Background Report Reference

AP-42 Section Number: 10.6.3

Background Report Section: 4

Reference Number: 5

Title: Certification Report for Continuous Mointoring System Louisiana - Pacific Corporation Oroville Boilers, #4 & 5,

Carnot

May 1994

CERTIFICATION REPORT FOR CONTINUOUS EMISSION MONITORING SYSTEM LOUISIANA-PACIFIC CORPORATION OROVILLE BOILERS #4 AND #5

Prepared For:

LOUISIANA-PACIFIC CORPORATION
Samoa, California

For Submittal To:

BUTTE COUNTY AIR POLLUTION CONTROL DISTRICT
Durham, California
and
U.S. ENVIRONMENTAL PROTECTION AGENCY REGION IX
San Francisco, California

Prepared By:

Kevin J. Crosby

CARNOT
Concord, California

MAY 1994

REVIEW AND CERTIFICATION

All work, calculations, and other activities and tasks performed and documented in this report were carried out under my direction and supervision.

Erick Mirabella Date 5/17/94

Erick M. Mirabella
Senior Technician

I have reviewed, technically and editorially, details, calculations, results, conclusions and other appropriate written material contained herein, and hereby certify that the presented material is authentic and accurate.

Kevin J. Crosby Date May 17, 1994

Kevin J. Crosby
Manager, Emission Measurement

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SECTION 1.0

INTRODUCTION

Carnot was contracted to perform a series of emission measurements at the Louisiana-Pacific Corporation (L-P) facility in Oroville, California. The testing program on Boilers #4 and #5 addressed two regulatory issues. Some of the tests were performed to determine compliance with EPA New Source Performance Standards and with conditions of the permits from the Butte County Air Pollution Control District (BCAPCD). Additional tests were performed to certify the performance of the continuous emission monitoring systems (CEMS) in accordance with 40 CFR 60, Appendix B. The CEMS certification results are presented in this report.

The tests were performed by Kevin Crosby, Erick Mirabella, and John Peterson of Carnot's Northern California Division on May 3, 4 and 5, 1994. Unit operations were coordinated by Bill Webb of L-P. The tests were observed by Bob McLaughlin of the BCAPCD.

The average test results are presented in Table 1-1 for comparison with the applicable Performance Specifications. These results indicate that the CEMS on Boilers #4 and #5 meets the applicable performance specifications. The results of individual test runs are presented in Section 4.0 and in the Appendices.

TABLE 1-1
RESULTS SUMMARY
CEMS CERTIFICATION TESTS
LOUISIANA-PACIFIC OROVILLE, BOILERS #4 AND #5
MAY 1994

Analyzer	Relative Accuracy, %[1]	Calibration Drift, %	Performance Specification RA%	CD%[2]
Boiler #4				
NO_x ppm vol. wet	6.49	(zero) 0.8 (span) 1.5	20	2.5 2.5
O_2, vol. wet	4.80	(zero) 0.2 (span) 0.3	20	0.5 0.5
Opacity, %	N/A	(zero) 0.00 (span) 0.11	N/A	2.0 2.0
Boiler #5				
NO_x, ppm vol. wet	7.35	(zero) 0.4 (span) 2.2	20	2.5 2.5
O_2, % vol. wet	1.34	(zero) 0.1 (span) 0.4	20	0.5 0.5
Opacity, %	N/A	(zero) 0.05 (span) 0.06	N/A	2.0 2.0

[1] Calculated in comparison to the Reference Method average results.
[2] The calibration drift specification for O_2 is 0.5% O_2. The drift specification for opacity is 2% opacity. Other calibration drift specifications are in % of the span value.

SECTION 2.0

FACILITY DESCRIPTION

The Louisiana-Pacific Corporation facility in Oroville, California produces medium density fiberboard (MDF). Steam for the plant's fiber dryers and board presses is produced by a wood-fired boiler and by a sander dust-fired boiler known as Boilers #4 and #5.

Boiler #4 is a four-cell wood-fired system manufactured by the Wellons Company of Tualatin, Oregon and rated at 80,000 lb/hr of steam production. Fuel is typically a variable bark-wood-nutshell hogged mixture. Boiler exhaust gases pass through an air pre-heater, a multiclone, an induced draft fan, and a two-stage electrostatic precipitator.

Boiler #5 is a Cleaver-Brooks boiler with a Coen suspension burner for firing sander dust from the hardboard manufacturing operation. No combustion air heating is done with the exhaust, so the exhaust temperature is relatively high for contemporary wood fired boilers (approximately 510° F). The boiler fires at permit capacity 5,000 lbs/hr of wood (sander dust) fuel, and produces 30,000 lbs/hr of steam. Particulate emissions are controlled with a multiclone and a single-stage electrostatic precipitator. Combustion controls and flue gas recirculation (FGR) are used to keep NO_x and CO emissions within permit limits. The fuel feed system and FGR system have been recently modified to provide improved combustion conditions.

2.1 DESCRIPTION OF CEMS

The CEMS for Boilers #4 and #5 includes an Oxygen analyzer and an Opacity monitor on each Boiler, and a single NO_x analyzer which is shared by the Boilers. The Oxygen analyzers are in-situ, wet-basis units. The NO_x analyzer system uses an extractive dilution probe system on each Boiler, and a microprocessing unit which provides outputs of the two NO_x signals (i.e. the current reading for one Boiler and the most recent reading for the other). The NO_x analyzer raw output of ppm wet volume is processed to units of ppm dry volume @ 12% CO_2 using constant correction factors and the measured O_2 concentration. These corrected NO_x results are reported as a running three-hour average.

The single NO_x analyzer is a Monitor Labs, Inc. Model 8840, which uses the chemiluminescence method for measurement of NO concentrations. The analyzer uses a thermal NO_2-to-NO converter to provide measurement of total NO_x concentrations. The analyzer is

designed to measure NO_x in concentrations less than 5 ppm. The sample from each Boiler is therefore diluted with dry air for delivery to the analyzer.

The dilution system at Boiler #5 is a Phoenix Instruments Model 1010 probe dilution extraction system. At Boiler #4, a Dynatron Model 5010 system is used. Both these systems condition the sample to remove particulate matter and to dilute the wet-basis sample with dry air. The samples delivered to the NO_x analyzer are therefore diluted to reduce the moisture content so that the dew point is below the ambient temperature. The sample gas is therefore delivered without condensing any moisture, so any water-soluble gases (e.g. NO_2) are retained. The analyzer output represents the wet-basis NO_x concentration as exists in the stack.

Since the calibration gases are delivered to the analyzer through the same sampling systems, each entire system is calibrated as an integral part of the analyzer. This allows for calibration checks on the same analyzer in a different concentration range for each boiler. The analyzer output is 0 to 1000 ppm volume wet for Boiler #5, and 0 to 200 ppm volume wet for Boiler #4. The analyzer is calibrated with a high-range calibration gas and with zero gas, on an automatic cycle once each 24 hours. The calibration response is output directly to the chart recorders.

A microprocessor unit is used to control the NO_x sampling and analysis system. The Analog Devices Model umac-4000 controls the auto calibrations, blow back of the sampling probes, and associated timing and sequencing for the O_2 and NO_x analyzers. The unit provides output of the NO_x concentrations in 2-minute averages for each boiler once every six minutes. The last average data output is held until the next sequence for each boiler. The data are recorded on a circular chart recorder. The system also processes the data to provide output of the NO_x concentrations corrected to dry-basis ppm @ 12% CO_2 which is recorded on a circular chart recorder as a three-hour running average.

The O_2 analyzer on each boiler is a Dynatron, Inc. Model 401. These analyzers are in-situ, wet-basis units with a range of 0 to 25 % volume wet O_2. The output from these analyzers is averaged, held and output to circular chart recorders with the NO_x concentration data. The analyzers are calibrated with a low-range calibration gas and with ambient air, on an automatic cycle once each 24 hours. The calibration response is output directly to the chart recorders.

The Opacity analyzer on each boiler is a Dynatron, Inc. Model 1100M. The outputs from these analyzers are output as one-minute averages to circular chart recorders on a range of 0 to 20 % opacity for both boilers. Calibration checks on both analyzers are made with calibrated neutral-density filters, on an automatic cycle each 24 hours. The calibration response is output directly to the chart recorders.

SECTION 3.0

TEST DESCRIPTION

3.1 TEST CONDITIONS

The CEMS relative accuracy test runs were conducted with each boiler at 50% capacity or more. Test conditions were established and unit operating data were collected by L-P personnel. Carnot monitored the collection of process and CEMS data.

3.2 SAMPLING LOCATIONS

Samples were collected at each boiler stack in turn, from sampling ports which meet EPA or CARB Method 1 criteria. Sampling traverse points were located according to 40CFR60 Appendix B, Section 3.2. Diagrams of the sampling locations and traverse point locations are located in Appendix B.2.

3.3 TEST PROCEDURES

The test procedures used are summarized in Table 3-1. Descriptions of standard procedures are included in Appendix A. Additional information on specific applications of and modifications to standard procedures are presented in the following sub-sections. Where any conflicts exist in the descriptions, the specific description here in Section 3.3 will take precedence.

3.3.1 Gaseous Emissions

Concentrations of the gaseous constituents of the stack gas (NO_x, O_2 and CO_2) were measured according to the procedures of the EPA Methods 7E and 3A (CARB Method 100) using Carnot's mobile Continuous Emissions Monitor (CEM) described in Appendix A. This system meets the requirements of EPA and CARB methods for gaseous species. The heated Teflon line and ice bath described in Appendix A was used to prevent loss of NO_2 in the sampling system. The CO_2 concentrations were monitored to provide data for correction of NO_x concentrations to 12% CO_2 basis.

Three gaseous emission test runs were performed to determine compliance with the permit conditions, with each run a minimum of forty minutes in duration. Each of these compliance test runs were performed during one of the three tests for particulate matter

TABLE 3-1
EMISSION TEST PROCEDURES USED FOR
CEMS RELATIVE ACCURACY TESTS AT
LOUISIANA-PACIFIC OROVILLE BOILERS # 4 AND #5

Parameter	No. Replicates	Duration of Test (min.)	Measurement Principle	Reference Method	Method Detection Limit
NO_x	3	30 to 40	Chemiluminescent	CARB 100 EPA 7E	Below 2% of instrument full scale
O_2	3	30 to 40	Electrochemical cell	CARB 100 EPA 3A	Below 2% of instrument full scale
CO_2	3	30 to 40	Nondispersive infrared	CARB 100 EPA 3A	Below 2% of instrument full scale

emissions. Additional 30-minute test runs were performed during and between the particulate test runs to provide data for the CEMS relative accuracy tests.

The sampling probe was placed at the three traverse points for 10 to 15 minutes each during the first test run on each boiler. Since no stratification of concentrations was detected, the probe was located near the center of the stack cross-section for the subsequent test runs.

The analyzers were calibrated with gases which have been certified by EPA Protocol 1 (NO_x) or by gravimetric analysis (O_2 and CO_2). The analyzer ranges and gas concentrations that were used are listed in Table 3-2. The NO_x calibration gases did not all meet exactly the range criteria of EPA Method 7E, but these gases were described in the Test Plan prior to the field testing program.

3.3.2 Flow Rate and Moisture Content

Stack gas volumetric flow rate and moisture content was determined by CARB Methods 2 and 4 in conjunction with every particulate test. The moisture results were used in calculation of the wet-basis NO_x and O_2 concentrations from the measured dry-basis concentrations.

3.3.3 CEMS Certification

Relative Accuracy Tests (RA Test) and Calibration Drift Tests (CD Test) were performed on the unit's continuous emission monitoring system (CEMS). The CEMS includes analyzers for measurement of concentrations of NO_x and O_2. A minimum of nine and a maximum of twelve test runs were performed to complete the RA Test as specified in 40CFR60, Appendix B. L-P personnel provided calibration drift data to determine compliance with the CD Test specifications of 40CFR60, Appendix B.

The plant CEMS data are recorded on circular chart recorders. The NO_x analyzer output is in ppm volume, wet basis. The data handling system provides output to the recorder for a two minute average NO_x concentration from each boiler once each six minutes. The analyzer reads one boiler for three minutes (one minute to stabilize the response, then two minutes of concentration monitoring), then the other boiler for three minutes. The two-minute average NO_x concentration is held as a steady output to the recorder until the next average output for that boiler. For determination of relative accuracy, the concentration trace on the recorder chart was averaged for the time period of each reference method test run. The NO_x relative accuracy was therefore determined from the average of the two-minute averages over the period of each test run.

TABLE 3-2
CARNOT MOBILE CEM INSTRUMENT RANGES
CEMS RELATIVE ACCURACY TESTS
LOUISIANA-PACIFIC OROVILLE BOILERS #4 AND #5
MAY, 1994

Analyzer	Range	Span Gas	Mid-Scale Gas
NO_x, Boiler #4	0 to 250 ppm	241 ppm	85 ppm
NO_x, Boiler #5	0 to 1000 ppm	722 ppm	453 ppm
O_2 both units	0 to 10%	8%	5%
CO_2, both units	0 to 25%	22%	15%

Each boiler has its own O_2 analyzer, which can provide continuous output of the O_2 concentration. However, the data handling system keeps the data consistent by averaging the O_2 output in the same way as the NO_x output. The O_2 relative accuracy was therefore also determined from the average of the two-minute averages from each boiler over the period of each test run.

The plant CEMS also outputs running averages of the "corrected" NO_x concentrations. The wet-basis NO_x and O_2 concentrations are used to calculate the equivalent dry-basis ppm NO_x at 12 % CO_2. Correction constants are used to correct for the stack gas moisture content and for the CO_2 equivalent from the O_2 concentration. The output to the recorders is in a three-hour running average. There is no recording of "corrected" NO_x concentrations with shorter averaging times.

3.3.4 Process Data and Analyzer Calibration Drift Data

The plant's process instrumentation was used to document process conditions during the test runs. Process data presented in the report includes steam production rate.

Data from the plant CEMS circular chart recorders was used to document the relative accuracy of the analyzers. The analyzer response to the daily calibration checks were also taken from the charts to provide seven days of calibration drift data. Copies of the charts can be found in Appendix C.

3.4 TEST SCHEDULE

The tests on Boilers #4 and #5 were performed on May 3, 4 and 5, 1994. The individual data sheets presented in Appendix C provide documentation of the test times.

SECTION 4.0

TEST RESULTS

The results of the relative accuracy and calibration drift tests are summarized in Tables 4-1 through 4-6. Average results are presented in Table 1-1 for comparison with the applicable performance specifications. The results show the CEMS components to meet the performance specifications for relative accuracy and calibration drift as set forth in 40 CFR 60, Appendix B.

Additional information is included in the Appendices. Appendix A contains brief descriptions of standard measurement procedures. Appendix B presents the quality assurance information for Carnot's measurements, including instrument calibration data and cylinder gas certificates. Field data, CEMS and process data, and emission calculation spreadsheets are included in Appendix C. Appendix D presents both the general and specific equations used for the calculations of emissions, relative accuracy and calibration drift. Appendix E contains Carnot instrument strip charts.

The process rate during the relative accuracy test runs was greater than 50% of permit capacity for both boilers. All the test runs were used for the calculation of relative accuracy, except Run 1-CEM-4 for O_2. The Carnot O_2 analyzer did not meet the calibration QA criteria for that run, so the result was deleted from the calculation. The O_2 analyzer cell was replaced so that the subsequent test runs were successful.

TABLE 4-1
RESULTS SUMMARY
CEMS CERTIFICATION TESTS
LOUISIANA-PACIFIC OROVILLE, BOILERS #4 AND #5
MAY 1994

Analyzer	Relative Accuracy, %[1]	Calibration Drift, %	Performance Specification RA%	CD%[2]
Boiler #4				
NO_x ppm vol. wet	6.49	(zero) 0.8	20	2.5
		(span) 1.5		2.5
O_2, vol. wet	4.80	(zero) 0.2	20	0.5
		(span) 0.3		0.5
Opacity, %	N/A	(zero) 0.00	N/A	2.0
		(span) 0.11		2.0
Boiler #5				
NO_x, ppm vol. wet	7.35	(zero) 0.4	20	2.5
		(span) 2.2		2.5
O_2, % vol. wet	1.34	(zero) 0.1	20	0.5
		(span) 0.4		0.5
Opacity, %	N/A	(zero) 0.05	N/A	2.0
		(span) 0.06		2.0

[1] Calculated in comparison to the Reference Method average results.
[2] The calibration drift specification for O_2 is 0.5% O_2. The drift specification for opacity is 2% opacity. Other calibration drift specifications are in % of the span value.

TABLE 4-2
RESULTS SUMMARY
NO_x RELATIVE ACCURACY TESTS
LOUISIANA-PACIFIC OROVILLE, BOILER #4
MAY 1994

RELATIVE ACCURACY DETERMINATION
NOx ppm vol. wet

CLIENT: L. P. Oroville
UNIT: Boiler #4
LOAD: Full Load

DATE: 5/4&5/94
Data By: Carnot
Data By: KJC

Run #	Time	Carnot	L.P.	Difference	n	t(0,975)
1	1220-1250	84.56	78.0	6.56	2	12.706
2	1320-1350	85.60	80.4	5.20	3	4.303
3	1545-1625	84.72	79.2	5.52	4	3.182
4	1635-1705	76.20	71.2	5.00	5	2.776
5	1720-1800	83.60	78.0	5.60	6	2.571
6	0908-0938	67.56	65.0	2.56	7	2.447
7	1013-1043	81.88	78.0	3.88	8	2.365
8	1108-1138	81.74	81.4	0.34	9	2.306
9	1208-1238	60.08	57.0	3.08	10	2.262
10	1443-1523	75.99	73.6	2.39	11	2.228
11	1538-1608	78.39	74.8	3.59	12	2.201
12	1618-1648	79.51	75.4	4.11		
AVERAGES:		78.32	74.33	3.99		
STANDARD DEVIATION				1.731103		
CONFIDENCE COEFFICIENT				1.099898		
RELATIVE ACCURACY, %						**6.49**

TABLE 4-3
RESULTS SUMMARY
O_2 RELATIVE ACCURACY TESTS
LOUISIANA-PACIFIC OROVILLE, BOILER #4
MAY 1994

RELATIVE ACCURACY DETERMINATION
O2 % vol. wet

CLIENT: L. P. Oroville
UNIT: Boiler #4
LOAD: Full Load

DATE: 5/4&5/94
Data By: Carnot
Data By: KJC

Run #	Time	Carnot	L.P.	Difference	n	t(0,975)
1	1220-1250	~~4.24~~	~~4.50~~	~~-0.26~~	2	12.706
2	1320-1350	4.12	4.25	-0.13	3	4.303
3	1545-1625	4.42	4.50	-0.08	4	3.182
4	1635-1705	4.75	4.75	0.00	5	2.776
5	1720-1800	4.89	4.70	0.19	6	2.571
6	0908-0938	4.74	4.80	-0.06	7	2.447
7	1013-1043	5.60	5.60	0.00	8	2.365
8	1108-1138	4.47	4.80	-0.33	9	2.306
9	1208-1238	3.53	4.00	-0.47	10	2.262
10	1443-1523	4.25	4.45	-0.20	11	2.228
11	1538-1608	4.35	4.38	-0.03	12	2.201
12	1618-1648	4.56	4.40	0.16		
AVERAGES:		4.52	4.60	-0.09	(Run 1 deleted, see data sheets)	
STANDARD DEVIATION				0.19423		
CONFIDENCE COEFFICIENT				0.130478		
RELATIVE ACCURACY, %						**4.80**

TABLE 4-4
RESULTS SUMMARY
NO_x RELATIVE ACCURACY TESTS
LOUISIANA-PACIFIC OROVILLE, BOILER #5
MAY 1994

RELATIVE ACCURACY DETERMINATION
NOx ppm vol. wet

CLIENT: L. P. Oroville
UNIT: Boiler #5
LOAD: Full Load

DATE: 5/3/94
Data By: Carnot
Data By: KJC

Run #	Time	Carnot	L.P.	Difference	n	t(0,975)
1	0945-1025	504.13	470.0	34.13	2	12.706
2	1100-1130	502.03	465.0	37.03	3	4.303
3	1145-1215	479.80	435.0	44.80	4	3.182
4	1240-1310	487.56	465.0	22.56	5	2.776
5	1325-1405	484.22	455.0	29.22	6	2.571
6	1420-1450	489.70	460.0	29.70	7	2.447
7	1510-1540	488.73	455.0	33.73	8	2.365
8	1605-1645	466.89	445.0	21.89	9	2.306
9	1700-1730	484.53	458.0	26.53	10	2.262
10	1750-1820	467.50	440.0	27.50	11	2.228
					12	2.201

AVERAGES:		485.51	454.80	30.71
STANDARD DEVIATION				6.948372
CONFIDENCE COEFFICIENT				4.970221
RELATIVE ACCURACY, %				**7.35**

TABLE 4-5
RESULTS SUMMARY
O_2 RELATIVE ACCURACY TESTS
LOUISIANA-PACIFIC OROVILLE, BOILER #5
MAY, 1994

RELATIVE ACCURACY DETERMINATION
O2 % vol. wet

CLIENT: L. P. Oroville
UNIT: Boiler #5
LOAD: Full Load

DATE: 5/3/94
Data By: Carnot
Data By: KJC

Run #	Time	Carnot	L.P.	Difference	n	t(0,975)
1	0945-1025	4.94	4.88	0.06	2	12.706
2	1100-1130	4.71	4.70	0.01	3	4.303
3	1145-1215	4.70	4.70	0.00	4	3.182
4	1240-1310	4.72	4.70	0.02	5	2.776
5	1325-1405	4.69	4.70	-0.01	6	2.571
6	1420-1450	4.67	4.75	-0.08	7	2.447
7	1510-1540	4.68	4.75	-0.07	8	2.365
8	1605-1645	4.53	4.68	-0.15	9	2.306
9	1700-1730	4.80	4.80	0.00	10	2.262
10	1750-1820	4.81	4.75	0.06	11	2.228
					12	2.201
AVERAGES:		4.73	4.74	-0.02		
STANDARD DEVIATION				0.065862		
CONFIDENCE COEFFICIENT				0.047111		
RELATIVE ACCURACY, %						**1.34**

TABLE 4-6
RESULTS SUMMARY
CEMS CALIBRATION DRIFT TESTS
LOUISIANA-PACIFIC OROVILLE, BOILERS #4 AND #5
MAY, 1994

Boiler #4		
NO_x analyzer calibration drift, % of span value:	(zero) 0.8	(span) 1.5
O_2 analyzer calibration drift, % O_2:	(low cal.) 0.2	(high cal.) 0.3
Opacity analyzer calibration drift, % Opacity:	(zero) 0.00	(cal.) 0.11
Boiler #5		
NO_x analyzer calibration drift, % of span value:	(zero) 0.4	(span) 2.2
O_2 analyzer calibration drift, % O_2:	(low cal.) 0.1	(high cal.) 0.4
Opacity analyzer calibration drift, % Opacity:	(zero) 0.05	(cal) 0.06

APPENDIX A
MEASUREMENT PROCEDURES

Continuous Emissions Monitoring System

Oxygen (O_2) by Continuous Analyzer

NO/NO_x by Continuous Analyzer

Determination of Moisture in Stack Gases

Continuous Emissions Monitoring System

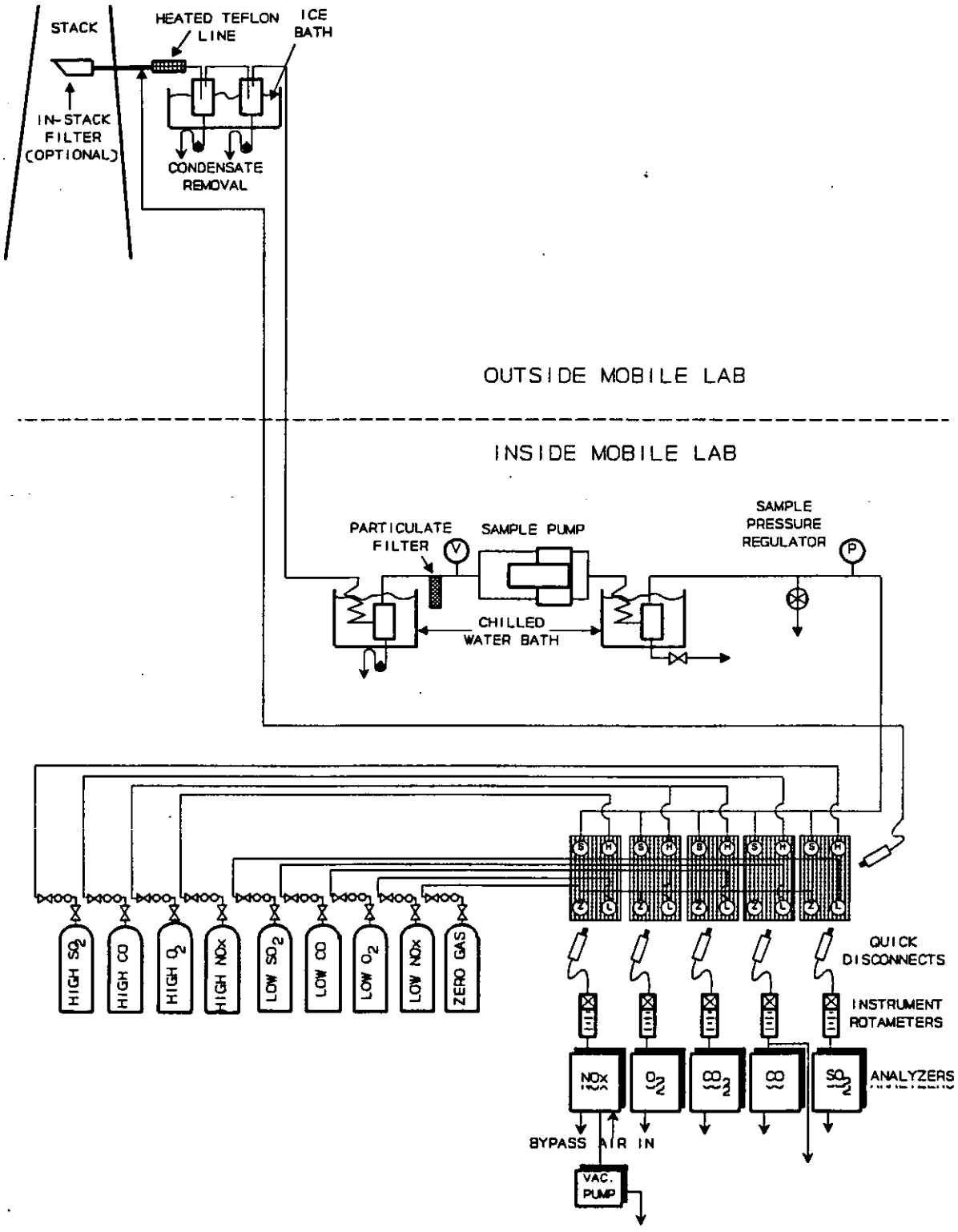
O_2, CO, CO_2, NO, NO_x and SO_2 are measured using an extractive continuous emissions monitoring (CEM) package, shown in the following figure. This package is comprised of three basic subsystems. They are: (1) the sample acquisition and conditioning system, (2) the calibration gas system, and (3) the analyzers themselves. This section presents a description of the sampling and calibration systems. Descriptions of the analyzers used in this program and the corresponding reference test methods follow. Information regarding quality assurance information on the system, including calibration routines and system performance data follows.

The sample acquisition and conditioning system contains components to extract a representative sample from the stack or flue, transport the sample to the analyzers, and remove moisture and particulate material from the sample. In addition to performing the tasks above, the system must preserve the measured species and deliver the sample for analysis intact. The sample acquisition system extracts the sample through a stainless steel probe. The probe is insulated or heated as necessary to avoid condensation. If the particulate loading in the stack is high, a sintered stainless steel filter is used on the end of the probe.

Where water soluble NO_2 and/or SO_2 are to be measured, the sample is drawn from the probe through a heated teflon sample line into an on-stack cooled (approximately 35-40°F) water removal trap. The trap consists of stainless steel flasks in a bath of ice and water. This design removes the water vapor by condensation. The contact between the sample and liquid water is minimized and the soluble NO_2 and SO_2 are conserved. This system meets the requirements of EPA Method 20. The sample is then drawn through a teflon transport line, particulate filter, secondary water removal and into the sample pump. The pump is a dual head, diaphragm pump. All sample-wetted components of the pump are stainless steel or teflon. The pressurized sample leaving the pump flows through a third condensate trap in a refrigerated water bath ($\approx$38°F) for final moisture removal. A drain line and valve are provided to constantly expel any condensed moisture from the dryer at this point. After the dryer, the sample is directed into a distribution manifold. Excess sample is vented through a back-pressure regulator, maintaining a constant pressure of 5-6 psig to the analyzer rotameters.

The calibration system is comprised of two parts: the analyzer calibration, and the system bias check (dynamic calibration). The analyzer calibration equipment includes pressurized cylinders of certified span gas. The gases used are, as a minimum, certified to 1% by the manufacturer. Where necessary to comply with reference method requirements EPA Protocol 1 gases are used. The cylinders are equipped with pressure regulators which supply the calibration gas to the analyzers at the same pressure and flow rate as the sample. The selection of zero, span, or sample gas directed to each analyzer is accomplished by operation of the sample/calibration selector fittings.

The system bias check is accomplished by transporting the same gases used to zero and span the analyzers to the sample system as close as practical to the probe inlet. This is done either by attaching the calibration gas supply line to the probe top with flexible tubing or by actuation of a solenoid valve located at the sample conditioner inlet (probe exit). The span gas is exposed to the same elements as the sample and the system response is documented. The analyzer indications for the system calibration check must agree within 5% of the analyzer calibration. Values are adjusted and changes/repairs are made to the system to compensate for any difference in analyzer readings. Specific information on the analytical equipment and test methods used is provided in the following pages.

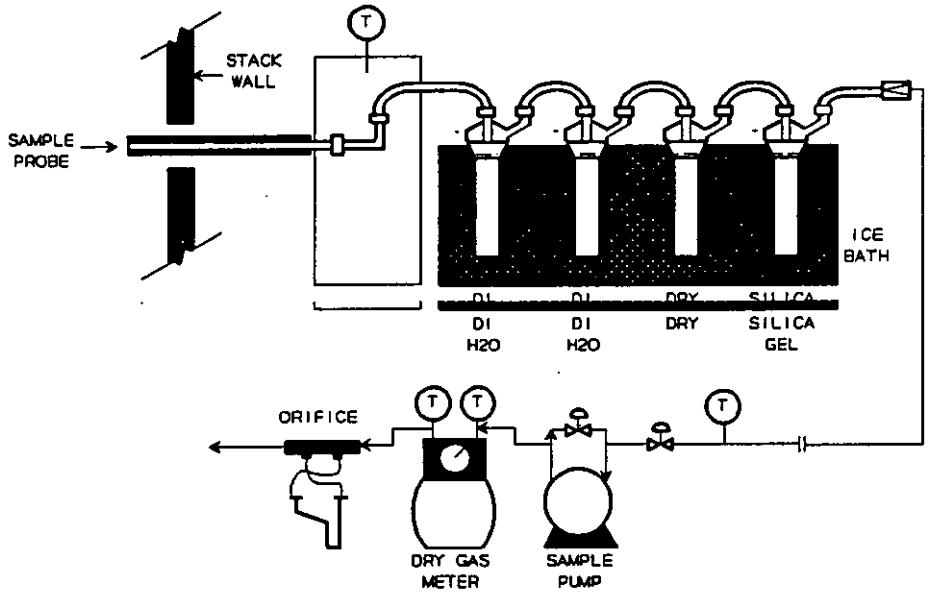


Schematic of CEM System

Method:	**Oxygen (O_2) by Continuous Analyzer**
Applicable Reference Methods:	EPA 3A, EPA 20, ARB 100, BA ST-14, SCAQMD 100.1
Principle:	A sample is continuously drawn from the flue gas stream, conditioned, and conveyed to the instrument for direct readout of O_2 concentration.
Analyzer:	Teledyne Model 326A
Measurement Principle:	Electrochemical cell
Ranges:	0-5, 0-10, 0-25% O_2
Accuracy:	1% of full scale
Output:	0-100 mV, linear
Interferences:	Halogens and halogenated compounds will cause a positive interference. Acid gases will consume the fuel cell and cause a slow calibration drift.
Response Time:	90% <7 seconds
Sampling Procedure:	A representative flue gas sample is collected and conditioned using the CEM system described previously. If Method 20 is used, that method's specific procedures for selecting sample points are used. Otherwise, stratification checks are performed at the start of a test program to select single or multiple-point sample locations.
Analytical Procedure:	An electrochemical cell is used to measure O_2 concentration. Oxygen in the flue gas diffuses through a Teflon membrane and is reduced on the surface of the cathode. A corresponding oxidation occurs at the anode internally, and an electric current is produced that is proportional to the concentration of oxygen. This current is measured and conditioned by the instrument's electronic circuitry to give an output in percent O_2 by volume.
Special Calibration Procedure:	The measurement cells used with the O_2 instrument have to be replaced on a regular basis. After extended use, the cell tend to produce a nonlinear response. Therefore, a three-point calibration is performed at the start of each test day to check for linearity. If the response is not linear ($\pm$ 2% of scale), the cell is replaced.

Method:	**NO/NO_x by Continuous Analyzer**
Applicable Reference Methods:	EPA 7E, EPA 20; ARB 100, BA ST-13A, SCAQMD 100.1
Principle:	A sample is continuously drawn from the flue gas stream, conditioned, and conveyed to the instrument for direct readout of NO or NO_x.
Analyzer:	Teco Model No. 10AR
Measurement Principle:	Chemiluminescence
Accuracy:	1% of full scale
Ranges:	0-2.5, 0-10, 0-25, 0-100, 0-250, 0-1000, 0-2500, 0-10,000 ppm
Output:	0-10 mV
Inferences:	Compounds containing nitrogen (other than ammonia) may cause interference.
Response Time:	90%, 1.5 seconds (NO mode) and 1.7 seconds (NO_x mode)
Sampling Procedure:	A representative flue gas sample is collected and conditioned using the CEM system described previously. If EPA Method 20 is used, that method's specific procedures for selecting sample points are used.
Analytical Procedure:	The oxides of nitrogen monitoring instrument is a chemiluminescent nitric oxide analyzer. The operational basis of the instrument is the chemiluminescent reaction of NO and ozone (O_3) to form NO_2 in an excited state. Light emission results when excited NO_2 molecules revert to their ground state. The resulting chemiluminescence is monitored through an optical filter by a high sensitivity photomultiplier tube, the output of which is electronically processed so it is linearly proportional to the NO concentration. The output of the instrument is in ppmV. When NO_2 is expected to be present in the flue gas, a supercooled water dropout flask will be placed in the sample line to avoid loss of NO_2. Since NO_2 is highly soluble in water, "freezing out" the water will allow the NO_2 to reach the analyzers for analysis. The analyzer measures NO only. In the NO_x mode, the gas is passed through a moly converter which converts NO_2 to NO and a total NO_x measurement is obtained. NO_2 is determined as the difference between NO and NO_x. Use of a moly converter instead of a stainless steel converter eliminates NH_3 interference; NH_3 is converted to NO with a stainless converter, but not with a moly converter.

Method:	**Determination of Moisture in Stack Gases**
Applicable Ref. Methods:	EPA 4, ARB 1-4, SCAQMD 4.1
Principle:	A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined volumetrically or gravimetrically.
Sampling Procedure:	The sample train used in the tests is shown in the following figure. The sample is drawn at a constant rate through a stainless steel probe. The probe is connected to an impinger train by Teflon tubing. The train consists of two Greenburg-Smith impingers which contain 100 ml water, an empty impinger as a knockout, and an impinger containing silica gel to protect the pump from moisture.



Sample Train for Determination of Moisture by EPA Method 4

Sample Recovery and Analysis:	Following testing, moisture content is determined gravimetrically from initial and final impinger weights.

APPENDIX B
QUALITY ASSURANCE

Appendix B.1

Quality Assurance Program Summary and ARB Certification

QUALITY ASSURANCE PROGRAM SUMMARY AND ARB CERTIFICATION

Carnot ensures the quality and validity of its emission measurement and reporting procedures through a rigorous quality assurance (QA) program. The program is developed and administered by an internal QA Officer and encompasses seven major areas:

1. Development and use of an internal QA manual.
2. QA reviews of reports, laboratory work, and field testing.
3. Equipment calibration and maintenance.
4. Chain of custody.
5. Training.
6. Knowledge of current test methods.
7. Agency certification.

Each of these areas is discussed individually below.

Quality Assurance Manual. Carnot has prepared a QA Manual according to EPA guidelines. The manual serves to document and formalize all of Carnot's QA efforts. The manual is constantly updated, and each member of the Source Test Division is required to read and understand its contents. The manual includes details on the other six QA areas discussed below.

QA Reviews. Carnot's review procedure includes review of each source test report by the QA Officer, and spot check reviews of laboratory and field work.

The most important review is the one that takes place before a test program begins. The QA Officer works closely with Source Test Division personnel to prepare and review test protocols. Test protocol review includes selection of appropriate test procedures, evaluation of any interferences or other restrictions that might preclude use of standard test procedures, and evaluation and/or development of alternate procedures.

Equipment Calibration and Maintenance. The equipment used to conduct the emissions measurements is maintained according to the manufacturer's instructions to ensure proper operation. In addition to the maintenance program, calibrations are carried out on each measurement device according to the schedule outlined by the California Air Resources Board (CARB). The schedule for maintenance and calibrations are given in Tables B-1 and B-2. Quality control checks are also conducted in the field for each test program. The following is a partial list of checks made as part of each CEM system test series.

- Sample acquisition and conditioning system leak check.
- 2-point analyzer calibrations (all analyzers)
- 3-point analyzer calibrations (analyzers with potential for linearity errors).
- Complete system calibration check ("dynamic calibration" through entire sample system).

- Periodic analyzer calibration checks (once per hour) are conducted at the start and end of each test run. Any change between pre- and post-test readings are recorded.

- All calibrations are conducted using gases certified by the manufacturer to be + 1% of label value (NBS traceable).

Calibration and CEM performance data are fully documented, and are included in each source test report.

Chain of Custody. Carnot maintains full chain of custody documentation on all samples and data sheets. In addition to normal documentation of changes between field sample custodians, laboratory personnel, and field test personnel, Carnot documents every individual who handles any test component in the field (e.g., probe wash, impinger loading and recovery, filter loading and recovery, etc.).

Samples are stored in a locked area to which only Source Test Division personnel have access. Neither other Carnot employees nor cleaning crews have keys to this area.

Data sheets are copied immediately upon return from the field, and this first generation copy is placed in locked storage. Any notes made on original sheets are initialed and dated.

Training. Personnel training is essential to ensure quality testing. Carnot has formal and informal training programs which include:

1. Attendance at EPA-sponsored training courses.
2. Enrollment in EPA correspondence courses.
3. A requirement for all technicians to read and understand Carnot's QA Manual.
4. In-house training and QA meetings on a regular basis.
5. Maintenance of training records.

Knowledge of Current Test Methods. With the constant updating of standard test methods and the wide variety of emerging test methods, it is essential that any qualified source tester keep abreast of new developments. Carnot subscribes to services which provide updates on EPA and CARB reference methods, and on EPA, CARB and SCAQMD rules and regulations. Additionally, source test personnel regularly attend and present papers at testing and emission-related seminars and conferences. Carnot personnel maintain membership in the Air Pollution Control Association, the Source Evaluation Society, and the ASME Environmental Control Division.

AGENCY CERTIFICATION

Carnot is certified by the CARB as an independent source test contractor for gaseous and particulate measurements. Carnot also participates in EPA QA audit programs for Methods 5, 6 and 7.

TABLE B-1
SAMPLING INSTRUMENTS AND EQUIPMENT CALIBRATION SCHEDULE
As Specified by the CARB

Instrument Type	Frequency of Calibration	Standard of Comparison or Method of Calibration	Acceptance Limits
Orifice Meter (large)	12 months	Calibrated dry test meter	± 2% of volume measured
Dry Gas Meter	12 months or when repaired	Calibrated dry test meter	± 2% of volume measured
S-Type Pitot (for use with EPA-type sampling train	6 months	EPA Method 2	Cp constant (+5%) over working range; difference between average Cp for each leg must be less than 2%
Vacuum Gauges Pressure Gauges	6 months	Manometer	± 3%
Field Barometer	6 months	Mercury barometer	± 0.2" Hg
Temperature Measurement	6 months	NBS mercury thermometer or NBS calibrated platinum RTD	± 4°F for <400°F ± 1.5% for >400°F
Temperature Readout Devices	6 months	Precision potentiometer	± 2% full scale reading
Analytical Balance	12 months (check prior to each use)	Should be performed by manufacturer or qualified laboratory	± 0.3 mg of stated weight
Probe Nozzles	12 Months	Nozzle diameter check micrometer	Range < ± 0.10 mm for three measurements
Continuous Analyzers	Depends upon use, frequency and performance	As specified by manufacturers operating manuals, EPA NBS gases and/or reference methods	Satisfy all limits specified in operating specifications

TABLE B-2
EQUIPMENT MAINTENANCE SCHEDULE
Based on Manufacturer's Specifications and Carnot Experience

Equipment	Performance Requirement	Maintenance Interval	Corrective Action
Pumps	1. Absence of leaks 2. Ability to draw manufacturer required vacuum and flow	Every 500 hours of operation or 6 months, whichever is less	1. Visual inspection 2. Clean 3. Replace worn parts 4. Leak check
Flow Measuring Device	1. Free mechanical movement 2. Absence of malfunction	Every 500 hours of operation or 6 months, whichever is less After each test, if used in H_2S sampling or other corrosive atmospheres	1. Visual inspection 2. Clean 3. Calibrate
Sampling Instruments	1. Absence of malfunction 2. Proper response to zero, span gas	As required by the manufacturer	As recommended by manufacturer
Integrated Sampling Tanks	Absence of leaks	Depends on nature of use	1. Steam clean 2. Leak check
Mobile Van Sampling Systems	Absence of leaks	Depends on nature of use	1. Change filters 2. Change gas dryer 3. Leak check 4. Check for system contamination
Sampling Lines	Sample degradation less than 2%	After each test or test series	Blow filtered air through line until dry

State of California
AIR RESOURCES BOARD

Executive Order G-836

Approval to Carnot
To Conduct Testing as an Independent Contractor

WHEREAS, the Air Resources Board ("Board"), pursuant to Section 41512 of the California Health and Safety Code, has established the procedures contained in Section 91200-91220, Title 17, California Code of Regulations, to allow the use of independent testers for compliance tests required by the Board; and

WHEREAS, pursuant to Sections 91200-91220, Title 17, California Code of Regulations, the Executive Officer has determined that Carnot meets the requirements of the Board for conducting Board Test Methods 1, 2, 3, 4, 5, 6, 8, 10, and 100 (NOx, O2) when the following conditions are met:

1. Carnot conducts Board Test Method 100 for O2 using a Teledyne 326 analyzer with either a A5 or a B1 sensor, or a paramagnetic analyzer.

NOW, THEREFORE, BE IT ORDERED that Carnot is granted an approval, from the date of execution of this order, until June 30, 1994 to conduct the tests listed above, subject to compliance with Section 91200-91220, Title 17, California Code of Regulations.

BE IT FURTHER ORDERED that during the approved period the Executive Officer or his or her authorized representative may field audit one or more tests conducted pursuant to this order for each type of testing listed above.

Executed this 14th day of June 1993, at Sacramento, California.

James J. Morgester, Chief
Compliance Division

State of California

Air Resources Board

Approved Independent Contractor

Carnot

This is to certify that the company listed above has been approved by the Air Resources Board to conduct compliance testing pursuant to Section 91207, Title 17, California Code of Regulations, until June 30, 1994, for those test methods listed below:

ARB Source Test Methods:
1, 2, 3, 4, 5, 6, 8, 10, 100(NOx, O2)

James J. Morgester, Chief
Compliance Division

Laura McKinney, Manager
Investigation and Certification Section

90 56165

Appendix B.2

Calibration Data

CARNOT
SPAN GAS RECORD

CLIENT/LOCATION: LP Orouille Boiler 5 DATE: 5-3-94

BY: KSC

GAS	SPAN CYLINDER		AUX. SPAN CYLINDER	
	CYLINDER NO.	CONCENTRATION	CYLINDER NO.	CONCENTRATION
ZERO	ALM012329	99.9999%	—	—
NOx	ALM033887 ALM046278	722.7 ppm 453 ppm	ALM010961	241.2
O_2	AAL630	8.05%	ALM12592	4.99%
CO	ALM002195	425.6 ppm	ALM013868	277.8 ppm
CO_2	AAL630	22.3%	ALM12592	15.1%
SO_2	—	—	—	—

CARNOT
INSTRUMENT LINEARITY

	ANALYZER				
	O_2	CO_2	CO	NOx	SO_2
ANALYZER RANGE	0-10	0-25	0-500	0-1000	—
SET TO HIGH STD (80-90% OF RANGE)	8.05	22.3	425.6	722.7	—
AS-FOUND LOW STD (50-60% OF RANGE)	5.08	15.00	288.6	458.1	—
ACTUAL VALUE OF LOW STD	4.99	15.1	277.8	453.0	—
DIFFERENCE IN % OF FULL SCALE	0.9	-0.4	1.8	0.8	—

ALLOWABLE DEVIATION IS 2% OF FULL SCALE (2 SQUARES ON STRIP CHART).

CARNOT

CARNOT
SPAN GAS RECORD

CLIENT/LOCATION: L-P Oroville Boiler 4 DATE: 5-4-94

BY: HC

GAS	SPAN CYLINDER		AUX. SPAN CYLINDER	
	CYLINDER NO.	CONCENTRATION	CYLINDER NO.	CONCENTRATION
ZERO	ALM-012329	99.999% N_2		
NOx	ALM-010961	241.2 ppm	ALM-006725	84.4 ppm
O_2	AAL630	8.05 %	ALM 12592	4.99 %
CO	ALM 002195	425.6 ppm	ALM 013868	277.8 ppm
CO_2	AAL630	22.3%	ALM 12592	15.1 %
SO_2				

CARNOT
INSTRUMENT LINEARITY

	ANALYZER				
	O_2	CO_2	CO	NOx	SO_2
ANALYZER RANGE	10%	25%	500 ppm	250 ppm	
SET TO HIGH STD (80-90% OF RANGE)	8.05	22.3	425.6	241.2	
ACTUAL VALUE OF LOW STD	4.99	15.1	277.8	84.4	
AS-FOUND LOW STD (50-60% OF RANGE)	5.29 / 5.10 *	* 4.99 / 15.04	287.0	85.2	
DIFFERENCE IN % OF FULL SCALE	3.0 / *1.1	0.24 / OK	1.8	0.32	

* 1310 hrs Reset O_2 + CO_2

% ERROR CALCULATION:

$$\frac{(\text{AS FOUND} - \text{ACTUAL VALUE OF SPAN})}{\text{RANGE}} \times 100$$

ALLOWABLE DEVIATION IS 2% OF FULL SCALE (2 SQUARES ON STRIP CHART).

CARNOT

CARNOT
SPAN GAS RECORD

CLIENT/LOCATION: LPOrouille #4 DATE: 5/5/94

BY: KSC

GAS	SPAN CYLINDER		AUX. SPAN CYLINDER	
	CYLINDER NO.	CONCENTRATION	CYLINDER NO.	CONCENTRATION
ZERO	ALM-012329	99.999 %		
NOx	ALM010961	241.2 ppm	ALM006725	84.4 ppm
O_2	AAL630	8.05%	ALM12592	4.99%
CO	ALM002195	425.6 ppm	ALM013868	277.8 ppm
CO_2	AAL630	22.3%	ALM12592	15.1 %
SO_2				

CARNOT
INSTRUMENT LINEARITY

	ANALYZER				
	O_2	CO_2	CO	NOx	SO_2
ANALYZER RANGE	0-10	0-25	0-500	0-250	
SET TO HIGH STD (80-90% OF RANGE)	8.05	22.3	425.6	241.2	
ACTUAL VALUE OF LOW STD	4.99	15.1	277.8	84.4	
AS-FOUND LOW STD (50-60% OF RANGE)	5.07	14.98	287.0	85.1	
DIFFERENCE IN % OF FULL SCALE					

% ERROR CALCULATION:

$$\frac{(\text{AS FOUND} - \text{ACTUAL VALUE OF SPAN})}{\text{RANGE}} \times 100$$

ALLOWABLE DEVIATION IS 2% OF FULL SCALE (2 SQUARES ON STRIP CHART).

CARNOT

CARNOT
SPAN GAS RECORD

CLIENT/LOCATION: LP Orouille DATE: 5/5/94

Analyzer ReCal before 4-PM-4 BY: EJC

GAS	SPAN CYLINDER		AUX. SPAN CYLINDER	
	CYLINDER NO.	CONCENTRATION	CYLINDER NO.	CONCENTRATION
ZERO				
NOx				
O_2				
CO				
CO_2				
SO_2				

Same as on previous 5/5/94 Sheet.

CARNOT
INSTRUMENT LINEARITY

	ANALYZER				
	O_2	CO_2	CO	NOx	SO_2
ANALYZER RANGE	0-10	0-25	0-500	0-250	
SET TO HIGH STD (80-90% OF RANGE)	8.05	22.3	425.6	241.2	
ACTUAL VALUE OF LOW STD	4.99	15.1	277.8	84.4	
AS-FOUND LOW STD (50-60% OF RANGE)	5.08	14.98	286.6	85.0	
DIFFERENCE IN % OF FULL SCALE	0.9	-0.5	1.8	0.2	

% ERROR CALCULATION:

$$\frac{\text{(AS FOUND - ACTUAL VALUE OF SPAN)}}{\text{RANGE}} \times 100$$

ALLOWABLE DEVIATION IS 2% OF FULL SCALE (2 SQUARES ON STRIP CHART).

CARNOT

Scott Specialty Gases, Inc.

Shipped From: 5121 BRANDIN COURT
FREMONT CA 94538
Phone: 510-659-0162 Fax: 510-659-9156

CERTIFICATE OF ANALYSIS

CARNOT

1150 BURNETT AVE
SUITE C
CONCORD CA 94520

PROJECT #: 09-16729-007
PO#: 1283
ITEM #: 0901811 AL
DATE: 10/18/93

CYLINDER #: ALM012329

PURE MATERIAL: NITROGEN CAS# 7727-37-9

GRADE: U Z A M

PURITY: 99.999%

LOT#9307-560,9308-382 ADDITIONAL CYLINDER#ALM013871

ANALYST: Paul Cowles

Scott Specialty Gases, Inc.

5121 BRANDIN COURT, FREMONT, CA 94538 (510) 659-0162 FAX: (510) 659-9156

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer :
CARNOT
1150 BURNETT AVE
SUITE C
CONCORD , CA 94520

Assay Laboratory
Scott Specialty Gases
5121 Brandin Ct.
Fremont, CA 94538

Purchase Order 1487
Scott Project # 0917987

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number	ALM-006725	**Certification Date**	01-14-94	**Expiration Date**	01-14-96
Cylinder Pressure	2000 psig	**Previous Certification Dates**	NONE		

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
NITRIC OXIDE	83.2 PPM	1% NIST traceable
NITROGEN	Balance	
NOx	84.4 PPM	

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
CRM # 1684	09-17-94	ALM-024584	95.3 PPM NO/N2

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
HORIBA/CLA-53A /850658092	01-07-94	CHEMILUMINESCENT

ANALYZER READINGS (Z=Zero Gas R= Reference Gas T=Test Gas r=Correlation Coefficient)

Components

NO

First Triad Analysis

01-07-94		Response Units: PPM
Z1 = -0.05	R2 = 93.79	Z3 = -0.05
R1 = 93.64	Z2 = -0.05	T3 = 81.63
T1 = 80.16	T2 = 81.64	R3 = 93.82
Conc = 81.59	Conc = 82.77	Conc = 82.93
Mean Assay = 82.43 ppm		

Second Triad Analysis

01-14-94		Response Units: PPM
Z1 = 0.01	R2 = 95.33	Z3 = 0.02
R1 = 95.28	Z2 = 0.03	T3 = 83.34
T1 = 83.20	T2 = 83.16	R3 = 95.39
Conc = 83.21	Conc = 83.13	Conc = 83.34
Mean Assay = 83.23 ppm		

Calibration Curve

Conc=A+Bx+Cx^2+Dx^3
A=-0.1884003
B= 97.90052

r=0.9999957

Special Notes

Analyst MIKE HUYNH

Scott Specialty Gases, Inc.

5121 BRANDIN COURT, FREMONT, CA 94538 (510) 659-0162 FAX: (510) 659-9156

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
CARNOT
1150 BURNETT AVE
SUITE C
CONCORD, CA 94520

Assay Laboratory
SCOTT SPECIALTY GASES, INC
5121 BRANDIN CT
FREMONT, CA 94538

Purchase Order 1283
Scott Project # 0916729

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number ALM-010961
Cylinder Pressure 2000 Psi
Certification Date 10-15-93
Previous Certification Dates NONE
General Exp. date 10-15-95

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
Nitric Oxide	236.2 ppm	±1 % NIST Directly Traceable
NOx	241.2 ppm	
Balance: Nitrogen		

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
CRM # 1685	11/18/94	ALM-024139	244.7 ppm NO/N2

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
HORIBA/CLA-53A/850658092	09-18-93	CHEMILUMINESCENT

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components: NITRIC OXIDE

First Triad Analysis
10-08-93 Response Units: ppm

Z1= 0.2	R2= 245.0	Z3= 0.2
R1= 244.5	Z2= 0.2	T3= 236.3
T1= 236.3	T2= 236.1	R3= 245.3

Mean Assay = 236.2 ppm
NOx = 237.6 ppm

Second Triad Analysis
10-15-93 Response Units: ppm

Z1= 0.1	R2= 246.0	Z3= 0.2
R1= 245.9	Z2= 0.1	T3= 236.7
T1= 235.5	T2= 236.3	R3= 246.0

Mean Assay = 236.2 ppm
NOx = 241.2 ppm

Calibration Curve
Concentration=A+Bx+Cx^2+Dx^3+Cx^4

r= 0.9999948
Constants: A= -0.2422028
B= 294.5839 C= 0

Special Notes

Analyst Mike Huynh

Scott Specialty Gases, Inc.

FAX 714-887-0549
PHONE: 714-887-2571

2600 CAJON BLVD., SAN BERNARDINO, CA 92405

CARNOT
ATTN: RICK MASRIGAL
15991 RED HILL AVE
SUITE 110
TUSTIN CA 92680

Shipped From: Scott SAN BERNARDINO, CA
Date Shipped 12/3/92
Our Project No: 22555
Your P.O. No: 9113
Page 1 of 1
Expiration Date: 5/94

CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES

Certified Per Traceability Protocol No. 1 Procedure No. G1 Cylinder No. ALM033887 Cylinder Pressure 2000 PSIG Certified Accuracy ±1% % NBS Traceable

COMPONENTS	CERTIFIED CONC	REFERENCE STD SRM/CRM NO.	REFERENCE STD CYL. NO.	REFERENCE STD CONC.	GAS ANALYZER MAKE/MODEL/SERIAL NO.	GAS ANALYZER LAST CAL. DATE	GAS ANALYZER ANALYTICAL PRINCIPLE
NITRIC OXIDE	716.3 PPM	GMIS TRACEABLE TO CRM1687	ALM14293	955.0 PPM	THERMO-ELECTRON 10AR 14853-150	10/29/92	CHEMI-LUMINESCENT
NOX	722.7 PPM						

BALANCE GAS NITROGEN

ANALYZER READINGS: Z = Zero Gas T = Test Gas R = Reference Gas

Component NITRIC OXIDE
First Analysis Date 11/19/92 Units mv
Z 0.00 R 93.36 T 69.58
R 93.07 Z 0.44 T 69.59
Z 0.40 T 69.84 R 93.17
Mean Test Assay 713.3 PPM
Second Analysis Date 11/30/92 Units mv
Z 0.00 R 94.12 T 70.84
R 94.01 Z -0.10 T 70.81
Z -0.10 T 70.80 R 94.02
Mean Test Assay 719.3 PPM

Component _____
Date _____ Units mv
Z _____ R _____ T _____
R _____ Z _____ T _____
Z _____ T _____ R _____
Mean Test Assay _____
Date _____ Units mv
Z _____ R _____ T _____
R _____ Z _____ T _____
Z _____ T _____ R _____
Mean Test Assay _____

Component _____
Date _____ Units mv
Z _____ R _____ T _____
R _____ Z _____ T _____
Z _____ T _____ R _____
Mean Test Assay _____
Date _____ Units mv
Z _____ R _____ T _____
R _____ Z _____ T _____
Z _____ T _____ R _____
Mean Test Assay _____

Chronology: Date _____
Assay _____

Analyst C. KING

Approved By: A. Lange
A.F. LANGE, Ph.D., MANAGER, QA

Scott Specialty Gases, Inc.
5121 BRANDIN COURT, FREMONT, CA 94538 (510) 659-0162 FAX: (510) 659-9156

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer :
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1150 BURNETT AVE
SUITE C
CONCORD, CA 94520

Assay Laboratory
Scott Specialty Gases
5121 Brandin Ct.
Fremont, CA 94538

Purchase Order 1487
Scott Project # 0917986

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number	ALM-013868	**Certification Date**	01-06-94	**Expiration Date**	01-06-97
Cylinder Pressure	2000 psig	**Previous Certification Dates**	NONE		

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
Carbon Monoxide	277.8 ppm	1% NIST traceable
Nitrogen	Balance	

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
CRM # 1680	01-18-96	ALM-031341	479.8 PPM CO/N2

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
HORIBA/AIA-23AS/850658016	10-20-93	NDIR

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components: CO

First Triad Analysis

12-30-93 Response Units: PPM

Z1=-0.1	R2= 479.5	Z3= -0.2
R1= 479.5	Z2= -0.0	T3= 275.9
T1= 275.9	T2= 275.8	R3= 479.4

Mean Assay = 275.9 ppm

Second Triad Analysis

01-05-94 Response Units: PPM

Z1= 0.1	R2= 480.6	Z3= 0.0
R1= 480.4	Z2= 0.2	T3= 277.9
T1= 278.0	T2= 277.5	R3= 480.3

Mean Assay = 277.8 ppm

Calibration Curve

Conc=A+Bx+Cx^2+Dx^3
A= - 0.1986406
B= 354.0686
C= 102.6648
D= 21.73912 r=0.9999978

Special Notes

Analyst MIKE HUYNH

Scott Specialty Gases, Inc.

2600 CAJON BLVD., SAN BERNARDINO, CA 92411

FAX 714-887-0549
PHONE: 714-887-2571

Shipped From: Scott SAN BERNARDINO, CA
Date Shipped 10/5/92
Our Project No: 21681
Your P.O. No: 8880
Page 1 of 1
Expiration Date: 4/94

CARNOT
ATTN: RICK MADRIGAL
15991 RED HILL AVE
SUITE 110
TUSTIN CA 92680

CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES

Certified Per Traceability Protocol No. 1 Procedure No. G1 Cylinder No. ALM002195 Cylinder Pressure 1900 PSIG Certified Accuracy ±1% % NIST Traceable

COMPONENTS	CERTIFIED CONC	REFERENCE STD SRM/CRM NO.	REFERENCE STD CYL. NO.	REFERENCE STD CONC.	GAS ANALYZER MAKE/MODEL/SERIAL NO.	GAS ANALYZER LAST CAL. DATE	GAS ANALYZER ANALYTICAL PRINCIPLE
CARBON MONOXIDE	425.6 PPM	CRM1680	ALM013394	475.0 PPM	OPE 135D	8/27/92	INFRA-RED

BALANCE GAS NITROGEN

ANALYZER READINGS: Z = Zero Gas T = Test Gas R = Reference Gas

Component CARBON MONOXIDE
First Analysis Date 9/22/92 Units mv

Z 0.00	R 59.9	T 54.8
R 59.9	Z 0.01	T 54.8
Z 0.00	T 54.9	R 59.9

Mean Test Assay 425.7 PPM

Second Analysis Date 10/1/92 Units mv

Z 0.00	R 59.9	T 54.8
R 59.9	Z 0.00	T 54.8
Z 0.00	T 54.8	R 59.9

Mean Test Assay 425.4 PPM

Component ____ Date ____ Units mv

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay ____

Date ____ Units mv

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay ____

Component ____ Date ____ Units mv

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay ____

Date ____ Units mv

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay ____

Chronology: Date ____
Assay ____

Analyst J. DE LA TORRE

Approved By: [signature]
A.F. LANGE, PH.D., MANAGER, QA

Scott Specialty Gases

CERTIFICATE OF ANALYSIS

CARNOT

ID No. 1487

CAS Reg. No.	Component	Certified Analysis	
124-38-9	CARBON DIOXIDE	15.1	PCT/M
7782-44-7	OXYGEN	4.99	PCT/M
7727-37-9	NITROGEN		BAL

Analytical Accuracy +-1%

Project No 09-17986
Cylinder No. ALM012592
Item No.0902C3000701AL

Scott Specialty Gases, Inc.

Shipped From: 5121 BRANDIN COURT
FREMONT CA 94538
Phone: 510-659-0162 Fax: 510-659-9156

CERTIFICATE OF ANALYSIS

CARNOT

1150 BURNETT AVE
SUITE C
CONCORD CA 94520

PROJECT #: 09-17986-002
PO#: 1487
ITEM #: 0902C3013601AL
DATE: 1/10/94

CYLINDER #: AAL630
FILL PRESSURE: 1800 PSIG

ANALYTICAL ACCURACY: +-1%

COMPONENT	REQUESTED GAS CONC	MOLES	ANALYSIS (MOLES)	
CARBON DIOXIDE	22.5	PCT	22.3	PCT
OXYGEN	8.	PCT	8.05	PCT
NITROGEN		BAL		BAL

LOT # 9312-565
ADDITIONAL CYL #: AAL9424

ANALYST: _____

APPENDIX C
DATA SHEETS

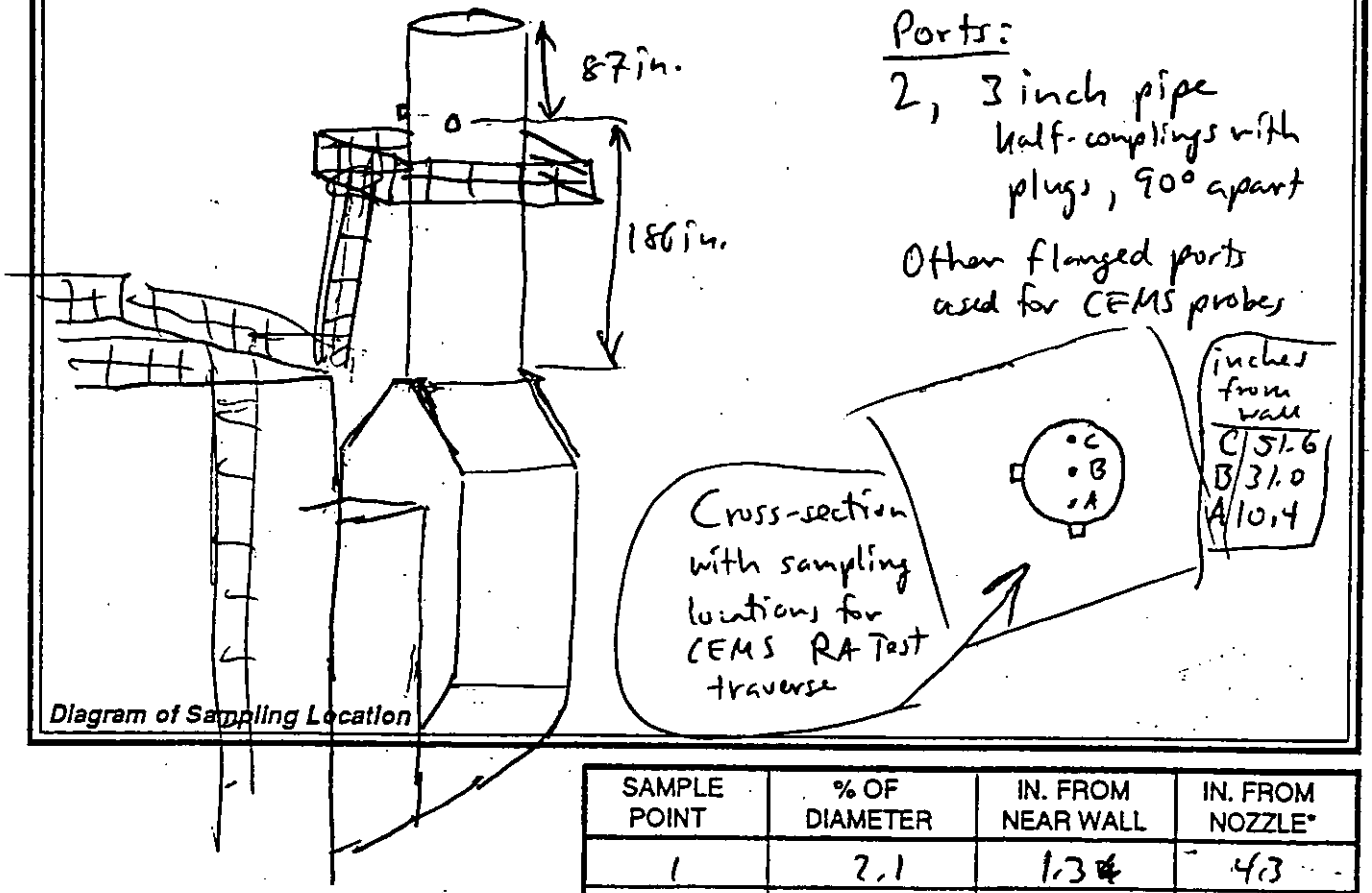
Appendix C.1
Sampling Locations

CARNOT
SAMPLING POINT LOCATION DATA - EPA METHOD 1

PLANT: L-P Oroville DATA BY: KJC

DATE: 5-4-94

TEST LOCATION: Boiler 4



UPSTREAM DIST./DIA.: 87in./ 1.4D

DOWNSTREAM DIST./DIA.: 186in./ 3.0D

COUPLING LENGTH: 3.0 in.

NO. OF SAMPLING PTS.: 24

STACK DIMENSION: 62.0in.

STACK AREA, FT²: 20,966

SAMPLE POINT	% OF DIAMETER	IN. FROM NEAR WALL	IN. FROM NOZZLE*
1	2.1	1.3	4.3
2	6.7	4.2	7.2
3	11.8	7.3	10.3
4	17.7	11.0	14.3
5	25.0	15.5	18.5
6	35.1	22.1	25.1
7	64.9	39.9	42.9
8	75.0	46.5	49.5
9	82.3	51.0	54.0
10	88.2	54.7	57.7
11	93.3	57.8	60.8
12	97.9	60.7	63.7

*INCHES FROM WALL PLUS COUPLING LENGTH

CARNOT

CARNOT

SAMPLING POINT LOCATION DATA - EPA METHOD 1

PLANT: L-P OROVILLE DATA BY: JP

DATE: 10/22/93

TEST LOCATION: STACK

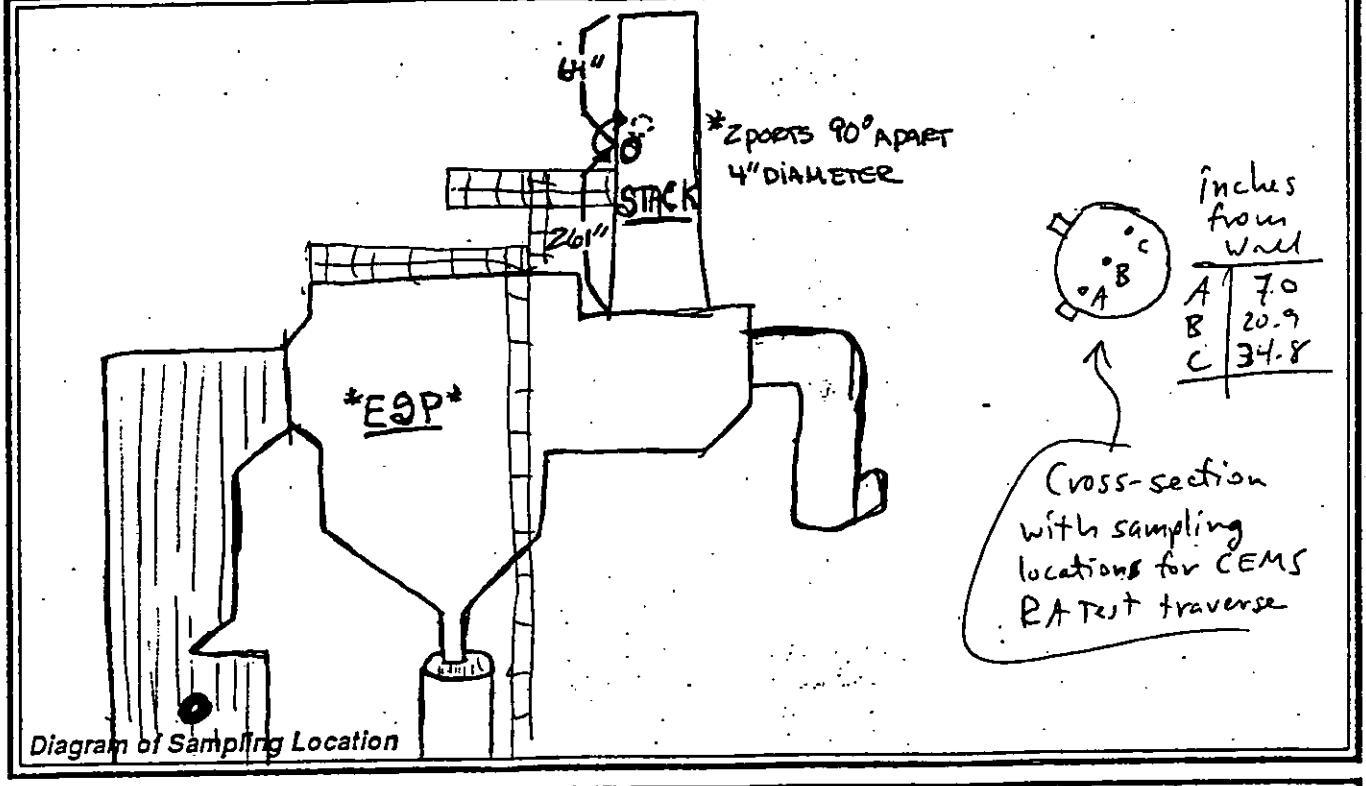


Diagram of Sampling Location

SAMPLE POINT	% OF DIAMETER	IN. FROM NEAR WALL	IN. FROM NOZZLE*
1	3.2	1.3	3.6
2	10.5	4.4	6.7
3	19.4	8.1	10.4
4	32.3	13.5	15.8
5	67.7	28.3	30.6
6	80.6	33.7	36.0
7	89.5	37.4	39.7
8	96.8	40.5	42.8

UPSTREAM DIST./DIA.: 1.53

DOWNSTREAM DIST./DIA.: 6.24

COUPLING LENGTH: 2.25"

NO. OF SAMPLING PTS.: 16

STACK DIMENSION: 41.75" diam.

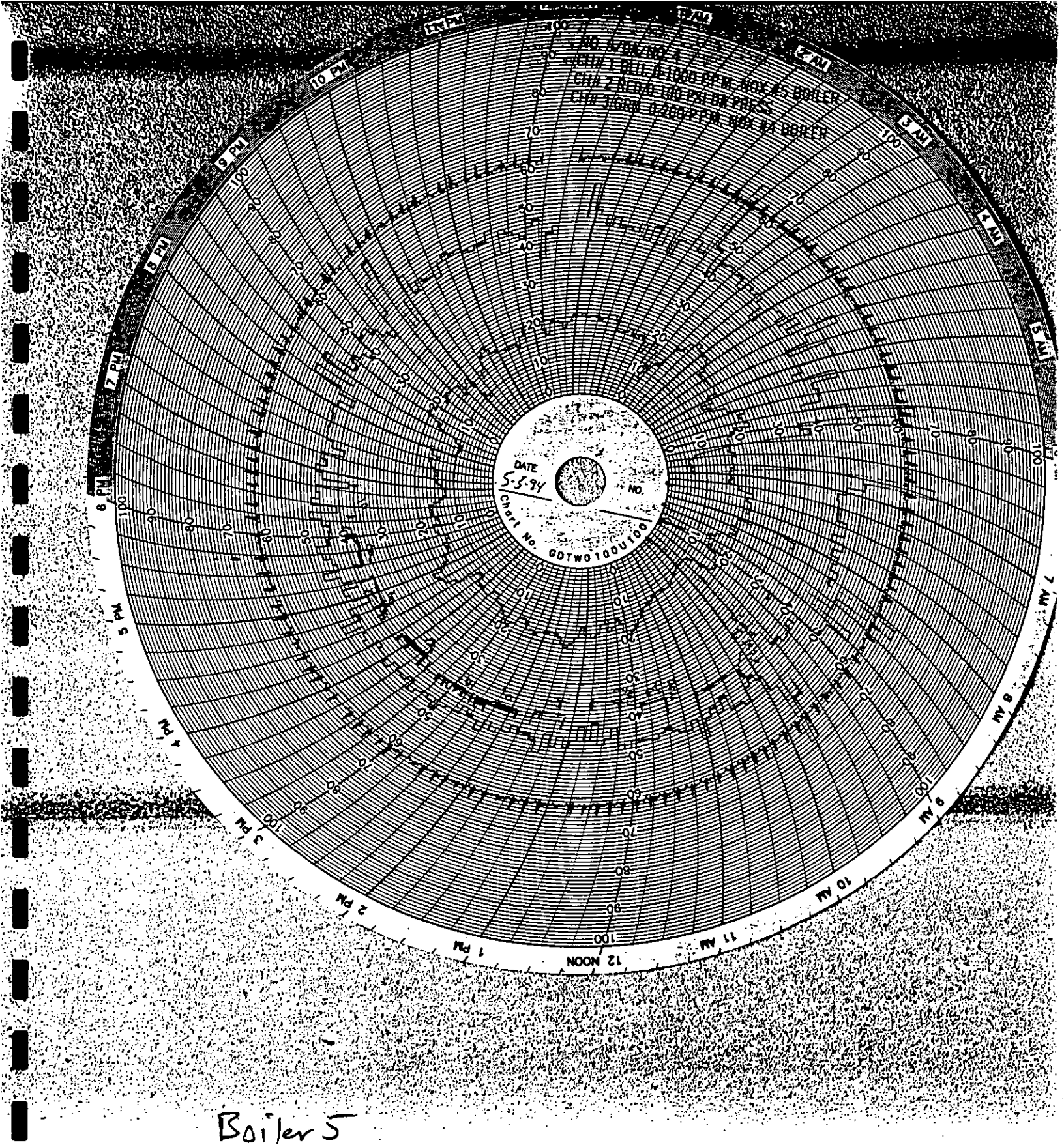
STACK AREA, FT²: 9.51

*INCHES FROM WALL PLUS COUPLING LENGTH

CARNOT

Appendix C.2

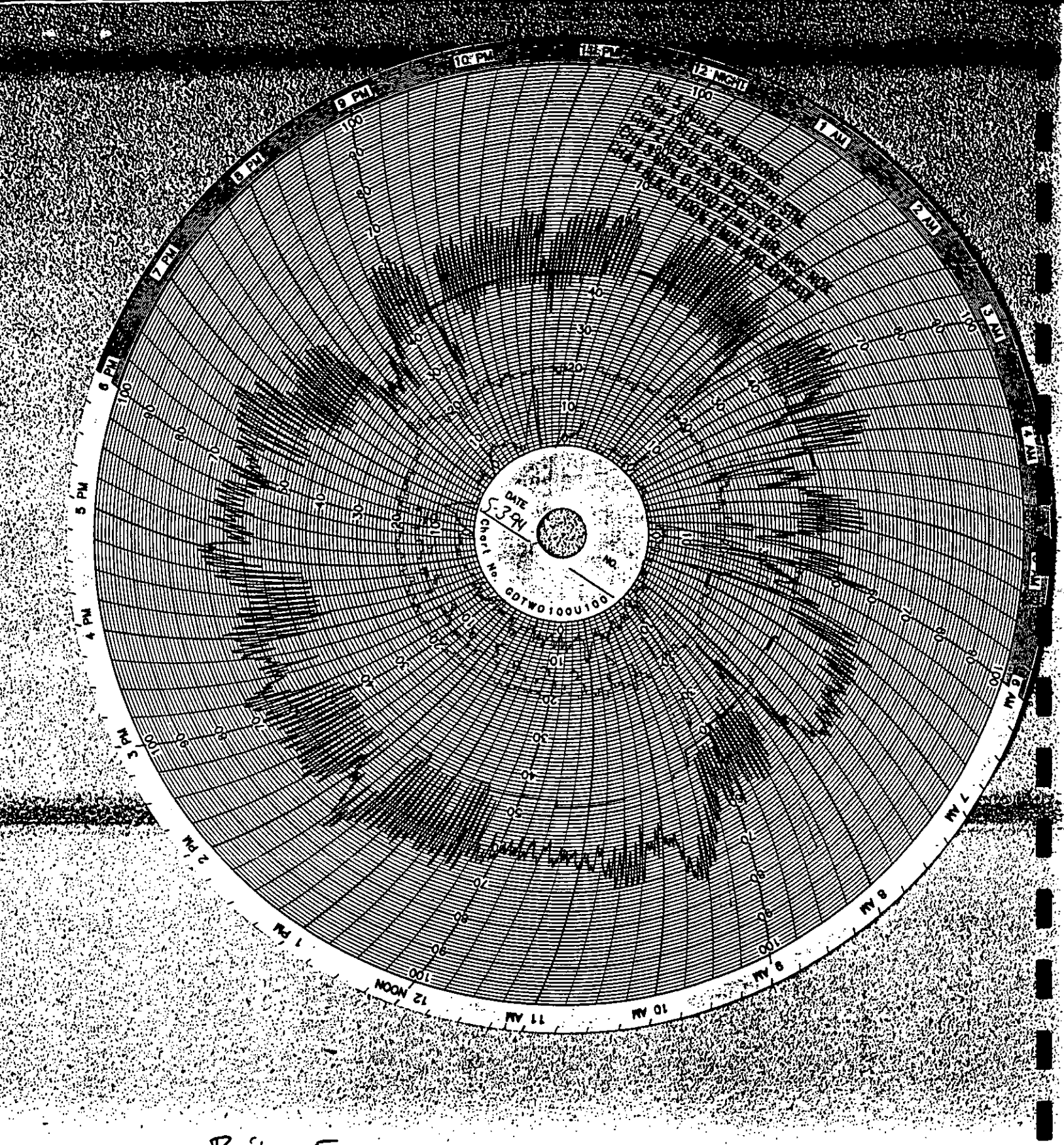
Plant Continuous Emission Monitoring System Data



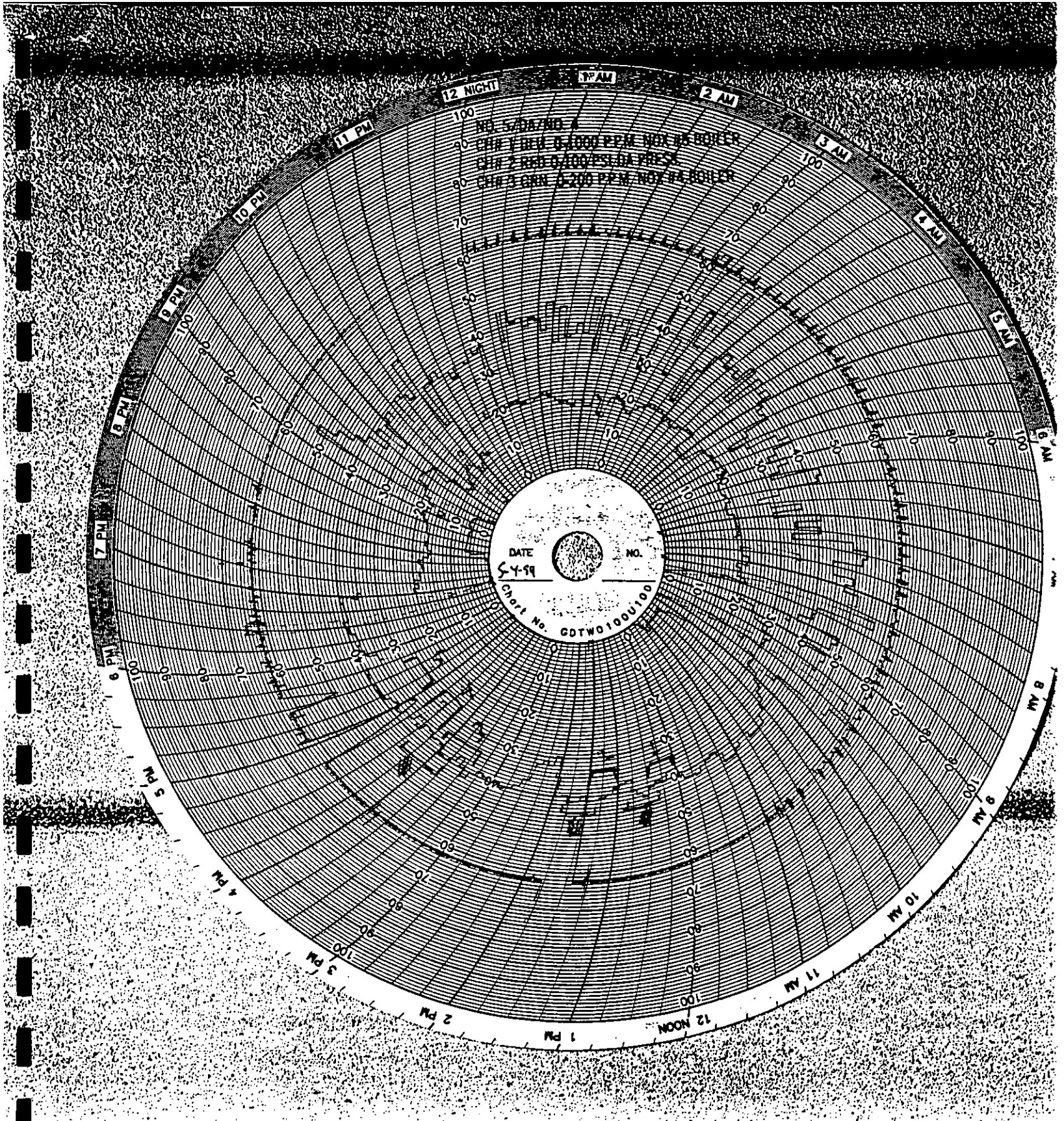
Boiler 5

RA Test Runs 5-3-94

NOx ppm vol. wet



Boiler 5
RA Test Runs 5-3-94
O_2 % vol. wet

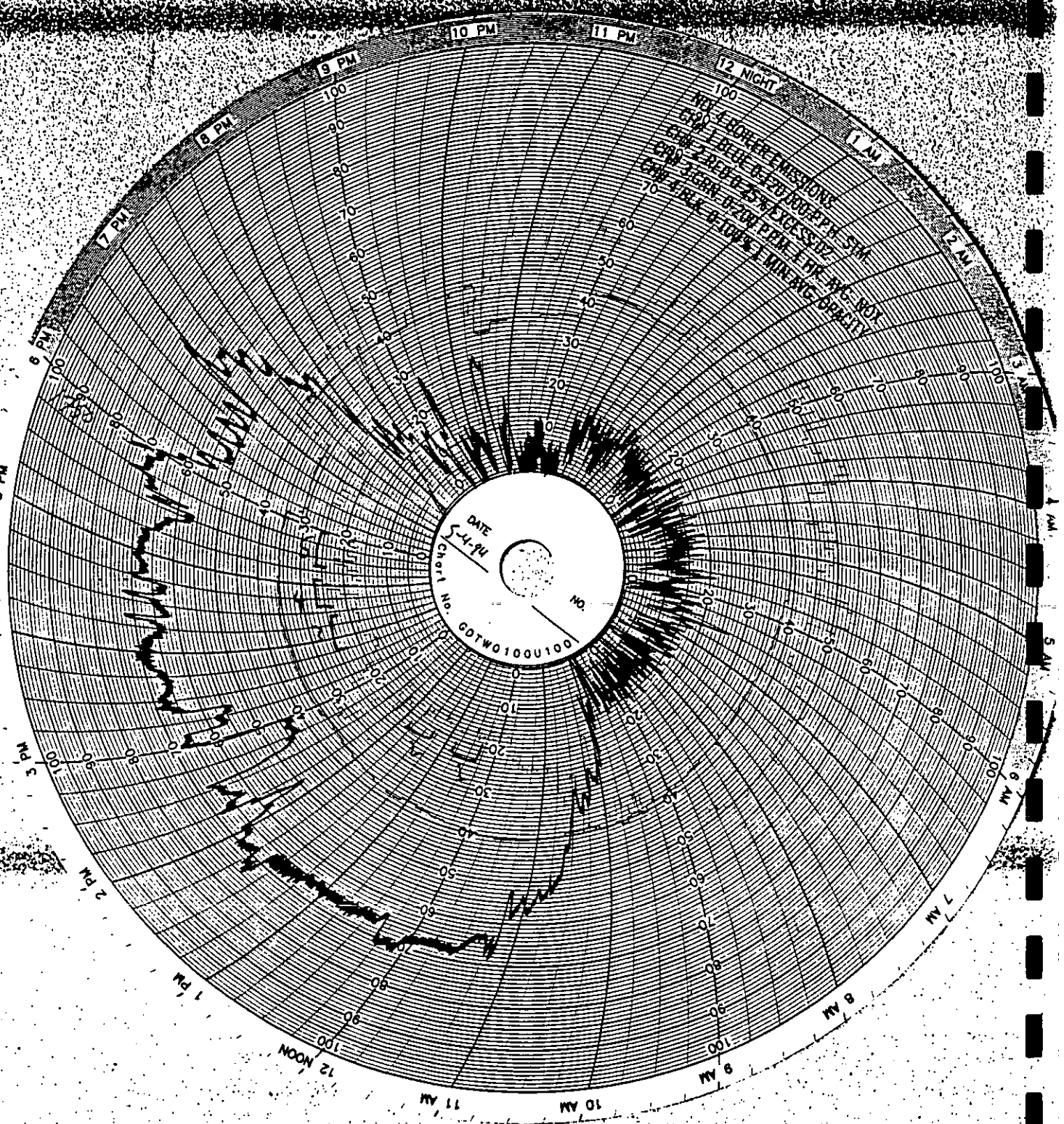


Green #4 NOx pen 20 min. behind time marks

Boiler 4

RA Test Runs 5-4-94

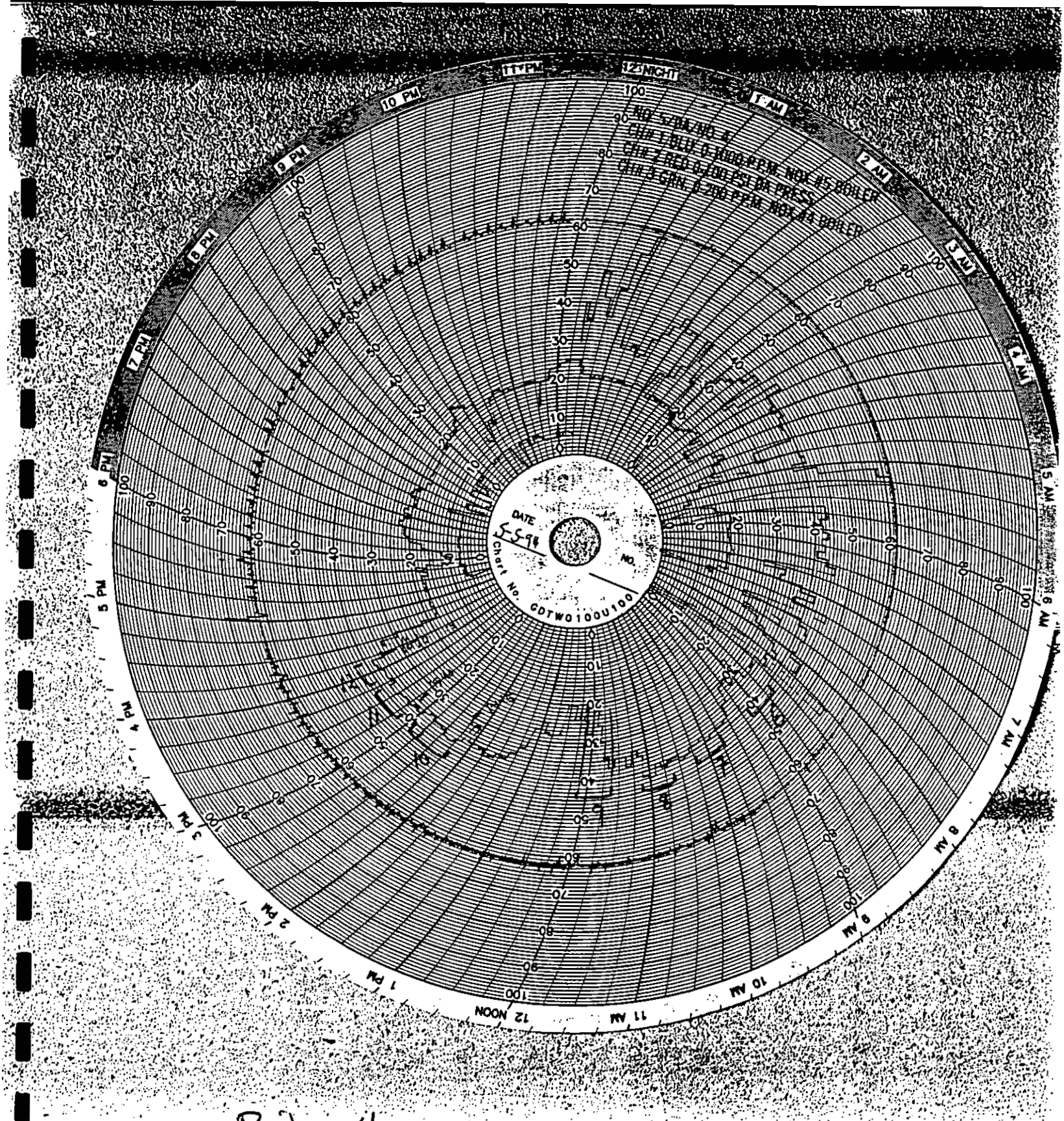
NOx ppm vol. wet



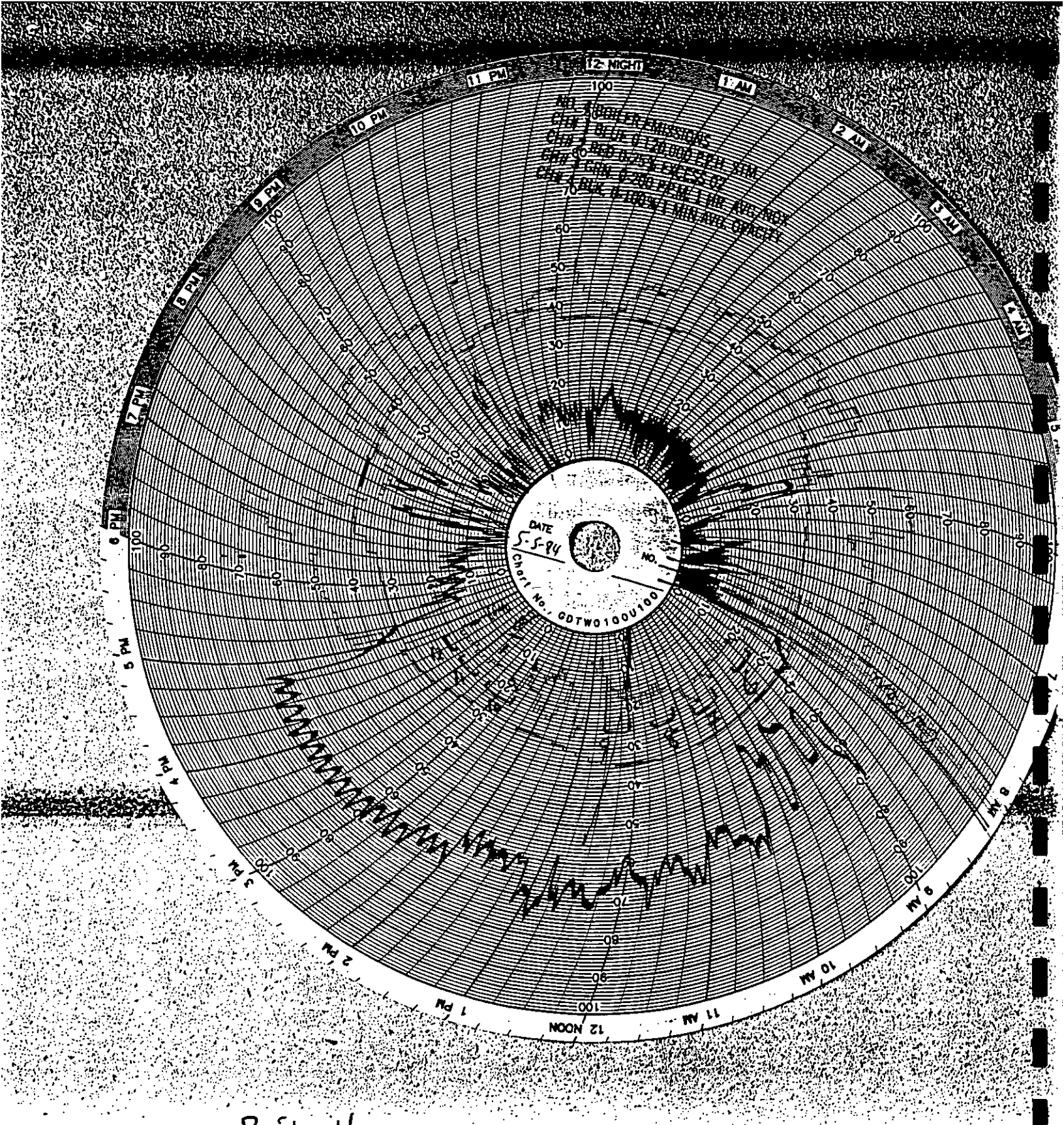
Boiler 4

RA Test Runs 5-4-94

O_2 % vol. wet



Boiler 4
RA test runs 5-5-94
NOx ppm vol. wet



Boiler 4
RA test runs 5-5-94
O_2 % vol, wet

7 S. Linden Avenue
South San Francisco, California 94080
Telephone: (415) 873-2055
Facsimile: (415) 952-1524

ALTAIR
Gases and Equipment, Inc.

MOORE BROS.
3524 51ST AVENUE
SACRAMENTO, CA 95823

Date: 12-01-93
Altair Order No.: 701448-00
Customer Order No.: 16625

Dear Sir:

This is your Certificate of Analysis for:

Cylinder Number	Mixture Components	Requested Composition	Certified Composition
K 840817	OXYGEN	3%	3.00%
	NITROGEN	97%	97.00%

Sincerely,

OPERATIONS SUPERVISOR

COA6MC

AGA
AGA Gas, Inc.

Specialists in Dependable gas mixtur
6421 Monclova Rd.
Maumee, Ohio 43537

SPECIALGAS

ANALYTICAL REPORT

Put up 11/15/93

BRANCH:MOORE BROTHERS PROD: 3910205- 0 PROD CODE: 527000031 DATE:03/14/91

CUSTOMER: P.O.#: 002570

CYL: 1 SIZE: 031 BLEND TYPE: PP TOLERANCE: 2% ANALYSIS

MIXTURE REQUESTED: 550 PPM NO/N2 CERTIFIED

ANALYSIS METHOD: CHEMILUMINESCENCE

ANALYSIS:
COMPRESSED GAS N.O.S.
577 PPM NITRIC OXIDE
BAL. NITROGEN

CYL #: CC84593 LOT #: 0311CT

BLENDER: CB SHIP CODE: NON-FLAMMABLE U.N.#: 1956

CGA: 660 ANALYST: _____

AGA Gas, Inc.

Specialists in Dependable gas mixtures

6421 Monclova Rd.
Maumee, Ohio 43537

SPECIALGAS

ANALYTICAL REPORT

BRANCH:MOORE BROTHERS PROD: 7930116- 0 PROD CODE: 545400031 DATE:07/19/93

CUSTOMER: REF. P.O. 16229 P.O.#:

CYL: 1 SIZE: 031 BLEND TYPE: PP TOLERANCE: 2% ANALYSIS

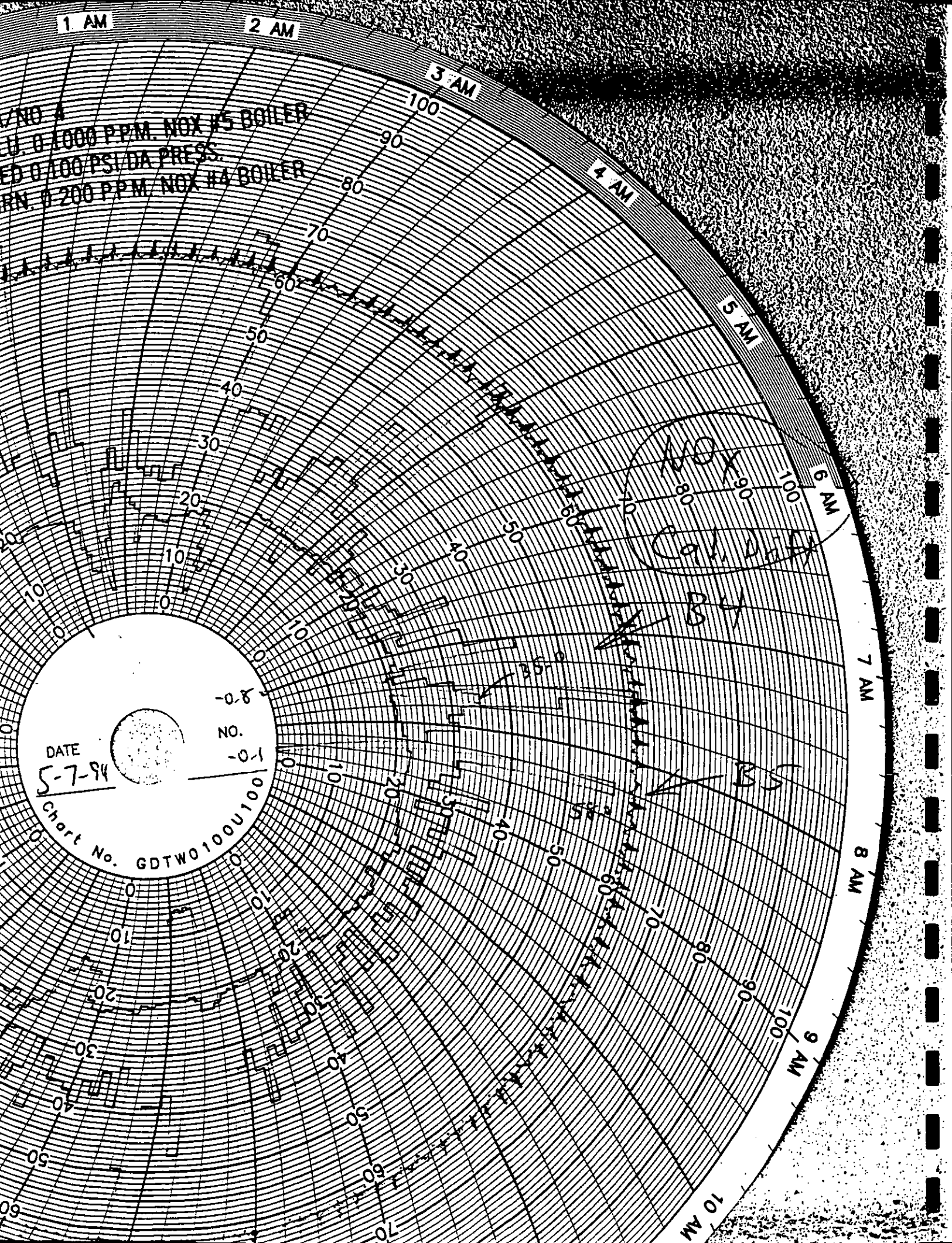
MIXTURE REQUESTED: 75 PPM NO/BAL. N2 CERTIFIED

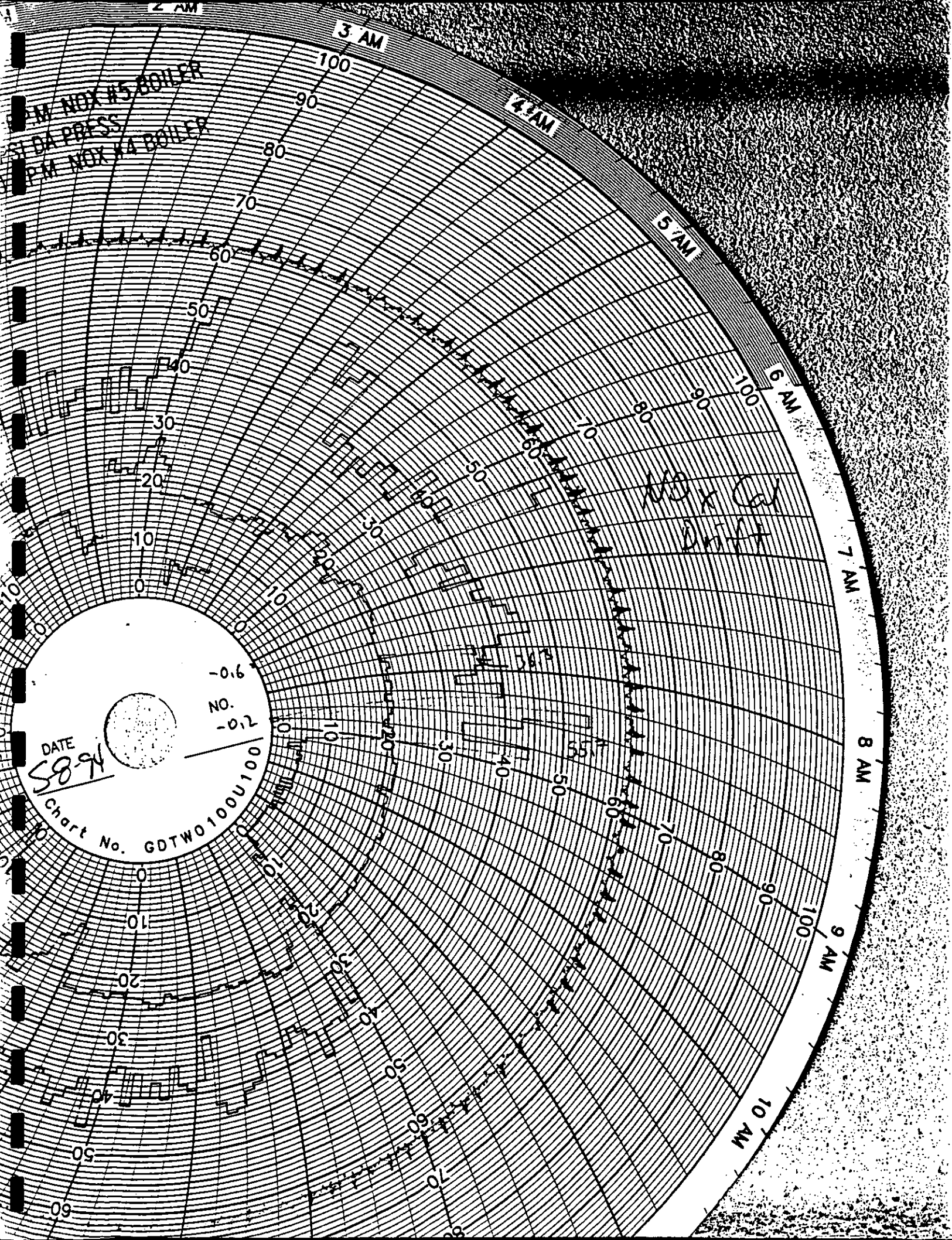
ANALYSIS METHOD: CHEMILUMINSCENCE

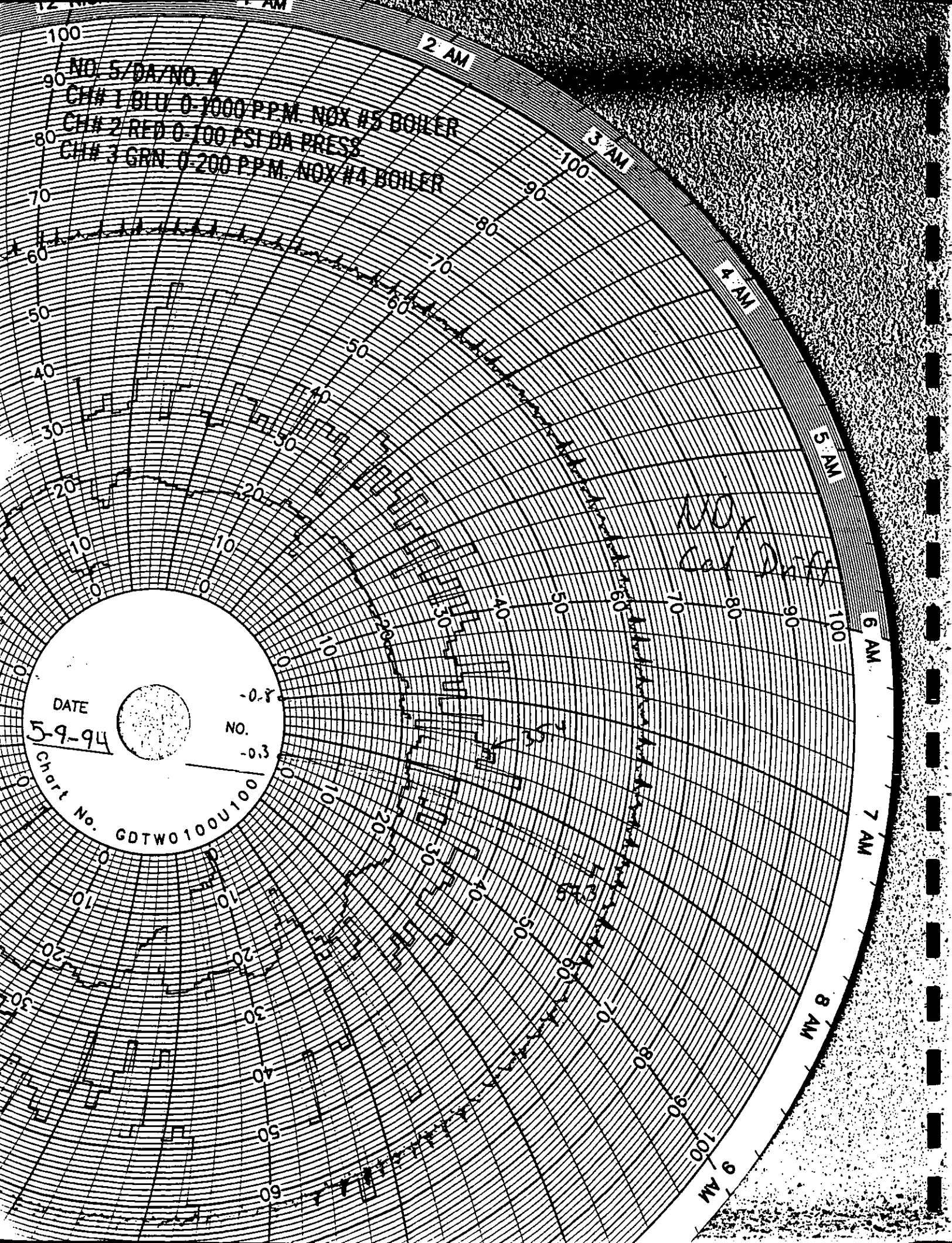
Analysis
COMPRESSED GAS N.O.S. CYL #: CC7463 LOT #: 0716BC
71.9 PPM NITRIC OXIDE
BAL. NITROGEN

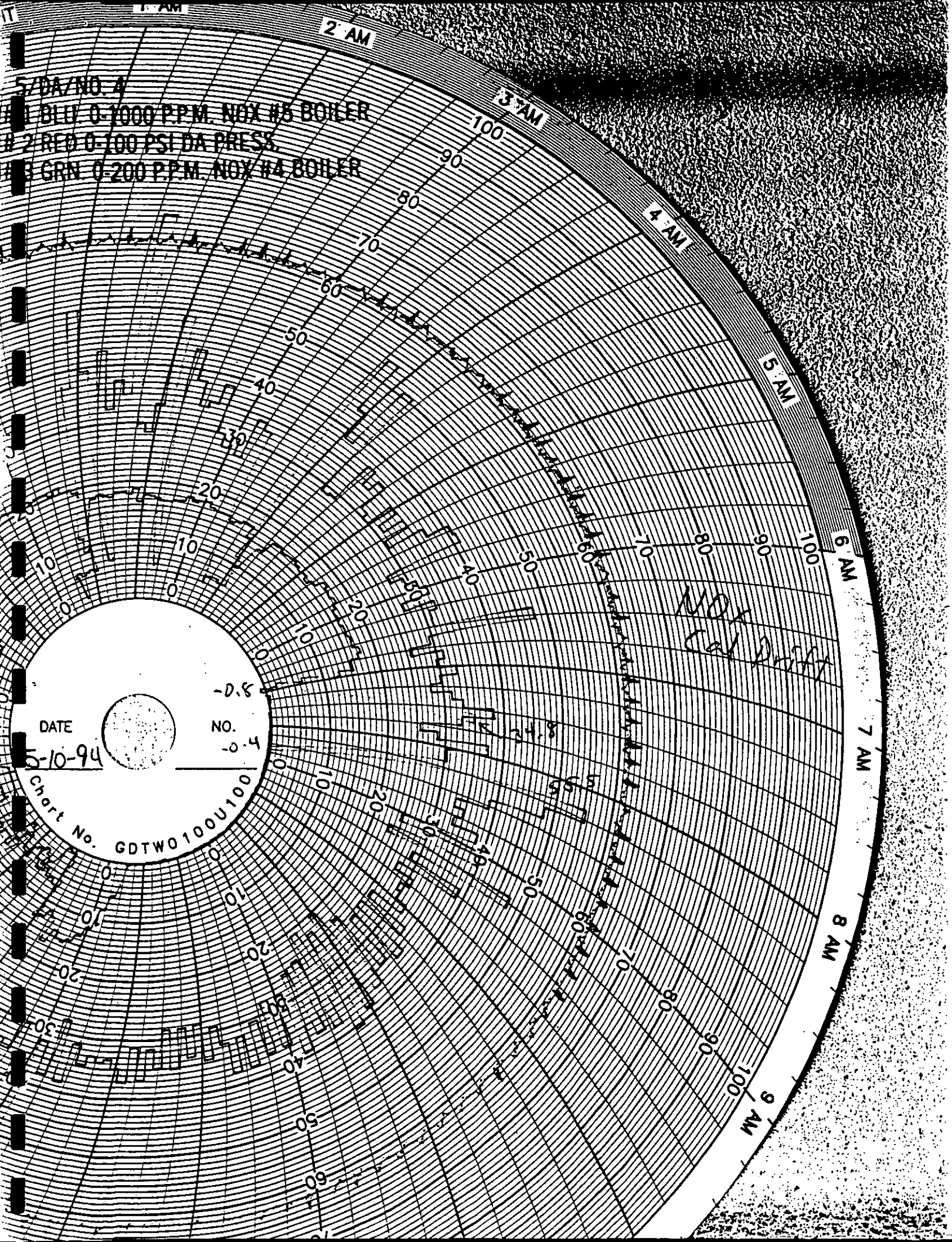
BLENDER: DB SHIP CODE: NON-FLAMMABLE U.N.#: 1956

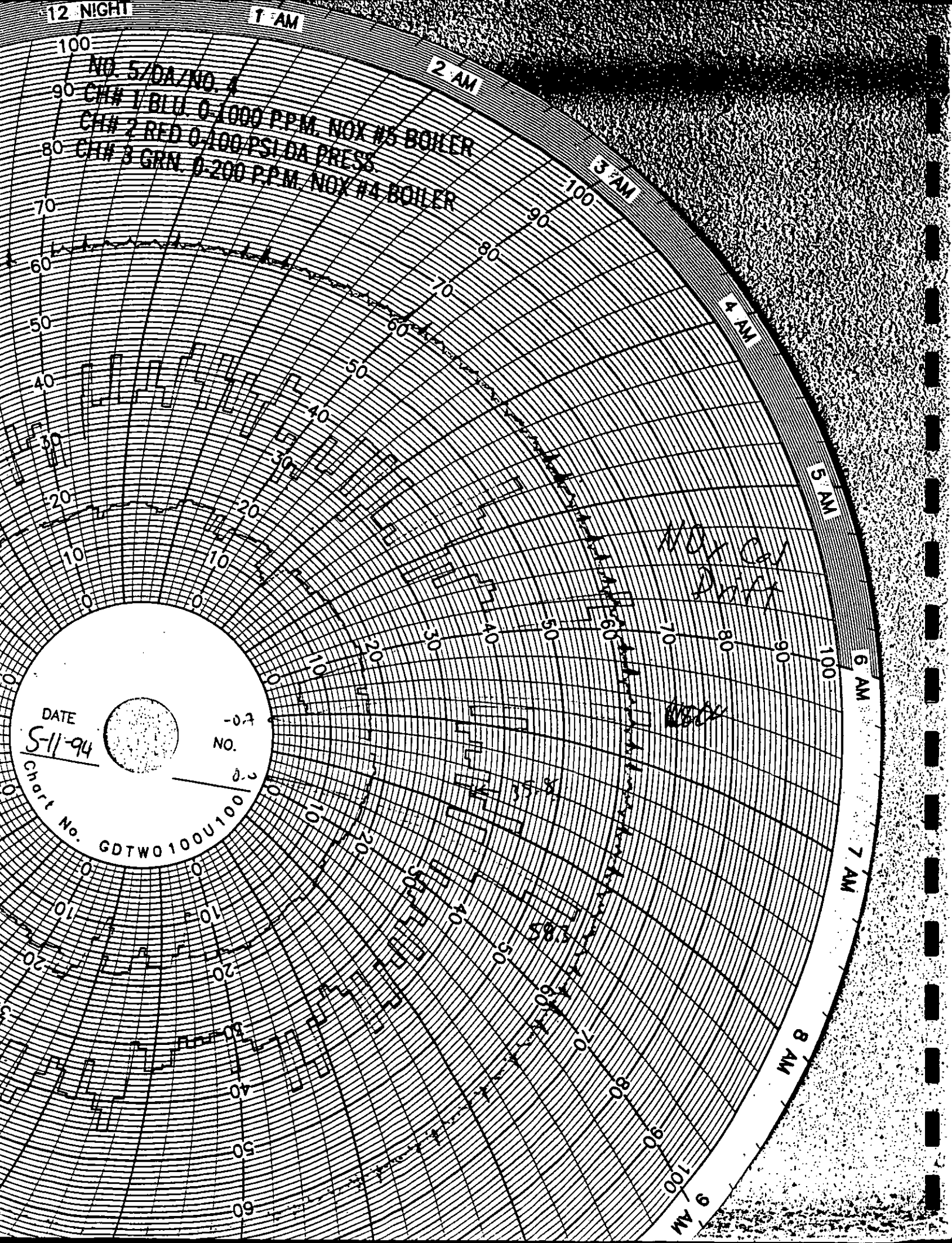
CGA: 660 ANALYST:

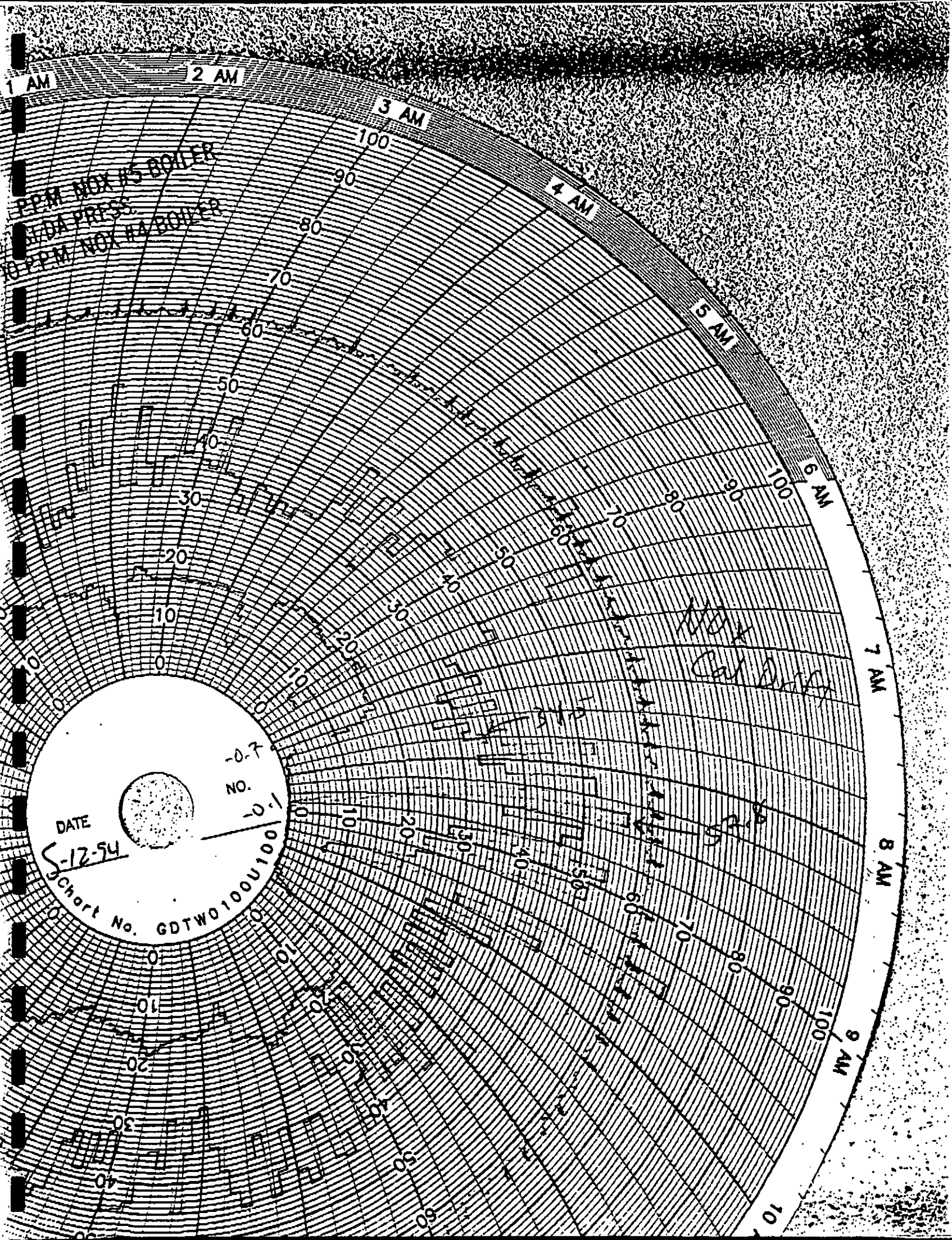

1 AM
2 AM
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
9 AM
10 AM
/NO #
U. 0 TO 1000 P.P.M. NOX #5 BOILER
ED 0 TO 100 PSI DA PRESS.
RN. 0 TO 200 P.P.M. NOX #4 BOILER
NOx
Cal. Data
#4 B
#5 B
DATE
5-7-94
NO.
-0.8
-0.1
Chart No. GDTW0100U100

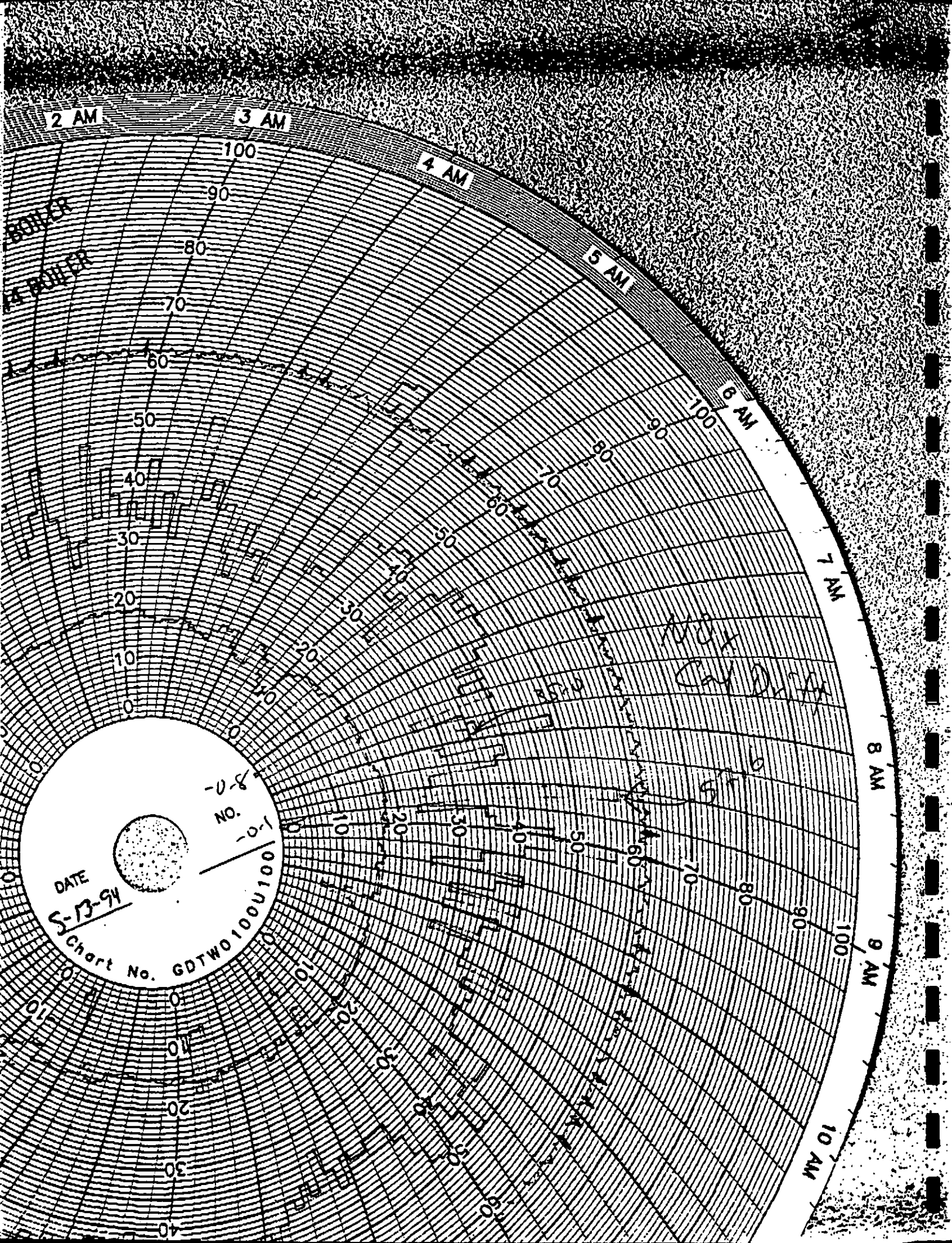

2 AM
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
9 AM
10 AM
PPM NOX #5 BOILER
STDA PRESS
PPM NOX #4 BOILER
-0.6
NO.
-0.2
DATE
5-8-94
Chart No. GDTW0100U100
MW Gen
Draft

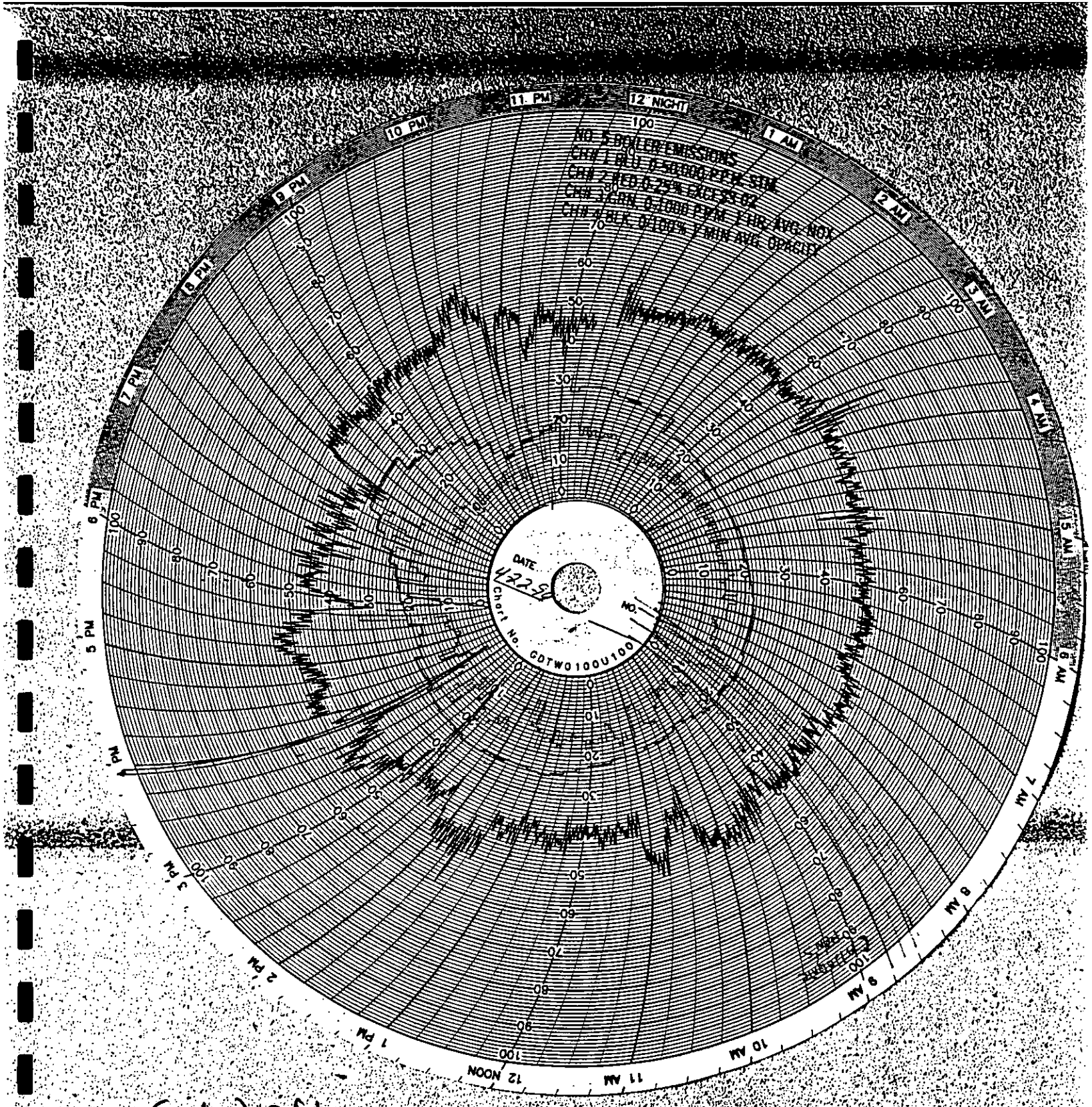

NO. 5/DA/NO. 4
CH# 1 BLU. 0-1000 P.P.M. NOX #5 BOILER
CH# 2 RED 0-100 PSI DA PRESS
CH# 3 GRN. 0-200 P.P.M. NOX #4 BOILER
12 AM
1 AM
2 AM
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
9 AM
DATE
5-9-94
NO.
Chart No. GDTW0100U100
NOx Cal Drift


5/DA/NO. 4
#1 BLU 0-1000 P.P.M. NOX #5 BOILER
2 RED 0-100 PSI DA PRESS.
#3 GRN 0-200 P.P.M. NOX #4 BOILER
1 AM
2 AM
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
9 AM
NOx Cal Drift
DATE
5-10-94
NO.
-0.4
Chart No. GDTW0100U100


12 NIGHT
1 AM
2 AM
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
9 AM
NO. 5/DA/NO. 4
CH# 1 BLU. 0-1,000 P.P.M. NOX #5 BOILER
CH# 2 RED 0-100 PSI DA PRESS.
CH# 3 GRN. 0-200 P.P.M. NOX #4 BOILER
DATE
5-11-94
NO.
Chart No. GDTW0100U100
Mr Cal Draft


1 AM
2 AM
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
9 AM
10
PPM NOX #5 BOILER
& DA PRESS.
10 PPM NOX #4 BOILER
DATE
5-12-94
NO.
-0.7
-0.1
Chart No. GDTW0100U100

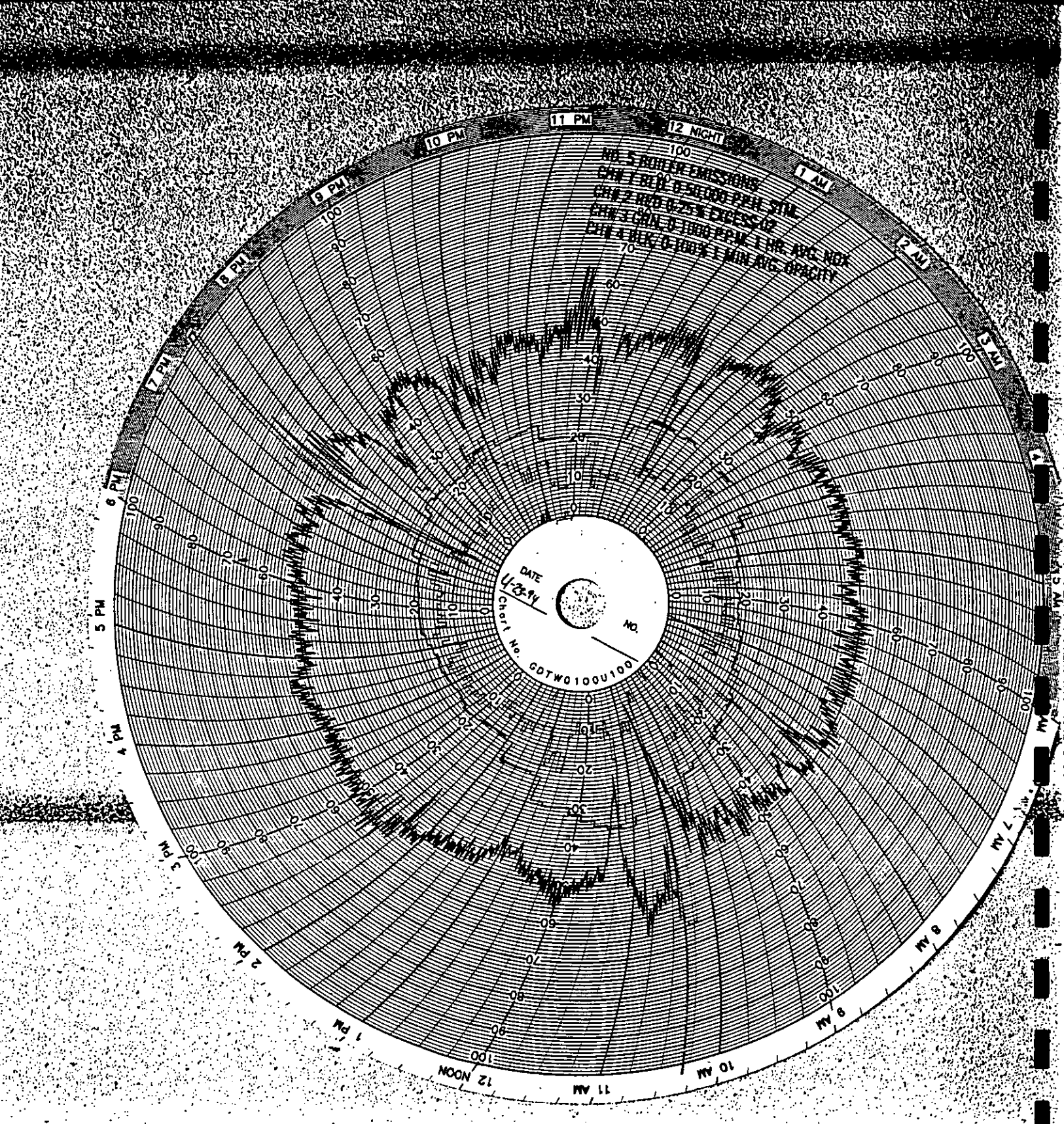

2 AM
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
9 AM
10 AM
BOILER
A BOILER
DATE
5-13-94
Chart No. GDTW0100U100
NO.
-0-1
-0-8



Cal-Drift

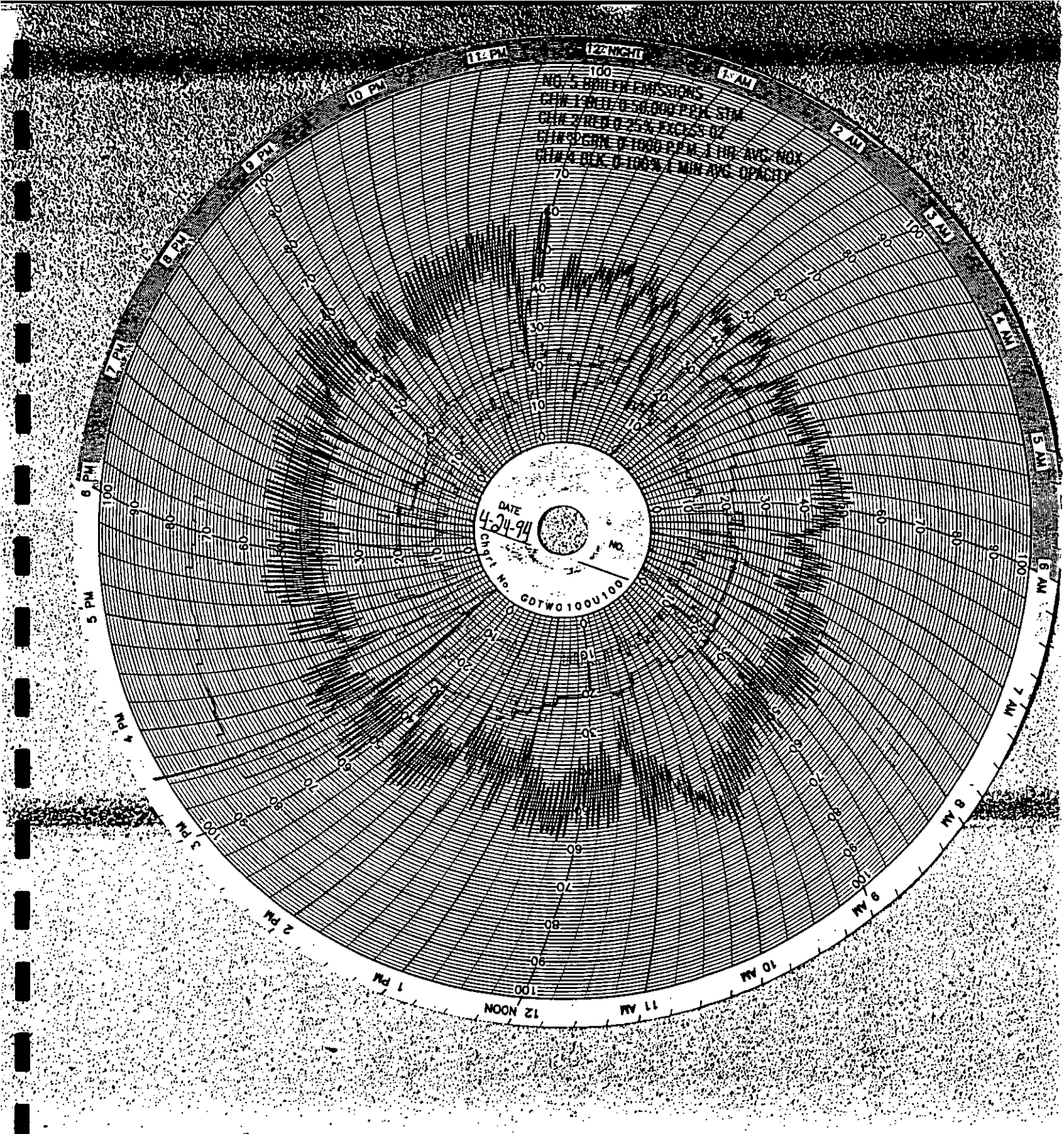
Boiler 5

	% F.S. Low	% F.S. High	(Cal. Value (7% opacity)
Opacity cal @ 0900 AM	-0.5	36.5	
O_2 cal @ 0820 AM	12.2 ($3.0\% O_2$)	85.2 ($20.9\% O_2$)	



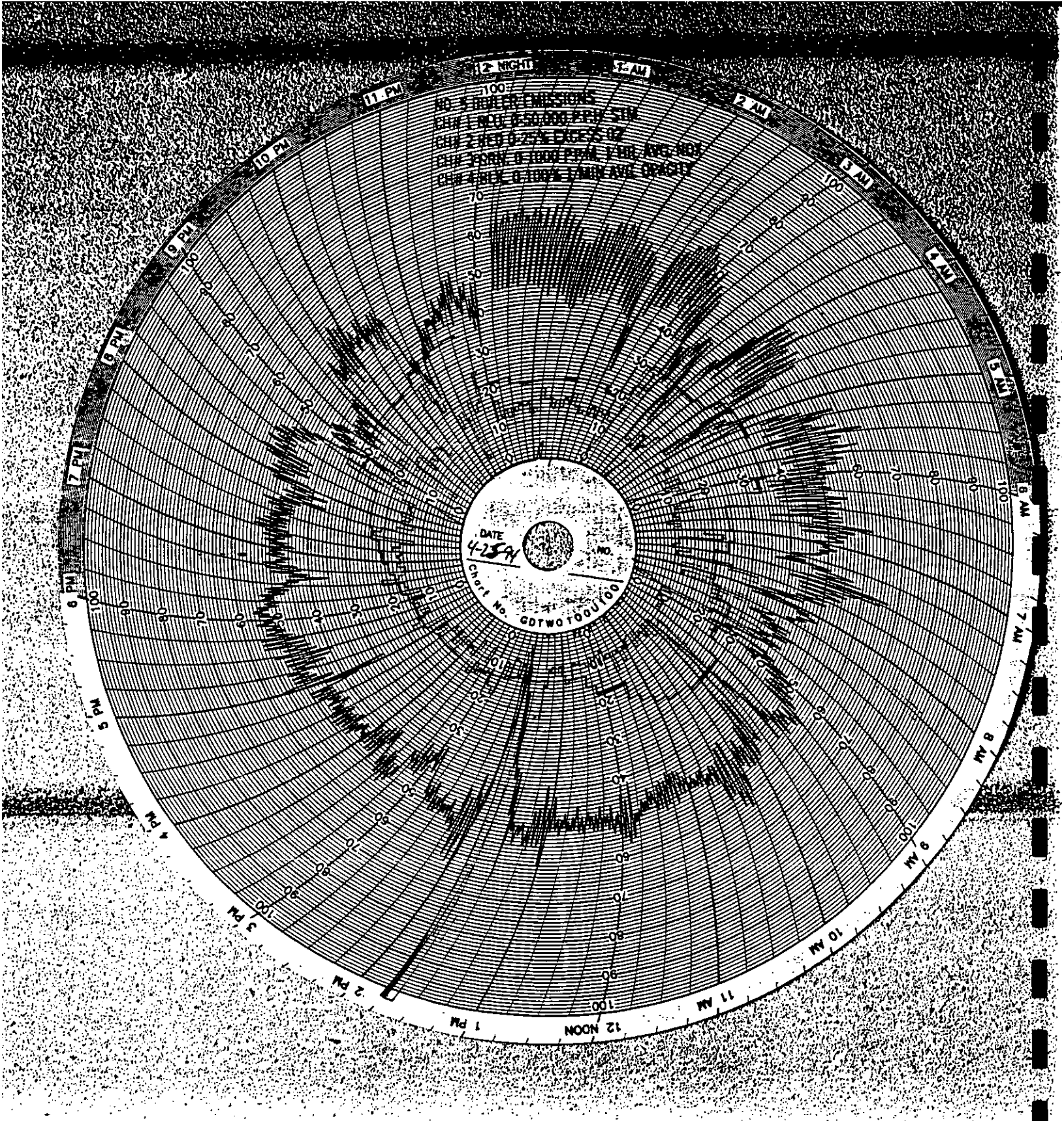
Boiler 5

	% FS	
	Low	High
Opacity	0.0	37.0
O_2	12.0	84.8



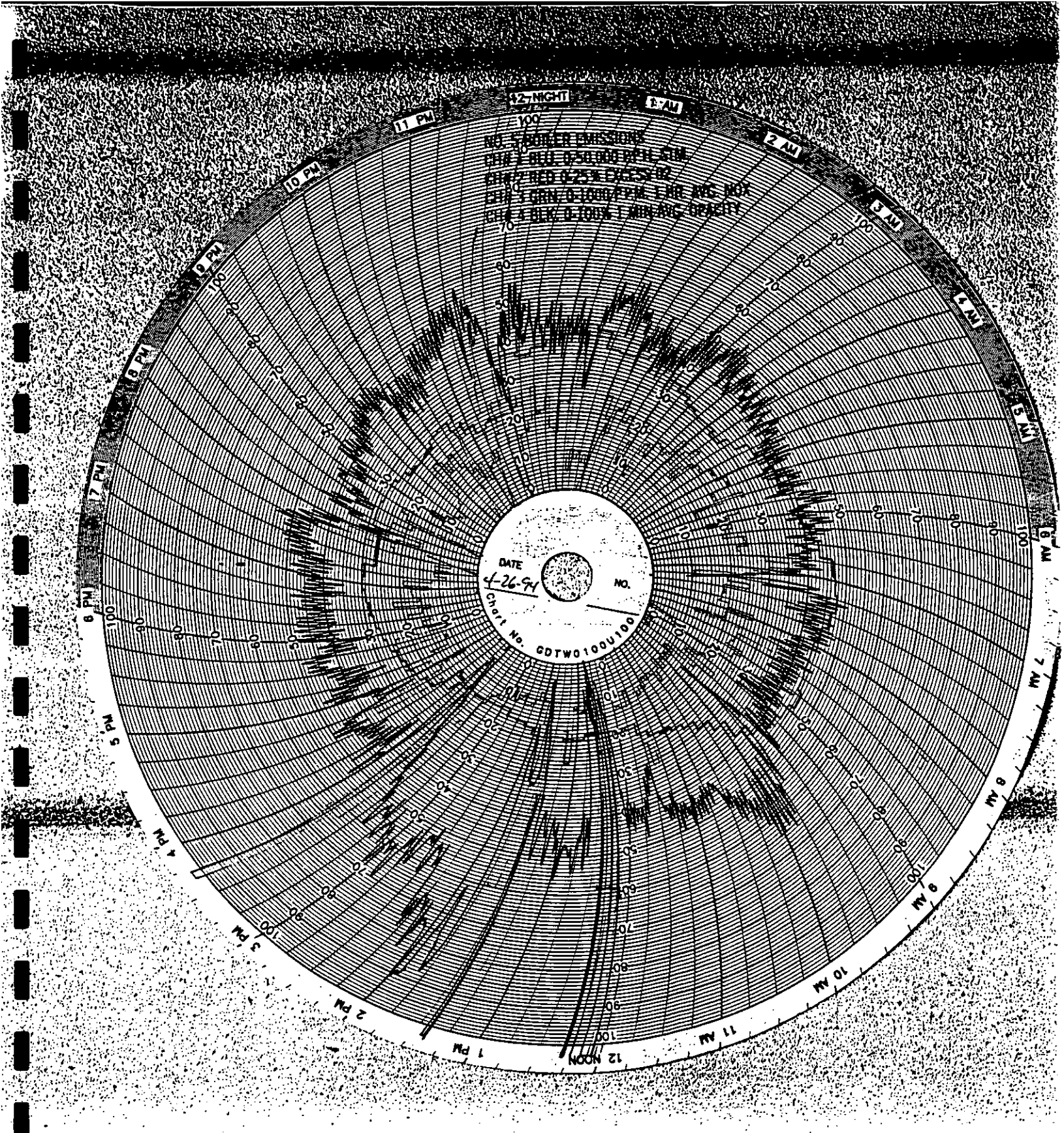
Boiler 5

	% FS	
	Low	High
Opacity	0.0	37.0
O_2	11.8	83.6



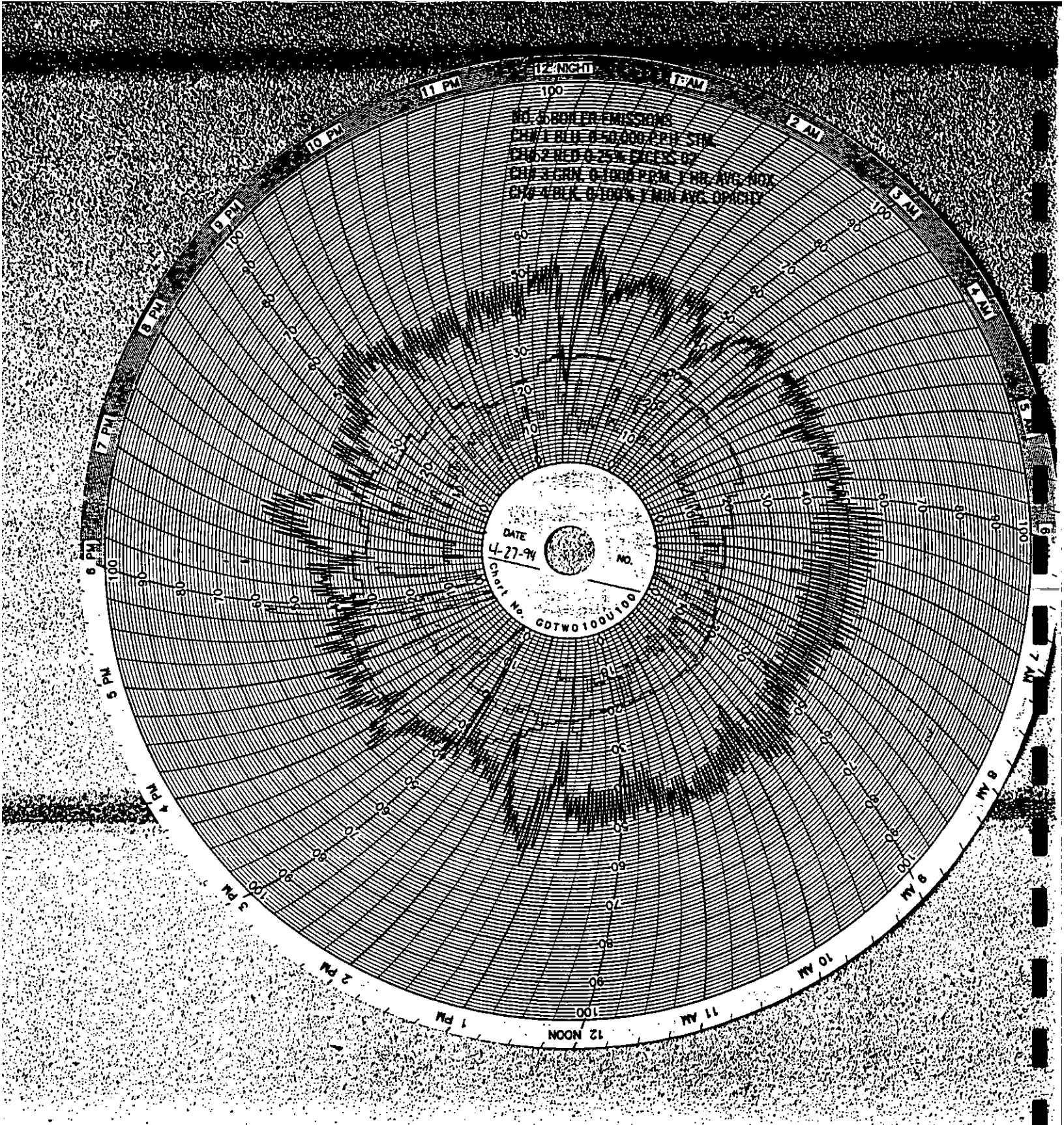
Boiler 5

	% FS	
	Low	High
Opacity	0.0	37.5
O_2	12.2	84.0



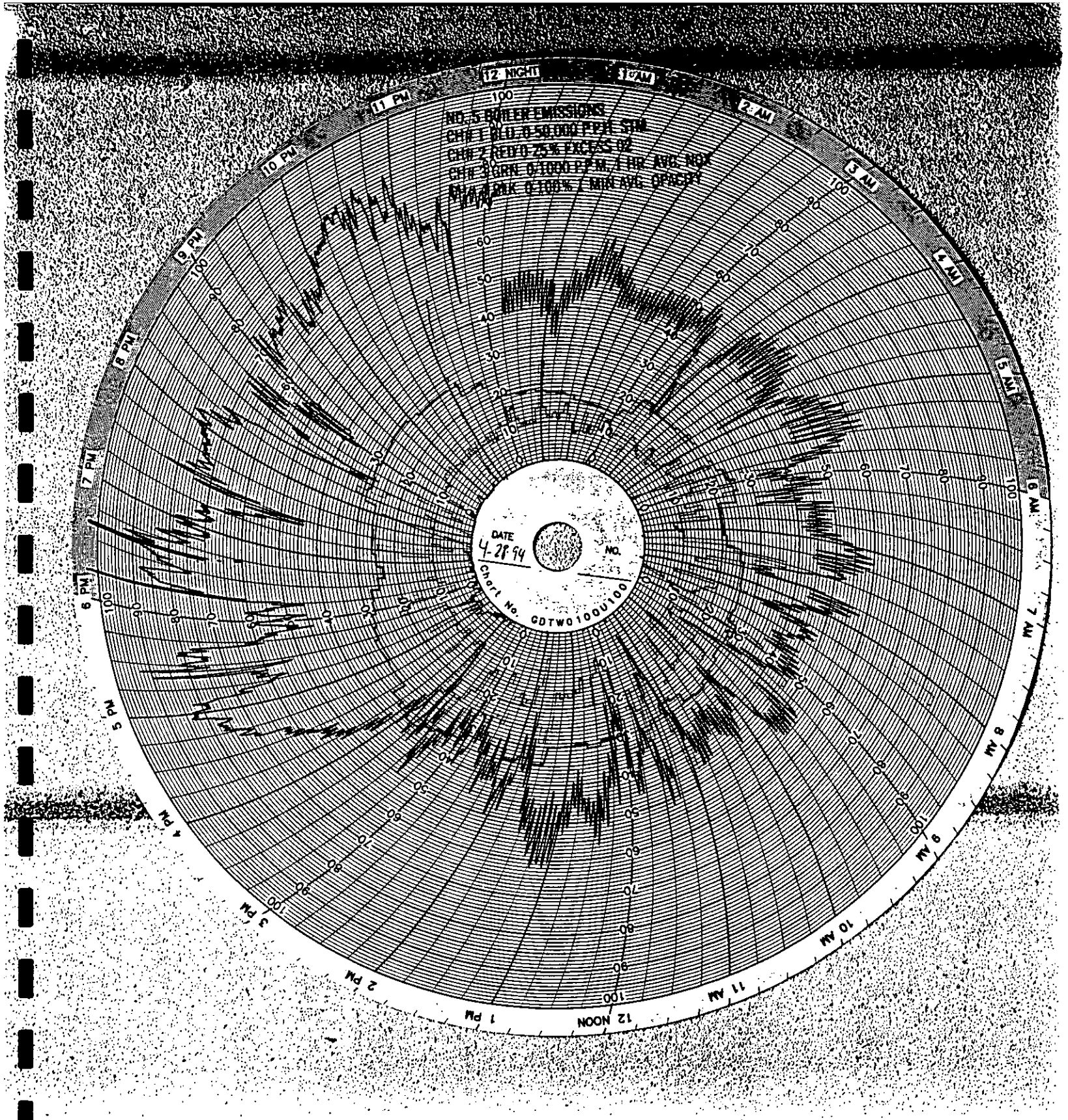
Boiler 5

	% FS	
	Low	High
Opacity	0.0	37.0
O_2	11.7	83.1



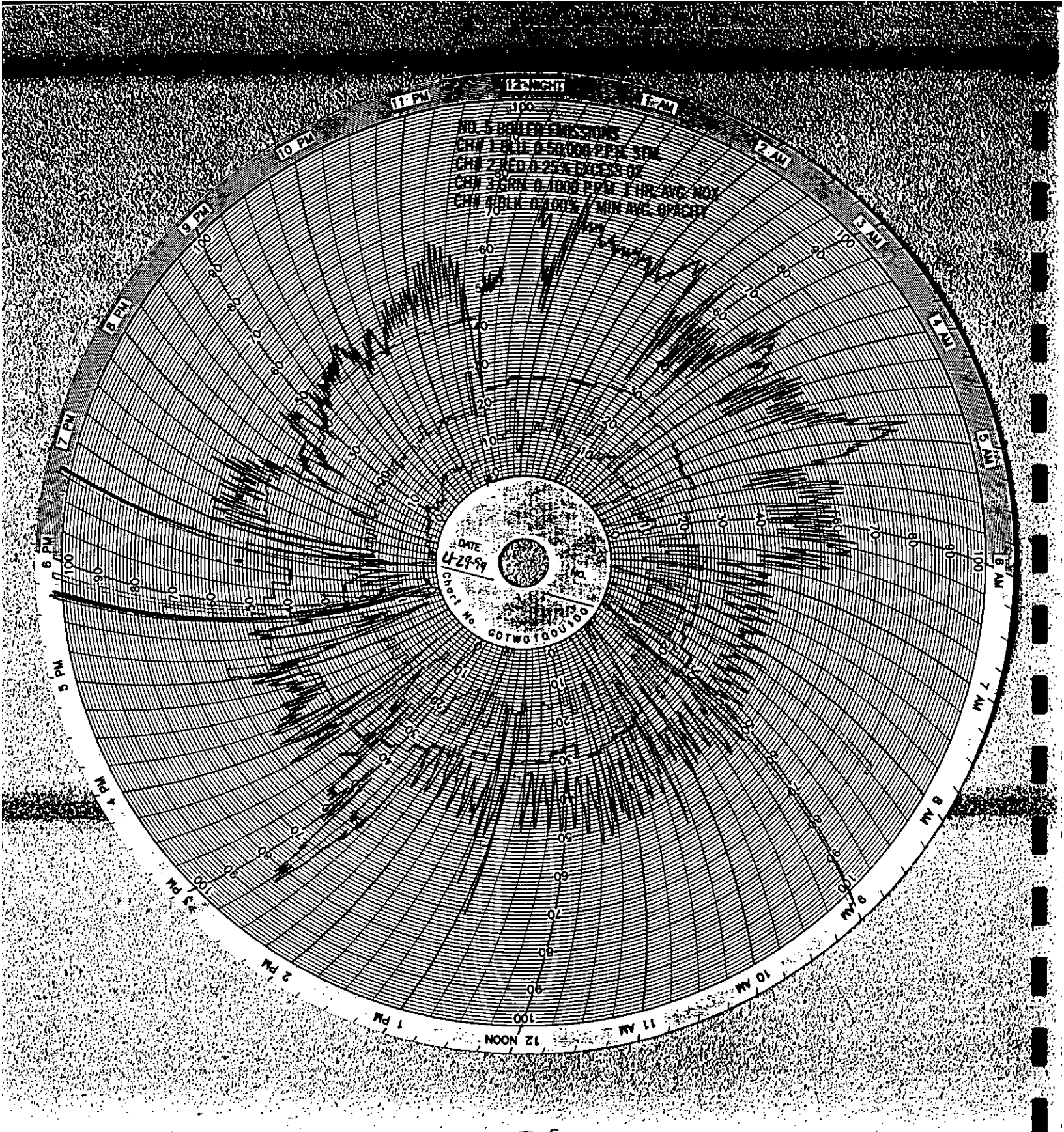
Boiler 5

	% FS	
	Low	High
Opacity	-0.2	36.8
O_2	11.6	13.6



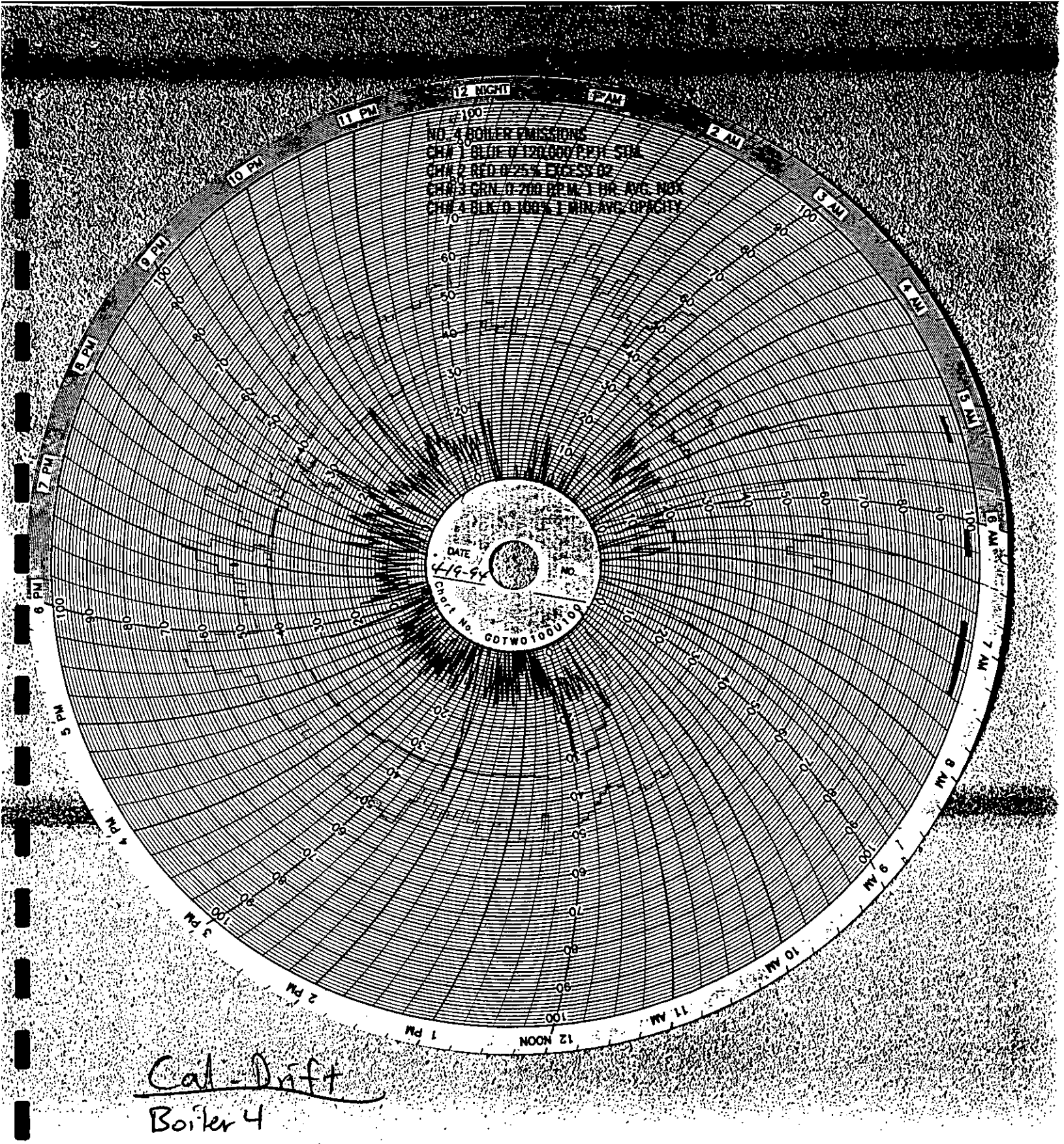
Boiler 5

	9. FS	
	Low	High
Opacity	-0.1	36.8
O_2	11.8	83.8



Boiler 5

	% FS	
	Low	High
Opacity	0.0	36.8



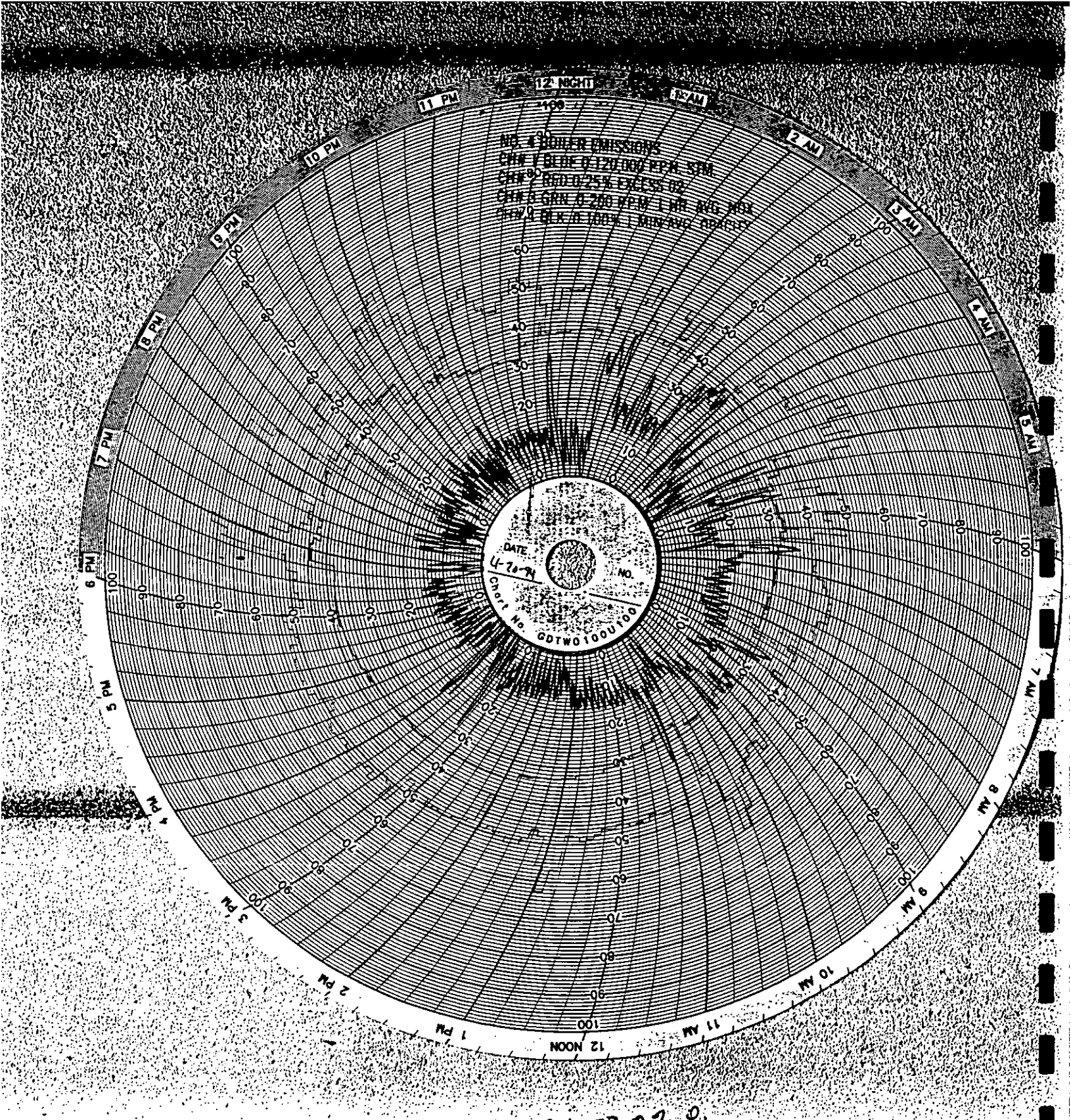
Cal - Drift

Boiler 4

~~Opacity Cal~~

Opacity Cal @ 840 PM (42.8% F.S.) Zero @ (0.0 % F.S.)

(Opacity Cal. filter 9%)



Boiler 4

O_2 Cal. @ 810 AM

Opacity

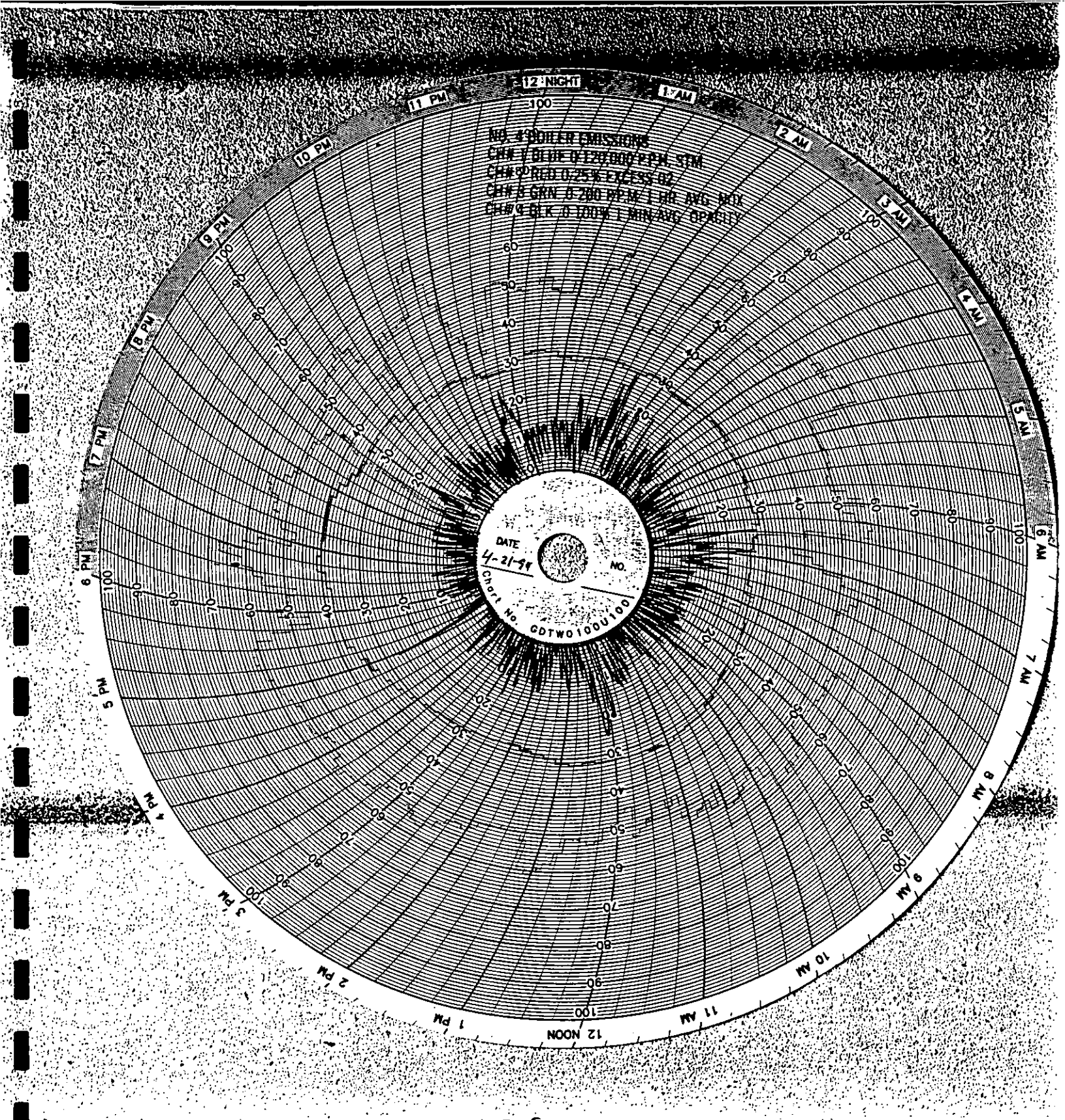
Low Cal. = 3.0% O_2

~~Zero~~ 12.4% F.S.

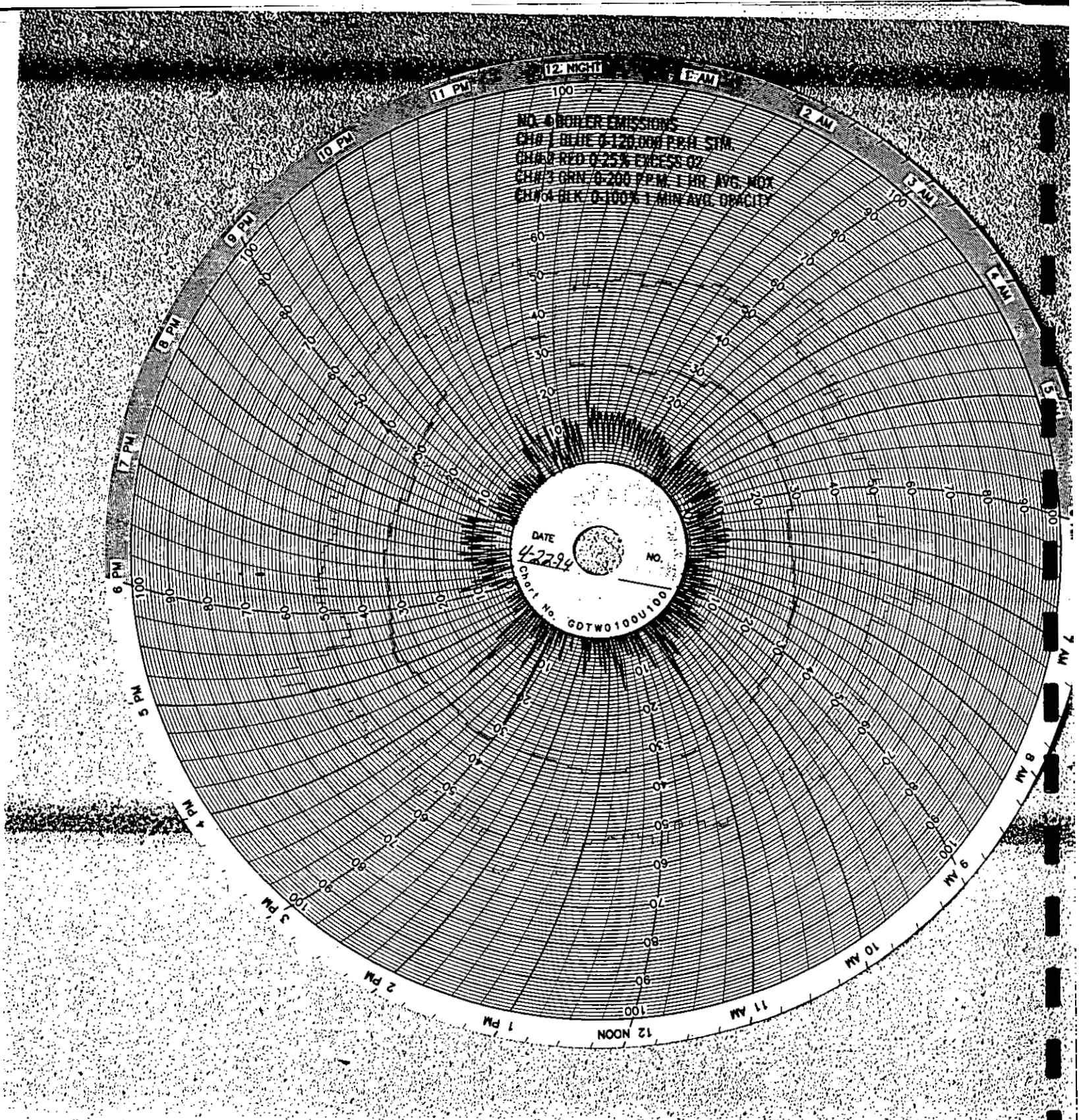
Cal. = 20.9% O_2

83.9% F.S.

Zero	Cal
0.0	42.6



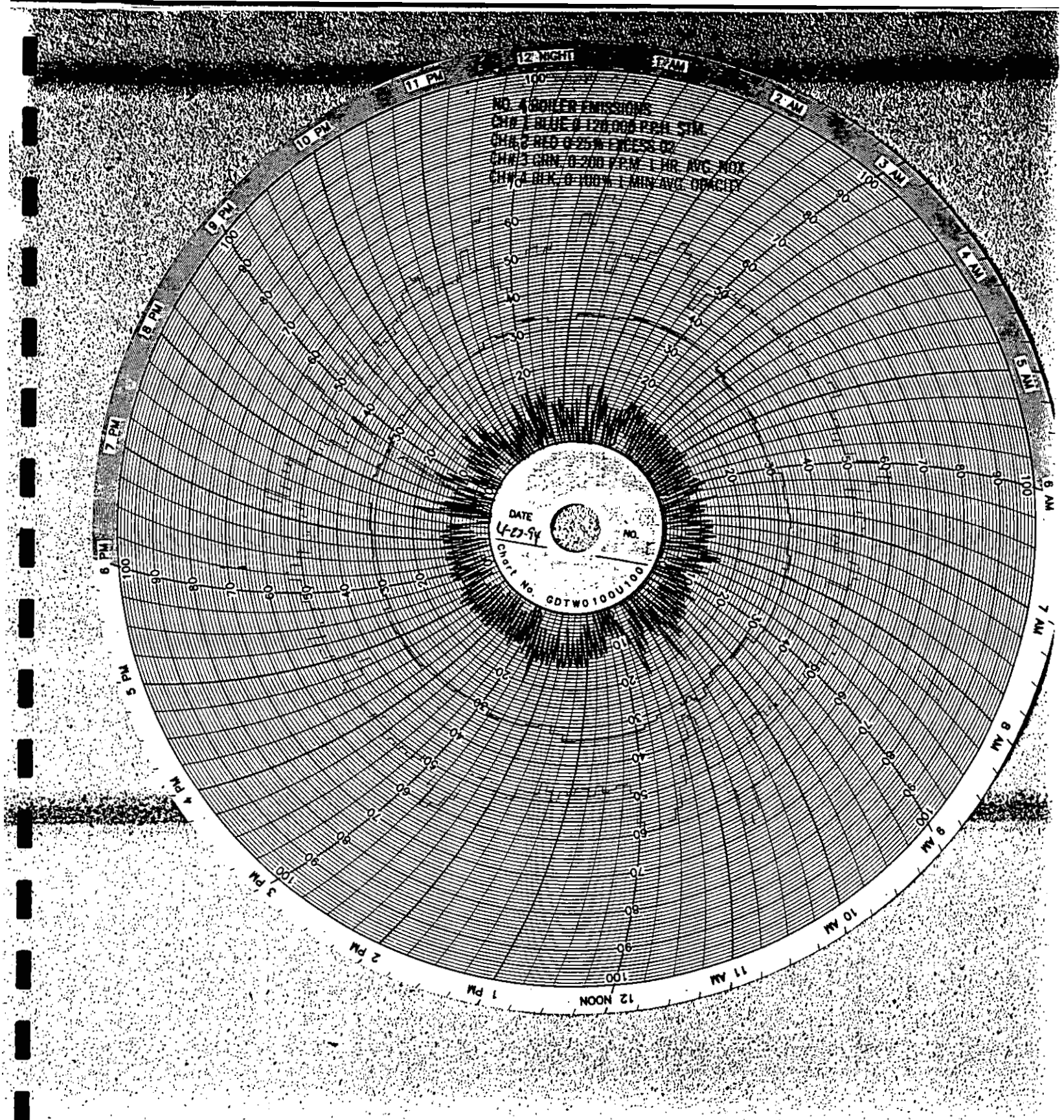
Boiler 4	% F.S.	
	Low	Hi
O_2	12.4	84.2
Opacity	0.0	43.0



Boiler 4

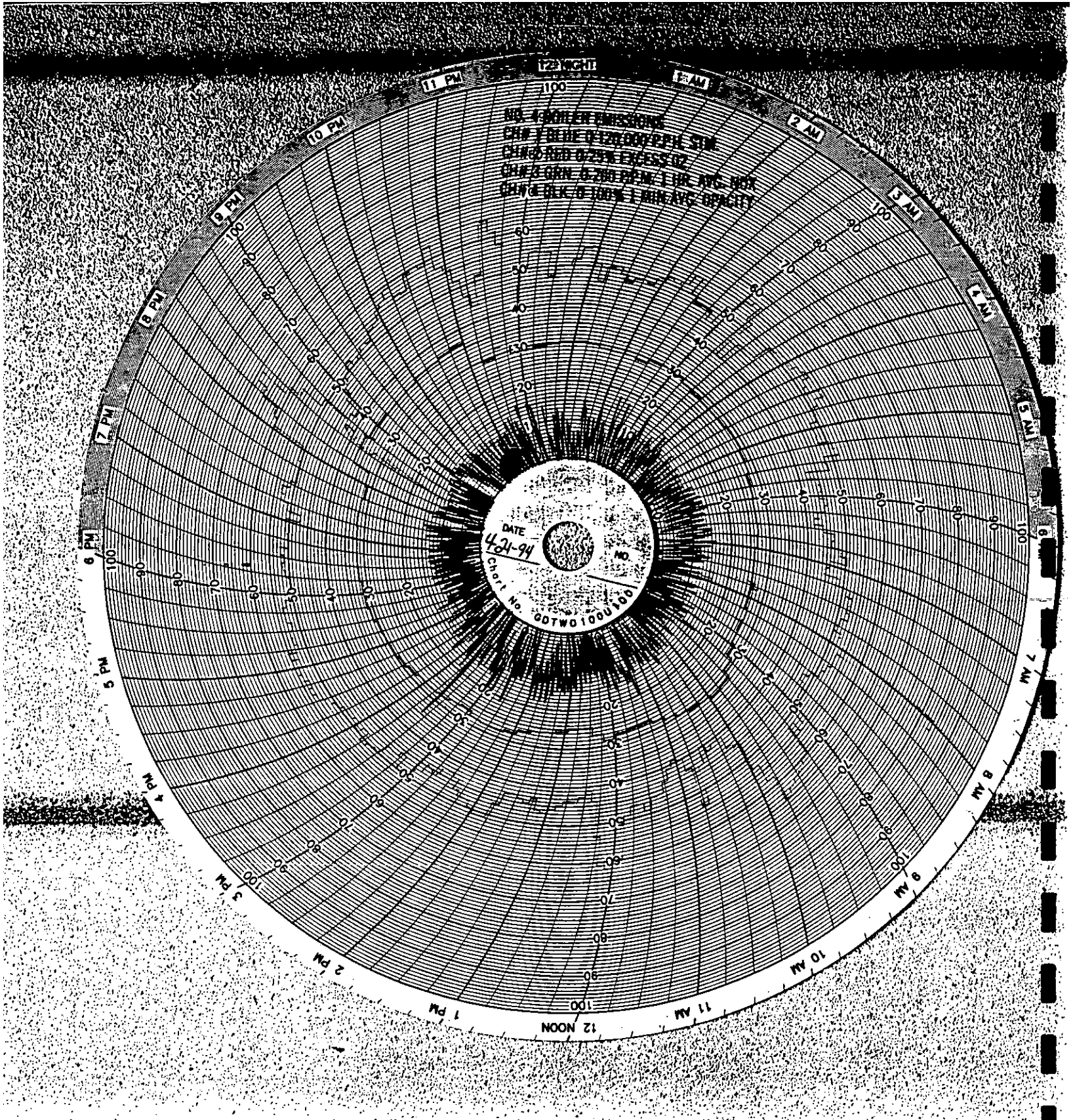
% F. S.

	Low	High
O_2	12.4	84.0
Opacity	0.0	42.5



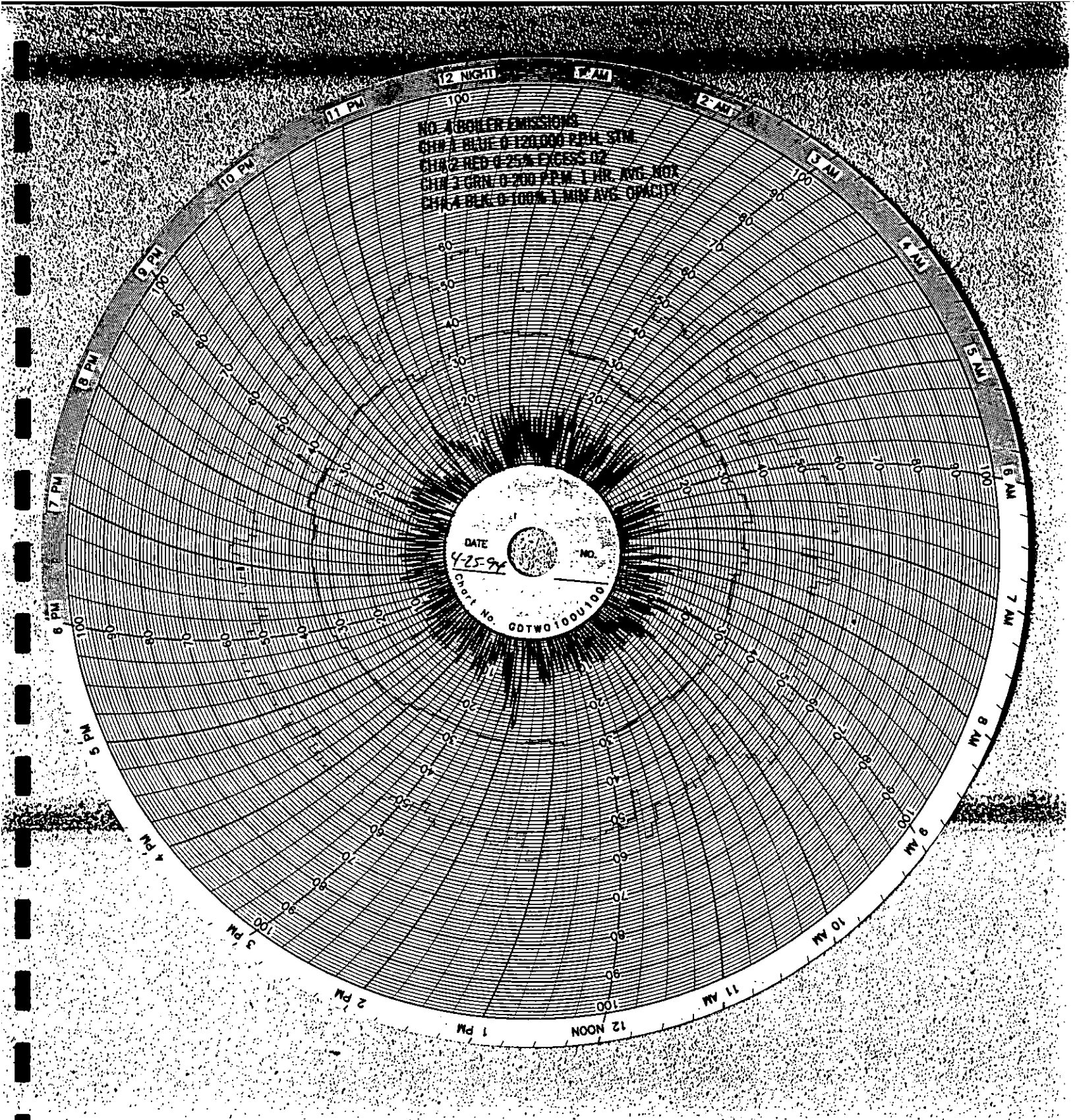
Boiler 4

	9. F.S.	
	Low	High
O_2	12.2	84.0
Opacity	0.0	42.7



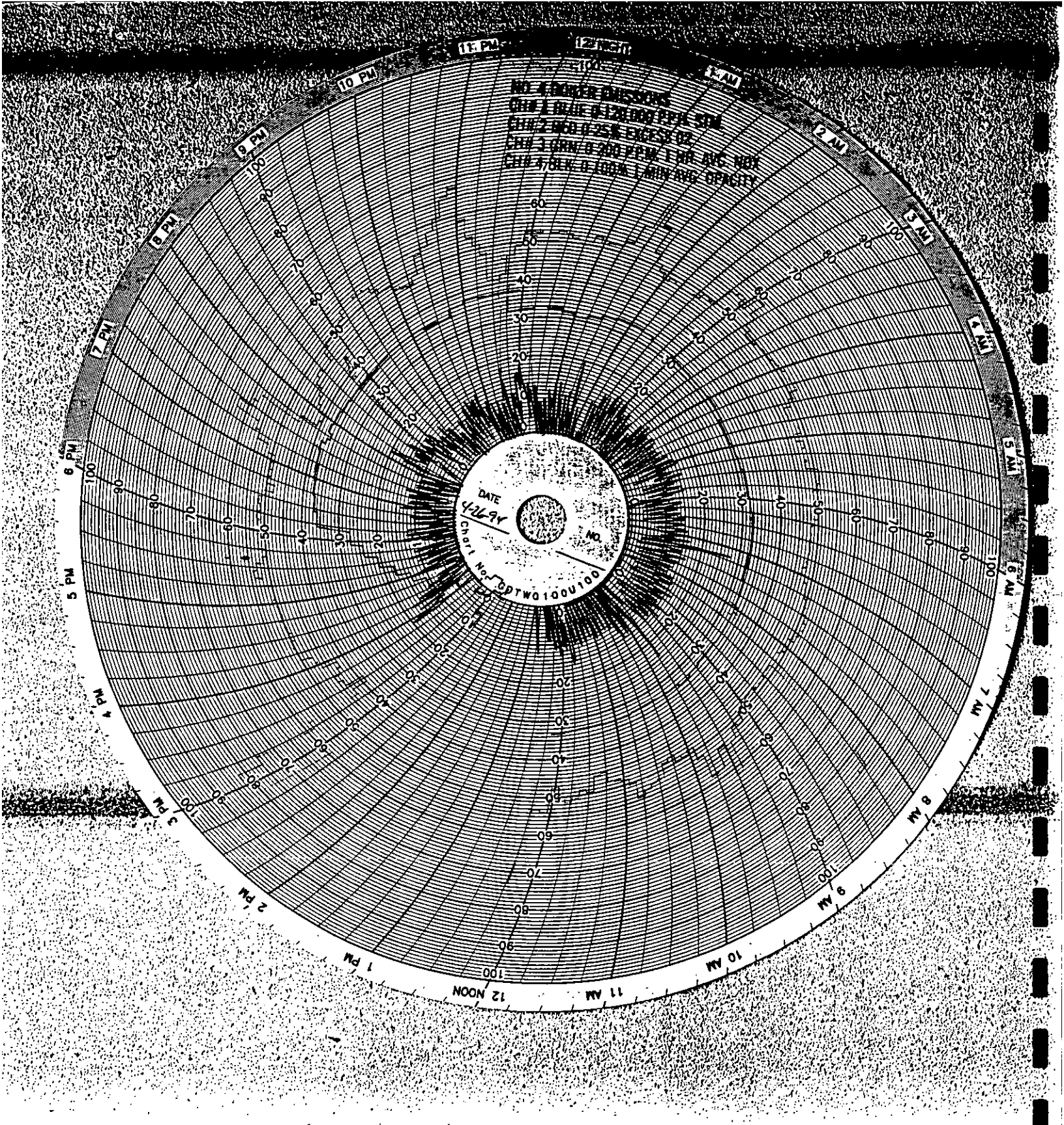
Boiler 4

	% F.S.	
	Low	High
O_2	12.4	84.0
Opacity	0.0	42.8



Boiler 4

	9. F. S.	
	Low	High
O_2	12.6	84.0
Opacity	0.0	42.5

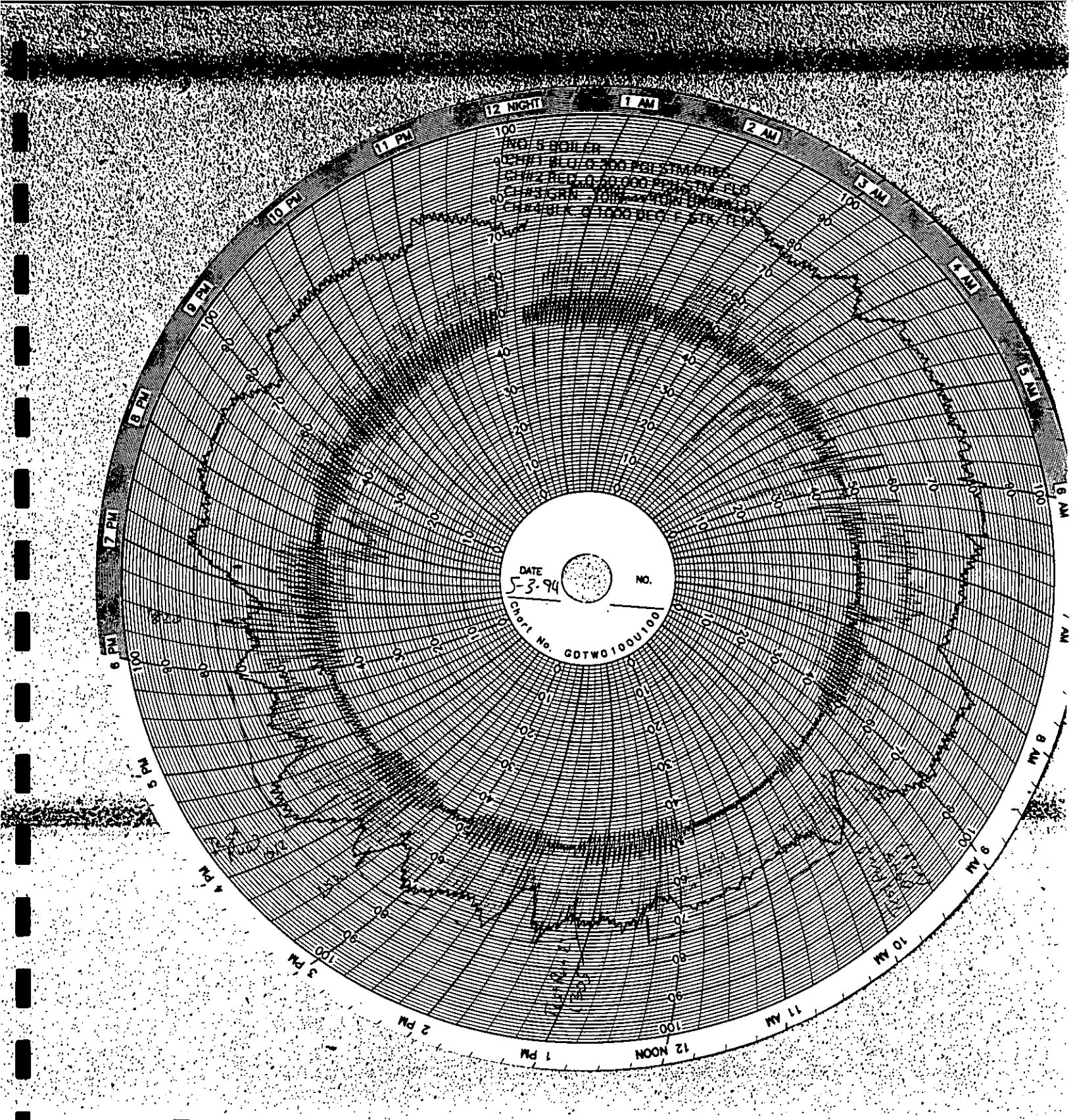


Boiler 4

	% F.S.	
	Low	High
O_2	12.8	84.8
Opacity	0.0	43.5

Appendix C.3

Plant Process Data



Boiler 5

Steam Flow 5-3-94

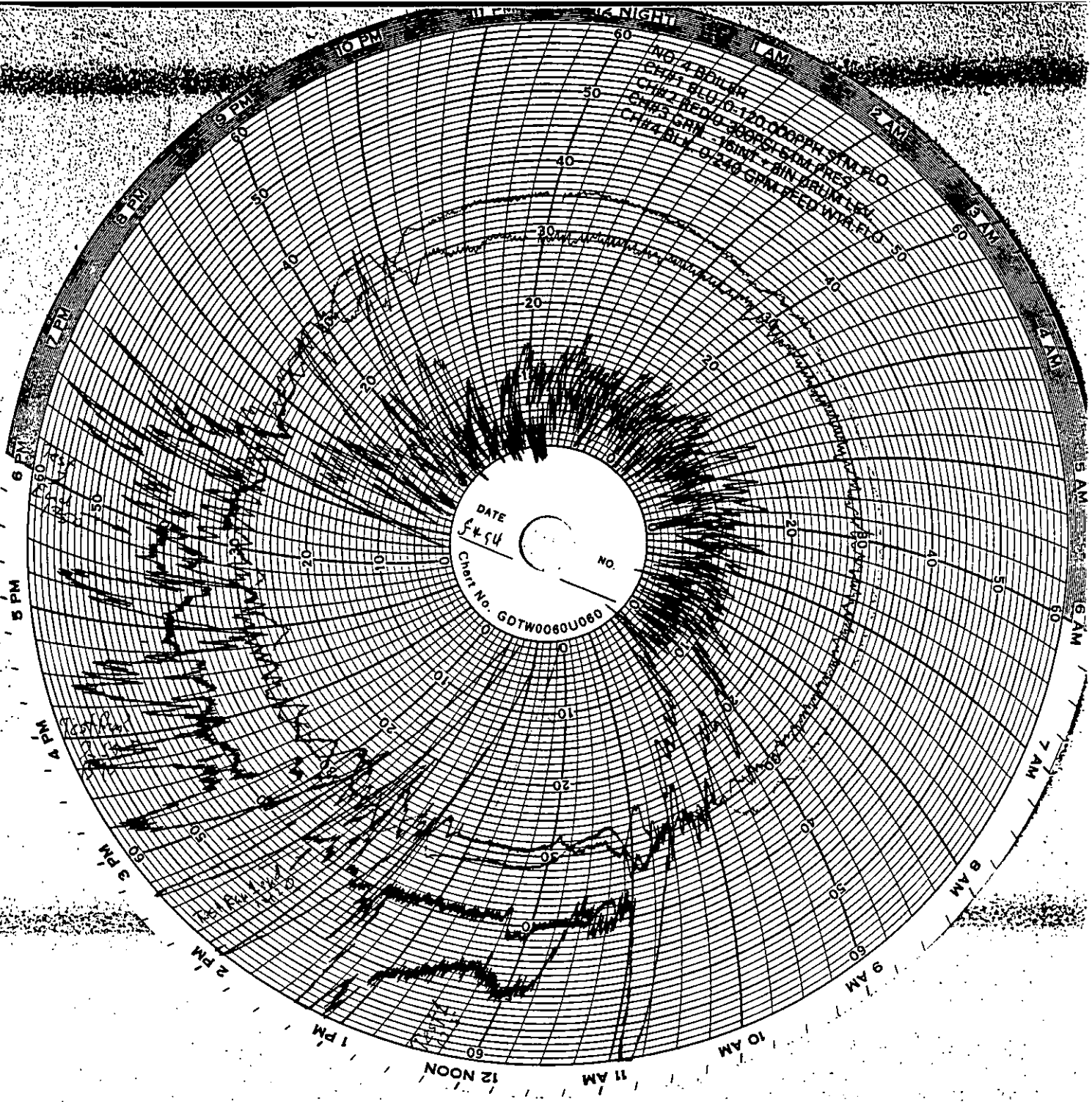
5-4-94 L-P Oroville KK
Boiler #4

Steam Flow Integrator

	Time	Reading 16x10		
1-PM-4	1218:15	4828277	165070	78,761 lb/hr
	1424:00	4984784	125.75 min	
2-PM-4	1545:00	4854167	170770	79,687 lb/hr
	1753:35	4871244	128.58 min	
5-5-94				
3-PM-4	1135:00	4918570	129270	78,743 lb/hr
	1313:30	4931497	98.5 min	
4-PM-4	1445:00	4943069	154970	79,813 lb/hr
	1641:30	4958566	116.5 min.	

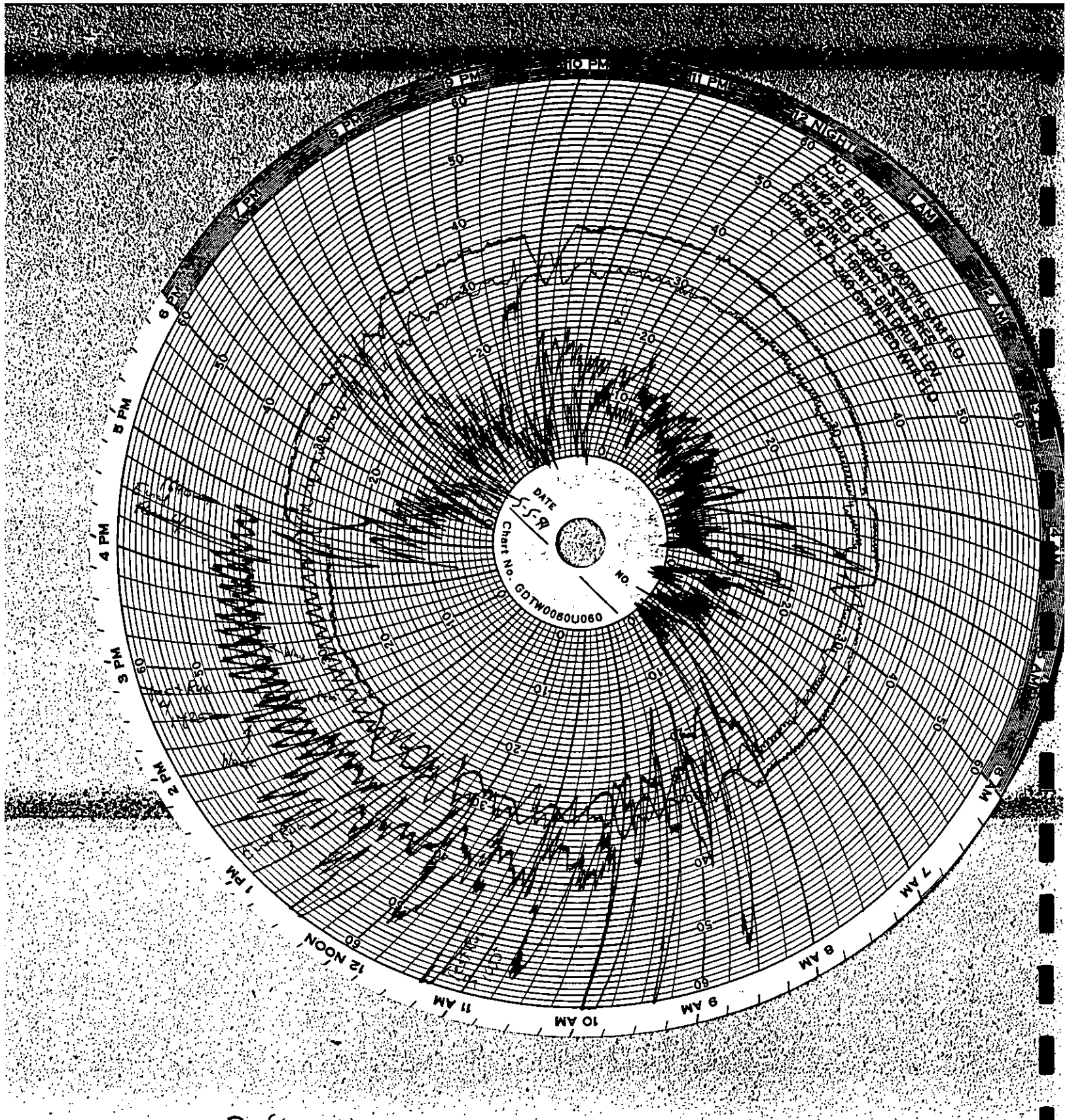
Fuel: Mixed Tan Oak, Madrone, Doug. Fir, Pond. Pine, Some Cedar

- Tried new "drier" fuel, couldn't get combustion in control
- Mixed in the drier fuel and ran again



Boiler 4

Steam Flow 5-4-94



Boiler 4

Steam Flow 5-5-94

Appendix C.4

Carnot Gaseous Emission Data

CEM System Bias and Linearity
Correction Calculations

TEST # 1-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.05	0.09	-0.60	0.00	< 5%	**PASS**
Span	5.01	14.91	286.20	444.60	< 5%	**PASS**
Posttest Bias:						
Zero	0.11	0.00	-0.60	0.00	< 5%	**PASS**
Span	5.13	14.78	286.80	444.90	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	0.60	-0.36	0.00	0.00	< 3%	**PASS**
Span Drift, %:	1.20	-0.52	0.12	0.03	< 3%	**PASS**
Test Ave.	5.69	13.45	3.06	561.81		
Corrected Ave.	**5.61**	**13.68**	**3.54**	**572.23**		

CEM System Bias and Linearity
Correction Calculations

TEST # 2-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.11	0.00	-0.60	0.00	< 5%	**PASS**
Span	5.13	14.78	286.80	444.90	< 5%	**PASS**
Posttest Bias:						
Zero	0.19	0.01	-0.60	0.10	< 5%	**PASS**
Span	5.14	14.85	287.20	445.00	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	0.80	0.04	0.00	0.01	< 3%	**PASS**
Span Drift, %:	0.10	0.28	0.08	0.01	< 3%	**PASS**
Test Ave.	5.49	13.62	2.30	559.70		
Corrected Ave.	**5.35**	**13.88**	**2.80**	**569.84**		

CEM System Bias and Linearity Correction Calculations

TEST # 3-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.19	0.01	-0.60	0.10	< 5%	**PASS**
Span	5.14	14.85	287.20	445.00	< 5%	**PASS**
Posttest Bias:						
Zero	0.24	0.00	-0.60	0.20	< 5%	**PASS**
Span	5.16	14.71	288.10	445.40	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	0.50	-0.04	0.00	0.01	< 3%	**PASS**
Span Drift, %:	0.20	-0.56	0.18	0.04	< 3%	**PASS**
Test Ave.	5.50	13.66	52.50	535.20		
Corrected Ave.	**5.34**	**13.96**	**51.17**	**544.61**		

CEM System Bias and Linearity Correction Calculations

TEST # 4-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.24	0.00	-0.60	0.20	< 5%	**PASS**
Span	5.16	14.71	288.10	445.40	< 5%	**PASS**
Posttest Bias:						
Zero	0.16	0.00	-0.60	0.20	< 5%	**PASS**
Span	5.05	14.75	288.00	443.20	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	-0.80	0.00	0.00	0.00	< 3%	**PASS**
Span Drift, %:	-1.10	0.16	-0.02	-0.22	< 3%	**PASS**
Test Ave.	5.47	13.60	4.75	542.75		
Corrected Ave.	**5.36**	**13.94**	**5.15**	**553.42**		

CEM System Bias and Linearity Correction Calculations

TEST # 5-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.16	0.00	-0.60	0.20	< 5%	**PASS**
Span	5.05	14.75	288.00	443.20	< 5%	**PASS**
Posttest Bias:						
Zero	0.30	0.01	-0.60	0.00	< 5%	**PASS**
Span	5.13	14.58	286.50	441.20	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	1.40	0.04	0.00	-0.02	< 3%	**PASS**
Span Drift, %:	0.80	-0.68	-0.30	-0.20	< 3%	**PASS**
Test Ave.	5.41	13.41	4.08	536.50		
Corrected Ave.	**5.32**	**13.81**	**4.52**	**549.62**		

CEM System Bias and Linearity Correction Calculations

TEST # 6-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.30	0.01	-0.60	0.00	< 5%	**PASS**
Span	5.13	14.58	286.50	441.20	< 5%	**PASS**
Posttest Bias:						
Zero	0.29	0.02	-0.60	0.20	< 5%	**PASS**
Span	5.07	14.60	286.40	444.90	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	-0.10	0.04	0.00	0.02	< 3%	**PASS**
Span Drift, %:	-0.60	0.08	-0.02	0.37	< 3%	**PASS**
Test Ave.	5.40	13.52	7.50	543.61		
Corrected Ave.	**5.30**	**13.99**	**7.84**	**555.84**		

CEM System Bias and Linearity Correction Calculations

TEST # 7-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.29	0.02	-0.60	0.20	< 5%	**PASS**
Span	5.07	14.60	286.40	444.90	< 5%	**PASS**
Posttest Bias:						
Zero	0.30	0.01	-0.70	0.60	< 5%	**PASS**
Span	5.02	14.53	287.40	444.20	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	0.10	-0.04	-0.02	0.04	< 3%	**PASS**
Span Drift, %:	-0.50	-0.28	0.20	-0.07	< 3%	**PASS**
Test Ave.	5.35	13.49	94.70	544.30		
Corrected Ave.	**5.31**	**13.98**	**92.12**	**554.74**		

CEM System Bias and Linearity Correction Calculations

TEST # 8-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.30	0.01	-0.70	0.60	< 5%	**PASS**
Span	5.02	14.53	287.40	444.20	< 5%	**PASS**
Posttest Bias:						
Zero	0.40	0.01	-0.60	0.60	< 5%	**PASS**
Span	5.07	14.68	289.10	440.60	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	1.00	0.00	0.02	0.00	< 3%	**PASS**
Span Drift, %:	0.50	0.60	0.34	-0.36	< 3%	**PASS**
Test Ave.	5.22	13.63	12.85	521.00		
Corrected Ave.	**5.18**	**14.09**	**12.98**	**533.59**		

CEM System Bias and Linearity Correction Calculations

TEST # 9-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.40	0.01	-0.60	0.60	< 5%	**PASS**
Span	5.07	14.68	289.10	444.20	< 5%	**PASS**
Posttest Bias:						
Zero	0.40	0.01	-0.60	0.30	< 5%	**PASS**
Span	5.14	14.42	288.70	437.10	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	0.00	0.00	0.00	-0.03	< 3%	**PASS**
Span Drift, %:	0.70	-1.04	-0.08	-0.71	< 3%	**PASS**
Test Ave.	5.57	13.27	12.13	538.55		
Corrected Ave.	**5.48**	**13.77**	**12.22**	**553.75**		

CEM System Bias and Linearity Correction Calculations

TEST # 10-CEM-5	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/3/94		**LINEARITY**				
Analyzer Range:	10	25	500	1000		
High Cal.	8.05	22.30	425.60	722.70		
Low Cal.	4.99	15.10	277.80	453.00		
Analyzer Reads:	5.08	15.00	286.60	455.10		
Anal. Cal. Error	0.9	-0.4	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.40	0.01	-0.60	0.30	< 5%	**PASS**
Span	5.14	14.42	288.70	437.10	< 5%	**PASS**
Posttest Bias:						
Zero	0.36	0.00	0.00	0.30	< 5%	**PASS**
Span	4.94	14.44	290.30	437.10	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	453.00		
Zero Drift, %:	-0.40	-0.04	0.12	0.00	< 3%	**PASS**
Span Drift, %:	-2.00	0.08	0.32	0.00	< 3%	**PASS**
Test Ave.	5.52	13.18	104.53	515.47		
Corrected Ave.	**5.50**	**13.79**	**100.49**	**534.28**		

CEM System Bias and Linearity Correction Calculations

TEST # 1-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/4/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.29	15.04	287.00	85.20		
Anal. Cal. Error	3.0	-0.2	1.8	0.3	< 2%	**FAIL**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.14	-0.11	-0.60	0.10	< 5%	**PASS**
Span	5.28	14.87	288.00	84.00	< 5%	**PASS**
Posttest Bias:						
Zero	0.29	-0.01	0.00	0.20	< 5%	**PASS**
Span	5.07	14.81	288.00	83.30	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	1.50	0.40	0.12	0.04	< 3%	**PASS**
Span Drift, %:	-2.10	-0.24	0.00	-0.28	< 3%	**PASS**
Test Ave.	5.57	14.64	29.65	106.58		
Corrected Ave.	5.39	14.90	28.86	107.58		

CEM System Bias and Linearity Correction Calculations

TEST # 2-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/4/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.10	14.99	287.00	85.20		
Anal. Cal. Error	1.1	-0.4	1.8	0.3	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.10	-0.01	0.00	0.20	< 5%	**PASS**
Span	5.08	14.88	288.00	83.30	< 5%	**PASS**
Posttest Bias:						
Zero	0.03	0.00	0.00	0.00	< 5%	**PASS**
Span	5.02	14.82	283.00	82.80	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	-0.70	0.04	0.00	-0.08	< 3%	**PASS**
Span Drift, %:	-0.60	-0.24	-1.00	-0.20	< 3%	**PASS**
Test Ave.	5.30	14.82	43.58	107.13		
Corrected Ave.	**5.24**	**15.07**	**42.40**	**108.90**		

CEM System Bias and Linearity Correction Calculations

TEST # 3-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/4/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.10	14.99	287.00	85.20		
Anal. Cal. Error	1.1	-0.4	1.8	0.3	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.03	0.00	0.00	0.00	< 5%	**PASS**
Span	5.02	14.82	283.00	82.80	< 5%	**PASS**
Posttest Bias:						
Zero	0.02	0.00	0.00	0.10	< 5%	**PASS**
Span	4.98	14.83	285.80	82.50	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	-0.10	0.00	0.00	0.04	< 3%	**PASS**
Span Drift, %:	-0.40	0.04	0.56	-0.12	< 3%	**PASS**
Test Ave.	5.58	14.40	51.55	104.60		
Corrected Ave.	**5.57**	**14.67**	**50.35**	**106.83**		

CEM System Bias and Linearity Correction Calculations

TEST # 4-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/4/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.10	14.99	287.00	85.20		
Anal. Cal. Error	1.1	-0.4	1.8	0.3	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.02	0.00	0.00	0.10	< 5%	**PASS**
Span	4.98	14.83	285.80	82.50	< 5%	**PASS**
Posttest Bias:						
Zero	0.01	0.00	0.00	0.10	< 5%	**PASS**
Span	4.90	14.78	285.50	83.10	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	-0.10	0.00	0.00	0.00	< 3%	**PASS**
Span Drift, %:	-0.80	-0.20	-0.06	0.24	< 3%	**PASS**
Test Ave.	5.93	13.99	65.98	94.25		
Corrected Ave.	**5.99**	**14.27**	**64.17**	**96.09**		

CEM System Bias and Linearity Correction Calculations

TEST # 5-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/4/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.10	14.99	287.00	85.20		
Anal. Cal. Error	1.1	-0.4	1.8	0.3	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.01	0.00	0.00	0.10	< 5%	**PASS**
Span	4.90	14.78	285.50	83.10	< 5%	**PASS**
Posttest Bias:						
Zero	0.01	-0.01	-0.10	0.20	< 5%	**PASS**
Span	4.88	14.80	285.30	83.30	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	0.00	-0.04	-0.02	0.04	< 3%	**PASS**
Span Drift, %:	-0.20	0.08	-0.04	0.08	< 3%	**PASS**
Test Ave.	6.04	13.85	35.39	103.88		
Corrected Ave.	**6.17**	**14.14**	**34.49**	**105.42**		

CEM System Bias and Linearity Correction Calculations

TEST # 6-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/5/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.07	14.98	287.00	85.10		
Anal. Cal. Error	0.8	-0.5	1.8	0.3	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.02	0.00	0.00	0.25	< 5%	**PASS**
Span	4.98	14.76	284.60	82.00	< 5%	**PASS**
Posttest Bias:						
Zero	0.01	0.00	1.00	0.00	< 5%	**PASS**
Span	4.99	14.82	286.00	82.70	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	-0.10	0.00	0.20	-0.10	< 3%	**PASS**
Span Drift, %:	0.10	0.24	0.28	0.28	< 3%	**PASS**
Test Ave.	6.23	13.78	10.33	86.72		
Corrected Ave.	**6.24**	**14.07**	**9.59**	**88.89**		

CEM System Bias and Linearity
Correction Calculations

TEST # 7-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/5/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.07	14.98	287.00	85.10		
Anal. Cal. Error	0.8	-0.5	1.8	0.3	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.01	0.00	1.00	0.00	< 5%	**PASS**
Span	4.99	14.82	286.00	82.70	< 5%	**PASS**
Posttest Bias:						
Zero	0.02	0.00	1.00	0.20	< 5%	**PASS**
Span	4.96	14.71	287.00	82.60	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	0.10	0.00	0.00	0.08	< 3%	**PASS**
Span Drift, %:	-0.30	-0.44	0.20	-0.04	< 3%	**PASS**
Test Ave.	7.34	12.61	26.70	105.48		
Corrected Ave.	**7.37**	**12.90**	**25.01**	**107.74**		

CEM System Bias and Linearity
Correction Calculations

TEST # 8-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/5/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.07	14.98	287.00	85.10		
Anal. Cal. Error	0.8	-0.5	1.8	0.3	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.02	0.00	1.00	0.00	< 5%	**PASS**
Span	4.96	14.71	287.00	82.60	< 5%	**PASS**
Posttest Bias:						
Zero	0.02	0.00	0.00	0.20	< 5%	**PASS**
Span	4.98	14.73	286.60	83.10	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	0.00	0.00	-0.20	0.08	< 3%	**PASS**
Span Drift, %:	0.20	0.08	-0.08	0.20	< 3%	**PASS**
Test Ave.	5.85	14.03	60.97	105.55		
Corrected Ave.	**5.88**	**14.39**	**58.67**	**107.55**		

CEM System Bias and Linearity Correction Calculations

TEST # 9-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/5/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.07	14.98	287.00	85.10		
Anal. Cal. Error	0.8	-0.5	1.8	0.3	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.02	0.00	0.00	0.20	< 5%	**PASS**
Span	4.98	14.73	286.60	83.10	< 5%	**PASS**
Posttest Bias:						
Zero	0.02	0.00	0.50	0.00	< 5%	**PASS**
Span	4.98	14.70	287.50	83.60	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	0.00	0.00	0.10	-0.08	< 3%	**PASS**
Span Drift, %:	0.00	-0.12	0.18	0.20	< 3%	**PASS**
Test Ave.	4.63	15.11	269.12	78.07		
Corrected Ave.	**4.64**	**15.51**	**260.43**	**79.05**		

CEM System Bias and Linearity Correction Calculations

TEST # 10-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/5/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.08	14.98	286.60	85.00		
Anal. Cal. Error	0.9	-0.5	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.02	0.00	0.50	0.00	< 5%	**PASS**
Span	5.02	14.82	288.50	82.60	< 5%	**PASS**
Posttest Bias:						
Zero	0.00	0.00	0.50	0.20	< 5%	**PASS**
Span	5.03	14.80	288.60	83.10	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	-0.20	0.00	0.00	0.08	< 3%	**PASS**
Span Drift, %:	0.10	-0.08	0.02	0.20	< 3%	**PASS**
Test Ave.	5.60	14.42	26.31	97.49		
Corrected Ave.	**5.56**	**14.70**	**24.89**	**99.33**		

CEM System Bias and Linearity Correction Calculations

TEST # 11-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/5/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.08	14.98	286.60	85.00		
Anal. Cal. Error	0.9	-0.5	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.00	0.00	0.50	0.20	< 5%	**PASS**
Span	5.03	14.80	288.60	83.10	< 5%	**PASS**
Posttest Bias:						
Zero	0.01	0.00	0.50	0.20	< 5%	**PASS**
Span	5.02	14.74	287.60	82.80	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	0.10	0.00	0.00	0.00	< 3%	**PASS**
Span Drift, %:	-0.10	-0.24	-0.20	-0.12	< 3%	**PASS**
Test Ave.	5.72	14.20	23.97	100.67		
Corrected Ave.	**5.68**	**14.52**	**22.67**	**102.47**		

CEM System Bias and Linearity Correction Calculations

TEST # 12-CEM-4	O2	CO2	CO	NOx	Criteria	Status
L.P. Oroville						
Date: 5/5/94		**LINEARITY**				
Analyzer Range:	10	25	500	250		
High Cal.	8.05	22.30	425.60	241.20		
Low Cal.	4.99	15.10	277.80	84.40		
Analyzer Reads:	5.08	14.98	286.60	85.00		
Anal. Cal. Error	0.9	-0.5	1.8	0.2	< 2%	**PASS**
		SYSTEM BIAS				
Pretest Bias:						
Zero	0.01	0.00	0.50	0.20	< 5%	**PASS**
Span	5.02	14.74	287.60	82.80	< 5%	**PASS**
Posttest Bias:						
Zero	0.00	0.01	0.50	0.20	< 5%	**PASS**
Span	5.02	14.79	289.50	83.40	< 5%	**PASS**
Span Value:	4.99	15.10	277.80	84.40		
Zero Drift, %:	-0.10	0.04	0.00	0.00	< 3%	**PASS**
Span Drift, %:	0.00	0.20	0.38	0.24	< 3%	**PASS**
Test Ave.	5.99	14.02	24.68	102.28		
Corrected Ave.	**5.96**	**14.34**	**23.32**	**103.93**		

CARNOT
CEM PERFORMANCE DATA

CLIENT/LOCATION: L-P Oroville Boiler 4 DATE: 5-4-94

30187 BY: KJC

SYSTEM CONFIGURATION		
ANALYZERS IN SERVICE		
	ANALYZERS:	O_2, CO_2, CO, NOx
PROBE		
	LENGTH:	6 ft.
	LINER MATERIAL:	stainless steel
	HEATED PROBE (Y/N):	Y
	HEATED LINE (Y/N):	Y
ON-STACK CONDITIONER		
	IN SERVICE (Y/N):	Y
	COOLANT:	ice/water
SAMPLE LINE		
	LENGTH:	100 ft.
	MATERIAL:	Teflon 3/8" o.d.

SYSTEM LEAK CHECK		
PRE-/POST-TEST		
	PRE-TEST (cfh):	<0.1 @ 25 in. Hg vac.
	POST-TEST (cfh):	" " " "

LEAK RATE (%) = $\frac{\text{POST-TEST (cfh)}}{\text{SYSTEM FLOW RATE (cfm) x 60}}$ x 100 = <0.1 %

SYSTEM RESPONSE TIME CHECK				
	1	2	3	Avg.
UPSCALE:	30 sec.	32 sec.	32 sec.	32 sec.
DOWNSCALE:	34 sec.	36 sec.	36 sec.	36 sec.

CARNOT

CARNOT
CEM PERFORMANCE DATA

CLIENT/LOCATION: L-P Oroville Boiler 5 DATE: 5-3-94
30187 BY: KJ Cosby

SYSTEM CONFIGURATION		
ANALYZERS IN SERVICE		
	ANALYZERS:	O_2, CO_2, CO, NOx
PROBE		
	LENGTH:	6 ft.
	LINER MATERIAL:	stainless steel
	HEATED PROBE (Y/N):	Y
	HEATED LINE (Y/N):	Y
ON-STACK CONDITIONER		
	IN SERVICE (Y/N):	Y
	COOLANT:	ice/water
SAMPLE LINE		
	LENGTH:	100 ft.
	MATERIAL:	Teflon 3/8" o.d.

SYSTEM LEAK CHECK		
PRE-/POST-TEST		
	PRE-TEST (cfh):	<0.1 @ 25 in. Hg vac
	POST-TEST (cfh):	" " " "

LEAK RATE (%) = $\frac{\text{POST-TEST (cfh)}}{\text{SYSTEM FLOW RATE (cfm) x 60}}$ x 100 = <0.1 %

SYSTEM RESPONSE TIME CHECK				
	1	2	3	Avg.
UPSCALE:	32 sec.	30 sec.	30 sec.	30 sec.
DOWNSCALE:	36 sec.	35 sec.	35 sec.	35 sec.

CARNOT

CARNOT
CEM PERFORMANCE DATA

CLIENT/LOCATION: L-Pdrville 30187 Boiler 5 DATE: 5-5-94

BY: HJC

SYSTEM CONFIGURATION		
ANALYZERS IN SERVICE		
	ANALYZERS:	O_2, CO_2, CO, NOx
PROBE		
	LENGTH:	6ft.
	LINER MATERIAL:	Stainless steel
	HEATED PROBE (Y/N):	Y
	HEATED LINE (Y/N):	Y
ON-STACK CONDITIONER		
	IN SERVICE (Y/N):	Y
	COOLANT:	ice/water
SAMPLE LINE		
	LENGTH:	100 ft.
	MATERIAL:	Teflon 3/8" o.d.

SYSTEM LEAK CHECK		
PRE-/POST-TEST		
	PRE-TEST (cfh):	<0.1 @ 25 in. Hg vac.
	POST-TEST (cfh):	" " " " "

LEAK RATE (%) = $\frac{\text{POST-TEST (cfh)}}{\text{SYSTEM FLOW RATE (cfm) x 60}}$ x 100 = <0.1 %

SYSTEM RESPONSE TIME CHECK				
	1	2	3	Avg.
UPSCALE:	33 sec.	30 sec.	32 sec.	32 sec.
DOWNSCALE:	36 sec.	35 sec.	35 sec.	35 sec.

CARNOT

CARNOT

PAGE ___ OF ___

REFERENCE METHOD GASEOUS MEASUREMENTS

CLIENT/LOCATION: C-P Orouille

CONDITION: 30,000 lb/hr steam

DATE: 5/3/94

OPERATOR: EM/KC

TEST NUMBER: 1-CEM-5

TEST LOCATION: Boiler 5

TEST NO.	TIME	SAMPLE POINT/ CONDITION	DRY, UNCORRECTED							CORRECTED TO 12 % CO_2 DRY		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	[illegible]	NOx	SO_2
SPAN GAS CONCENTRATION			4.99	15.1	277.8	453.9						
		AS FOUND ANAL. SPAN	5.08	15.03 ~~15.53~~	286.6	455.1						
		SYSTEM ZERO	0.05	0.09	-0.6	0.0						
		SYSTEM SPAN	5.01	14.91	286.2	444.6			corrected 5.61	1368	3.54	572.23
1	BEGIN 0945 / END 1025	1-CEM-5	5.69	13.45	3.06	561.81		From CEMS				
	BEGIN / END ----	Sys. Zero	0.11	0.0	-0.6	0.0						
	BEGIN / END ----	Sys. Span	5.13	14.78	286.8	444.9						
~~1~~	BEGIN Corr / END [illegible]	~~1-CEM-5~~	5.61	13.68	3.78	572.23	← Corrected Values	NO_x 470			501.96	
								O_2 4.93				
2	BEGIN 1100 / END 1130	2-CEM-5	5.49	13.62	2.3	557.7						
	BEGIN / END ----	Sys. Zero	0.19	0.01	-0.6	0.1	Wet	NO_x	504.13			
								O_2	4.94			
	BEGIN / END ----	Sys. Span	5.14	14.85	287.2	445.0						
	BEGIN Corr. / END	2-CEM-5	5.35	13.88	2.80	569.84		NO_x	465		492.66	
	BEGIN 1145 / END 1215	3-CEM-5	5.50	13.66	52.5	535.2		O_2	4.68			
	BEGIN / END ----	Sys. Zero	0.24	0.0	-0.6	0.2	Wet	NO_x	502.03			
								O_2	4.71			
	BEGIN / END ----	Sys. Span	5.16	14.71	288.1	445.4						
	BEGIN / END Corr.	3-CEM-5	5.34	13.96	57.17	544.61		NO_x	435		468.15	
								O_2	4.75			
		SYSTEM ZERO										
		SYSTEM SPAN					Wet	NO_x	479.80			
								O_2	4.70			
RAW AVERAGE												
CORRECTED AVERAGE												
COMMENTS:												

CARNOT

PMF-039

493.5
95.3
.13

425
.17
1.95

1065
1586
11.9

CARNOT

PAGE ___ OF ___

REFERENCE METHOD GASEOUS MEASUREMENTS

CLIENT/LOCATION: L-P Oroville

CONDITION: 30,000 lb/hr steam

DATE: 5-3-94

OPERATOR: KJC/LP

TEST NUMBER: ___

TEST LOCATION: Boiler #5

TEST NO.	TIME		SAMPLE POINT/ CONDITION	DRY, UNCORRECTED							CORRECTED TO ___% ___, DRY		
				O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
SPAN GAS CONCENTRATION													
			AS FOUND ANAL. SPAN										
			SYSTEM ZERO	0.24	0.0	-0.6	0.2						
			SYSTEM SPAN	5.16	14.71	288.1	445.4						
	BEGIN	1240	4-CEM-5	5.47	13.60 ~~15.12~~	4.75	542.75						
	END	1310											
	BEGIN	---	Sys. Zero	0.16	0.0	-0.6	0.2						
	END												
	BEGIN	---	Sys. Span	5.05	14.75	288.0	443.2						
	END												
	BEGIN	~~1325~~	5-CEM-5	5.41	13.41	4.08	536.5						
	END	~~1405~~ 1405											
	BEGIN	---	SysZero	0.3	0.01	-0.6	0.0						
	END												
	BEGIN	---	Sys. Span	5.13	14.58	286.5	441.2						
	END												
	BEGIN	1420	6-CEM-5	5.40	13.52	7.5	543.61						
	END	1450											
	BEGIN	---	Sys. Zero	0.29	0.02	-.6	0.2						
	END												
	BEGIN	---	Sys. Span	5.07	14.6	286.4	444.9						
	END												
	BEGIN	1510	7-CEM-5	5.35	13.49	94.7	544.3						
	END	1540											
	BEGIN	---	Sys. Zero	0.30	0.01	-0.7	0.6						
	END												
	BEGIN	---	Sys. Span	5.02	14.53	287.4	449.2						
	END												
			SYSTEM ZERO										
			SYSTEM SPAN										
RAW AVERAGE													
CORRECTED AVERAGE													
COMMENTS:													

CARNOT

PAGE ___ OF ___

REFERENCE METHOD GASEOUS MEASUREMENTS

CLIENT/LOCATION: L-P Oroville

CONDITION: 30,000 lb/hr steam

DATE: 5-3-94

OPERATOR: KJC

TEST NUMBER: ___

TEST LOCATION: Boiler #5

TEST NO.	TIME	SAMPLE POINT/ CONDITION	DRY, UNCORRECTED							CORRECTED TO ___% ___, DRY		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
SPAN GAS CONCENTRATION												
		AS FOUND ANAL. SPAN										
		SYSTEM ZERO	0.30	0.01	-0.7	0.6						
		SYSTEM SPAN	5.02	14.53	287.4	444.2						
	BEGIN 1605 / END 1645	8-CEM-5	5.22	13.63	12.65	521.0						
	BEGIN / END ----	Sys. Zero	0.40	0.01	-0.6	0.6						
	BEGIN / END ----	Sys. Span	5.07	14.68	288.1	442.6						
	BEGIN 1700 / END 1730	9-CEM-5	5.57	13.27	12.13	538.55						
	BEGIN / END ----	Sys Zero	0.40	0.01	0.6	0.3						
	BEGIN / END ----	Sys Span	5.14	14.42	288.7	437.1						
	BEGIN 1750 / END 1820	10-CEM-5	5.52	13.18	104.53	515.47						
	BEGIN / END ----	Sys. Zero	0.36	0.0	0.0	0.3						
	BEGIN / END ----	Sys. Span	4.94	14.44	290.3	437.1						
	BEGIN / END ----	Hi Span	7.52	21.46	429.9	690.4						
	BEGIN / END ----											
	BEGIN / END ----											
		SYSTEM ZERO										
		SYSTEM SPAN										
RAW AVERAGE												
CORRECTED AVERAGE												
COMMENTS:												

CARNOT

PAGE ___ OF ___

REFERENCE METHOD GASEOUS MEASUREMENTS

CLIENT/LOCATION: L-P Oroville

CONDITION: Full Load

DATE: 5-4-94

OPERATOR: KYE

TEST NUMBER: ___

TEST LOCATION: Boiler 4

TEST NO.	TIME		SAMPLE POINT/ CONDITION	DRY, UNCORRECTED							CORRECTED TO ___% ___ DRY		
				O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
SPAN GAS CONCENTRATION													
			AS FOUND ANAL. SPAN										
			SYSTEM ZERO	0.14	-0.11	~~-0.6~~	~~0.1~~						
			SYSTEM SPAN	~~5.25~~	~~14.87~~	288.0	84.0						
	BEGIN / END	1220 / 1250	1-CEM-4	5.57*	14.64	29.65	106.58						
	BEGIN / END	---	Sys. Zero	0.29	-0.01	0.0	0.2						
	BEGIN / END	---	Sys. Span	5.07	14.81	288.0	83.3						
	BEGIN / END	Reset O_2+CO_2	[illegible]	Sys. 0.10	Zero -0.01	~~0.0~~	~~0.0~~						
	BEGIN / END	---	Sys. Span	5.08	14.88								
	BEGIN / END	1320 / 1350	2-CEM-4	5.30	14.82	43.58	107.13						
	BEGIN / END	---	Sys. Zero	0.03	0.0	0.0	0.0						
	BEGIN / END	---	Sys. Span	5.02	14.82	283.0	82.8						
	BEGIN / END	1545 / 1625	3-CEM-4	5.58	14.40	51.55	104.6						
	BEGIN / END	---	Sys. Zero	0.02	0.0	0.0	0.1						
	BEGIN / END	---	Sys. Span	4.98	14.83	285.8	82.5						
	BEGIN / END	---											
			SYSTEM ZERO										
			SYSTEM SPAN										
RAW AVERAGE													
CORRECTED AVERAGE													
COMMENTS:													

CARNOT

PAGE ___ OF ___

REFERENCE METHOD GASEOUS MEASUREMENTS

CLIENT/LOCATION: L-P Oroville

CONDITION: Full Load

DATE: 5-4-94

OPERATOR: KC

TEST NUMBER: ___

TEST LOCATION: Boiler 4

TEST NO.	TIME	SAMPLE POINT/ CONDITION	DRY, UNCORRECTED							CORRECTED TO ___% ___, DRY		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
SPAN GAS CONCENTRATION												
		AS FOUND ANAL. SPAN										
		SYSTEM ZERO	0.02	0.0	0.0	0.1						
		SYSTEM SPAN	~~4.98~~	14.83	~~285.8~~	~~82.5~~						
	BEGIN 1635 / END 1705	4-CEM-4	5.93	13.99	65.98	~~94.25~~						
	BEGIN ___ / END ___	Sys. Zero	0.01	0.0	0.0	0.1						
	BEGIN ___ / END ___	Sys. Span	4.90	14.78	285.5	83.1						
	BEGIN 1720 / END 1800	5-CEM-4	6.04	13.85	35.39	103.81						
	BEGIN ___ / END ___	Sys. Zero	0.01	-0.01	-0.1	0.2						
	BEGIN ___ / END ___	Sys. Span	4.88	14.80	285.3	83.3						
	BEGIN ___ / END ___											
	BEGIN ___ / END ___											
	BEGIN ___ / END ___											
	BEGIN ___ / END ___											
	BEGIN ___ / END ___											
	BEGIN ___ / END ___											
		SYSTEM ZERO										
		SYSTEM SPAN										
RAW AVERAGE												
CORRECTED AVERAGE												
COMMENTS:												

CARNOT
CONTINUOUS EMISSIONS MEASUREMENTS

CLIENT: L-P Oroville

DATE: 5-5-94

OPERATOR: KJC

TEST LOCATION: Boiler 4

TEST NUMBERS:

AMBIENT TEMP., DB/WB:

BAROMETRIC PRESSURE:

DUCT STATIC PRESSURE:

FUEL:

TEST NO.	SAMPLE TIME	SAMPLE POINT/ CONDITION	DRY, UNCORRECTED							CORRECTED TO ___% ___, DRY		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
		As-found	4.95	15.1	277.8	84.4						
		And. Span	5.04	15.03	286.1	85.3						
		System Zero	0.02	0.0	0.0	0.0						
		System Span	5.00	14.81	285.6	82.0						
	908-938	6-CEM-4	6.23	13.78	10.33	86.72						
		Sys. Zero	0.01	0.0	1.0	0.0						
		Sys. Span	4.99	14.82	286.0	82.7						
	1013-1043	7-CEM-4	7.34	12.61	26.70	105.48						
		Sys. Zero	0.02	0.0	1.0	0.2						
		Sys. Span	4.96	14.71	287.0	82.6						
	1108-1138	8-CEM-4	5.85	14.03	60.97	105.55						
		Sys. Zero	.02	0.0	0.0	0.2						
		Sys. Span	4.98	14.73	286.6	83.1						
[redacted]	1208-1238	9-CEM-4	4.63	15.11	269.8	78.07						
COMMENTS:		Zero	0.02	0.0	0.5	0.0						
		Span	4.98	14.7	287.5	83.6						

CARNOT

CARNOT
CONTINUOUS EMISSIONS MEASUREMENTS

CLIENT: L-P Oroville

DATE: 5-5-94

OPERATOR: KJC

TEST LOCATION: Boiler 4

TEST NUMBERS: 10-12-CEM-4

AMBIENT TEMP., DB/WB:

BAROMETRIC PRESSURE:

DUCT STATIC PRESSURE:

FUEL:

TEST NO.	SAMPLE TIME	SAMPLE POINT/ CONDITION	DRY, UNCORRECTED							CORRECTED TO ___% ___, DRY		
			O_2	CO_2	CO	NOx	NO	NO_2	SO_2	CO	NOx	SO_2
	1430	As-found	4.99	15.1	277.8	84.4						
		And. Span	5.09	14.98	288.6	85.0						
		System Zero	0.02	0.0	0.5	0.0						
	1436	System Span	5.02	14.82	288.5	82.6						
	1443 -1523	10-CEM-4	5.60	14.42	26.31	97.49						
		System Zero	0.0	0.0	0.5	0.2						
		System Span	5.03	14.80	288.6	83.1						
	1538 -1608	11-CEM-4	5.72	14.20	23.97	108.67						
		System Zero	0.01	0.0	0.5	0.2						
		System Span	5.02	14.74	287.6	82.8						
	1618 -1638	12-CEM-4	5.99	14.02	24.68	102.28						
		System Zero	0.0	0.01	0.5	0.2						
		System Span	5.02	14.79	289.5	83.4						

COMMENTS:

CARNOT

PMF-013

Appendix C.5

Stack Gas Moisture Content Data

MOISTURE CORRECTION CALCULATIONS
Carnot Relative Accuracy Data

Client: L-P Oroville
Unit: Boiler 5
Date: May 3, 1994

	Raw Data, Dry			Raw Data, Wet			
Time	NOx ppm	O2 %	CO2 %	NOx ppm	O2 %	Moisture H2O, %	NOx Dry ppm @ 12% CO2
0945-1025	572.23	5.61	13.68	504.13	4.94	11.9	501.96
1100-1130	569.84	5.35	13.88	502.03	4.71	11.9	492.66
1145-1215	544.61	5.34	13.96	479.80	4.70	11.9	468.15
1240-1310	553.42	5.36	13.94	487.56	4.72	11.9	476.40
1325-1405	549.62	5.32	13.81	484.22	4.69	11.9	477.58
1420-1450	555.84	5.30	13.99	489.70	4.67	11.9	476.77
1510-1540	554.74	5.31	13.98	488.73	4.68	11.9	476.17
1605-1645	533.59	5.18	14.09	466.89	4.53	12.5	454.44
1700-1730	553.75	5.48	13.77	484.53	4.80	12.5	482.57
1750-1821	534.28	5.5	13.79	467.50	4.81	12.5	464.93

MOISTURE CORRECTION CALCULATIONS
Carnot Relative Accuracy Data

Client: L-P Oroville
Unit: Boiler 4
Date: May 4-5, 1994

	Raw Data, Dry			Raw Data, Wet			
Time	NOx ppm	O2 %	CO2 %	NOx ppm	O2 %	Moisture H2O, %	NOx Dry ppm @ 12% CO2
1220-1250	107.6	5.39	14.90	84.56	4.24	21.4	86.64
1320-1350	108.9	5.24	15.07	85.60	4.12	21.4	86.72
1545-1625	106.8	5.57	14.67	84.72	4.42	20.7	87.39
1635-1705	96.09	5.99	14.27	76.20	4.75	20.7	80.80
1720-1800	105.4	6.17	14.14	83.60	4.89	20.7	89.47
0908-0938	88.89	6.24	14.07	67.56	4.74	24.0	75.81
1013-1043	107.7	7.37	12.90	81.88	5.60	24.0	100.2
1108-1138	107.6	5.88	14.39	81.74	4.47	24.0	89.69
1208-1238	79.05	4.64	15.51	60.08	3.53	24.0	61.16
1443-1523	99.33	5.56	14.70	75.99	4.25	23.5	81.09
1538-1608	102.5	5.68	14.52	78.39	4.35	23.5	84.69
1618-1638	103.93	5.96	14.34	79.51	4.56	23.5	86.97

SOURCE TEST DATA SUMMARY

Client/Location.....	LP. Orov	Date.....	4-3-94
Test Number.....	1-PM-5	Data By.....	EMM
Test Method.....	CARB 5	Sample Location.....	Stack
Fuel.....	Sndr Dust	Unit.....	Boiler 5
Sample Train.....	ES-11	Start/Stop Time.....	0940-1200

Pitot Factor	0.84	Reference Temp (F)..	60
Stack Area (sq ft)..	9.51	Meter Cal Factor....	1.0120
Bar Press (in Hg)...	29.92	Sample Time (Min)...	120
Meter Vol (acf).....	55.475	Nozzle Diam (in)....	0.317
Stack Press (iwg)...	-0.06	Meter Temp (F).....	95.50
Vel Head (iwg).....	0.141	Stack Temp (F).....	490.10
Liquid Vol (ml).....	152.8	Stack O2 (%).....	5.60
Meter Press (iwg)...	0.88	Stack CO2 (%).....	13.55

Std Sample Vol (SCF).....	52.63
Moisture Fraction.....	0.119
Stack Gas Mol Wt.....	28.92
Stack Gas Velocity (ft/sec).....	28.21
Stack Flow Rate (wacfm).....	16089
Stack Flow Rate (dscfm).....	7756
Isokinetic Ratio (%).....	98.06

Particulate Catch, mg.....	
Grain Loading, gr/dscf.....	0.0000
Grain Loading @ 12% CO2.....	0.0000
Mass Emissions, lb/hr.....	0.00

SOURCE TEST DATA SUMMARY

Client/Location.....	LP. Orov	Date.....	4-3-94
Test Number.....	2-PM-5	Data By.....	EMM
Test Method.....	CARB 5	Sample Location.....	Stack
Fuel.....	Sndr Dust	Unit.....	Boiler 5
Sample Train.....	ES-11	Start/Stop Time.....	1305-1510

Pitot Factor	0.84	Reference Temp (F)..	60
Stack Area (sq ft)..	9.51	Meter Cal Factor....	1.0120
Bar Press (in Hg)...	29.90	Sample Time (Min)...	120
Meter Vol (acf).....	82.270	Nozzle Diam (in)....	0.371
Stack Press (iwg)...	-0.10	Meter Temp (F).....	96.80
Vel Head (iwg).....	0.170	Stack Temp (F).....	500.00
Liquid Vol (ml).....	226.8	Stack O2 (%).....	5.41
Meter Press (iwg)...	1.93	Stack CO2 (%).....	13.47

Std Sample Vol (SCF).....	78.02
Moisture Fraction.....	0.119
Stack Gas Mol Wt.....	28.90
Stack Gas Velocity (ft/sec).....	31.14
Stack Flow Rate (wacfm).....	17761
Stack Flow Rate (dscfm).....	8466
Isokinetic Ratio (%).....	97.22

Particulate Catch, mg.....	
Grain Loading, gr/dscf.....	0.0000
Grain Loading @ 12% CO2.....	0.0000
Mass Emissions, lb/hr.....	0.00

SOURCE TEST DATA SUMMARY

Client/Location.....	LP. Orov	Date.....	4-3-94
Test Number.....	3-PM-5	Data By.....	EMM
Test Method.....	CARB 5	Sample Location.....	Stack
Fuel.....	Sndr Dust	Unit.....	Boiler 5
Sample Train.....	ES-11	Start/Stop Time.....	1610-1820

Pitot Factor	0.84	Reference Temp (F)..	60
Stack Area (sq ft)..	9.51	Meter Cal Factor....	1.0120
Bar Press (in Hg)...	29.90	Sample Time (Min)...	120
Meter Vol (acf).....	83.566	Nozzle Diam (in)....	0.371
Stack Press (iwg)...	-0.11	Meter Temp (F).....	90.75
Vel Head (iwg).....	0.168	Stack Temp (F).....	519.80
Liquid Vol (ml).....	245.6	Stack O2 (%).....	5.42
Meter Press (iwg)...	1.94	Stack CO2 (%).....	13.38

Std Sample Vol (SCF).....	80.12
Moisture Fraction.....	0.125
Stack Gas Mol Wt.....	28.82
Stack Gas Velocity (ft/sec).....	31.34
Stack Flow Rate (wacfm).....	17879
Stack Flow Rate (dscfm).....	8296
Isokinetic Ratio (%).....	101.89

Particulate Catch, mg.....	
Grain Loading, gr/dscf.....	0.0000
Grain Loading @ 12% CO2.....	0.0000
Mass Emissions, lb/hr.....	0.00

SOURCE TEST DATA SUMMARY

Client/Location.....	LP. Orov	Date.....	5-4-94
Test Number.....	1-PM-4	Data By.....	EMM
Test Method.....	CARB 5	Sample Location.....	Stack
Fuel.....	Hog	Unit.....	Boiler 4
Sample Train.....	ES-11	Start/Stop Time.....	1215-1420

Pitot Factor	0.84	Reference Temp (F)..	60
Stack Area (sq ft)..	20.97	Meter Cal Factor....	1.0120
Bar Press (in Hg)...	29.80	Sample Time (Min)...	120
Meter Vol (acf).....	82.468	Nozzle Diam (in)....	0.290
Stack Press (iwg)...	-0.22	Meter Temp (F).....	106.20
Vel Head (iwg).....	0.365	Stack Temp (F).....	368.60
Liquid Vol (ml).....	447.7	Stack O2 (%).....	5.47
Meter Press (iwg)...	1.68	Stack CO2 (%).....	14.68

Std Sample Vol (SCF).....	76.60
Moisture Fraction.....	0.214
Stack Gas Mol Wt.....	27.88
Stack Gas Velocity (ft/sec).....	43.25
Stack Flow Rate (wacfm).....	54410
Stack Flow Rate (dscfm).....	26723
Isokinetic Ratio (%).....	109.15

Particulate Catch, mg.....	50.00
Grain Loading, gr/dscf.....	0.0101
Grain Loading @ 12% CO2.....	0.0082
Mass Emissions, lb/hr.....	2.31

SOURCE TEST DATA SUMMARY

Client/Location.....	LP. Orov	Date.....	5-4-94
Test Number.....	2-PM-4	Data By.....	EMM
Test Method.....	CARB 5	Sample Location.....	Stack
Fuel.....	Hog	Unit.....	Boiler 4
Sample Train.....	ES-11	Start/Stop Time.....	1640-1845

Pitot Factor	0.84	Reference Temp (F)..	60
Stack Area (sq ft)..	20.97	Meter Cal Factor....	1.0120
Bar Press (in Hg)...	29.71	Sample Time (Min)...	120
Meter Vol (acf).....	78.630	Nozzle Diam (in)....	0.285
Stack Press (iwg)...	-0.21	Meter Temp (F).....	104.60
Vel Head (iwg).....	0.387	Stack Temp (F).....	349.20
Liquid Vol (ml).....	409.9	Stack O2 (%).....	6.45
Meter Press (iwg)...	1.54	Stack CO2 (%).....	13.38

Std Sample Vol (SCF).....	73.00
Moisture Fraction.....	0.207
Stack Gas Mol Wt.....	27.83
Stack Gas Velocity (ft/sec).....	44.11
Stack Flow Rate (wacfm).....	55493
Stack Flow Rate (dscfm).....	28060
Isokinetic Ratio (%).....	102.57

Particulate Catch, mg.....	
Grain Loading, gr/dscf.....	0.0000
Grain Loading @ 12% CO2.....	0.0000
Mass Emissions, lb/hr.....	0.00

SOURCE TEST DATA SUMMARY

Client/Location.....	LP. Orov	Date.....	5-5-94
Test Number.....	3-PM-4	Data By.....	EMM
Test Method.....	CARB 5	Sample Location.....	Stack
Fuel.....	Hog	Unit.....	Boiler 4
Sample Train.....	ES-11	Start/Stop Time.....	1055-1300

Pitot Factor	0.84	Reference Temp (F)..	60
Stack Area (sq ft)..	20.97	Meter Cal Factor....	1.0120
Bar Press (in Hg)...	29.70	Sample Time (Min)...	120
Meter Vol (acf).....	71.996	Nozzle Diam (in)....	0.285
Stack Press (iwg)...	-0.23	Meter Temp (F).....	96.42
Vel Head (iwg).....		Stack Temp (F).....	
Liquid Vol (ml).....	459.3	Stack O2 (%).....	
Meter Press (iwg)...	1.37	Stack CO2 (%).....	

Std Sample Vol (SCF).....	67.77
Moisture Fraction..... Used for moisture only	0.240
Stack Gas Mol Wt.....	~~25.66~~
Stack Gas Velocity (ft/sec).....	0.00
Stack Flow Rate (wacfm).....	0
Stack Flow Rate (dscfm).....	0
Isokinetic Ratio (%).....	~~#DIV/0!~~

Particulate Catch, mg.....	
Grain Loading, gr/dscf.....	0.0000
Grain Loading @ 12% CO2.....	~~#DIV/0!~~
Mass Emissions, lb/hr.....	0.00

SOURCE TEST DATA SUMMARY

Client/Location.....	LP. Orov	*	Date.....	5-5-94
Test Number.....	4-PM-4	*	Data By.....	EMM
Test Method.....	CARB 5	*	Sample Location.....	Stack
Fuel.....	Hog	*	Unit.....	Boiler 4
Sample Train.....	ES-11	*	Start/Stop Time.....	1425-1627

Pitot Factor	0.84	*	Reference Temp (F)..	60
Stack Area (sq ft)..	20.97	*	Meter Cal Factor....	1.0120
Bar Press (in Hg)...	29.68	*	Sample Time (Min)...	120
Meter Vol (acf).....	75.460	*	Nozzle Diam (in)....	0.285
Stack Press (iwg)...	-0.20	*	Meter Temp (F).....	108.90
Vel Head (iwg).....	0.360	*	Stack Temp (F).....	342.50
Liquid Vol (ml).....	459.3	*	Stack O2 (%).....	5.66
Meter Press (iwg)...	1.40	*	Stack CO2 (%).....	14.30

Std Sample Vol (SCF).....	69.44
Moisture Fraction.....	0.235
Stack Gas Mol Wt.....	27.57
Stack Gas Velocity (ft/sec).....	42.60
Stack Flow Rate (wacfm).....	53591
Stack Flow Rate (dscfm).....	26328
Isokinetic Ratio (%).....	103.98

Particulate Catch, mg.....	
Grain Loading, gr/dscf.....	0.0000
Grain Loading @ 12% CO2.....	0.0000
Mass Emissions, lb/hr.....	0.00

APPENDIX D
CALCULATIONS

Appendix D.1

General Emissions Calculations

EMISSION CALCULATIONS

1. Sample Volume and Isokinetics

a. Sample gas volume, dscf

$$V_{m\ std} = 0.03342\ V_m \left(P_{bar} + \frac{H}{13.6}\right)\left(\frac{T_{ref}}{T_m}\right)(Y)$$

b. Water vapor volume, scf

$$V_{w\ std} = 0.0472\ V_{lc} \left(\frac{T_{ref}}{528\ °R}\right)$$

c. Moisture content, nondimensional

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

d. Stack gas molecular weight, lb/lb mole

$$MW_{dry} = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2)$$

$$MW_{wet} = MW_{dry}\ (1 - B_{wo}) + 18\ (B_{wo})$$

e. Absolute stack pressure, in Hg

$$P_s = P_{bar} + \frac{P_{sg}}{13.6}$$

f. Stack velocity, ft/sec

$$V_s = 2.90\ C_p \sqrt{\Delta P T_s} \sqrt{\left(\frac{29.92}{p_s}\right)\left(\frac{28.95}{MW_{wet}}\right)}$$

g. Actual stack flow rate, wacfm

$$Q = (V_s)(A_s)(60)$$

h. Standard stack gas flow rate, dscfm

$$Q_{std} = Q\ (1 - B_{wo})\left(\frac{T_{ref}}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

i. Percent isokinetic

$$I = \left(\frac{17.32\,(T_s)(V_{m\ std})}{(1 - B_{wo})(\Theta)(V_s)(P_s)(D_n^{\,2})}\right)\left(\frac{528\ °R}{T_{ref}}\right)$$

2. Particulate Emissions

a. Grain loading, gr/dscf

$$C = 0.01543 \left(\frac{M_n}{V_{m\ std}} \right)$$

b. Grain loading at 12% CO_2, gr/dscf

$$C_{12\%CO_2} = C \left(\frac{12}{\%CO_2} \right)$$

c. Mass emissions, lb/hr

$$M = C(Q_{sd}) \frac{(60\ \text{min/hr})}{(7000\ gr/lb)}$$

3. Gaseous Emissions, lb/hr

$$M = (ppm)(10^{-6}) \left(\frac{MW_i\ lb/lb\ mole}{SV} \right) (Q_{sd})(60\ \text{min/hr})$$

where,

SV = *specific molar volume of an ideal gas*:

$SV = 385.3\ ft^3/lb\ mole \quad for\ T_{ref} = 528\ °R$

$SV = 379.5\ ft^3/lb\ mole \quad for\ T_{ref} = 520\ °R$

4. Emissions Rates, lb/10^6 Btu

a. Fuel factor at 68 °F, dscf/10^6 Btu at 0% O_2

$$F_{68} = \frac{10^6 [3.64(\%H) + 1.53(\%C) + 0.14\ (\%N) + 0.57(\%S) - 0.46(\%O_2, fuel)]}{HHV,\ Btu/lb}$$

b. Fuel factor at 60 °F

$$F_{60} = F_{68} \left(\frac{520\ °R}{528\ °R} \right)$$

c. Gaseous Emissions factor

$$\left(\frac{lb}{10^6\ Btu} \right)_i = (ppm)_i\ (10^{-6}) \left(\frac{MW_i\ lb}{lb\ mole} \right) \left(\frac{1}{SV} \right) (F) \left(\frac{20.9}{20.9 - \%O_2} \right)$$

d. Particulate emission factor

$$\left(\frac{lb}{10^6\ Btu} \right) = C \left(\frac{1\ lb}{7000\ gr} \right) (F) \left(\frac{20.9}{20.9 - \%O_2} \right)$$

Nomenclature:

A_s = stack area, ft^2

B_{wo} = flue gas moisture content

$C_{12\%\ CO_2}$ = particulate grain loading, gr/dscf corrected to 12% CO_2

C = particulate grain loading, gr/dscf

C_p = pitot calibration factor, dimensionless

Dn = nozzle diameter, in.

F = fuel F factor, dscf/10^6 Btu at 0% O_2

H = orifice pressure differential, iwg

I = % isokinetics

M_n = mass of collected particulate, mg

M_i = mass emissions of species i, lb/hr

MW = molecular weight of flue gas

MW_i = molecular weight of species i:

NO_x	:	46
CO	:	28
SO_x	:	64
HC	:	16

θ = sample time, min.

ΔP = average velocity head, iwg = $\left(\overline{\sqrt{\Delta P}}\right)^2$

P_{bar} = barometric pressure, in.Hg

P_s = stack absolute pressure, in.Hg

P_{sg} = stack static pressure, iwg

Nomenclature (Continued):

Q	=	wet stack gas flow rate at actual conditions, wacfm
Qsd	=	dry stack gas flow rate at standard conditions, dscfm
SV	=	specific molar volume of an ideal gas at standard conditions, ft^3/lb mole
Tm	=	meter temperature, °R
T_{ref}	=	reference temperature, °R
Ts	=	stack temperature, °R
V_s	=	stack velocity, ft/sec
V_{lc}	=	volume of liquid collected in impingers, ml
Vm	=	dry meter volume uncorrected, dcf
$V_{m\ std}$	=	dry meter volume at standard conditions, dscf
$V_{w\ std}$	=	volume of water vapor at standard conditions, scf
Y	=	meter calibration coefficient

Appendix D.2

Relative Accuracy and Calibration Drift Calculations

RELATIVE ACCURACY DETERMINATION
NOx ppm vol. wet

CLIENT: L. P. Oroville
UNIT: Boiler #5
LOAD: Full Load

DATE: 5/3/94
Data By: Carnot
Data By: KJC

Run #	Time	Carnot	L.P.	Difference	n	t(0,975)
1	0945-1025	504.13	470.0	34.13	2	12.706
2	1100-1130	502.03	465.0	37.03	3	4.303
3	1145-1215	479.80	435.0	44.80	4	3.182
4	1240-1310	487.56	465.0	22.56	5	2.776
5	1325-1405	484.22	455.0	29.22	6	2.571
6	1420-1450	489.70	460.0	29.70	7	2.447
7	1510-1540	488.73	455.0	33.73	8	2.365
8	1605-1645	466.89	445.0	21.89	9	2.306
9	1700-1730	484.53	458.0	26.53	10	2.262
10	1750-1820	467.50	440.0	27.50	11	2.228
					12	2.201

AVERAGES:		485.51	454.80	30.71
STANDARD DEVIATION				6.948372
CONFIDENCE COEFFICIENT				4.970221
RELATIVE ACCURACY, %				**7.35**

RELATIVE ACCURACY DETERMINATION
O2 % vol, wet

CLIENT: L. P. Oroville
UNIT: Boiler #5
LOAD: Full Load

DATE: 5/3/94
Data By: Carnot
Data By: KJC

Run #	Time	Carnot	L.P.	Difference	n	t(0,975)
1	0945-1025	4.94	4.88	0.06	2	12.706
2	1100-1130	4.71	4.70	0.01	3	4.303
3	1145-1215	4.70	4.70	0.00	4	3.182
4	1240-1310	4.72	4.70	0.02	5	2.776
5	1325-1405	4.69	4.70	-0.01	6	2.571
6	1420-1450	4.67	4.75	-0.08	7	2.447
7	1510-1540	4.68	4.75	-0.07	8	2.365
8	1605-1645	4.53	4.68	-0.15	9	2.306
9	1700-1730	4.80	4.80	0.00	10	2.262
10	1750-1820	4.81	4.75	0.06	11	2.228
					12	2.201

AVERAGES:	4.73	4.74	-0.02
STANDARD DEVIATION		0.065862	
CONFIDENCE COEFFICIENT		0.047111	
RELATIVE ACCURACY, %			**1.34**

RELATIVE ACCURACY DETERMINATION
NOx ppm vol. wet

CLIENT: L. P. Oroville
UNIT: Boiler #4
LOAD: Full Load

DATE: 5/4&5/94
Data By: Carnot
Data By: KJC

Run #	Time	Carnot	L.P.	Difference	n	t(0,975)
1	1220-1250	84.56	78.0	6.56	2	12.706
2	1320-1350	85.60	80.4	5.20	3	4.303
3	1545-1625	84.72	79.2	5.52	4	3.182
4	1635-1705	76.20	71.2	5.00	5	2.776
5	1720-1800	83.60	78.0	5.60	6	2.571
6	0908-0938	67.56	65.0	2.56	7	2.447
7	1013-1043	81.88	78.0	3.88	8	2.365
8	1108-1138	81.74	81.4	0.34	9	2.306
9	1208-1238	60.08	57.0	3.08	10	2.262
10	1443-1523	75.99	73.6	2.39	11	2.228
11	1538-1608	78.39	74.8	3.59	12	2.201
12	1618-1648	79.51	75.4	4.11		

AVERAGES:		78.32	74.33	3.99
STANDARD DEVIATION			1.731103	
CONFIDENCE COEFFICIENT			1.099898	
RELATIVE ACCURACY, %				**6.49**

RELATIVE ACCURACY DETERMINATION
O2 % vol. wet

CLIENT: L. P. Oroville
UNIT: Boiler #4
LOAD: Full Load

DATE: 5/4&5/94
Data By: Carnot
Data By: KJC

Run #	Time	Carnot	L.P.	Difference	n	t(0,975)
1	1220-1250	~~4.24~~	~~4.50~~	~~-0.26~~	2	12.706
2	1320-1350	4.12	4.25	-0.13	3	4.303
3	1545-1625	4.42	4.50	-0.08	4	3.182
4	1635-1705	4.75	4.75	0.00	5	2.776
5	1720-1800	4.89	4.70	0.19	6	2.571
6	0908-0938	4.74	4.80	-0.06	7	2.447
7	1013-1043	5.60	5.60	0.00	8	2.365
8	1108-1138	4.47	4.80	-0.33	9	2.306
9	1208-1238	3.53	4.00	-0.47	10	2.262
10	1443-1523	4.25	4.45	-0.20	11	2.228
11	1538-1608	4.35	4.38	-0.03	12	2.201
12	1618-1648	4.56	4.40	0.16		

AVERAGES:	4.52	4.60	-0.09	(Run 1 deleted, see data sheets)
STANDARD DEVIATION			0.19423	
CONFIDENCE COEFFICIENT			0.130478	
RELATIVE ACCURACY, %				**4.80**

POLLUTANT CALIBRATION DRIFT DETERMINATION

CLIENT: L. P. Oroville
UNIT: Boiler #4

Run #	Date	% Full Scale NOx Cal.	% Full Scale NOx Zero	ppm vol wet NOx Cal.	ppm vol wet NOx Zero	Difference NOx Cal.	Difference NOx Zero	% Cal. Drift NOx Cal.	% Cal. Drift NOx Zero
1	5-7-94	35.0	-0.8	70.0	-1.6	-1.9	-1.6	1.0	0.8
2	5-8-94	36.3	-0.6	72.6	-1.2	0.7	-1.2	0.3	0.6
3	5-9-94	35.4	-0.8	70.8	-1.6	-1.1	-1.6	0.6	0.8
4	5-10-94	34.8	-0.8	69.6	-1.6	-2.3	-1.6	1.2	0.8
5	5-11-94	35.8	-0.7	71.6	-1.4	-0.3	-1.4	0.2	0.7
6	5-12-94	34.5	-0.7	69.0	-1.4	-2.9	-1.4	1.5	0.7
7	5-13-94	35.0	-0.8	70.0	-1.6	-1.9	-1.6	1.0	0.8
		Cal. Value:		71.9	0.0				
		Span Value:		200					

	SPAN	ZERO
CALIBRATION DRIFT, %	**1.45**	**0.8**

DILUENT CALIBRATION DRIFT DETERMINATION

CLIENT: L. P. Oroville
UNIT: Boiler #4

Run #	Date	% Full Scale O2 High	% Full Scale O2 Low	% vol wet O2 High	% vol wet O2 Low	Difference O2 High	Difference O2 Low	% Cal. Drift O2 High	% Cal. Drift O2 Low
1	4-20-94	83.9	12.4	21.0	3.1	0.08	0.10	0.1	0.1
2	4-21-94	84.2	12.4	21.1	3.1	0.15	0.10	0.2	0.1
3	4-22-94	84.0	12.4	21.0	3.1	0.10	0.10	0.1	0.1
4	4-23-94	84.0	12.2	21.0	3.1	0.10	0.05	0.1	0.0
5	4-24-94	84.0	12.4	21.0	3.1	0.10	0.10	0.1	0.1
6	4-25-94	84.0	12.6	21.0	3.2	0.10	0.15	0.1	0.2
7	4-26-94	84.8	12.8	21.2	3.2	0.30	0.20	0.3	0.2
		Cal. Value:		20.9	3.0				
		Span Value:		25					

	SPAN	ZERO
CALIBRATION DRIFT, %	**0.3**	**0.2**

OPACITY CALIBRATION DRIFT DETERMINATION

CLIENT: L. P. Oroville
UNIT: Boiler #4

Run #	Date	Percent Full Scale Zero	Percent Full Scale Upsc.	Percent Opacity Zero	Percent Opacity Upsc.	Drift Opacity Zero	Drift Opacity Upsc.	% Cal. Drift
1	4-19-94	0.0	42.8	0.00	8.56			
2	4-20-94	0.0	42.6	0.00	8.52	0.00	-0.04	-0.04
3	4-21-94	0.0	43.0	0.00	8.60	0.00	0.08	0.08
4	4-22-94	0.0	42.5	0.00	8.50	0.00	-0.10	-0.10
5	4-23-94	0.0	42.7	0.00	8.54	0.00	0.04	0.04
6	4-24-94	0.0	42.8	0.00	8.56	0.00	0.02	0.02
7	4-25-94	0.0	42.5	0.00	8.50	0.00	-0.06	-0.06
8	4-26-94	0.0	43.5	0.00	8.70	0.00	0.20	0.20
Arithmetic Mean:						0.00		0.02
Confidence Coefficient:						0.00		0.09

Zero Drift, % Opacity: **0.00**

Calibration Drift, % Opacity: **0.11**

POLLUTANT CALIBRATION DRIFT DETERMINATION

CLIENT: L. P. Oroville
UNIT: Boiler #5

Run #	Date	% Full Scale NOx Cal.	% Full Scale NOx Zero	ppm vol wet NOx Cal.	ppm vol wet NOx Zero	Difference NOx Cal.	Difference NOx Zero	% Cal. Drift NOx Cal.	% Cal. Drift NOx Zero
1	5-7-94	58.0	-0.1	580.0	-1.0	3.0	-1.0	0.3	0.1
2	5-8-94	55.7	-0.2	557.0	-2.0	-20.0	-2.0	2.0	0.2
3	5-9-94	57.3	-0.3	573.0	-3.0	-4.0	-3.0	0.4	0.3
4	5-10-94	55.5	-0.4	555.0	-4.0	-22.0	-4.0	2.2	0.4
5	5-11-94	58.3	0.0	583.0	0.0	6.0	0.0	0.6	0.0
6	5-12-94	57.8	-0.1	578.0	-1.0	1.0	-1.0	0.1	0.1
7	5-13-94	57.6	-0.1	576.0	-1.0	-1.0	-1.0	0.1	0.1
		Cal. Value:		577.0	0.0				
		Span Value:		1000					

	SPAN	ZERO
CALIBRATION DRIFT, %	**2.2**	**0.4**

DILUENT CALIBRATION DRIFT DETERMINATION

CLIENT: L. P. Oroville
UNIT: Boiler #5

Run #	Date	% Full Scale O2 High	% Full Scale O2 Low	% vol wet O2 High	% vol wet O2 Low	Difference O2 High	Difference O2 Low	% Cal. Drift O2 High	% Cal. Drift O2 Low
1	4-22-94	85.2	12.2	21.3	3.1	0.40	0.05	0.4	0.0
2	4-23-94	84.8	12.0	21.2	3.0	0.30	0.00	0.3	0.0
3	4-24-94	83.6	11.8	20.9	3.0	0.00	-0.05	0.0	0.0
4	4-25-94	84.0	12.2	21.0	3.1	0.10	0.05	0.1	0.0
5	4-26-94	83.1	11.7	20.8	2.9	-0.13	-0.08	0.1	0.1
6	4-27-94	83.6	11.6	20.9	2.9	0.00	-0.10	0.0	0.1
7	4-28-94	83.8	11.8	21.0	3.0	0.05	-0.05	0.1	0.0
		Cal. Value:		20.9	3.0				
		Span Value:		25					

	SPAN	ZERO
CALIBRATION DRIFT, %	0.4	0.1

OPACITY CALIBRATION DRIFT DETERMINATION

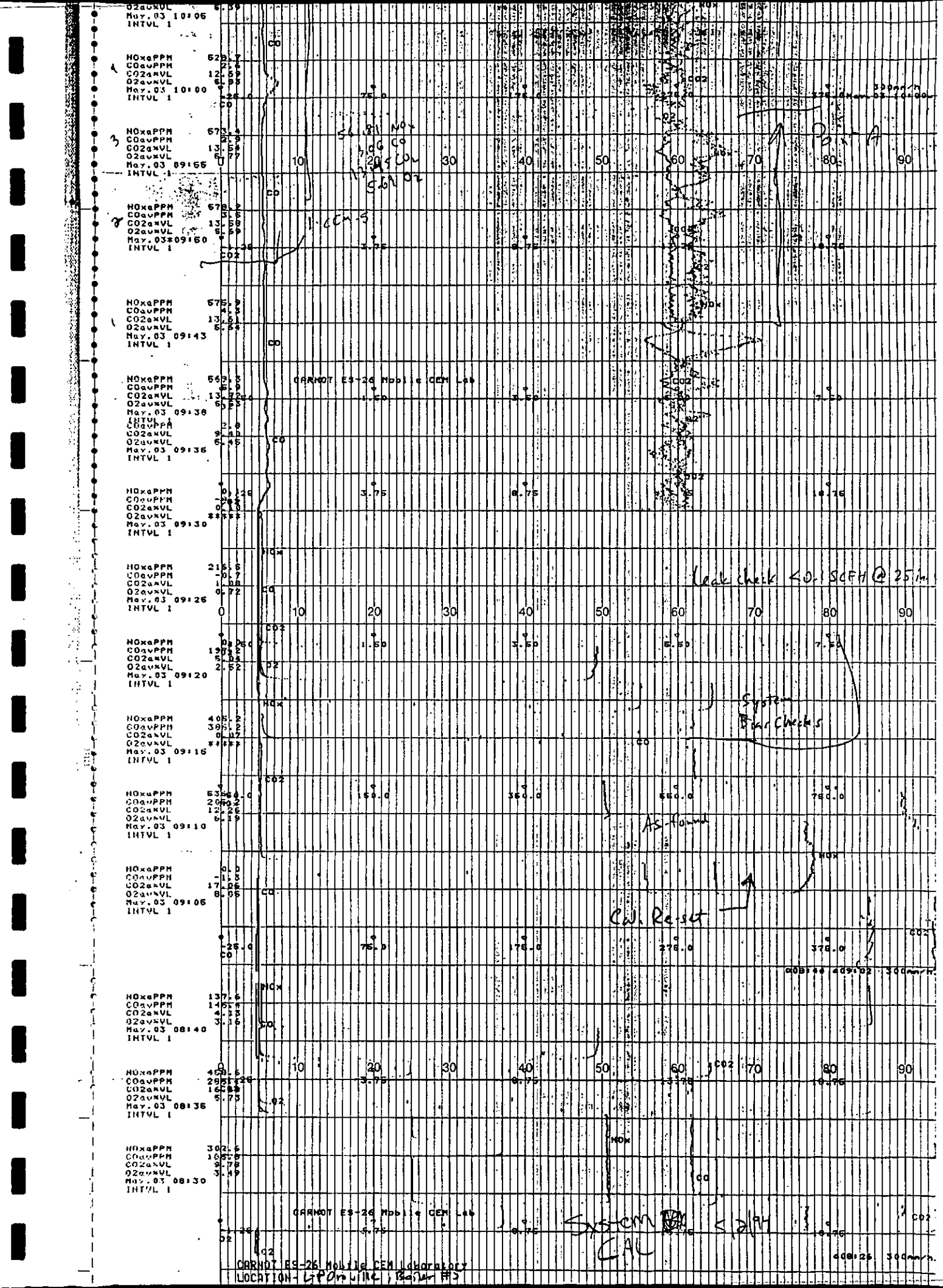
CLIENT: L. P. Oroville
UNIT: Boiler #5

Run #	Date	Percent Full Scale Zero	Percent Full Scale Upsc.	Percent Opacity Zero	Percent Opacity Upsc.	Drift Opacity Zero	Drift Opacity Upsc.	% Cal. Drift
1	4-22-94	-0.5	36.5	-0.10	7.30			
2	4-23-94	0.0	37.0	0.00	7.40	0.10	0.10	0.00
3	4-24-94	0.0	37.0	0.00	7.40	0.00	0.00	0.00
4	4-25-94	0.0	37.5	0.00	7.50	0.00	0.10	0.10
5	4-26-94	0.0	37.0	0.00	7.40	0.00	-0.10	-0.10
6	4-27-94	-0.2	36.8	-0.04	7.36	-0.04	-0.04	0.00
7	4-28-94	-0.1	36.8	-0.02	7.36	0.02	0.00	-0.02
8	4-29-94	0.0	36.8	0.00	7.36	0.02	0.00	-0.02
Arithmetic Mean:						0.01		-0.01
Confidence Coefficient:						0.04		0.05

Zero Drift, % Opacity: **0.05**

Calibration Drift: **0.06**

APPENDIX E
STRIP CHARTS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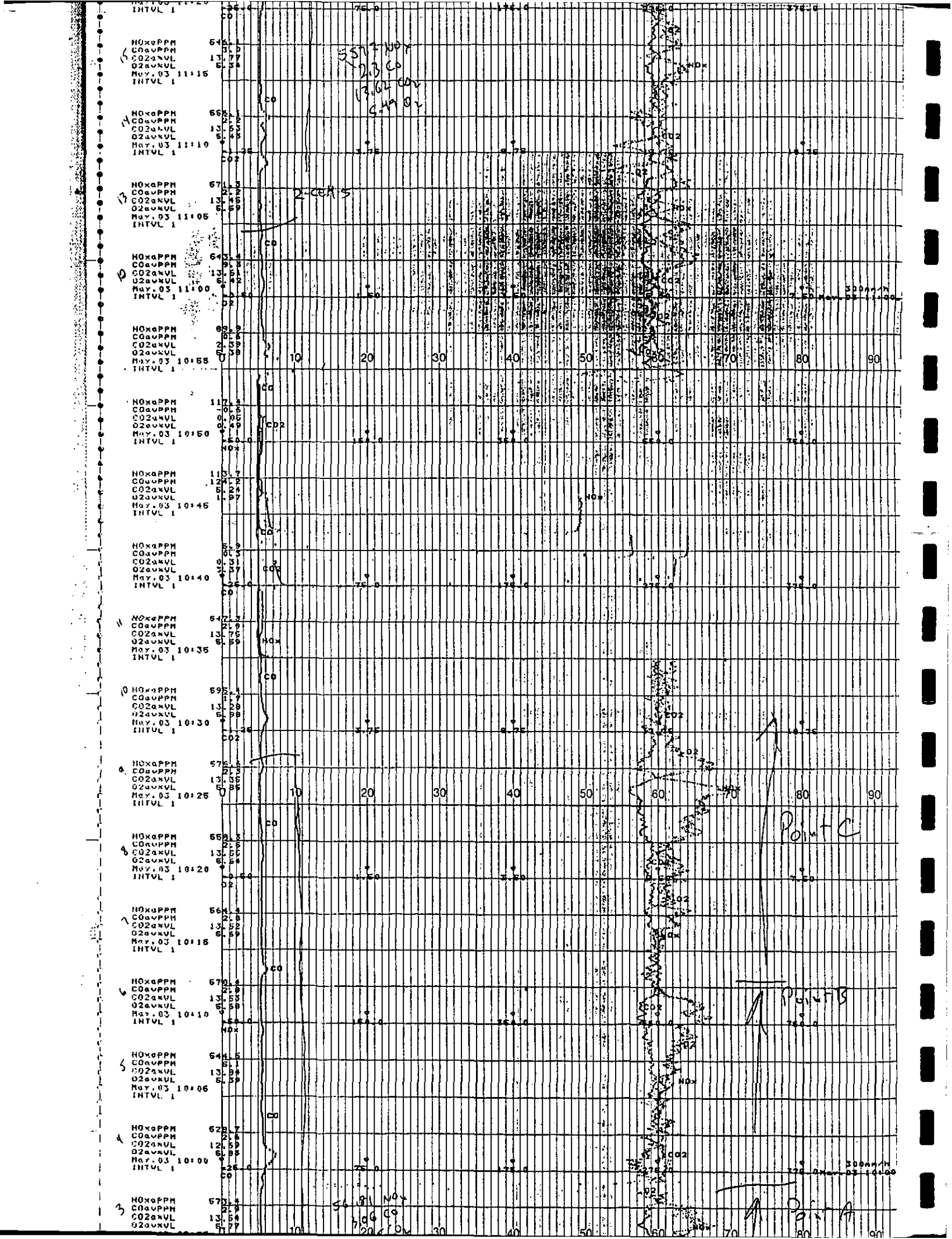
May.03 09:55
May.03 09:50
May.03 09:43
May.03 09:38
May.03 09:36
May.03 09:30
May.03 09:26
May.03 09:20
May.03 09:16
May.03 09:10
May.03 09:06
May.03 08:40
May.03 08:36
May.03 08:30
CARNOT ES-26 Mobile CEM Lab
Leak check <0.1 SCFH @ 25 in
System Bias Checks
As-found
CAL
CARNOT ES-26 Mobile CEM Laboratory
LOCATION - Lyondell, Berwyn, PA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COavPPM
CO2avXVL
O2avXVL
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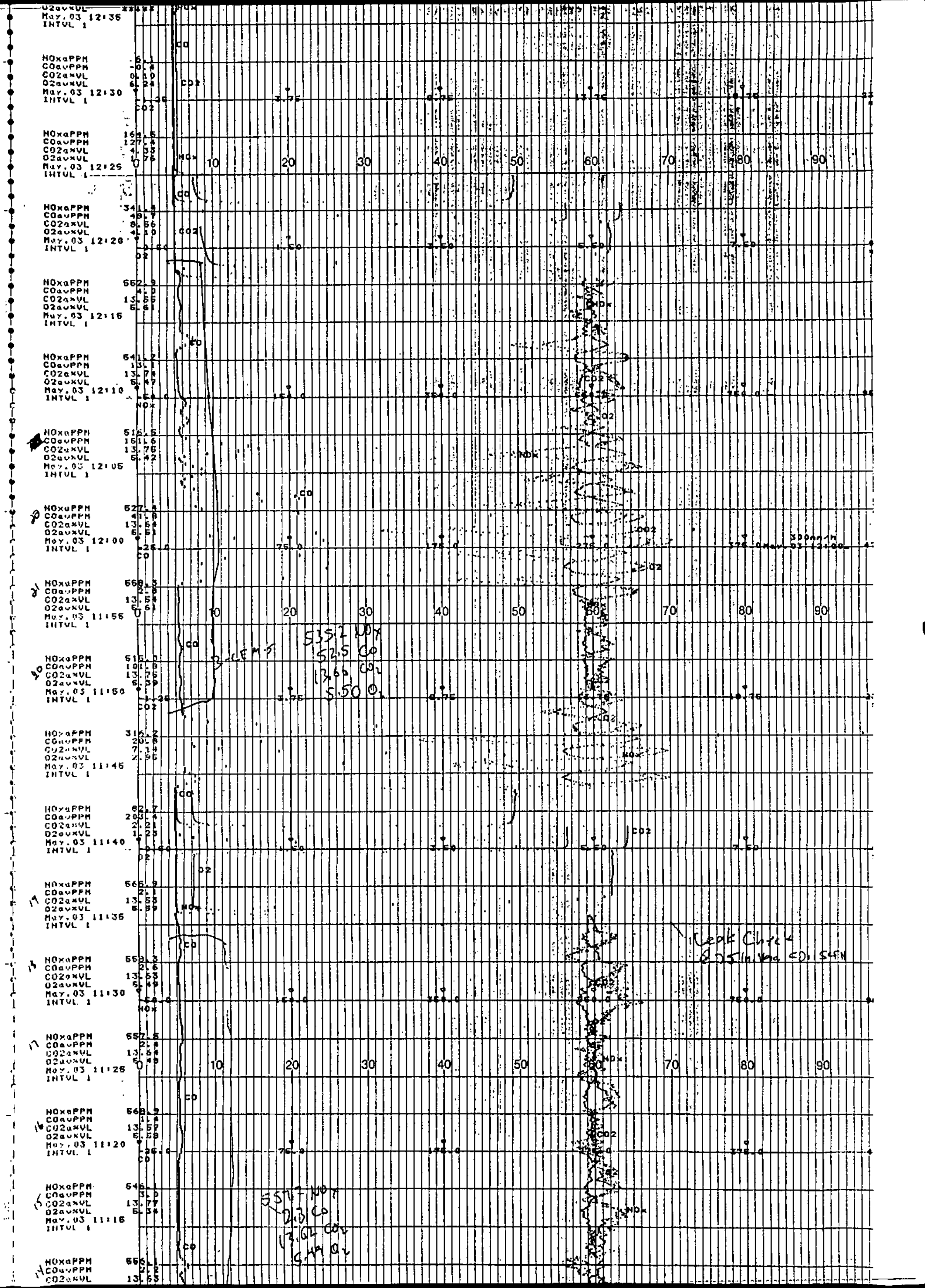
INTVL 1
May.03 11:10
May.03 11:05
May.03 11:00
May.03 10:55
May.03 10:50
May.03 10:46
May.03 10:40
May.03 10:35
May.03 10:30
May.03 10:25
May.03 10:20
May.03 10:15
May.03 10:10
May.03 10:06
May.03 10:00
55ppm NOx
2.3 CO
13.6% CO2
4.4% O2
2 CEMS
Point C
Point B
Point A
NOx
CO
CO2
O2
0
10
20
30
40
50
60
70
80
90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COavPPM -0.4
CO2axVL 0.10
O2avxVL 6.24
May.03 12:30
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NOxaPPM 164.5
COavPPM 127.4
CO2axVL 4.33
O2avxVL 1.76
May.03 12:25
INTVL 1
NOxaPPM 341.8
COavPPM 49.7
CO2axVL 8.56
O2avxVL 4.10
May.03 12:20
INTVL 1
NOxaPPM 662.9
COavPPM 4.0
CO2axVL 13.56
O2avxVL 5.61
May.03 12:16
INTVL 1
NOxaPPM 641.2
COavPPM 13.1
CO2axVL 13.74
O2avxVL 5.47
May.03 12:10
INTVL 1
NOxaPPM 516.5
COavPPM 161.6
CO2axVL 13.76
O2avxVL 5.42
May.03 12:05
INTVL 1
NOxaPPM 627.4
COavPPM 41.8
CO2axVL 13.64
O2avxVL 5.51
May.03 12:00
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NOxaPPM 560.3
COavPPM 2.8
CO2axVL 13.54
O2avxVL 5.61
May.03 11:55
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COavPPM 101.8
CO2axVL 13.75
O2avxVL 5.39
May.03 11:50
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COavPPM 205.8
CO2axVL 7.14
O2avxVL 2.96
May.03 11:45
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NOxaPPM 62.7
COavPPM 203.4
CO2axVL 2.21
O2avxVL 1.23
May.03 11:40
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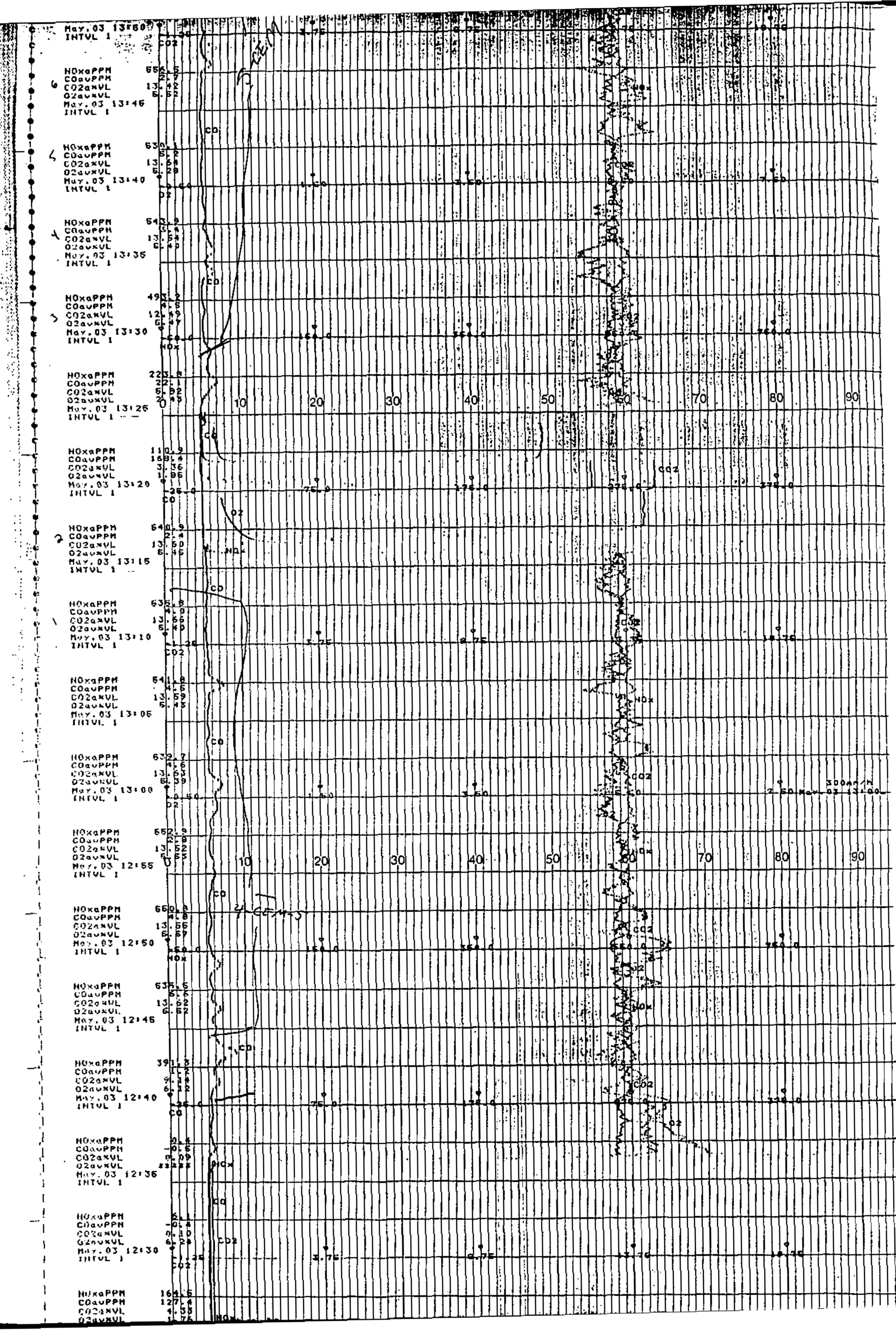
NOxaPPM 565.9
COavPPM 2.1
CO2axVL 13.53
O2avxVL 5.39
May.03 11:35
INTVL 1
NOxaPPM 569.3
COavPPM 2.6
CO2axVL 13.53
O2avxVL 5.49
May.03 11:30
INTVL 1
NOxaPPM 557.5
COavPPM 2.4
CO2axVL 13.64
O2avxVL 5.49
May.03 11:26
INTVL 1
NOxaPPM 568.9
COavPPM 1.4
CO2axVL 13.57
O2avxVL 5.58
May.03 11:20
INTVL 1
NOxaPPM 546.1
COavPPM 3.0
CO2axVL 13.77
O2avxVL 5.34
May.03 11:16
INTVL 1
NOxaPPM 556.1
COavPPM 2.2
CO2axVL 13.63
0 10 20 30 40 50 60 70 80 90
NOx
CO
CO2
O2
535.2 NOx
52.5 CO
13.60 CO2
5.50 O2
Leak Check
557.7 NOx
2.3 CO
13.62 CO2
5.49 O2



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COavPPM 2.7
CO2axVL 13.42
O2avxVL 6.62
May.03 13:45
INTVL 1
NOxaPPM 630.1
COavPPM 5.2
CO2axVL 13.64
O2avxVL 6.28
May.03 13:40
INTVL 1
NOxaPPM 543.9
COavPPM 3.4
CO2axVL 13.54
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INTVL 1
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COavPPM 4.6
CO2axVL 12.49
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May.03 13:30
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COavPPM 22.1
CO2axVL 5.82
O2avxVL 2.45
May.03 13:25
INTVL 1
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COavPPM 168.4
CO2axVL 3.36
O2avxVL 1.96
May.03 13:20
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NOxaPPM 640.9
COavPPM 2.4
CO2axVL 13.50
O2avxVL 6.45
May.03 13:15
INTVL 1
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COavPPM 4.0
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O2avxVL 5.40
May.03 13:10
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COavPPM 4.5
CO2axVL 13.59
O2avxVL 5.43
May.03 13:05
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O2avxVL 6.39
May.03 13:00
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O2avxVL 6.53
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INTVL 1
NOxaPPM 650.8
COavPPM 4.8
CO2axVL 13.56
O2avxVL 6.57
May.03 12:50
INTVL 1
NOxaPPM 635.5
COavPPM 6.6
CO2axVL 13.52
O2avxVL 6.52
May.03 12:45
INTVL 1
NOxaPPM 391.3
COavPPM 1.2
CO2axVL 9.14
O2avxVL 6.12
May.03 12:40
INTVL 1
NOxaPPM 0.4
COavPPM -0.6
CO2axVL 0.09
O2avxVL *****
May.03 12:35
INTVL 1
NOxaPPM 6.1
COavPPM -0.4
CO2axVL 0.10
O2avxVL 6.24
May.03 12:30
INTVL 1
NOxaPPM 164.5
COavPPM 127.4
CO2axVL 4.53
O2avxVL 1.75
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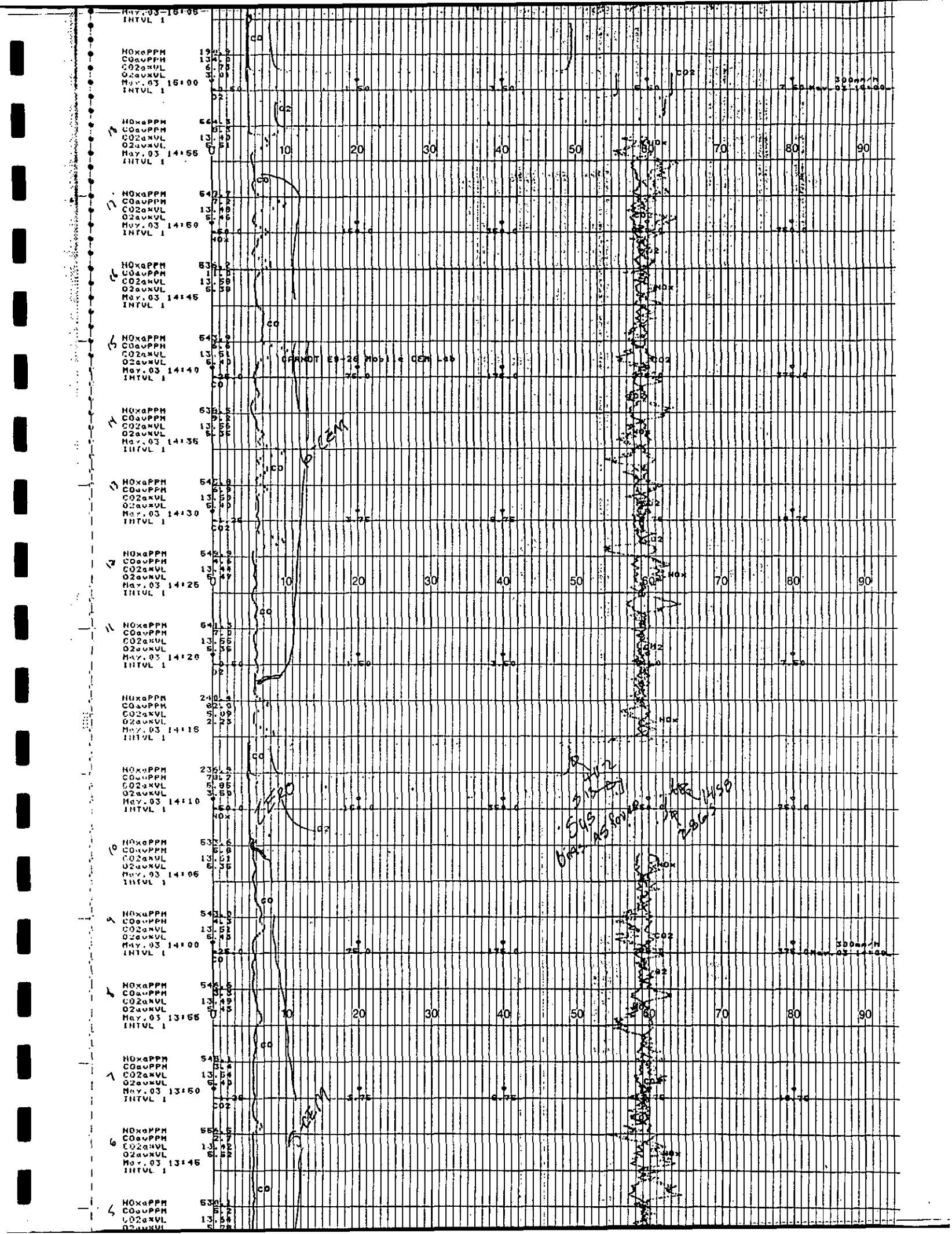
CO2
O2
NOx
CO
300mm/H May.03 13:00


CARNOT E9-26 Mobile CEM Lab
CO
CO2
NOx
O2
ZERO
SPAN
May.03 16:05
INTVL 1
May.03 16:00
May.03 14:55
May.03 14:50
May.03 14:45
May.03 14:40
May.03 14:36
May.03 14:30
May.03 14:25
May.03 14:20
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May.03 13:55
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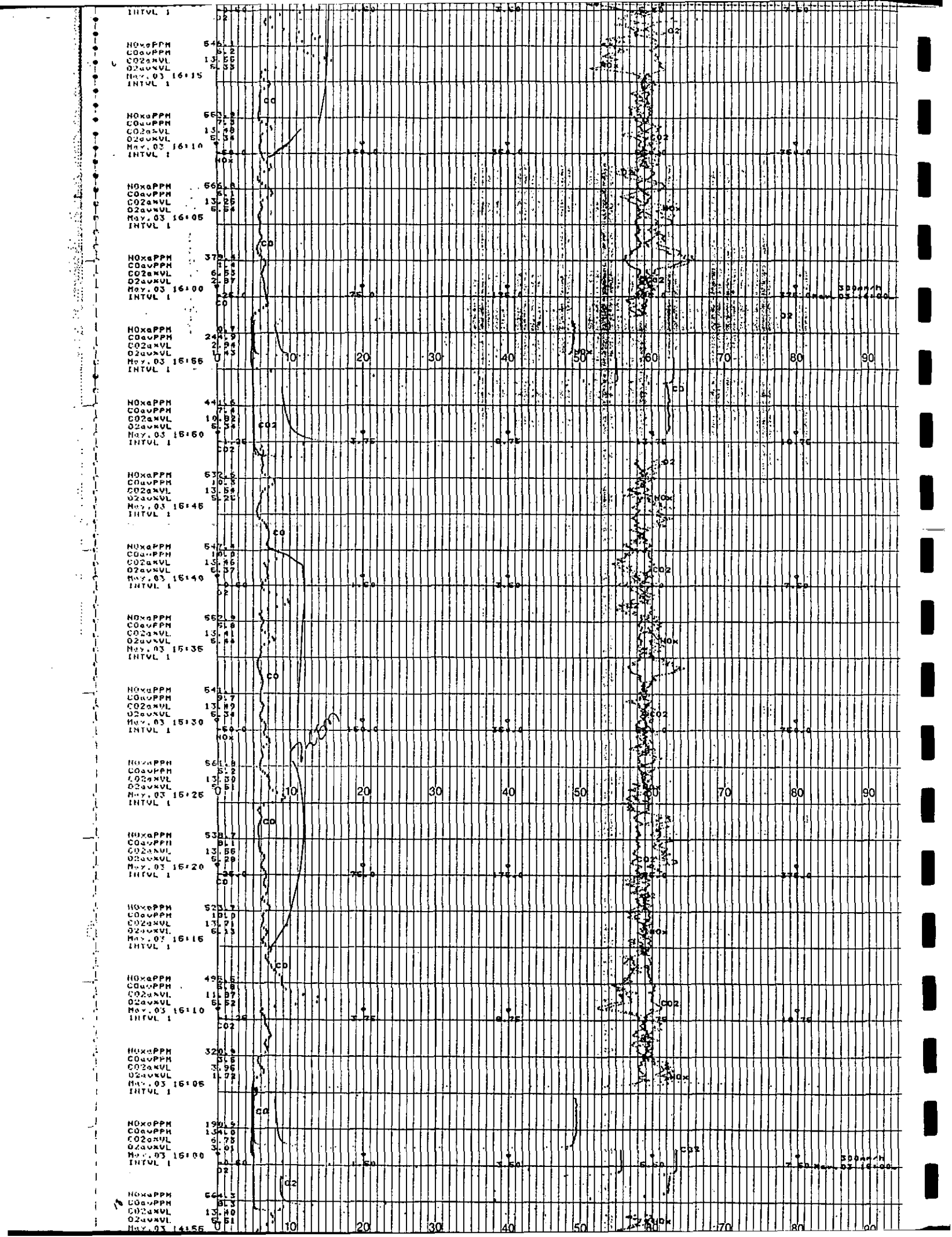
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COavPPM
CO2avXVL
O2avXVL
May.03 16:15
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May.03 16:05
May.03 16:00
May.03 15:55
May.03 15:50
May.03 15:45
May.03 15:40
May.03 15:35
May.03 15:30
May.03 15:25
May.03 15:20
May.03 15:15
May.03 15:10
May.03 15:05
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CO
CO2
O2
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20
30
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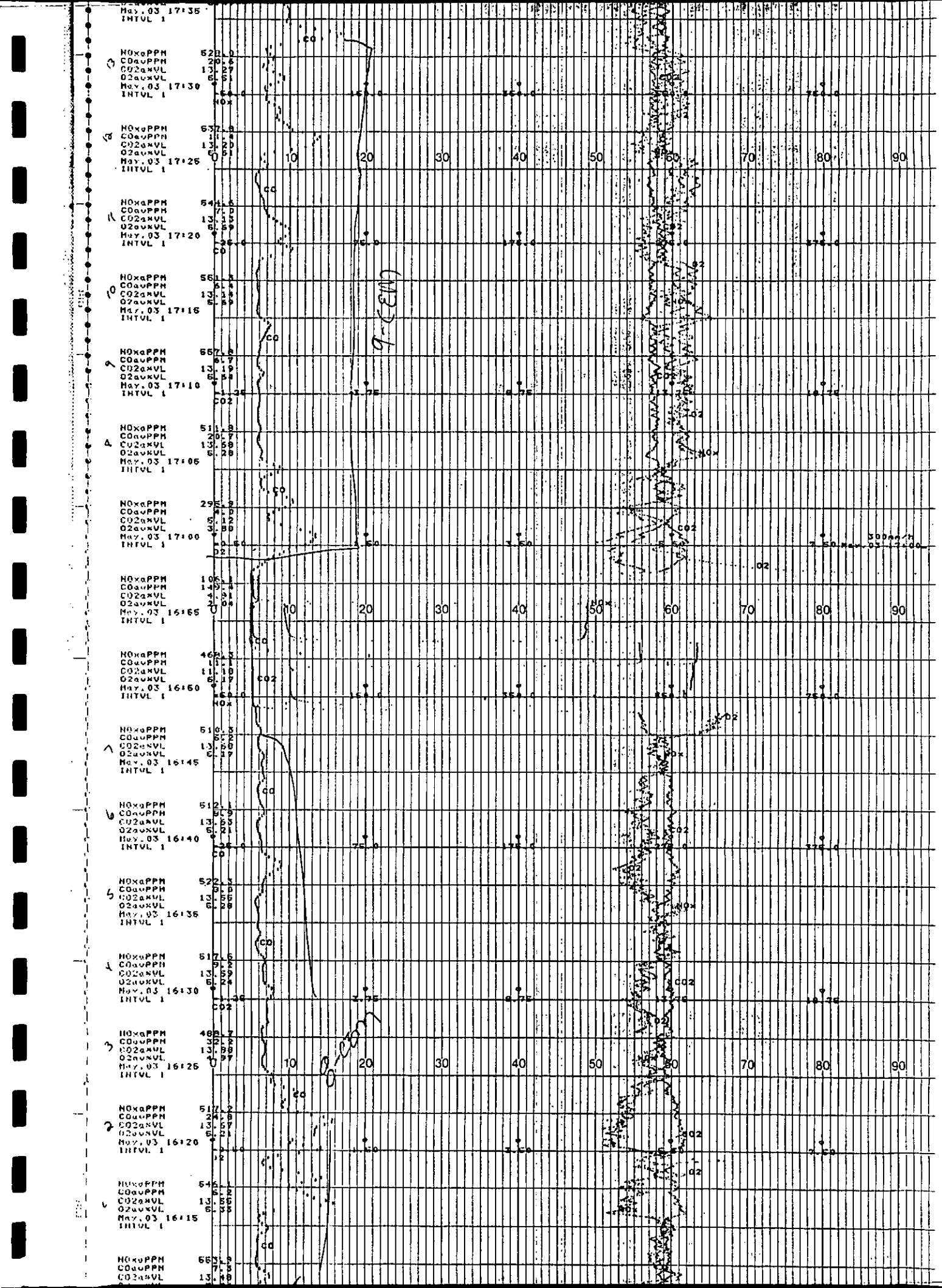
80
90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COauPPM
CO2aXVL
O2auXVL
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INTVL 1
May.03 17:30
May.03 17:25
May.03 17:20
May.03 17:15
May.03 17:10
May.03 17:05
May.03 17:00
May.03 16:55
May.03 16:50
May.03 16:45
May.03 16:40
May.03 16:35
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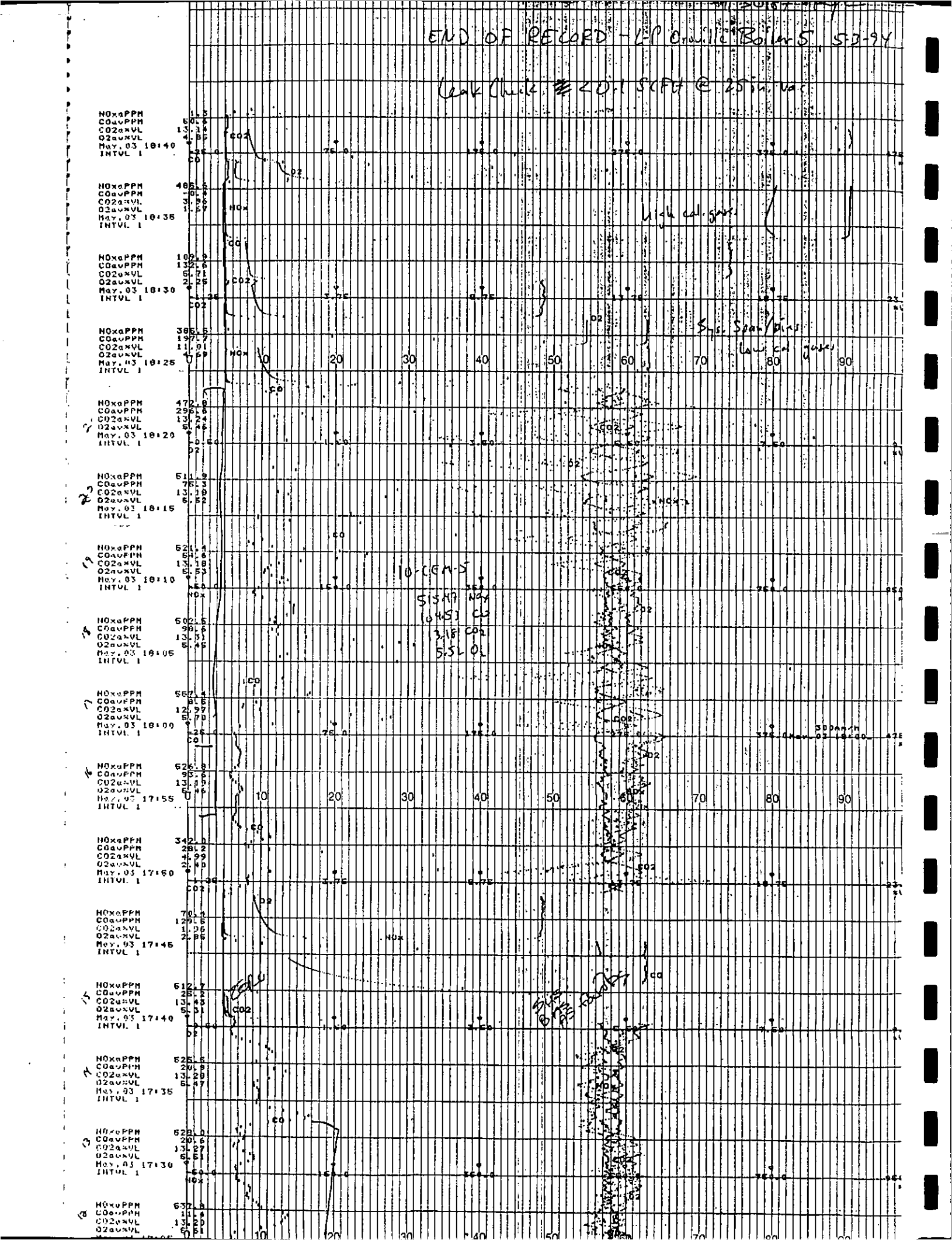
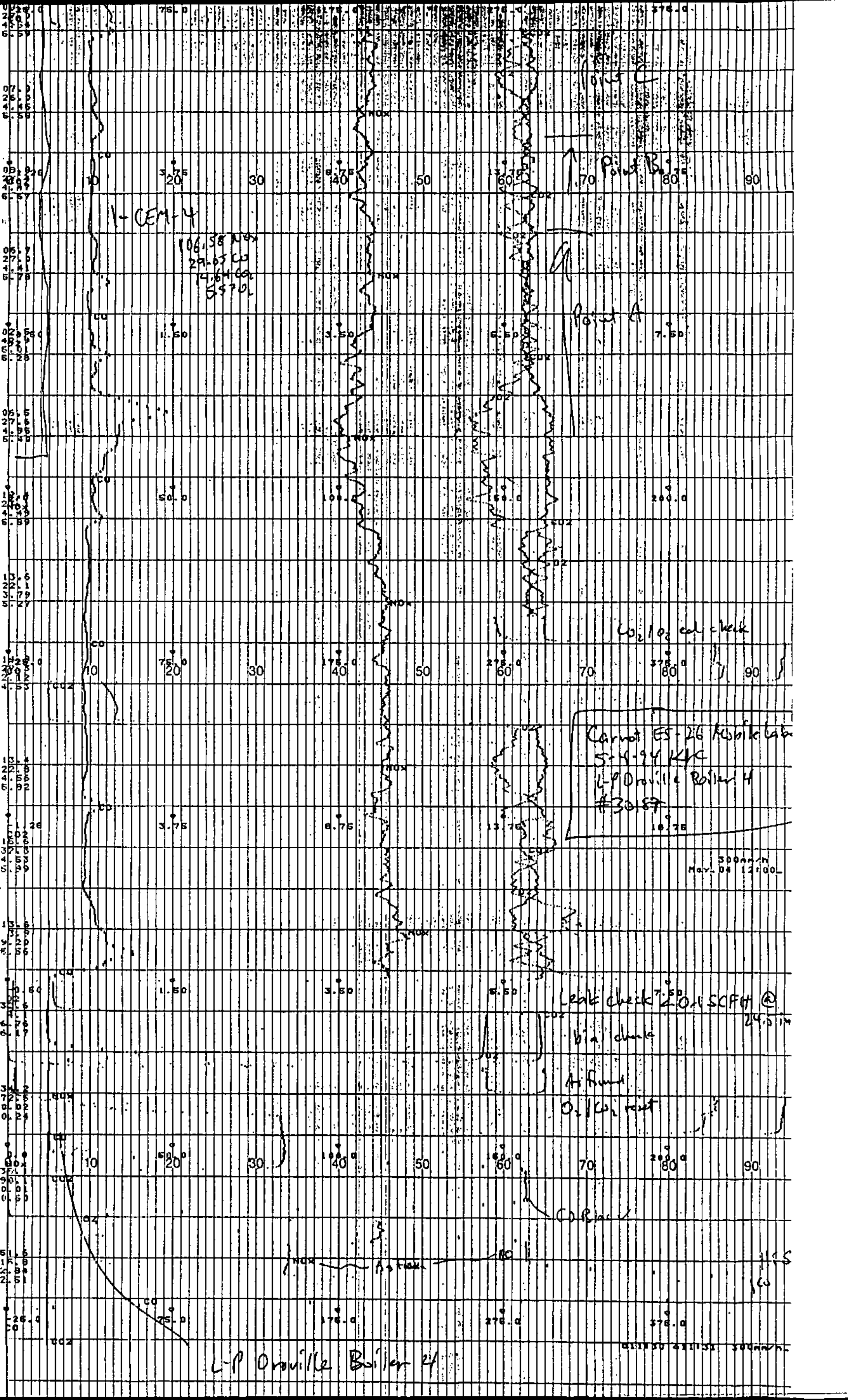
CO
NOx
CO2
O2


END OF RECORD - LCP Oroville Boiler 5, 5-3-94
Leak Check ≡ 20.1 SCFH @ 25 in. Vac
High cal. gas
5 pt. Span/Bias
Low cal. gases
10-CEM-5
NOx
CO
CO2
O2
HOxaPPM
COavPPM
CO2avXVL
O2avXVL
May.03 18:40
May.03 18:35
May.03 18:30
May.03 18:25
May.03 18:20
May.03 18:15
May.03 18:10
May.03 18:05
May.03 18:00
May.03 17:55
May.03 17:50
May.03 17:45
May.03 17:40
May.03 17:35
May.03 17:30
INTVL 1



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6	May.04 12:45	107.0	26.0	14.46	6.58	1
5	May.04 12:40	109.[illegible]	27.2	14.47	6.57	1
4	May.04 12:35	105.7	27.0	14.41	6.78	1
3	May.04 12:30	102.5	48.9	15.01	6.28	1
2	May.04 12:25	106.5	27.6	14.95	6.40	1
1	May.04 12:20	112.0	2[illegible]	14.49	6.89	1
	May.04 12:15	113.6	22.1	13.79	5.27	1
	May.04 12:10	11[illegible]	20.3	12.12	4.53	1
	May.04 12:03	113.4	22.8	14.56	6.92	1
	May.04 11:58	115.6	37.6	14.53	5.99	1
	May.04 11:53	13.6	3.9	9.20	5.56	1
	May.04 11:48	30.6	4.1	16.76	6.17	1
	May.04 11:43	34.2	172.6	-0.02	0.24	1
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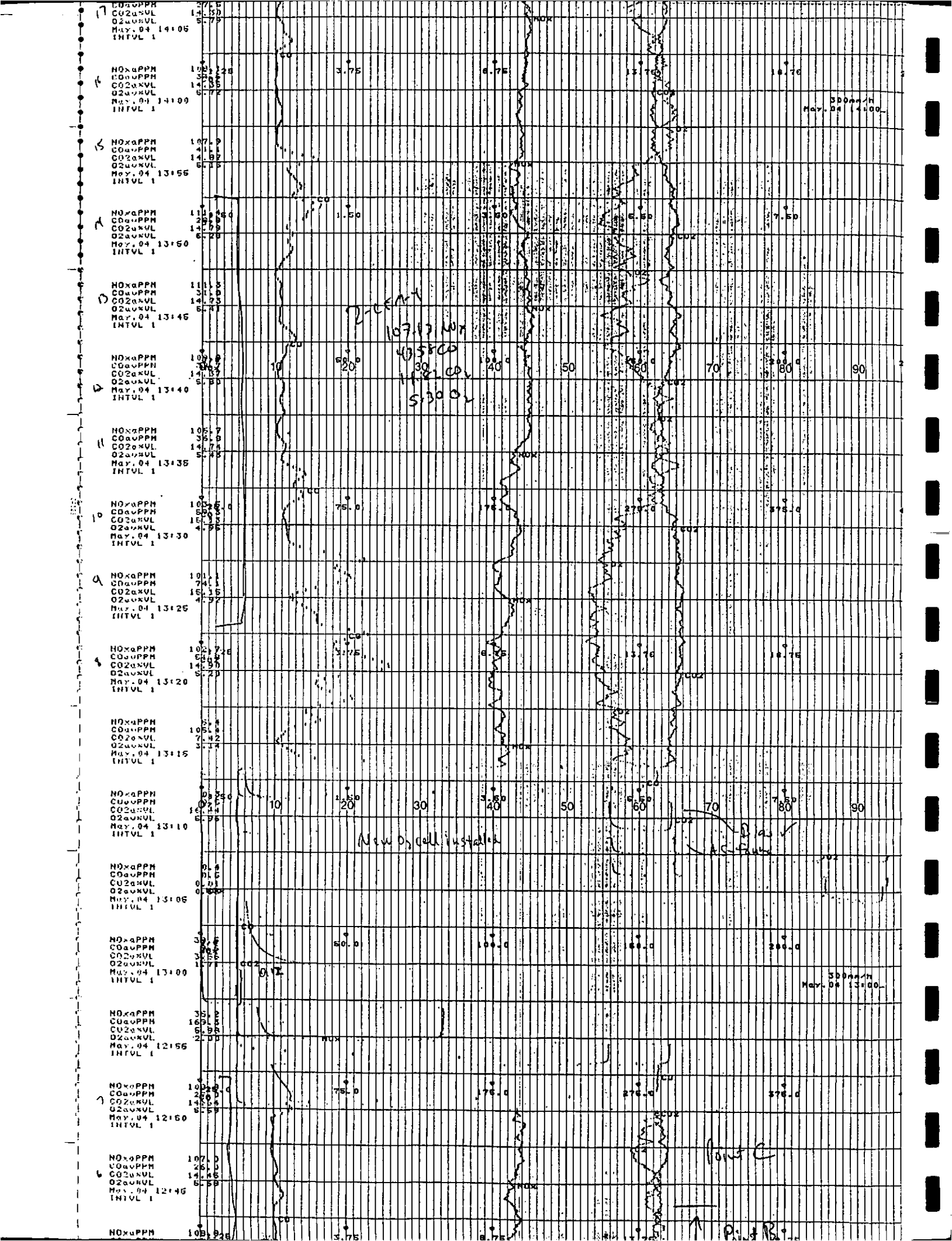
	May.04 11:33	51.6	15.8	2.84	2.51	1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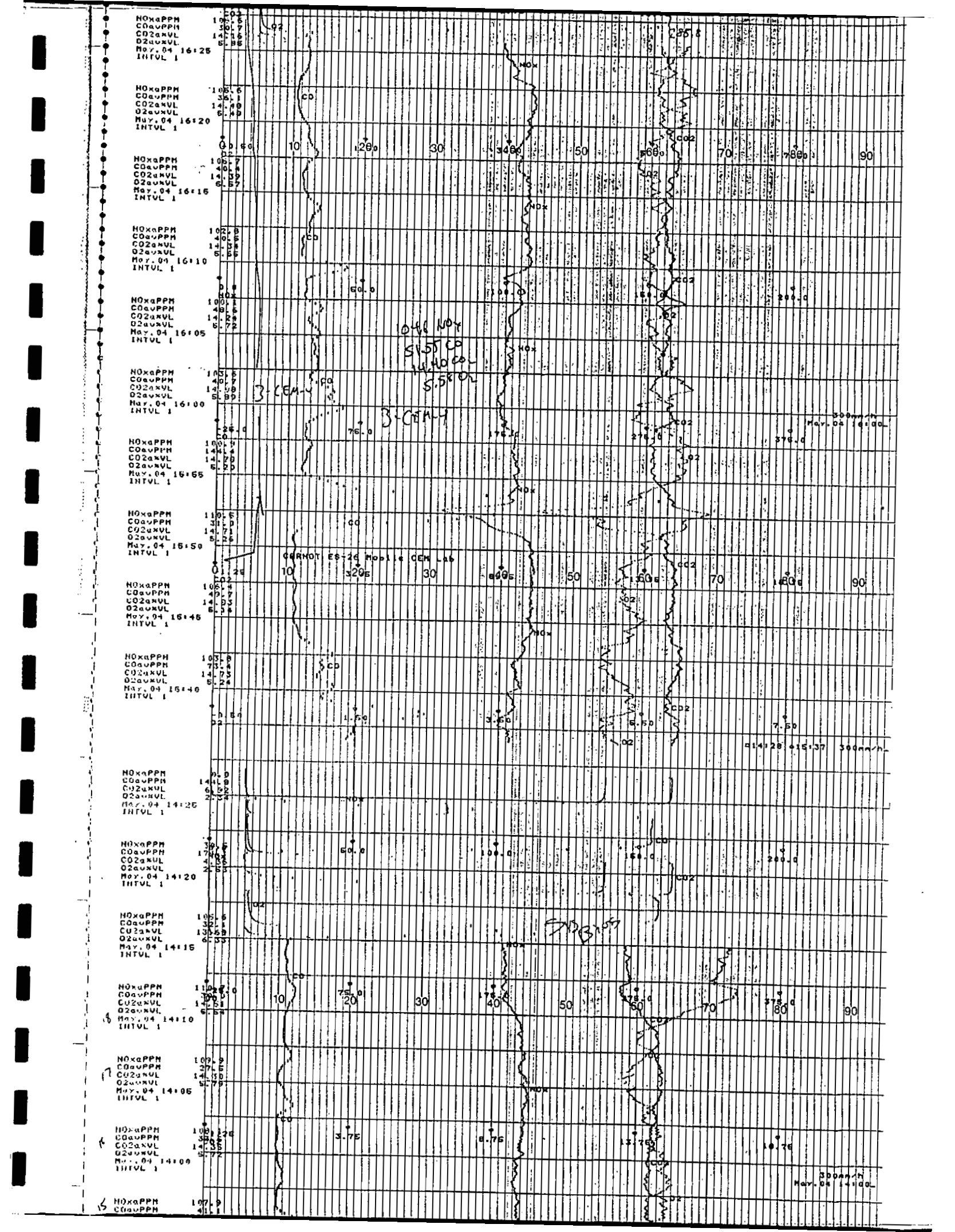
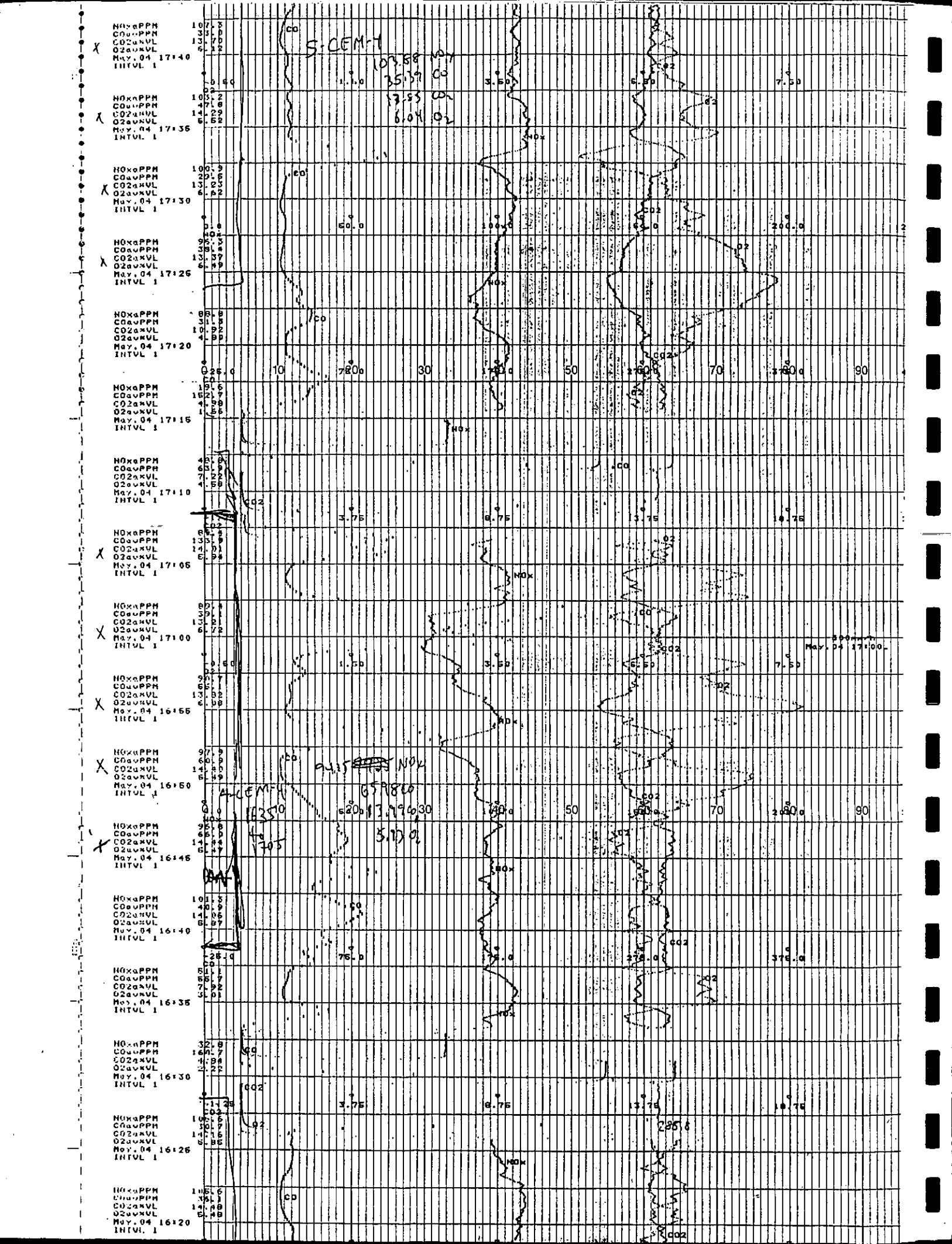
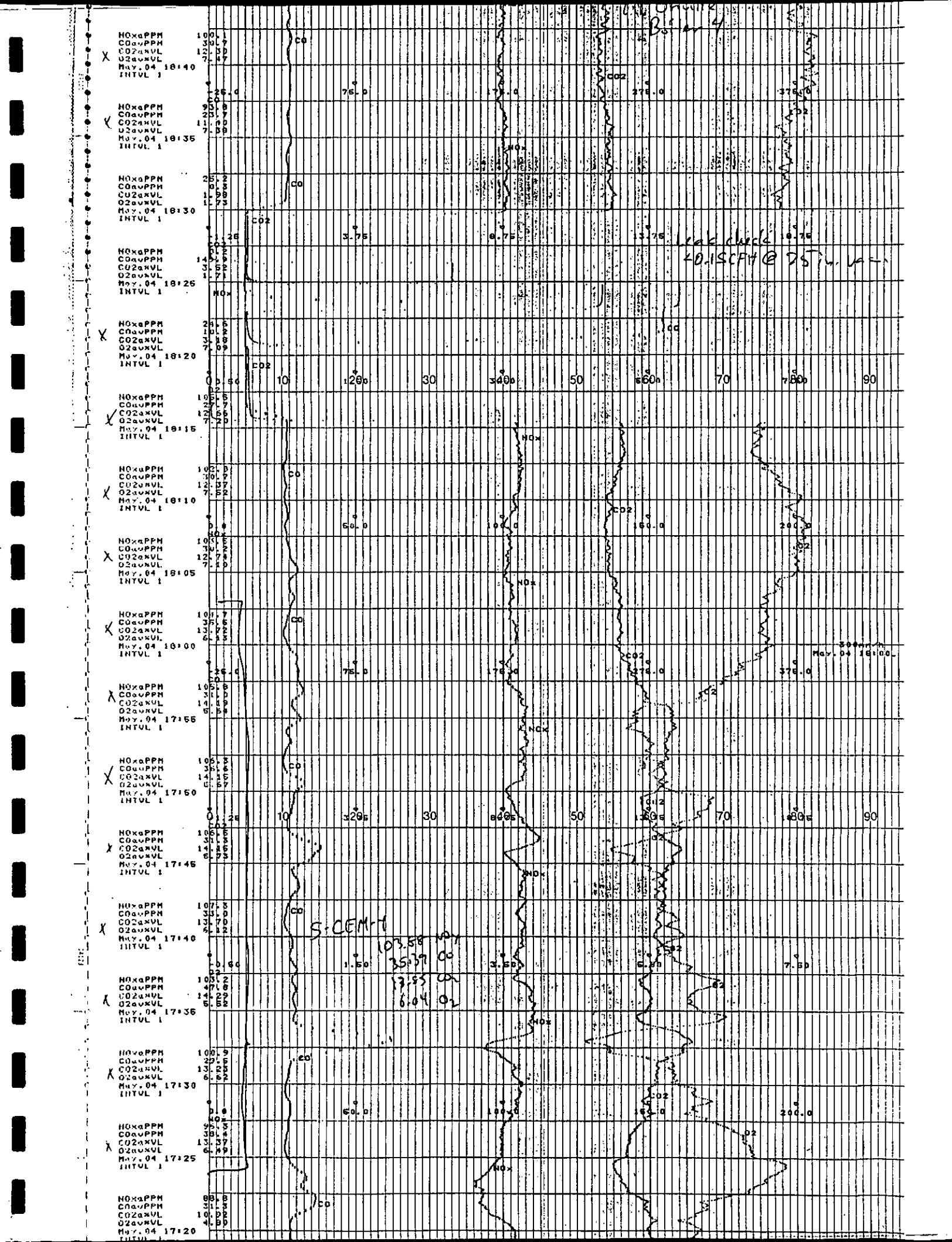
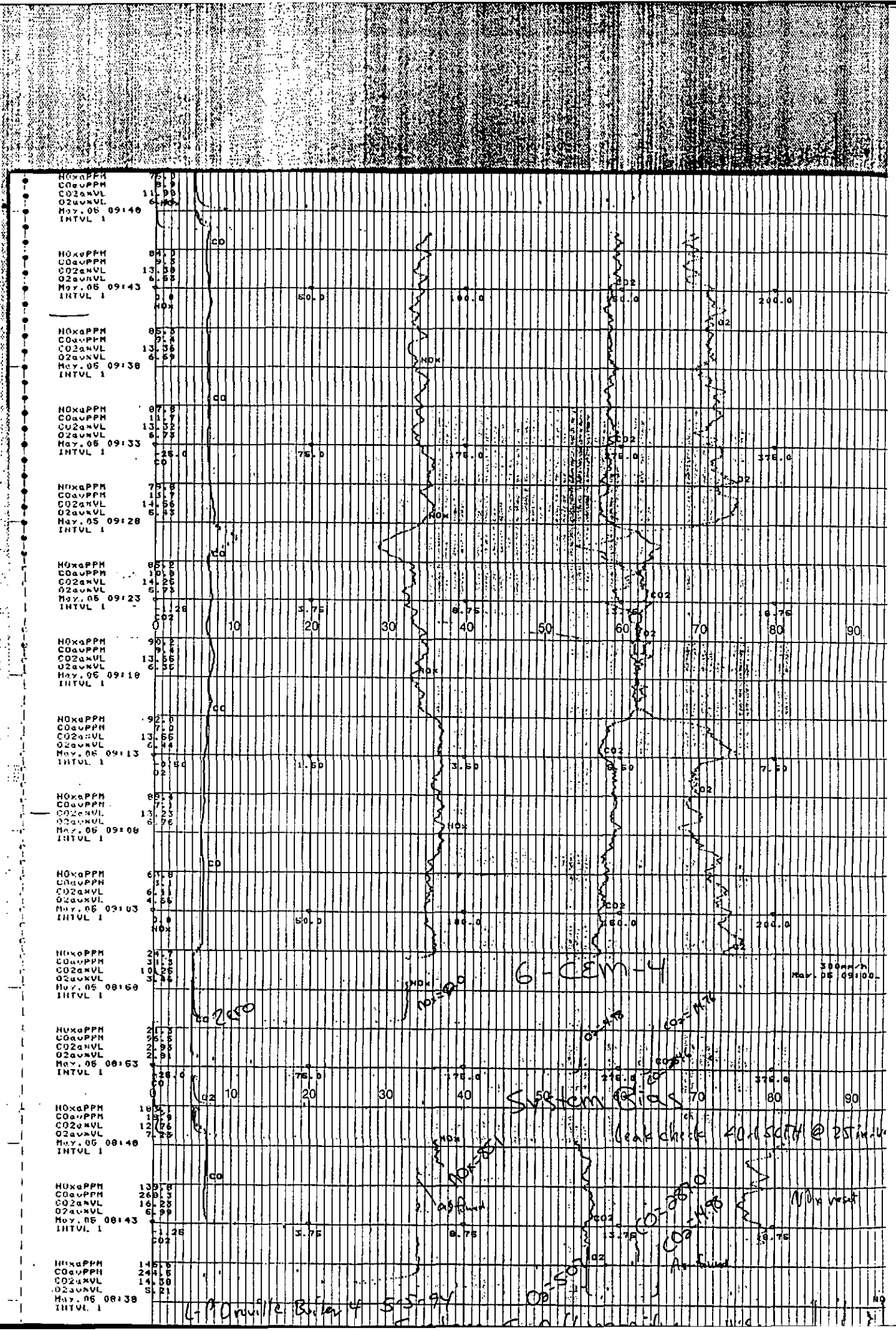
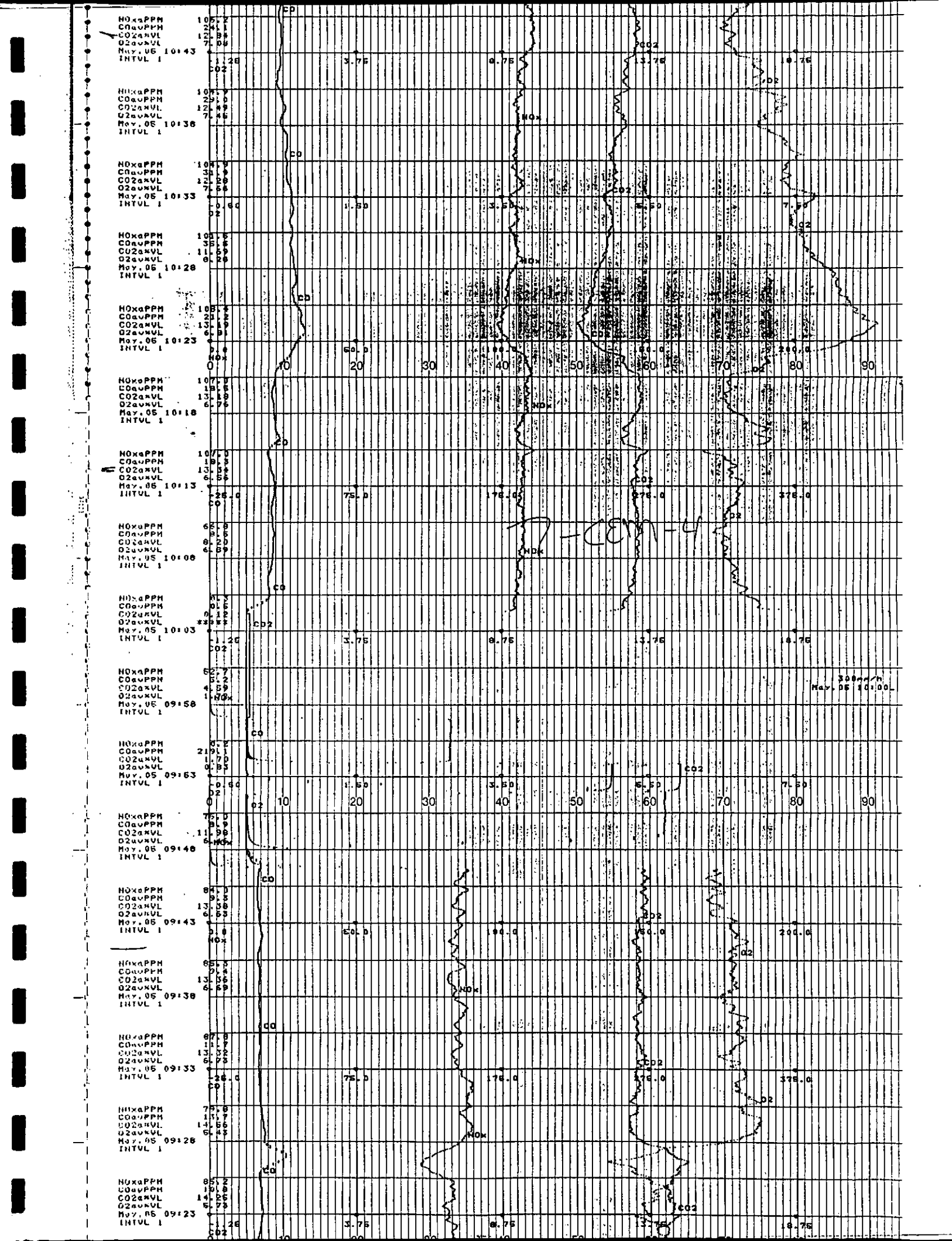
COavPPM
CO2avXVL
O2avXVL
May.04 14:05
INTVL 1
May.04 14:00
May.04 13:55
May.04 13:50
May.04 13:45
May.04 13:40
May.04 13:35
May.04 13:30
May.04 13:25
May.04 13:20
May.04 13:15
May.04 13:10
May.04 13:05
May.04 13:00
May.04 12:56
May.04 12:50
May.04 12:46
2-CEM+
107.13 NOx
405.00
14.82 CO2
5.30 O2
New O2 cell installed
Point C
Point B

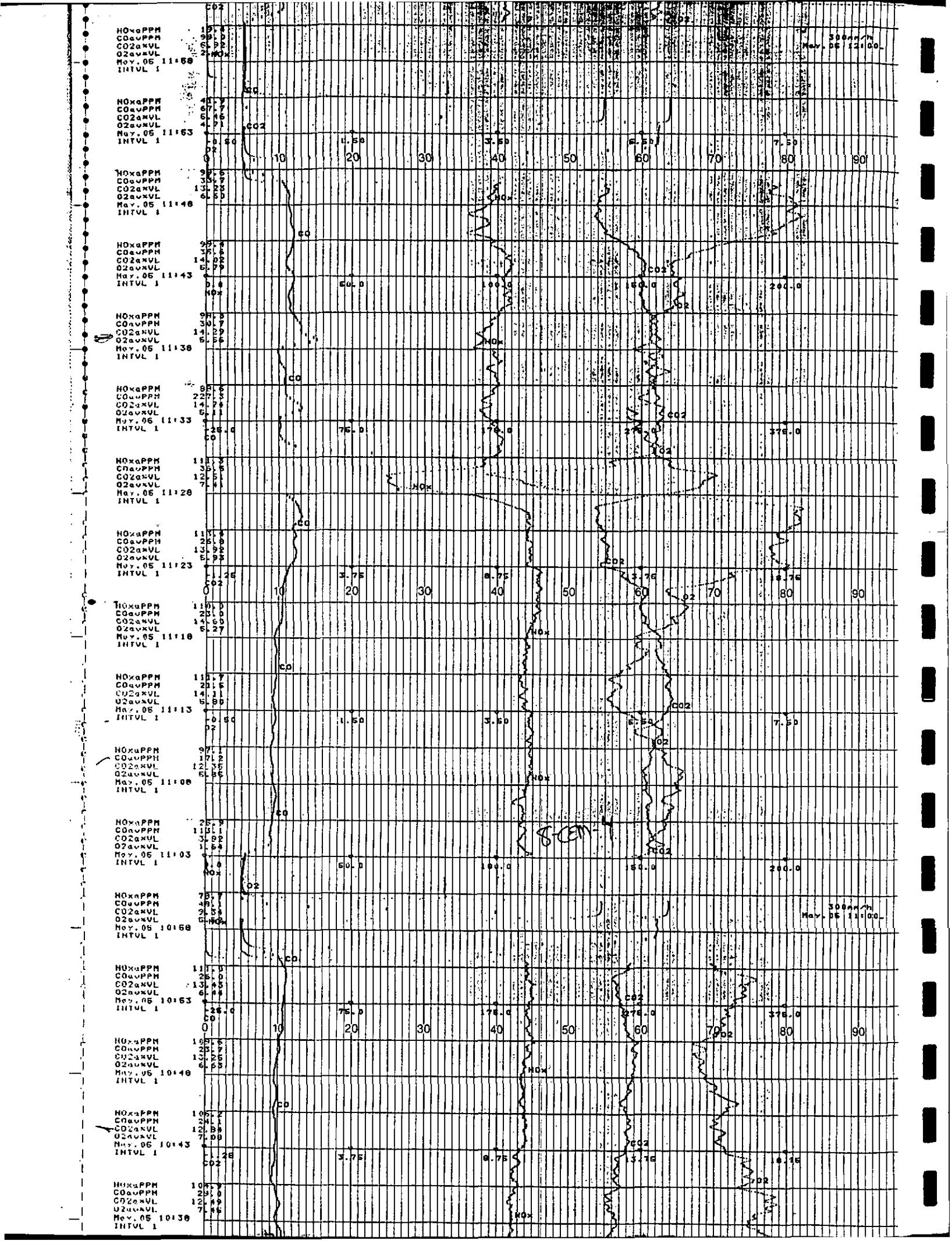

NOxaPPM
COavPPM
CO2avXVL
O2avXVL
May.04 16:25
INTVL 1
May.04 16:20
May.04 16:15
May.04 16:10
May.04 16:05
May.04 16:00
May.04 15:55
May.04 15:50
May.04 15:45
May.04 15:40
May.04 14:25
May.04 14:20
May.04 14:15
May.04 14:10
May.04 14:05
May.04 14:00
104 NOx
51.5 CO
14.4 CO2
5.5% O2
3-CEM-1
CARNOT ES-26 Mobile CEM Lab
NOx
CO
CO2
O2

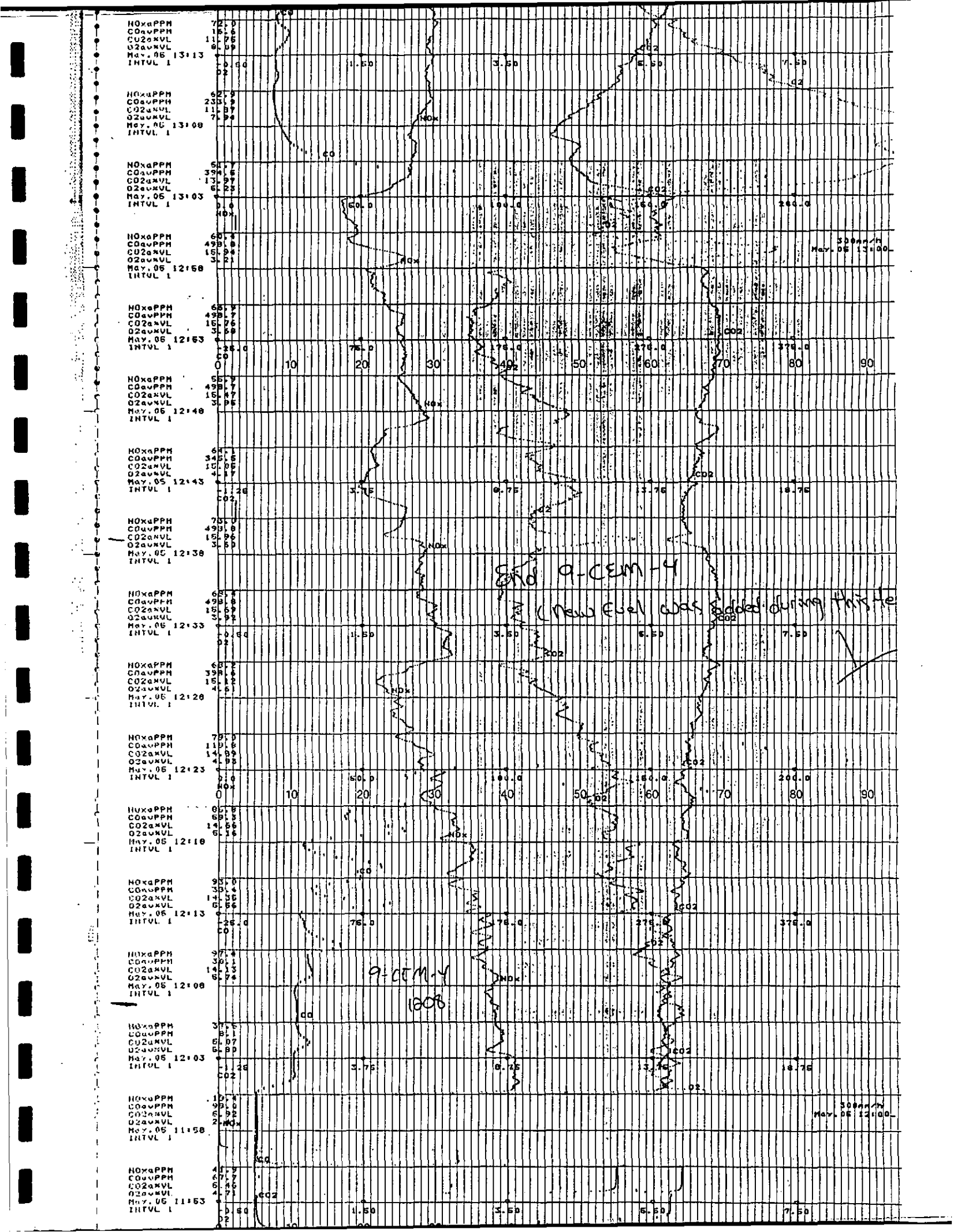

S-CEM-1
NOxaPPM
COavPPM
CO2avXVL
O2avXVL
May.04 17:40
INTVL 1
May.04 17:36
May.04 17:30
May.04 17:26
May.04 17:20
May.04 17:15
May.04 17:10
May.04 17:05
May.04 17:00
May.04 16:55
May.04 16:50
May.04 16:45
May.04 16:40
May.04 16:35
May.04 16:30
May.04 16:26
May.04 16:20
CO
CO2
O2
NOx

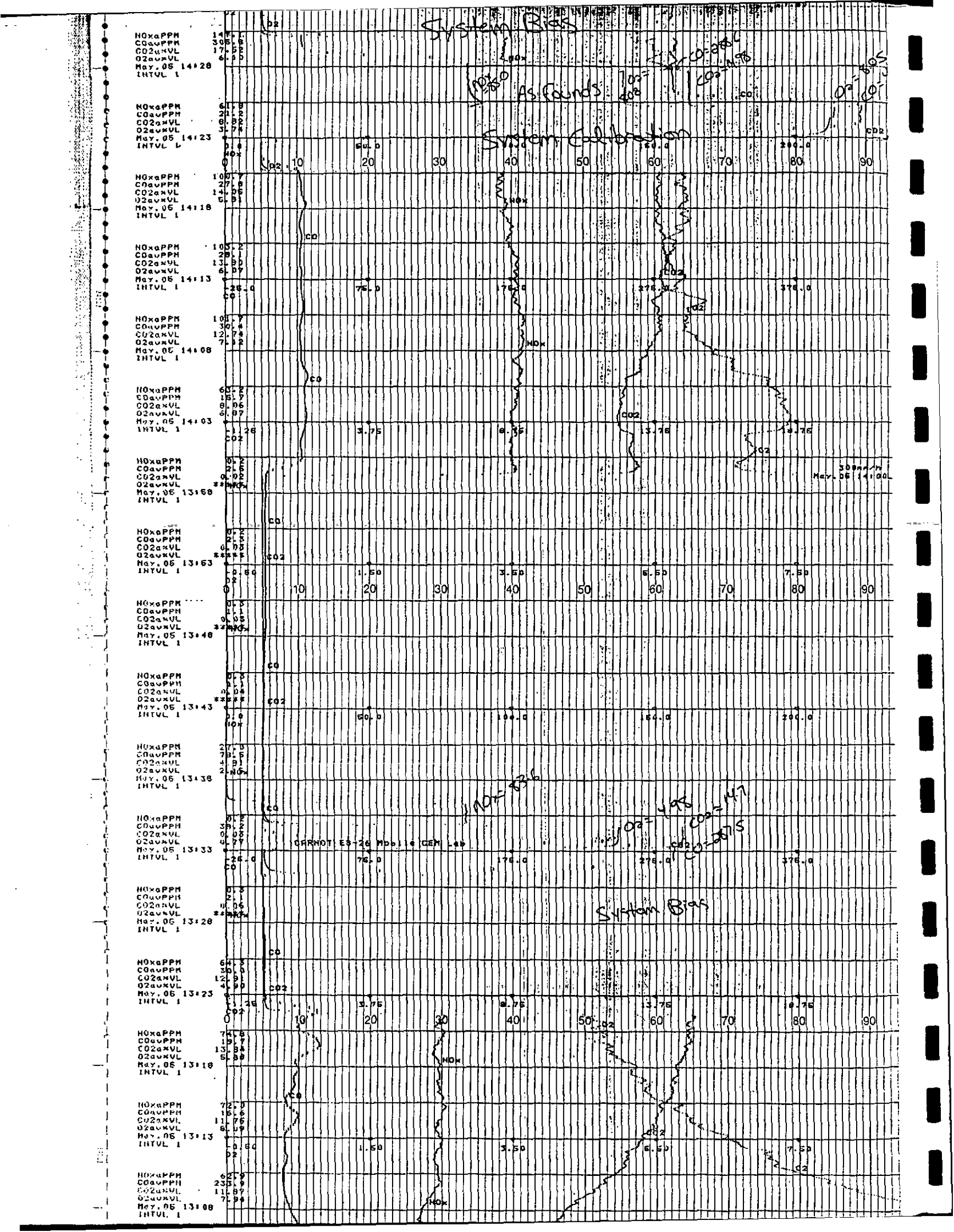

Run 4
Leak check
<0.1SCFM @ 25 in. Hg
5-CEM-1
103.58 NOx
35.39 CO
13.65 CO2
6.04 O2
NOxaPPM
COavPPM
CO2avXVL
O2avXVL
May.04 18:40
May.04 18:35
May.04 18:30
May.04 18:26
May.04 18:20
May.04 18:15
May.04 18:10
May.04 18:05
May.04 18:00
May.04 17:55
May.04 17:50
May.04 17:45
May.04 17:40
May.04 17:36
May.04 17:30
May.04 17:25
May.04 17:20
INTVL 1
CO
CO2
NOx
O2

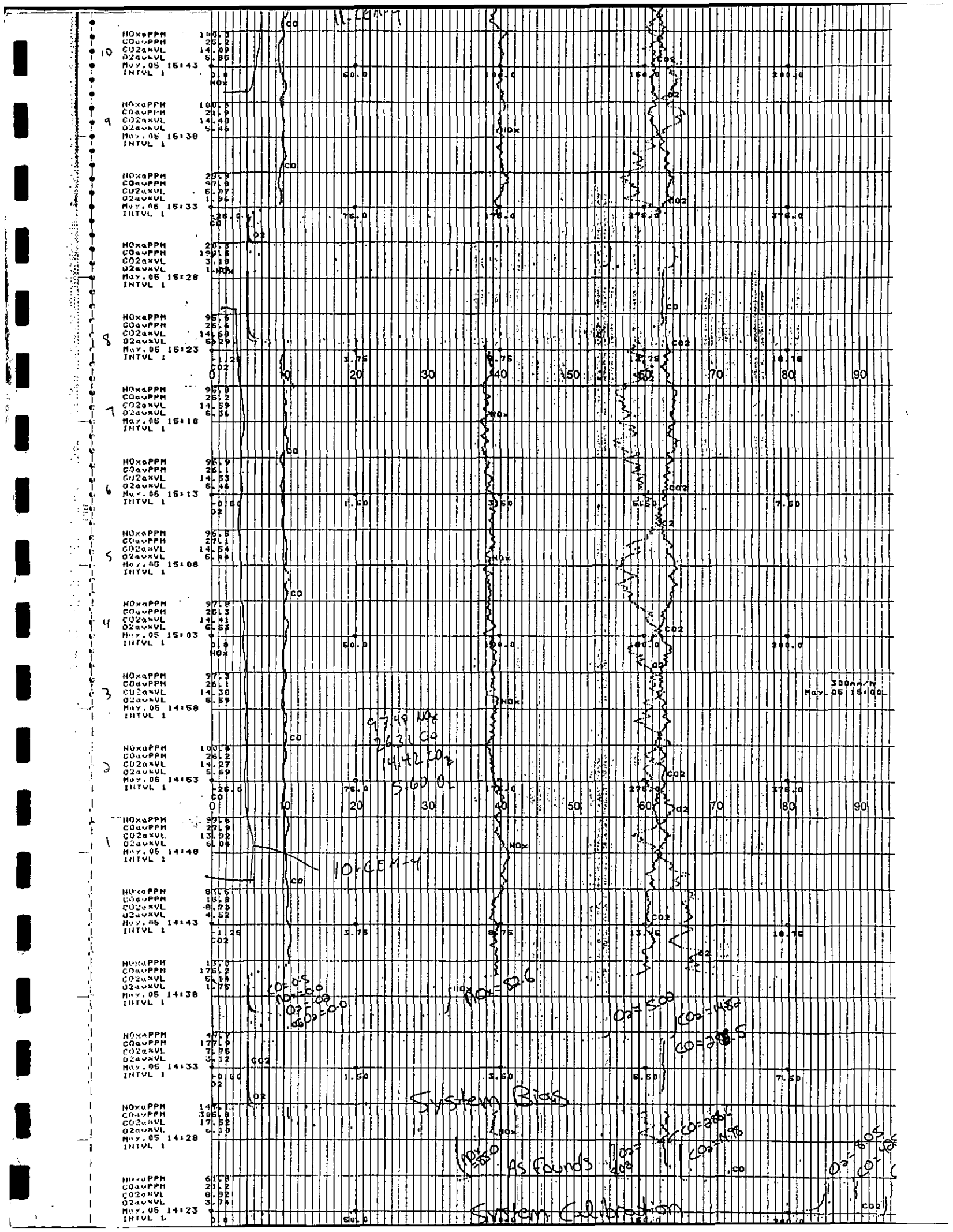

NOxaPPM
COavPPM
CO2avVL
O2avVL
May.05 09:46
INTVL 1
May.05 09:43
May.05 09:38
May.05 09:33
May.05 09:28
May.05 09:23
May.05 09:18
May.05 09:13
May.05 09:08
May.05 08:58
May.05 08:53
May.05 08:48
May.05 08:43
May.05 08:38
NOx
CO
CO2
O2
6-CEM-4
System Bias
Leak check
Boiler 4 Stack

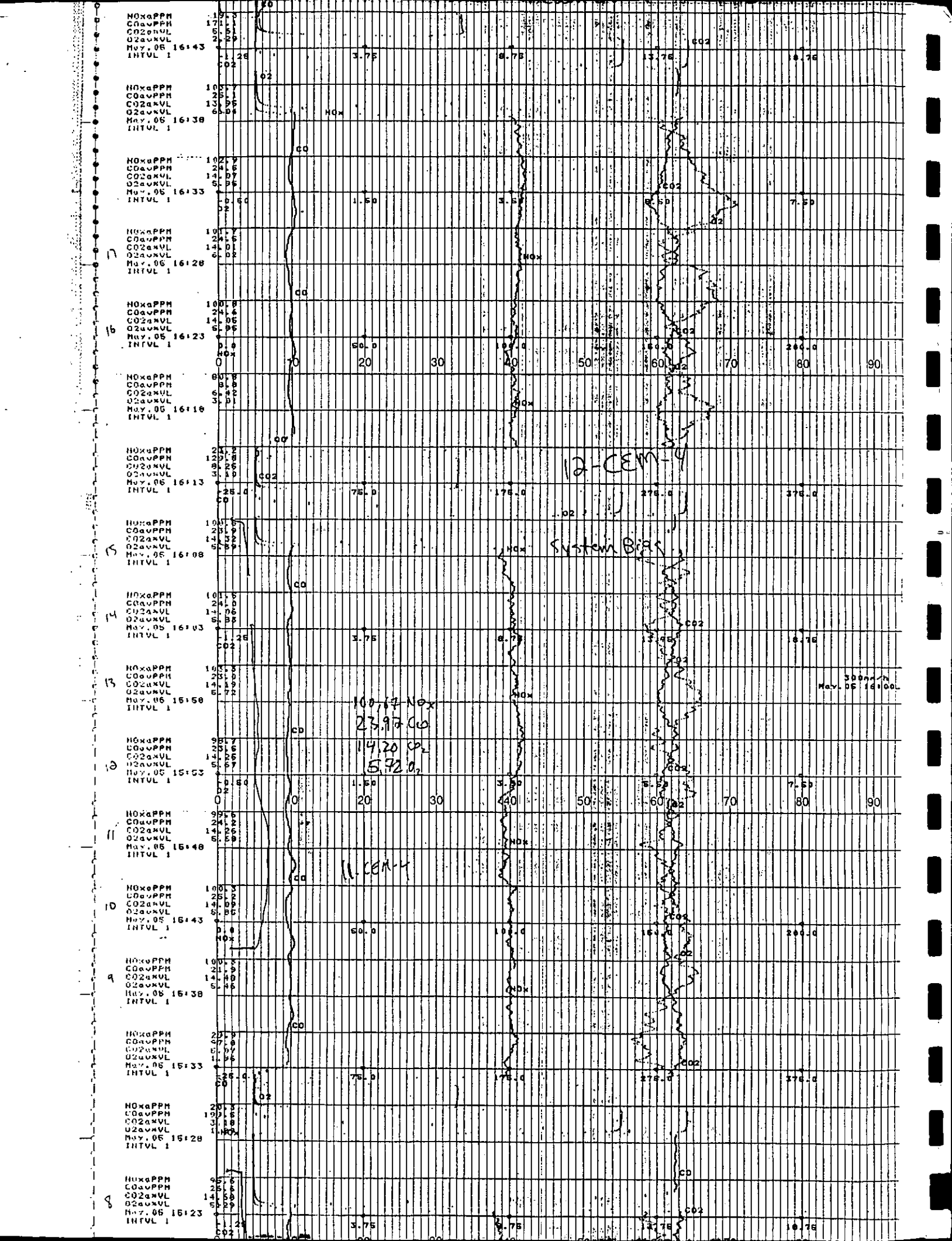

NOxaPPM
COavPPM
CO2avXVL
O2avXVL
May.05 10:43
INTVL 1
May.05 10:38
May.05 10:33
May.05 10:28
May.05 10:23
May.05 10:18
May.05 10:13
May.05 10:08
May.05 10:03
May.05 09:58
May.05 09:53
May.05 09:48
May.05 09:43
May.05 09:38
May.05 09:33
May.05 09:28
May.05 09:23
CO
CO2
O2
NOx
0
10
20
30
40
50
60
70
80
90


NOxaPPM
COavPPM
CO2avXVL
O2avXVL
May.05 11:58
INTVL 1
May.05 11:53
May.05 11:48
May.05 11:43
May.05 11:38
May.05 11:33
May.05 11:28
May.05 11:23
May.05 11:18
May.05 11:13
May.05 11:08
May.05 11:03
May.05 10:58
May.05 10:53
May.05 10:48
May.05 10:43
May.05 10:38
NOx
CO
CO2
O2
300Amin
May.05 12:00


NOxaPPM 72.0
COavPPM 15.6
CO2avVL 11.76
O2avVL 6.09
May.05 13:13
INTVL 1
NOxaPPM 62.9
COavPPM 233.9
CO2avVL 11.87
O2avVL 7.94
May.05 13:08
INTVL 1
NOxaPPM 54.7
COavPPM 394.6
CO2avVL 13.97
O2avVL 6.23
May.05 13:03
INTVL 1
NOxaPPM 60.4
COavPPM 498.8
CO2avVL 15.96
O2avVL 3.21
May.05 12:58
INTVL 1
NOxaPPM 65.9
COavPPM 498.7
CO2avVL 15.76
O2avVL 3.59
May.05 12:53
INTVL 1
NOxaPPM 56.9
COavPPM 498.7
CO2avVL 16.47
O2avVL 3.95
May.05 12:48
INTVL 1
NOxaPPM 64.1
COavPPM 345.6
CO2avVL 10.05
O2avVL 4.17
May.05 12:43
INTVL 1
NOxaPPM 73.0
COavPPM 493.8
CO2avVL 15.96
O2avVL 3.50
May.05 12:38
INTVL 1
NOxaPPM 65.4
COavPPM 498.8
CO2avVL 15.69
O2avVL 3.93
May.05 12:33
INTVL 1
NOxaPPM 68.2
COavPPM 398.6
CO2avVL 15.12
O2avVL 4.61
May.05 12:28
INTVL 1
NOxaPPM 79.0
COavPPM 119.6
CO2avVL 14.09
O2avVL 4.93
May.05 12:23
INTVL 1
NOxaPPM 85.8
COavPPM 69.33
CO2avVL 14.66
O2avVL 6.16
May.05 12:18
INTVL 1
NOxaPPM 95.0
COavPPM 30.44
CO2avVL 14.30
O2avVL 5.56
May.05 12:13
INTVL 1
NOxaPPM 97.4
COavPPM 30.11
CO2avVL 14.17
O2avVL 6.74
May.05 12:08
INTVL 1
NOxaPPM 30.5
COavPPM 8.1
CO2avVL 6.07
O2avVL 5.80
May.05 12:03
INTVL 1
NOxaPPM 101.4
COavPPM 99.0
CO2avVL 6.92
O2avVL 2.
May.05 11:58
INTVL 1
NOxaPPM 41.9
COavPPM 67.7
CO2avVL 6.40
O2avVL 4.71
May.05 11:53
INTVL 1
9-CEM-4
1808
9-CEM-4
(new fuel was added during this test
NOx
CO
CO2
O2
May.05 13:00
May.05 12:00


System Bias
As Founds
System Calibration
NOxaPPM 14[illegible]
COauvPPM 306.8
CO2axVL 17.52
O2auxVL 6.80
May.05 14:28
INTVL 1
NOxaPPM 61.8
COauvPPM 21.8
CO2axVL 8.82
O2auxVL 3.74
May.05 14:23
INTVL 1
NOxaPPM 100.7
COauvPPM 27.8
CO2axVL 14.06
O2auxVL 5.91
May.06 14:18
INTVL 1
NOxaPPM 105.2
COauvPPM 28.1
CO2axVL 13.90
O2auxVL 6.07
May.05 14:13
INTVL 1
NOxaPPM 101.7
COauvPPM 30.4
CO2axVL 12.74
O2auxVL 7.32
May.05 14:08
INTVL 1
NOxaPPM 60.2
COauvPPM 15.7
CO2axVL 8.06
O2auxVL 6.97
May.05 14:03
INTVL 1
NOxaPPM 0.2
COauvPPM 2.6
CO2axVL 0.02
O2auxVL ******
May.05 13:58
INTVL 1
NOxaPPM 0.2
COauvPPM 2.5
CO2axVL 0.03
O2auxVL ******
May.05 13:53
INTVL 1
NOxaPPM 0.3
COauvPPM 1.1
CO2axVL 0.05
O2auxVL ******
May.05 13:48
INTVL 1
NOxaPPM 0.3
COauvPPM 0.1
CO2axVL 0.04
O2auxVL ******
May.05 13:43
INTVL 1
NOxaPPM 27.5
COauvPPM 73.5
CO2axVL 4.91
O2auxVL 2.NOx
May.05 13:38
INTVL 1
NOxaPPM 0.2
COauvPPM 38.2
CO2axVL 0.06
O2auxVL 6.97
May.05 13:33
INTVL 1
NOxaPPM 0.3
COauvPPM 2
CO2axVL 0.06
O2auxVL ******
May.05 13:28
INTVL 1
NOxaPPM 64.5
COauvPPM 30.0
CO2axVL 12.90
O2auxVL 4.90
May.05 13:23
INTVL 1
NOxaPPM 74.8
COauvPPM 19.7
CO2axVL 13.34
O2auxVL 5.88
May.05 13:18
INTVL 1
NOxaPPM 72.0
COauvPPM 15.6
CO2axVL 11.76
O2auxVL 6.09
May.06 13:13
INTVL 1
NOxaPPM 62.9
COauvPPM 233.9
CO2axVL 11.87
O2auxVL 7.94
May.05 13:08
INTVL 1
CARNOT ES-26 Mobile CEM Lab
May.05 14:00
NOx
CO
CO2
O2


11-CEM-1
10-CEM-1
System Bias
As Founds
System Calibration
NOx
CO
CO2
O2
May. 05 15:43
May. 05 15:38
May. 05 15:33
May. 05 15:28
May. 05 15:23
May. 05 15:18
May. 05 15:13
May. 05 15:08
May. 05 15:03
May. 05 14:58
May. 05 14:53
May. 05 14:48
May. 05 14:43
May. 05 14:38
May. 05 14:33
May. 05 14:28
May. 05 14:23
INTVL 1
300mm/H
May. 05 15:00


NOxaPPM
COavPPM
CO2avXVL
O2avXVL
May.06 16:43
INTVL 1
May.06 16:38
May.06 16:33
May.06 16:28
May.06 16:23
May.06 16:18
May.06 16:13
May.06 16:08
May.06 16:03
May.06 15:58
May.06 15:53
May.06 15:48
May.06 15:43
May.06 15:38
May.06 15:33
May.06 15:28
May.06 15:23
NOx
CO
CO2
O2
12-CEM-1
System Bias
100.1 NOx
23.9 CO
14.20 CO2
5.72 O2
11-CEM-1
309nd
May.05 16:00