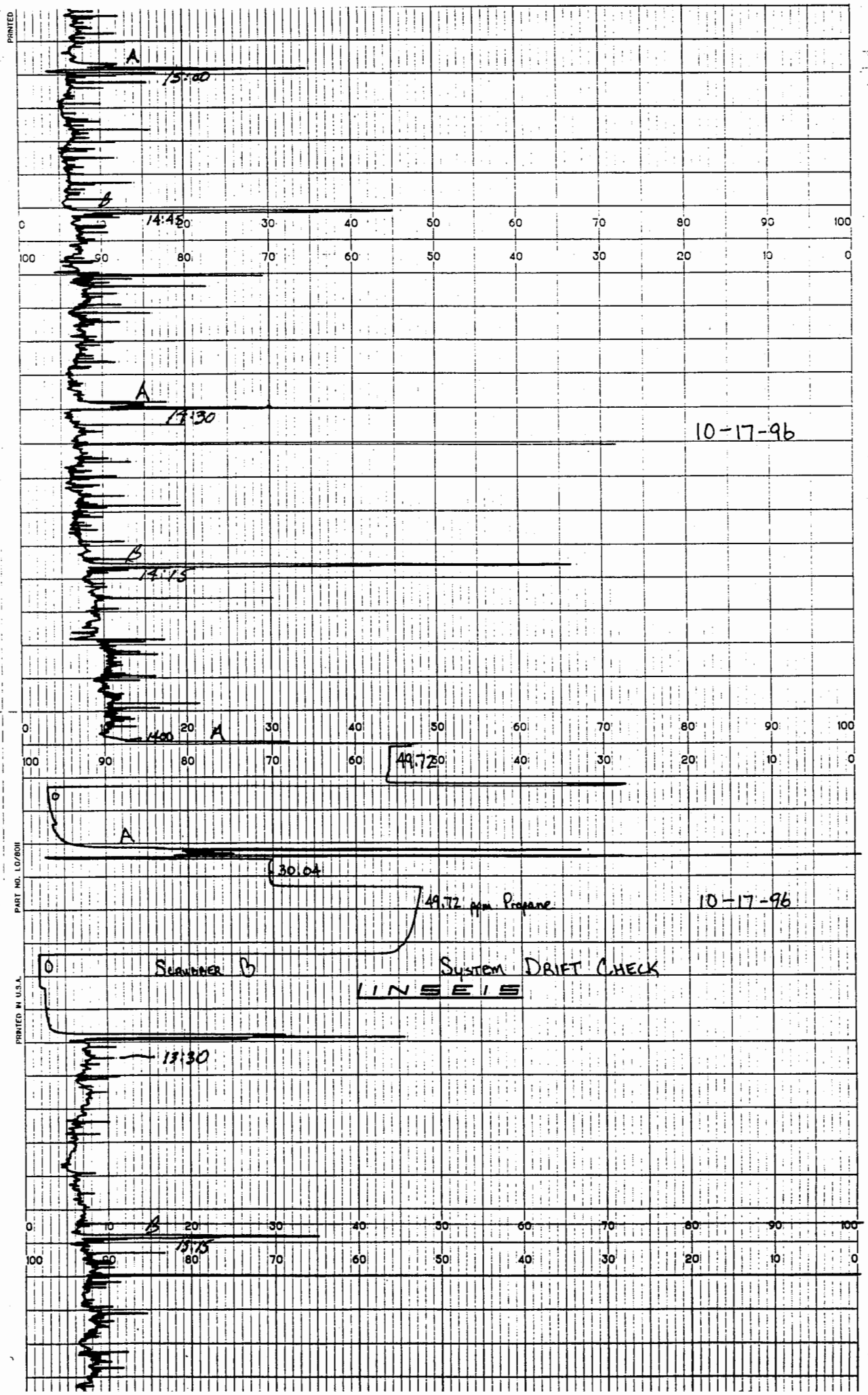
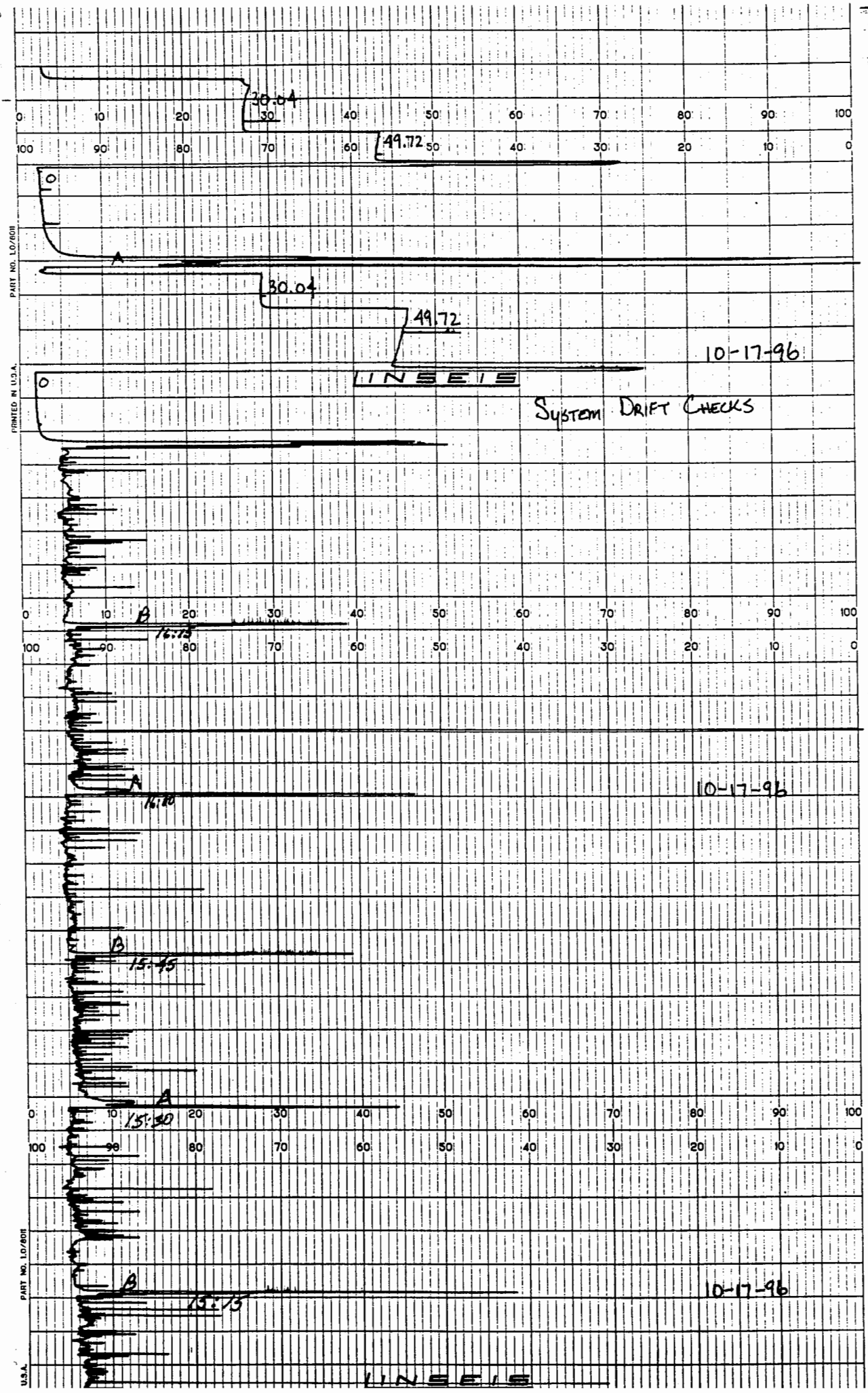
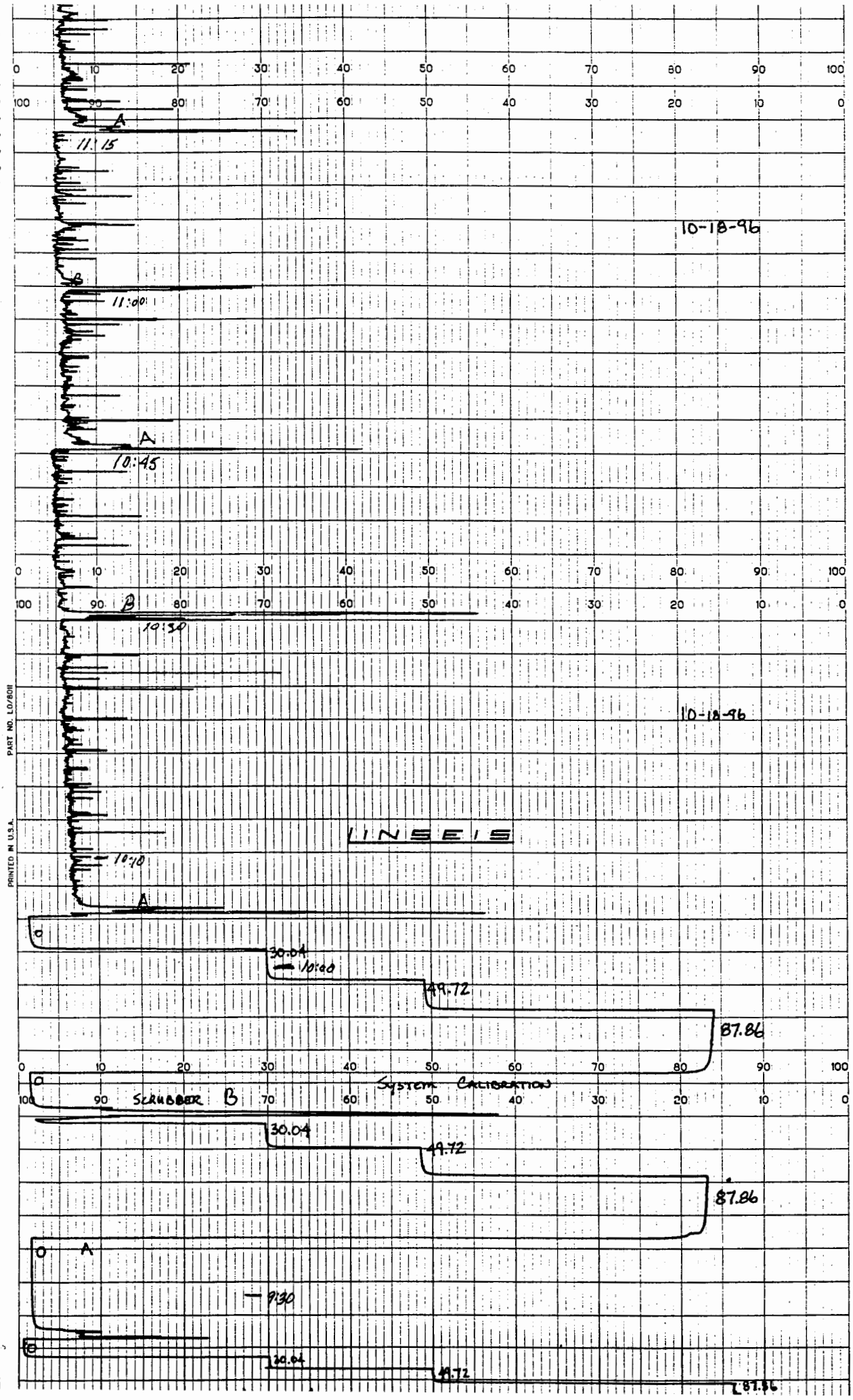

PRINTED IN U.S.A.
LINSEIS
10-17-96
10:00
30.04
49.72
87.86
SCRUBBER B SYSTEM CALIBRATION
30.04
49.72
87.86
SYSTEM CALIBRATION
SCRUBBER A
30.04
49.72
9:50
87.86
DIRECT CALIBRATION
EASTERN RIDGE LIME Co., RIVERHEAD, VA 10-17-96 KILN No 2 SCRUBBERS A & B OUTLET
S401.003
PART NO. LD/8011
49.72
LINSEIS
SCRUBBER A
30.04
49.72 ppm Propane
10-16-96
B
SYSTEM DRIFT CHECKS
B
20:15


12:00
SCRUBBER B
12:45
A
12:30
B
12:15
Probe Blocked
Increased Pressure at analyzer
INSEIS
10-17-96
B
12:00
11:45
START
SCRUBBER A
11:30
30.04
A
87.86
49.72
System CALIBRATION
10-17-96
49.72
SCRUBBER B
System DRIFT CHECK
B 11:10
PART NO. 10-0011
PRINTED IN U.S.A.


A
15:00
B
14:45
A
14:30
10-17-96
B
14:15
A
14:00
49.72
A
30.04
49.72 ppm Propane
10-17-96
Scrubber B
System Drift Check
LINSEIS
13:30
B
13:15


30.04
49.72
0
A
30.04
49.72
10-17-96
LINSEIS
0
System Drift Checks
B
16:12
A
16:10
10-17-96
B
15:45
A
15:30
B
15:15
10-17-96
LINSEIS
PART NO. L0/8011
PRINTED IN U.S.A.
PART NO. L0/8011
U.S.A.



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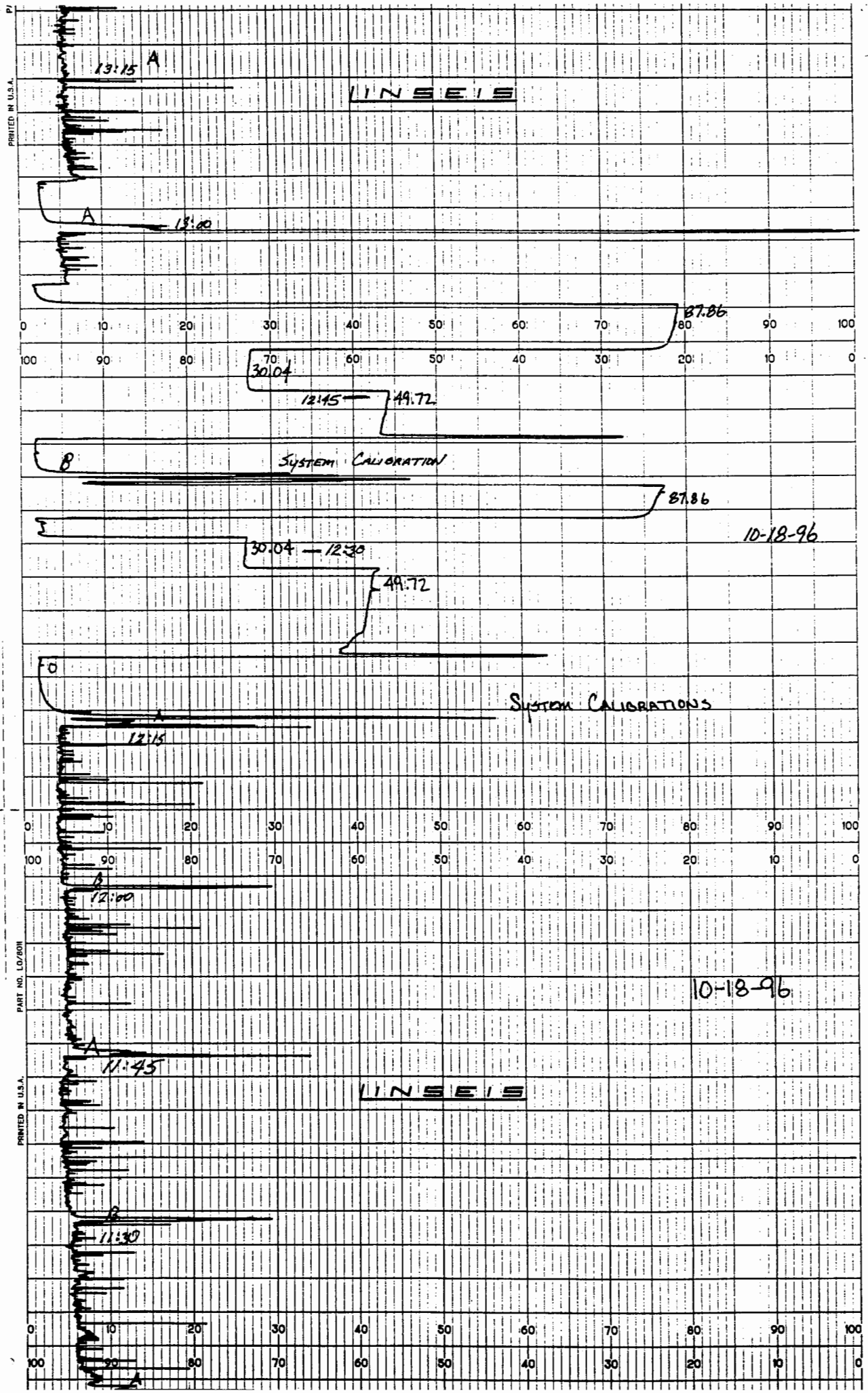
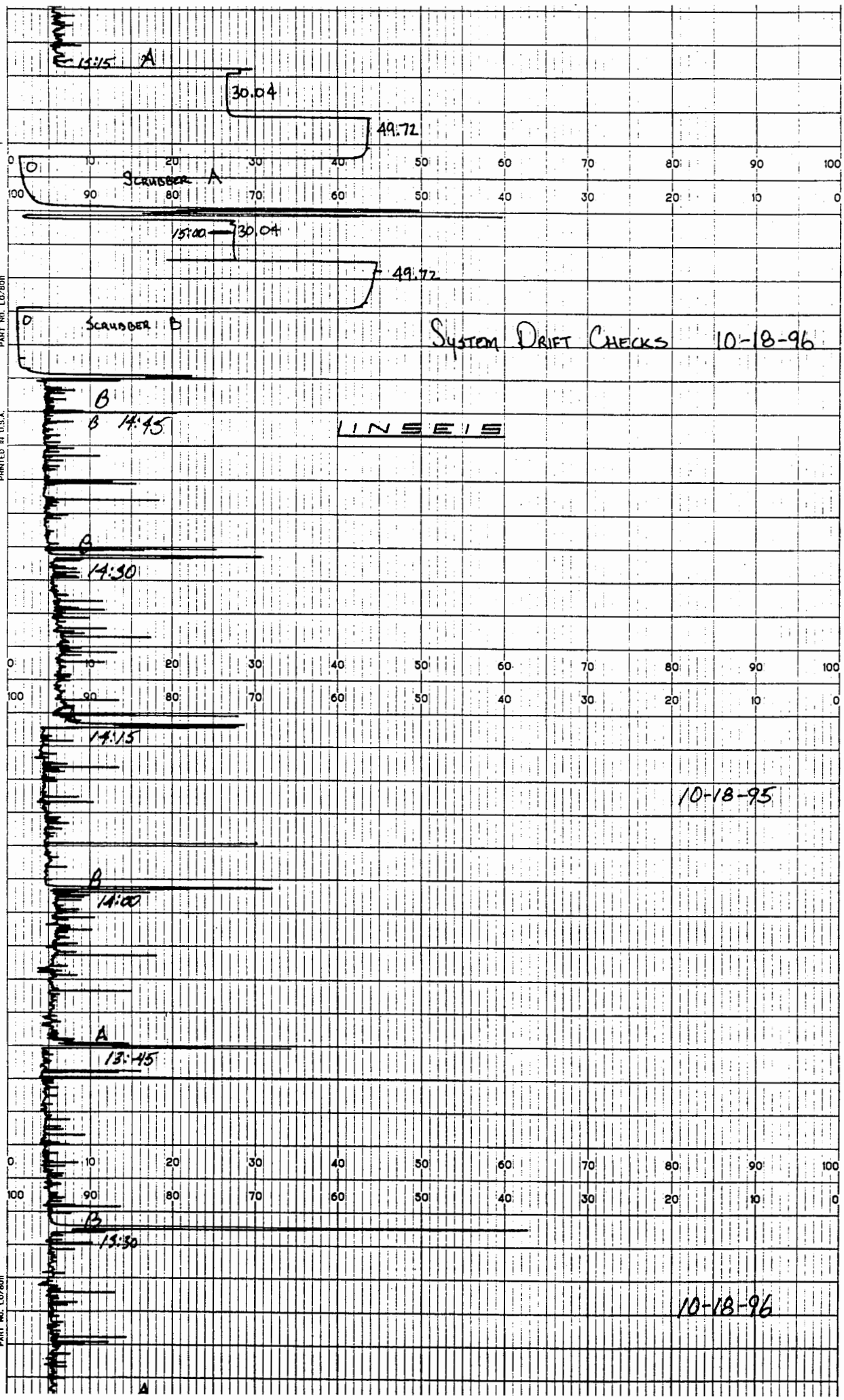

13:15 A
LINSEIS
A
13:00
87.86
30.04
12:45
49.72
B
System Calibration
87.86
10-18-96
30.04 — 12:30
49.72
System Calibrations
12:15
12:00
10-18-96
A
11:45
LINSEIS
B
11:30
A



PART NO. LO/8011

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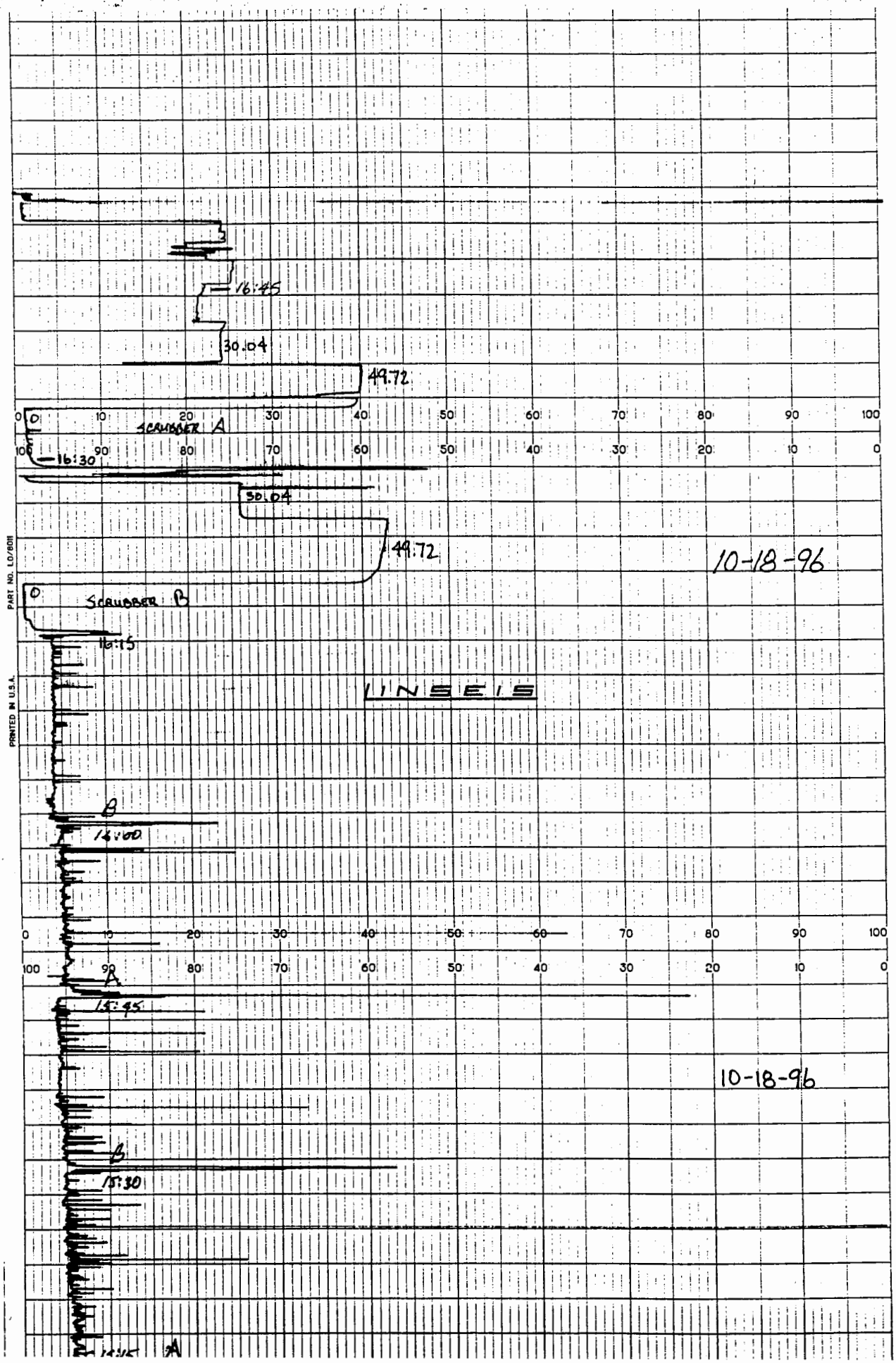
PART NO. LO/8011



PART NO. L0/8011
PRINTED IN U.S.A.

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME CO.
Location: KILN NO 2 SCRUBBER A
Date: 10-16-96

Parameter: SO_2, CO_2, O_2, NO_X*, THC, CO
Operator: P. SIEGEL
Project #: S401.003

$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division - b})}{\text{m}} = \frac{(\text{CD - 2.808})}{(\ 0.8589\ )}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	15:15-15:30	4.2	1.6	100' and 50' of heated sample line
	15:45-16:06	5.4	3.0	
	16:21-16:36	5.5	3.1	
	16:51-17:06	5.2	2.8	
	18:15-18:30	5.4	3.0	
	18:45-19:00	4.5	2.0	
	19:15-19:30	4.7	2.2	
	19:45-20:00	4.4	1.9	

* For NO_X Indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated By: Paul T. Siegel Date: 10-16-96
Checked By: [illegible] Date: 12-19-96

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME Co
Location: KILN No 2 SCRUBBER B
Date: 10-16-96

Parameter: SO_2, CO_2, O_2, NO_X*, THC, CO
Operator: P. SIEGEL
Project #: S401.003

$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division} - b)}{m} = \frac{(CD - 1.302)}{(0.9575)}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	15:30-15:45	4.8	3.7	75' and 75' of heated sample line
	16:06-16:21	5.7	4.6	
	16:36-16:51	5.7	4.6	
	17:06-17:21	4.0	2.8	
	18:30-18:45	4.7	3.5	
	19:00-19:15	4.3	3.1	
	19:30-19:45	4.5	3.3	
	20:00-20:15	~~4~~ 4.1	2.9	

* For NO_X Indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated By: Paul T. Siegel Date: 10-16-96
Checked By: [illegible] Date: 12-19-96

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME CO.
Location: KILN NO. 2 SCRUBBER A
Date: 10-17-96

Parameter: SO_2, CO_2, O_2, NO_X*, THC, CO
Operator: P. SIEGEL
Project #: S401.003

$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division - b})}{\text{m}} = \frac{(\text{CD - 1.742})}{(0.88911)}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	11:45 - 12:00	6.7	5.6	
	12:30 - 12:45	8.1	7.2	
	13:00 - 13:15	7.8	6.8	
	14:00 - 14:15	9.8	9.1	
	14:30 - 14:45	7.3	6.3	
	15:00 - 15:15	7.0	5.9	
	15:30 - 15:45	6.0	4.8	
	16:00 - 16:15	6.0	4.8	

* For NO_X Indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated By: Paul T. Siegel Date: 10-17-96
Checked By: [illegible] Date: 12-19-96

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME CO.
Location: KILN NO. 2 SCRUBBER B
Date: 10-17-96

Parameter: SO_2, CO_2, O_2, NO_X*, THC, CO
Operator: P. SIEGEL
Project #: S401.003

$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division - b})}{\text{m}} = \frac{(\text{CD - 1.360})}{(0.9609)}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	12:15 - 12:30	6.0	4.8	
	12:45 - 13:00	5.8	4.6	
	13:15 - 13:30	6.7	5.6	
	14:15 - 14:30	7.0	5.9	
	14:45 - 15:00	6.2	5.0	
	15:15 - 15:30	5.5	4.3	
	15:45 - 16:00	5.3	4.1	
	16:15 - 16:30	5.5	4.3	

* For NO_X Indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated By: Paul T. Siegel Date: 10-17-96
Checked By: [illegible] Date: 12-19-96

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME CO
Location: KILN NO. 2 SCRUBBER A
Date: 10-18-96

Parameter: SO_2, CO_2, O_2, NO_X*, THC, CO
Operator: P. SIEGEL
Project #: S401.003

$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division} - b)}{m} = \frac{(CD - 1.347)}{(0.8508)}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	10:10 - 10:30	6.3	5.8	
	10:45 - 11:00	6.3	5.8	
	11:15 - 11:30	6.2	5.7	
	11:45 - 12:00	~~6.0~~ 5.0	4.3	
	13:15 - 13:30	5.5	4.9	
	13:45 - 14:00	5.7	5.1	
	14:15 - 14:30	6.2	5.7	
	15:15 - 15:30	5.5	4.9	
	15:45 - 16:00	5.0	4.3	

* For NO_X Indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated By: Paul T. Siegel Date: 10-18-96
Checked By: [illegible] Date: 12-19-96

CEM DATA REDUCTION - BAG ANALYSIS OR STEADY READINGS

Plant: EASTERN RIDGE LIME CO
Location: KILN NO 2 SCRUBBER B
Date: 10-18-96

Parameter: SO_2, CO_2, O_2, NO_X*, THC, CO
Operator: P. SIEGEL
Project #: S401.003

$$\text{Pollutant, ppm/\%} = \frac{(\text{Chart Division - b})}{\text{m}} = \frac{(\text{CD} - 1.360)}{(0.8779)}$$

Run #	Time** (24-Hr)	Average Chart Division	Concentration ppm wet	Comments
	10:30 - 10:45	5.2	4.4	
	11:00 - 11:15	5.2	4.4	
	11:30 - 11:45	4.8	3.9	
	12:00 - 12:15	4.4	3.5	
	13:30 - 13:45	4.7	3.8	
	14:00 - 14:15	4.5	3.6	
	14:30 - 14:45	4.8	3.9	
	15:30 - 15:45	4.5	3.6	
	16:00 - 16:15	4.0	3.0	

* For NO_X Indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

Calculated By: Paul T. Siegel Date: 10-18-96
Checked By: [illegible] Date: 12-19-96

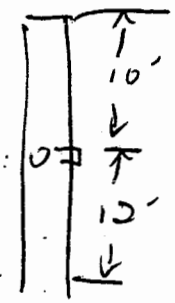
Appendix B.2

Raw Field Data

Hydrator

EPA METHOD 1
TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Eastern Ridge
CITY Rippleemed STATE VA
SAMPLING LOCATION Hydrator
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 26 1/2
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 3
NEAREST UPSTREAM DISTURBANCE
DISTURBANCE 10'
NEAREST DOWNSTREAM DISTURBANCE
DISTURBANCE 12'
SAMPLER AB DATE 10/18/96



SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8-INCH)	DISTANCE B	TRAVERSE DISTANCE FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	0.032	23 1/2	3/4	3	3 3/4"
2	0.105		2 1/2		5 1/2"
3	0.194		4 1/2		7 1/2"
4	0.323		7 5/8		10 5/8"
5	0.677		15 5/8"		18 5/8"
6	0.806		19"		21"
7	0.895		21"		24"
8	0.968		22 3/4		25 3/4"

25.5
3
22.5

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: EPA Eastern Ridge Lime Co. Date: 10-19-96
Sampling Location: Hydrator Clock Time: 855
Run #: Prelim Operators: TH/DF
Barometric Pressure, in. Hg: 28.25 Static Pressure, in. H_2O: -.18
Moisture, %: 36 Molecular wt., Dry: _____ Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: 22.5 Side 2: _____
Wet Bulb, °F: _____ Dry Bulb, °F: _____

Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F
1	.11	180
2	.13	181
3	.17	182
4	.06	181
5	.03	178
6	.06	178
7	.05	175
8	.06	174
1	.14	172
2	.14	174
3	.07	177
4	.02	175
5	.07	181
6	.08	176
7	.09	176
8	.06	179
	$\overline{\sqrt{\Delta P}}$ =	$\overline{Ts}$ = 177

$\overline{\Delta P}$ 0.0806

DN = 0.471

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$ 24.94

$\overline{Ts} =$ °F = °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps =$ 28.26 in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\,(°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs =$ ft/s

$As =$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs =$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} =$ dscfm

FIELD DATA SHEET

K = ~~2.7~~ 2.088

Plant: EVA Eastern Ridge Lime
Sampling Location: Hydrator
Run Number: M-29-5 Date: 10-19-96
Pretest Leak Rate: .005 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: NA

Sample Type: M-29 Operator: TA/BF
Pbar: 29.25 Ps: .17
CO2: 0 O2: 21
Probe Length/Type: 4' Glass Pitot #: 4C
Stack Diameter: 22.5 As:

Nozzle ID: .439 Thermocouple #: 4C
Assumed Bws: 36 Filter #: 301665
Meter Box #: 15 Y: 1.003 ΔH@: 1.685
Post-Test Leak Rate: .002 cfm @ 9 in. Hg.
Post-Test Leak Check: Pitot: ____ Orsat: NA

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Actual	Stack Temp. (Ts)	Temperature °F Probe	Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Outlet (Tm out °F)	Pump Vacuum (in. Hg)
0	0	1339	524.701										
1	7.5	1346	530.6	0.14	1.9	1.9	184	242	245	46	62	62	5
2	15	1353	536.4	0.14	1.9	1.9	182	253	255	45	67	60	5
3	22.5	1400	542.3	0.14	1.9	1.9	184	252	245	48	69	60	6
4	30	1408	548.3	0.12	1.7	1.7	187	250	252	50	70	61	5
5	37.5	1416	551.7	0.03	0.42	0.42	187	252	247	52	72	62	3
6	45	1423	555.3	0.05	0.70	0.70	188	251	249	54	67	62	3
7	52.5	1430	559.2	0.05	0.70	0.70	185	251	246	52	66	62	4
8	60	1437	562.973	0.05	0.70	0.70	186	250	247	50	67	61	4
1													
Reset K Factor 1	67.5	1450	569.1	0.17	~~2.4~~ .28	~~2.4~~ .28	185	251	242	52	65	60	2
2	75	1457	571.5	0.17	0.~~26~~ .31	0.~~26~~ .31	184	252	246	44	66	61	2
3	82.5	1504	573.2	0.07	0.13	0.13	185	253	243	41	65	61	1
4	90	1512	574.2	0.03	0.05	0.05	186	251	251	48	63	59	1
5	97.5	1519	575.2	0.03	0.05	0.05	185	251	251	43	62	59	1
6	105	1526	577.0	0.07	0.13	0.13	186	251	251	44	62	60	1
7	112.5	1533	578.6	0.07	0.13	0.13	184	252	253	43	62	60	1
8	120	1541	580.213	0.07	0.13	0.13	185	251	251	43	62	61	1

ΔVm= 55.512 $\sqrt{\Delta p}$= 0.2839 ΔH= 0.70 Ts= 185°F (645°R) Tm= 63°F (523°R)

29-5

MULTI-METALS SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Eastern Ridge Lime Co.		Run No. 29-5 ~~Run 5~~
Date: 10-19-96	Sample Box No.: 29-4	Job No.: S-401
Sample Location: Hydrator Stack		
Sample Type: Method 29		
Sample Recovery Person: CEB		

Container	Description	Volume, ml	Sealed/Level Marked
Front Half			
1	Filter No.(s) 301665		F1 ✓
2	Acetone Rinse		AR2 ✓
3	Nitric Rinse		FH3 ✓
Back Half			
4	Nitric Rinse - Imp. 1,2,3, + Back 1/2 Filter		BH4 ✓
5A	Nitric Rinse - Impinger No. 4		5A ✓
5B	KMNO4/H2O Rinse - Impingers 5 & 6		5B ✓
5C	HCl Rinse - Impingers 5 & 6		5C ✓

Moisture Data

Impinger No.	Contents	Initial Volume, ml	Weight, grams Initial	Final	Net
1	Empty	0	730.4	1988.0	1257.6
2	5% HNO3/10% H2O2	100	592.6	843.2	250.6
3	" "	100	577.2	654.8	77.6
4	Empty	0	489.4	498.9	9.5
5	KMnO4	100	594.5	598.6	4.1
6	KMnO4	100	650.4	~~1434~~	651.1 cor 0.7
7	Silica Gel	—	903.0	903.6	CEB
				911.4	8.4
Total					1608.5

Comments: Saturated moisture; collected large amount of water in 1st + 2nd impinger. Plan to use 2 large impingers in Runs 3 + 4 to collect water.

19# = 5870 K = 9.55

FIELD DATA SHEET

Plant: EPA Eastern Ridge Lime Co. Sample Type: M-29 Operator: TH/PF Nozzle ID: .437 Thermocouple #: 4K RTD

Sampling Location Hydrator Pbar: 28.26 Ps: .18 Assumed Bws: 2.61 Filter #: 301, 448

Run Number: M29-6 Date: 10-20-96 CO2: 0 O2: 21 Meter Box #: 15 Y: 1.003 ΔH@: 1.685

Pretest Leak Rate: .003 cfm @ 15 in. Hg. Probe Length/Type: 4' Glass Pitot #: 4K RTD Post-Test Leak Rate: .004 cfm @ 10 in. Hg.

Pretest Leak Check: Pitot: ✓ Orsat: NA Stack Diameter: 22.5 As: Post-Test Leak Check: Pitot: ____ Orsat: NA

	Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Orifice Pressure Differential (ΔH) in H2O Actual	Stack Temp. (Ts)	Temperature °F Probe	Temperature °F Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Dry Gas Meter Temp. Outlet (Tm out °F)	Pump Vacuum (in. Hg)
A	0	0	1005	590.803										
	1	7.5	1015	594.5	0.13	0.68	0.68	186	253	247	50	63	63	4
	2	15	1023	598.4	0.15	0.78	0.78	188	253	247	50	68	65	4
	3	22.5	1030	602.1	0.13	0.68	0.68	186	247	250	52	70	70	4
	4	30	1038	603.8	0.03	0.15	0.15	189	250	246	52	71	67	1
	5	37.5	1046	608.1	0.15	0.96	0.96	184	244	251	53	70	66	5
	6	45	1053	610.0	0.03	0.16	0.16	187	250	253	49	72	67	2
	7	52.5	1100	612.0	0.03	0.19	0.19	185	249	250	47	72	68	2
	8	60	1108	613.972	0.03	0.19	0.19	186	250	249	46	72	69	2
											~~49~~	~~72~~	~~69~~	
B	1	67.5	1120	618.1	0.14	0.87	0.87	185	250	249	49	71	69	7
	2	75	1127	622.2	0.14	0.74	0.74	187	252	247	49	71	69	7
	3	82.5	1135	624.7	0.05	0.31	0.31	185	250	246	52	75	71	3
	4	90	1143	625.9	0.01	0.06	0.06	185	252	247	52	74	72	1
	5	97.5	1150	627.0	0.01	0.06	0.06	185	251	251	53	73	71	1
	6	105	1158	628.9	0.02	0.16	0.16	180	251	251	52	73	73	1
	7	112.5	1205	632.1	0.07	0.54	0.54	182	251	252	47	72	70	5
	8	120	1213	635.525	0.07	0.54	0.54	183	251	246	46	74	71	5

ΔVm= 44.722 $\overline{\sqrt{\Delta p}}$= ____ $\overline{\Delta H}$= .442 $\overline{Ts}$= 185 $\overline{Tm}$= 70°F

MULTI-METALS SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Eastern Ridge Lime Co.		Run No.: 29-6
Date: 10-20-96	Sample Box No.: 29-6	Job No.: S-401
Sample Location: Hydrator Stack		
Sample Type: Method 29		
Sample Recovery Person: CER		

Container	Description	Volume, ml	Sealed/Level Marked
Front Half			
1	Filter No.(s) 301448		F1 ✓
2	Acetone Rinse		AR2 ✓
3	Nitric Rinse		FH3 ✓
Back Half	(used 2 large knockout impgs)		
4	Nitric Rinse - Imp. 1,2,3, + Back 1/2 Filter		BH4 ✓
5A	Nitric Rinse - Impinger No. 4		5A ✓
5B	KMNO4/H2O Rinse - Impingers 5 & 6		5B ✓
5C	HCl Rinse - Impingers 5 & 6		5C ✓

Moisture Data

Impinger No.	Contents	Initial Volume, ml	Weight, grams Initial	Final	Net
1	Empty	0	743.5	1872.0	1128.5
2	Empty	0	705.9	813.4	107.5
3	5% HNO_3/10% H_2O_2	100	679.5	691.2	11.7
4	" "	100	633.2	634.8	1.6
5	Empty	0	559.5	559.3	-0.2
6	$KMnO_4$	100	645.8	645.7	-0.1
7	$KMnO_4$	100	656.1	655.6	-0.5
8	Silica gel	—	874.9	881.8	6.9
Total			5598.4		1255.4

64

Comments: Installed two large knockout impgs in train to collect excess moisture.

181 - 11-4

FIELD DATA SHEET

Plant: EPA Eastern Ridge Lim Co.
Sampling Location Hydrator
Run Number: m-29-7 Date: 10-20-96
Pretest Leak Rate: .002 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: NA

Sample Type: m-29 Operator: TA/BF
Pbar: 28.20 Ps: .15
CO2: 0 O2: 21
Probe Length/Type: 4' Glass Pitot #: 4C
Stack Diameter: 22.5 As:

Nozzle ID: .439 Thermocouple #: 4C
Assumed Bws: .32 Filter #: 301676
Meter Box #: 15 Y: 1.003 ΔH@: 1.685
Post-Test Leak Rate: .003 cfm @ 10 in. Hg.
Post-Test Leak Check: Pitot: ____ Orsat: ____

	Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Actual	Stack Temp. (Ts)	Temperature °F Probe	Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Outlet (Tm out °F)	Pump Vacuum (in. Hg)
B	0	0	1233	635.837										
	1	7.5	1241	640.0	0.14	0.89	0.89	185	242	250	51	75	73	5
	2	15	1248	643.2	0.14	0.89	0.89	187	249	255	51	75	74	5
	3	22.5	1255	647.0	0.07	0.38	0.38	188	248	252	47	79	78	4
	4	30	1303	648.2	0.01	0.06	0.06	188	251	251	49	79	75	1
	5	37.5	1310	650.8	0.05	0.27	0.27	187	249	251	54	78	76	2
	6	45	1317	654.2	0.10	0.64	0.64	185	248	252	52	78	76	5
	7	52.5	1325	657.9	0.10	0.64	0.64	187	249	250	52	79	76	5
	8	60	1333	661.716	0.10	0.64	0.64	186	251	253	54	80	76	5
A	1	67.5	1343	666.3	0.15	0.96	0.96	185	246	251	58	80	76	6
	2	75	1352	670.6	0.15	0.96	0.96	186	251	251	49	80	76	6
	3	82.5	1359	674.9	0.14	0.89	0.89	185	253	251	44	75	72	5
	4	90	1406	677.2	0.03	0.24	0.24	184	251	264	48	79	74	2
	5	97.5	1413	679.5	0.03	0.24	0.24	184	251	269	50	72	71	3
	6	105	1421	682.6	0.07	0.45	0.45	184	249	269	48	70	69	4
	7	112.5	1429	685.7	0.07	0.45	0.45	185	248	269	50	71	70	4
	8	120	1436	688.771	0.07	0.45	0.45	184	251	268	50	72	70	4

ΔVm= 52.934 $\overline{\sqrt{\Delta p}}$= 0.2859 $\overline{\Delta H}$= .57 $\overline{Ts}$= 186 $\overline{Tm}$= 75

MULTI-METALS SAMPLE RECOVERY DATA

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: Eastern Ridge Lime Co.		Run No.: 29-7
Date: 10-20-96	Sample Box No.: 29-7	Job No.: S-401
Sample Location: Hydrator Stack		
Sample Type: Method 29		
Sample Recovery Person: C C A		

Container	Description	Volume, ml	Sealed/Level Marked
Front Half			
1	Filter No.(s) 301676		F1 ✓
2	Acetone Rinse		AR2 ✓
3	Nitric Rinse		FH3 ✓
Back Half	(used 2 large impg for knockout of H_2O)		
4	Nitric Rinse - Imp. 1,2,3, + Back 1/2 Filter		BH4 ✓
5A	Nitric Rinse - Impinger No. 4		5A ✓
5B	KMNO4/H2O Rinse - Impingers 5 & 6		5B ✓
5C	HCl Rinse - Impingers 5 & 6		5C ✓

Moisture Data

Impinger No.	Contents	Initial Volume, ml	Weight, grams Initial	Final	Net
1	Empty	0	730.3	1917.2	1186.9
2	Empty	0	744.9	971.9	227.0
3	5% HNO_3/1% H_2O_2	100	590.9	648.0	57.1
4	" "	100	576.7	589.1	12.4
5	Empty	0	489.6	491.6	2.0
6	$KMnO_4$	100	596.3	597.9	1.6
7	$KMnO_4$	100	647.4	~~649.6~~	0.2
8	Silica gel	—	910.7	919.0	8.3
Total					1495.5

64

Comments: Installed two large knockout impg in train to recover H_2O.

TECHNICAL REPORT DATA

Please read instructions on the reverse before completing

1. REPORT NO. EPA-454/R-99-044a	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Lime Manufacturing Emissions Test Report Chemical Lime Company (Formerly Eastern Ridge Lime Company) Ripplemead, Virginia Volume I of II		5. REPORT DATE September 1999 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) [redacted] Michael Toney		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Pacific Environmental Services, Inc. Post Office Box 12077 Research Triangle Park, NC 27709-2077		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO. 68D70069
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Emission, Monitoring and Analysis Division Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED Final 14. SPONSORING AGENCY CODE EPA/200/04
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

This report presents the results of a testing program conducted at the Chemical Lime Company (formerly Eastern Ridge Lime Company), Ripplemead, Virginia to obtain air emissions data to support the EPA's development of the lime manufacturing NESHAP. Testing was conducted on a coal-fired rotary kiln to (1) determine total hydrocarbons (THC) at the common inlet and individual outlets of two parallel wet scrubbers and (2) determine concentrations and mass emission rates of particulate matter (PM) metals, and dioxin/furan (CDD/CDF) at the individual outlets of the two scrubbers. In addition, testing was conducted on the hydrator exhaust to determine emissions of PM and metals.

Volume I of II - Report Text and Appendices A & B (213 Pages)

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTIONS	b.IDENTIFIERS/OPEN ENDED TERMS	c. COASTI Field/Group
Baghouse Dioxin/Furan Lime Manufacturing Metals Particulate Matter Total Hydrocarbons		

18. DISTRIBUTION STATEMENT Unlimited	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 1042
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