AP42 Section:	Chapters 1 and 3
Related:	3
Title:	Source Test Review, Pennzoil Products Company, Cornplanter Township, PA Pennzoil Products Company September 1996

IATA FILE
PDEP0030

COMMONWEALTH OF PENNSYLVANIA
Department of Environmental Protection
September 19, 1996
717-787-9483

SUBJECT: Source Test Review
Pennzoil Products Company
Cornplanter Township, Venango County

TO: Devendra Verma
Engineering Services Chief
Northwest Regional Office

FROM: Bryon Richwine BR
Air Pollution Control Engineer
Source Testing Section
Division of Source Testing and Monitoring

refinery gas/oil fired boilers

THROUGH: L. Blaine DeHaven
Chief
Division of Source Testing and Monitoring

Timothy R. Brooks TRB
Chief
Source Testing Section
Division of Source Testing and Monitoring

Pennzoil Products Company operates two Zurn Keystone (Model 20M) gas/oil-fired boilers, designated Nos. 2A and 3A. Each unit has a rated capacity of 144.4 MMBtu/hr. Boiler No. 2A has been retrofitted with a Pillard Products (Model GRC-6) low NO_x Burner. Boiler No. 3A has been committed to an 80% switch to low nitrogen fuel. Emissions from the units are discharged to the atmosphere via a 60" inside diameter stack.

On June 5 and 6, 1996, Pennzoil Products Company conducted testing to determine the emissions for nitrogen oxides (EPA method 7E) on boiler Nos. 2A and 3A. The boilers were both firing refinery fuel gas while testing was conducted. The tests are acceptable to the Department.

The following information was extracted from the test report:

Nitrogen Oxide Emissions Summary (Boiler No. 2A):

Run No.	1	2	3
Test Date	06/05/96	06/05/96	06/05/96
Concentration [ppm]	158	161	160
Emission Rate [lb./hr]	20.9	20.6	20.1
Emission Rate [lb./MMBtu]	0.196	0.194	0.191
Allowable Emission Rate [lb./hr]			
Per File 61-016	66.2	66.2	66.2
Per File 61-302-032	35.0	35.0	35.0

Nitrogen Oxide Emissions Summary (Boiler No. 3A):

Run No.	1	2	3
Test Date	06/06/96	06/06/96	06/06/96
Concentration [ppm]	313	308	302
Emission Rate [lb./hr]	39.7	38.0	36.7
Emission Rate [lb./MMBtu]	0.352	0.344	0.339
Allowable Emission Rate [lb./hr]			
Per File 61-016	66.2	66.2	66.2
Per File 61-302-032	35.0	35.0	35.0

Process Data Summary at Maximum Obtainable Capacity:

Unit	Steam Load (lbs/hr)	Percent of Rated Capacity	Fuel Flow (scf/hr)	Fuel Analysis (Btu/scf)	Heat Input (MMBtu/hr)
Boiler No. 2A	80,033	76	72,100	1,302	106.1
Boiler No. 3A	77,967	74	86,233	1,281	110.4

cc: Permit File 61-302-032
Permit File 61-302-033
RACT File 61-016
Technical Support Section - Krish Ramamurthy
Compliance and Enforcement - Scott Kepner
EPA/TRB
Data File - Stack Testing
Reading File, Source Testing Section

LBD:TRB:BR:br

please mail this ~~draft~~ memo copy to ~~Ted~~ Tim Brooks in Hsbg.

PENNZOIL PRODUCTS COMPANY

TWO MAIN STREET * ROUSEVILLE, PA 16344 * PHONE 814-677-1333 * FAX 814-678-4690

June 20, 1996

Mr. Devendra Verma
Engineering Services Chief
Air Quality Control
Northwest Regional Office
230 Chestnut Street
Meadville, PA 16335

Dear Mr. Verma:

As required under Plan Approvals 61-302-032 and 61-302-033 (Boiler 2A and 3A RACT Compliance) and RACT Approval PA 61-016, please find the results of Pennzoil's Annual NOx compliance testing. This testing was performed at "maximum obtainable" capacities of Boilers 2A and 3A while firing refinery fuel gas. Please note that no testing was performed while burning #6 burning oil as the burning oil system was destroyed in the October, 1995 fire and has not yet been replaced.

The testing was performed according to the DEP Source Testing Section (STS) approved protocol. The results of the testing indicate compliance with all limits expressed in the aforementioned Plan and RACT Approvals as follows:

Boiler 2A NOx Limits

Fuel	*RACT Approval Limit*	*Plan Approval Limit*	*Emission Test Results*
Refinery Gas	**66.2 lbs/hr**	**35.0 lbs/hr**	**20.6 lbs/hr**
# 6 Oil	**66.2 lbs/hr**	**56.0 lbs/hr**	**NA**

Boiler 3A NOx Limits

Fuel	*RACT Approval Limit*	*Plan Approval Limit*	*Emission Test Results*
Refinery Gas	**66.2 lbs/hr**	**76.0 lbs/hr**	**38.1 lbs/hr**
# 6 Oil	**66.2 lbs/hr**	**56.0 lbs/hr**	**NA**

The complete testing report is enclosed with all necessary back-up data. If you have any questions regarding these testing results, please give me a call at (814) 678-4649.

Sincerely,
PENNZOIL PRODUCTS COMPANY

Lee E. Wilson

Lee E. Wilson
Senior Environmental Engineer
Eastern Refining Business Unit

cc: JBK;SAM

Table of Contents

PENNZOIL PRODUCTS COMPANY

EMISSION TEST REPORT

BOILERS 2A AND 3A
PENNZOIL PRODUCTS COMPANY
ROUSEVILLE, PENNSYLVANIA

BY

LEE E. WILSON
SENIOR ENVIRONMENTAL ENGINEER
EASTERN REFINING BUSINESS UNIT

JUNE 1996

1.0 Introduction

On June 5 and June 6, 1996, Pennzoil Products Company conducted emission tests on Boilers 2A and 3A located at the Plant 1 Boiler House in Rouseville, Pennsylvania. The purpose of this testing was to obtain emission measurements for oxides of nitrogen (NO_x) and O_2 (diluent) to verify compliance with Reasonably Available Control Technology (RACT) emission limits set under Title 25, Section 129.91(i).

Concentrations of NO_x and oxygen were measured in accordance with U.S. Environmental Protection Agency (EPA) Methods 7E and 3B (Fyrite), respectively. All testing was also performed following a Department of Environmental Protection (DEP) approved test protocol (Attachment A). Emission rates were derived using F-factor calculations from EPA Method 19 (Attachment B).

Testing was performed by Lee E. Wilson, Senior Environmental Engineer, Pennzoil Products Company. Larry Vogul of the DEP Knox Field office observed one full hour run on each day of the testing.

2.0 Summary of Results

Tables 1 and 2 present a summary of operating data and mass emission rates for NO_x for boilers 2A and 3A, respectively. Please note that testing was only performed while firing refinery fuel gas, as our burning oil system was destroyed in the October 1995 fire. Both units were operated at approximately 75 % of rated capacity which represents a normal maximum rate for these boilers generally attained at any time during the year.

Boiler 2A (equipped with low NO_x burners) tested at 0.194 lbs/MMBtu NO_x or 20.6 pounds per hour (based on a boiler rate of 106.1 MMBtu/hr). These test results were diluent normalized using an average oxygen concentration of 3.3 % dry basis. O_2 readings for each run were the average of three Fyrite readings taken from an integrated sample collected during the run.

Boiler 3A tested at 0.345 lbs/MMBtu NO_x or 38.1 pounds per hour (based on a boiler rate of 110.4 MMBtu/hr). The average O_2 content was 1.9 percent on a dry basis. Figures 1 and 2 provide a visual portrayal of calibrations and test runs for boilers 2A and 3A, respectively.

Table 3 provides more detail on the data runs, corrections, and calculations used to come up with the emission rates. Appendix B contains fuel analytical and F-factor calculations. Appendix C provides the field logsheets, minute by minute NOx ppm averages, and strip chart records. Appendix D contains EPA Protocol calibration gas certifications, and Appendix E contains Process data collected by operators during the test runs.

Pennzoil Boiler 2A - NOx Compliance Testing

Table 1 - Operating and Emissions Data while Firing Refinery Fuel Gas

								NOx Emissions		
Run No.	Steam Load (lbs/hr)	Percent of Rated Capacity	Fuel Flow (scf/hr)	Gross Btu (Btu/scf)	Unit Rate MMBtu/hr *	O2 Dry %	Fd Factor dscf/MMBtu **	Corrected ppm	lbs/MMBtu	lbs/hr
1	80,600	77	73,300	1,280	106.8	3.7	8541	158	0.196	20.9
2	80,100	76	72,000	1,305	106.2	3.2	8561	161	0.194	20.6
3	79,400	76	71,000	1,321	105.2	3.0	8580	160	0.191	20.1
Averages	80,033	76	72,100	1,302	106.1	3.3	8561	160	0.194	20.6

* Note: The unit rates as calculated by fuel flow x btu value are lower than expected when compared to corresponding steam loads. This indicates that there may have been a fuel flow calibration problem during testing. Therefore, a more accurate (and conservative) unit rate is estimated based on the steam load, 1100 Btus/# steam, and an estimated boiler efficiency of 83 % as follows:

Unit Rate (MMBtu/hr) = steam load (lbs/hr) x 1100 Btus/ lb steam x 1/0.83 x 1MMBtu/1,000,000 Btus

** Compares well to natural gas Fd factor from Method 19 of 8,710 scf/MMBtu

Pennzoil Boiler 3A - NOx Compliance Testing

Table 2 - Operating and Emissions Data while Firing Refinery Fuel Gas

								NOx Emissions		
Run No.	Steam Load (lbs/hr)	Percent of Rated Capacity	Fuel Flow (scf/hr)	Gross Btu (Btu/scf)	Unit Rate MMBtu/hr	O2 Dry %	Fd Factor dscf/MMBtu *	Corrected ppm	lbs/MMBtu	lbs/hr
1	77,700	74	85,900	1,312	112.7	1.9	8561.0	313	0.352	39.7
2	77,600	74	85,800	1,285	110.3	1.8	8559.0	308	0.344	38.0
3	78,600	75	87,000	1,245	108.3	1.9	8539.0	302	0.339	36.7
Averages	77,967	74	86,233	1,281	110.4	1.9	8553.0	308	0.345	38.1

* Compares well to natural gas Fd factor from Method 19 of 8,710 scf/MMBtu

Table 3. CEM Data Correction Data Sheet

Plant Name:	Pennzoil Rouseville
Sampling Location:	Boilers 2A & 3A
Date:	6/5/96 & 6/6/96
Project Number:	
CEM Operator:	Lee E. Wilson
Pollutant:	NOx & O2 Diluent
Molecular Weight:	46.01

Run No.	Start Time	Stop Time	Raw Data (% or ppm)	Calibration Data			Source Information			Calibration Corrected Data (% or ppm)	Oxygen Corrected Data (@3% O2)	Mass Emission Rate (lb/MMBtu)
				Cma	Co	Cm	Stack Flow (dscfm)	Fd Factor (dscf/ MMBtu)	Stack O2 Conc. (%)			
2A-1	10:45 AM	11:45 AM	159	447.0	1.0	447.0		8,541	3.7	158	165	0.196
2A-2	12:15 PM	1:15 AM	161	447.0	1.0	445.0		8,561	3.2	161	163	0.194
2A-3	2:05 PM	3:05 PM	161	447.0	1.0	447.0		8,580	3.0	160	160	0.192
3A-1	10:15 AM	11:15 AM	314	447.0	2.0	448.0		8,561	1.9	313	295	0.352
3A-2	11:45 AM	12:45 PM	304	447.0	2.5	440.0		8,559	1.8	308	289	0.345
3A-3	1:15 PM	2:15 PM	295	447.0	2.5	435.5		8,539	1.9	302	285	0.339

Calibration Error Correction

Cgas = (Cobs-Co) * (Cma/(Cm-Co))

Oxygen Corrected Data

C = Cgas * ((20.9-O2 fact)/(20.9-O2 obs))

Mass Emission Rate (lb/hr)

E(lb/hr) = Cgas * MWgas * Qs(dscfm) * 60/385300000

Mass Emission Rate (lb/MMBtu)

E(lb/MMBtu) = Cgas * MWgas * Fd * (20.9/(20.9-O2 obs))/385300000

Pollutant	MWgas
CO	28.01
Propane	44.10
NOx	46.01
SO2	64.06

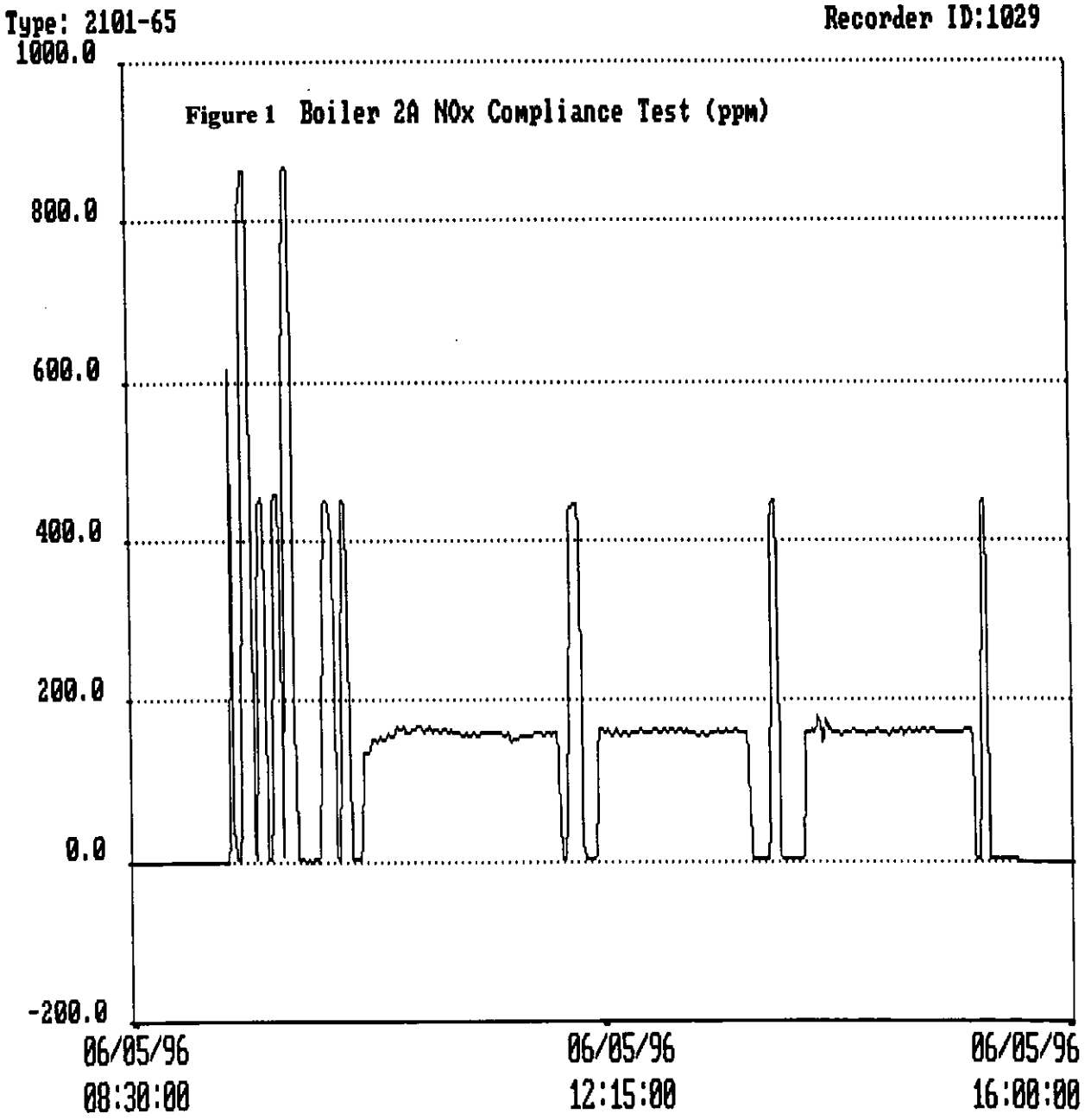
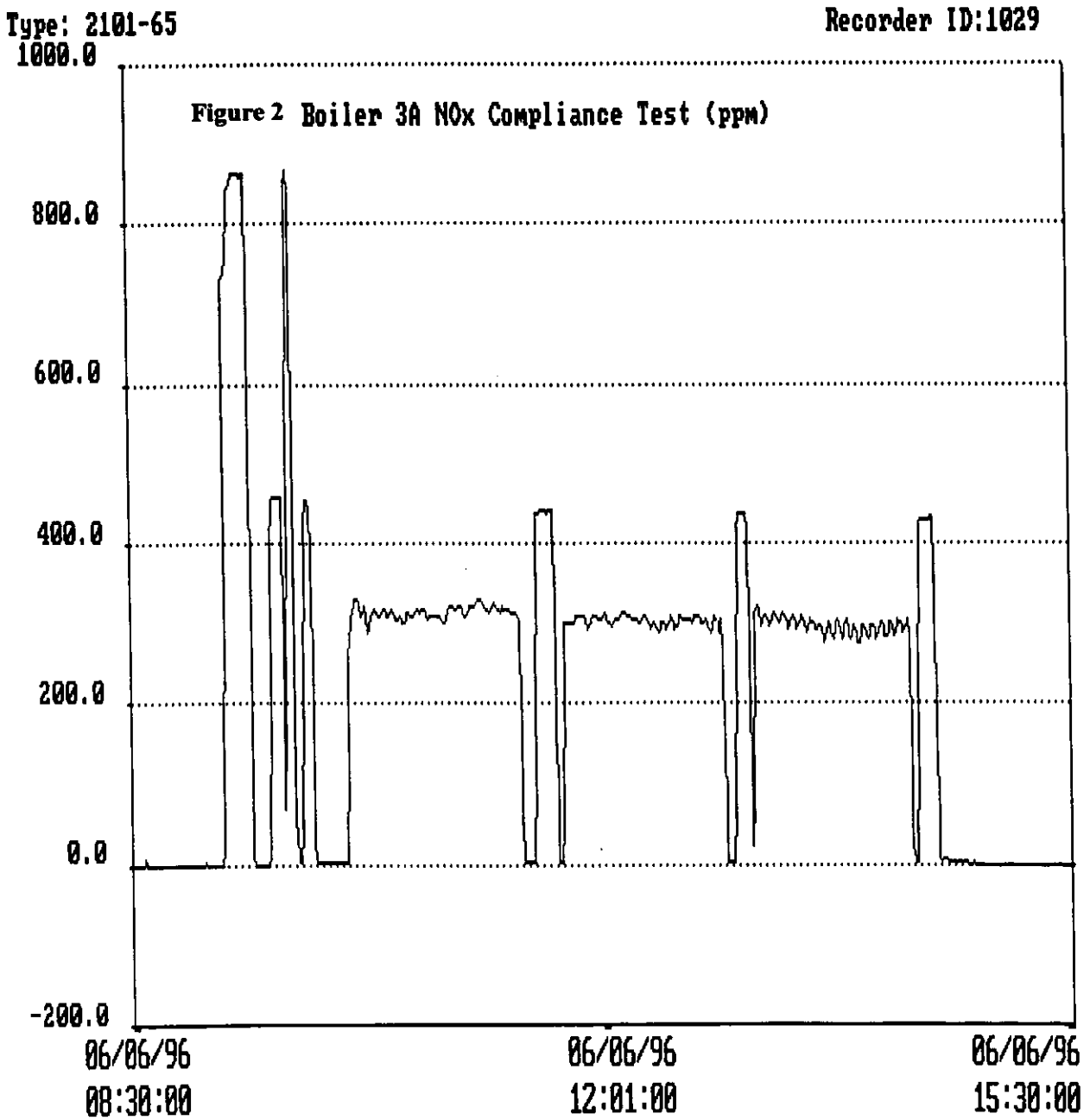


Figure 1 Boiler 2A NOx Compliance Test (ppm)


Type: 2101-65
Recorder ID:1029
1000.0
Figure 2 Boiler 3A NOx Compliance Test (ppm)
800.0
600.0
400.0
200.0
0.0
-200.0
06/06/96
08:30:00
06/06/96
12:01:00
06/06/96
15:30:00

3.0 Sampling Locations and Test Methods

Sampling Location

Samples of NO_x and O_2 were collected at single points in the centroid of the stacks just above the economizers. Although not meeting the spacing requirements of EPA Method 1, the location has been verified for absence of cyclonic flow and approved by the DEP as acceptable for the measurement of gaseous constituents.

Sampling and Measurement Apparatus

Pennzoil's sampling and measurement system consists of the following:

- Sampling Probe - Stainless steel tubing inserted into the gas stream being sampled. A ball valve at the outlet of the probe is used to introduce calibration gas during system bias and drift tests. A short run of insulated Teflon tubing (~ 5 ft) is used to convey a hot gas sample to a sample conditioner.
- Sample Conditioner - A Baker Process Equipment stainless steel condenser immersed in an ice bath is used to remove moisture from the flue gas sample. Moisture is removed continuously by a peristaltic pump to minimize contact between the sample gas and condensate. The conditioner also has a Balston fiber filter on the unit exit to remove fine particulates.
- Sampling Line - Teflon lines rapped in a black plastic umbilical are used to convey both calibration and sample gas.
- Sample Gas Handling System - A stainless steel/viton head pump is used to draw gases from the stack to the analyzers. Rotameters in a manifold are used to balance and monitor flow to the NO_x analyzer and to the integrated sample tedlar bag used for O_2 Fyrite analysis. Gas samples to the analyzer are delivered via an atmospheric dump and pulled through the analyzer with a pump pack.
- Calibration Gases - EPA Protocol 1 standard gases in nitrogen certified to be within 1 percent of labeled values are used for testing. A high range gas of 80-100 % analyzer span and a mid range gas of 40-60 % of span are used for calibrations. Ambient air is used for a zero gas.
- Gas Analyzers - An Advanced Pollution Instrumentation (API) Model 252H Chemiluminescence NO_x analyzer equipped with a NO_2 to NO stainless steel converter is used to analyze total NO_x in ppm. Interference test data applicable to this analyzer are included in Attachment F. O_2 analysis is performed by taking an integrated sample over the duration of each run and analyzing the resulting gas sample with a Bacharach Fyrite O_2 Analyzer.
- Data Acquisition System - Pennzoil uses a Telog 2101 Analog Voltage Recorder to continuously measure NO_x ppm and provide minute by minute averages of the data (Appendix C). Data are pulled from the recorder to the PC via a RS 232 serial connection and Telog software. A Eurotherm Chessel Model 342A chart recorder is used to provide a backup for the Telog unit. Strip charts are also included in Appendix C.

Nitrogen Oxides Measurement

The concentration of NOx was determined by use of the procedures described in U.S. EPA Method 7E and the Department of Environmental Protection's *Source Testing Manual* using the above described analyzer. A sample was extracted from the stack and analyzed continuously during each test run.

Oxygen (diluent) Measurement

The O_2 concentration in percent was measured by a Bacharach Fyrite oxygen analyzer (EPA Method 3B). Three measurements were taken for each run from one integrated sample. The average of the readings was used as the oxygen concentration for the run.

Fuel Analysis

A fuel-specific F-factor was determined by use of the procedures described in U.S. EPA Method 19. One refinery gas sample during each hour test was collected for ultimate analysis and gross heating value analysis. Gas sample analysis was performed on-site by the Pennzoil Laboratory using Gas Chromatography (ASTM D1945) to obtain fuel composition. The heating value of the gas was calculated from the composition analysis as per *API Technical Data Book - Petroleum Refining Procedure 14A1.3.* Fuel analyses and F-factor calculations are documented in Appendix B.

4.0 Quality Assurance

The following quality assurance procedures were used in the determination of NO_x and O_2 concentrations:

- Designated analyzer procedures. The NOx analyzer met all performance specifications outlined in EPA Method 7E. These data are presented in Table 4.
- System integrity and bias. These parameters were measured by injecting calibration gases through the calibration valve on the stack probe outlet and comparing the response obtained with the response obtained when the gas was introduced directly to the analyzer. System bias was less than the allowable 3 percent for all runs. Bias results are also presented in Table 4.
- Pre- and post-test calibrations. At the beginning and end of the test, each analyzer was calibrated with a mid-range gas and zero air. The calibration data were then used to correct the raw data for NO_x. All drift specifications were met (Table 4).
- Fyrite calibration checks. Prior to use, the Fyrite analyzer was zero calibrated following the manufacturers instructions. The freshness of the Fyrite absorbing solution was checked by sampling against ambient air to ensure a reading of 21% O_2. Also, a 2 % oxygen primary calibration gas was used to verify the fyrite reading. Readings were within 0.5 % . As an additional check, Fyrite readings were compared to process stack oxygen readings and were found to be ~ 0.3 to 1.3 % higher. This indicates good agreement as the process analyzers are on a wet basis.
- Calibration Gases. Calibration gases are EPA Protocol 1 certified gases to ensure accuracy (Appendix D).

Table 4. CEM CALIBRATION DATA

Plant Name	Pennzoil Rouseville	Plant Rep.	L. Wilson
Sampling Location	Boiler 2A & 3A	Team Leader	
Date	6/5/96 & 6/6/96	CEM Operator	L. Wilson
Run Number	2A,1-3 & 3A, 1-3	Project Number	RACT 96

	Analyzer Number	Analyzer Span
CO		
CO2		
O2		
THC		
NOx	Serial # 243	1000
SO2		

	Calibration Gas Specificatio (% of Span)	CALIBRATION ERROR CHECK Calibration Value (Cma) (% or ppm)	Cylinder Number	Analyzer Calibration Response	Difference (% of Span)	SYSTEM CAL CHECK PRETEST System Response	PRETEST Syst. Bias (% of Span)	POST TEST System Response	POST TEST Syst. Bias (% of Span)	POST TEST Drift (% of Span)	Calibration Correction Factors
2A Run 1											
NOx Zero	0	0	na	1	0.1	1	0.0	1	0.0	0.0	Co=1.0
NOx Low	20-30 (1)										
NOx Mid	45-55	447	SO-12916	454	0.7	450	-0.4	444	-1.0	-0.6	Cm=447.0
NOx High	80-90	860	ALM059613	865	0.5						
2A Run 2											
NOx Zero	0	0	na	1	0.1	1	0.0	1	0.0	0.0	Co=1.0
NOx Low	20-30 (1)										
NOx Mid	45-55	447	SO-12916	454	0.7	444	-1.0	446	-0.8	0.2	Cm=445.0
NOx High	80-90										
2A Run 3											
NOx Zero	0	0	na	0	0.0	1	0.1	1	0.1	0.0	Co=1.0
NOx Low	20-30 (1)										
x Mid	45-55	447	SO-12916	454	0.7	446	-0.8	448	-0.6	0.2	Cm=447.0
x High	80-90										
3A Run 1											
NOx Zero	0	0	na	1	0.1	2	0.1	2	0.1	0.0	Co=2.0
NOx Low	20-30 (1)										
NOx Mid	45-55	447	SO-12916	456	0.9	454	-0.2	442	-1.4	-1.2	Cm=448.0
NOx High	80-90	860	ALM059613	865	0.5						
3A Run 2											
NOx Zero	0	0	na	1	0.1	2	0.1	3	0.2	0.1	Co=2.5
NOx Low	20-30 (1)										
NOx Mid	45-55	447	SO-12916	456	0.9	442	-1.4	438	-1.8	-0.4	Cm=440.0
NOx High	80-90	860		865	0.5						
3A Run 3											
NOx Zero	0	0	na	1	0.1	3	0.2	2	0.1	-0.1	Co=2.5
NOx Low	20-30 (1)										
NOx Mid	45-55	447	SO-12916	456	0.9	438	-1.8	433	-2.3	-0.5	Cm=435.5
NOx High	80-90	860		865	0.5						

Calibration Error = [Analyzer Response - Cylinder Value / Analyzer Span] * 100; Allowable Error = ± 2%

System Bias = [System Response - Analyzer Response / Analyzer Span] * 100; Allowable Error = ± 5%

Drift = [Post Test System Response - Pretest System Response / Analyzer Span] * 100; Allowable Error = ± 3%

Co = [Pretest System Zero Response + Post Test System Zero Response] / 2

Cm = [Pretest Upscale Response + Post Test System Upscale Response] / 2

Required for Method 20 only, not required for Method 7E.

APPENDIX A

DEP Approved Test Protocol

NO_x EMISSION TEST PROTOCOL
PENNZOIL PRODUCTS COMPANY
ROUSEVILLE, PA
JUNE 1995

1.0 Introduction

Pennzoil Products Company (Pennzoil) operates an oil refinery at their facility in Rouseville, PA. NO_x controls have been implemented on two boilers (2A and 3A) under PAs RACT regulation (Sections 129.91-95). Boiler 2A has been retrofitted with a Pillard staged-fuel low NO_x burner. Boiler 3A has been committed to an 80 % fuel switch to low nitrogen burning oil based on annual steam load. As these sources have a rated capacity > 100 MMBtu/hr (144.4 MMBtu/hr), they are subject to annual NOx compliance testing under Section 129.91(i). This protocol outlines the procedures that Pennzoil or an approved contractor will follow when performing this testing. Note that this protocol is very similar to Pennzoil's NOx testing protocol that was approved by the DER for RACT baseline testing (See Attachment A).

The sources to be tested will be operated at maximum obtainable capacity (~110 MMBtu/hr). Initially, six one-hour tests will be performed on each source (three while firing gas and three while firing oil). Future annual testing will be conducted for three hours while firing the primary fuel (refinery gas for 2A and buning oil for 3A) and for one hour while firing the secondary fuel.

A continuous sample will be drawn from the exit of the economizers for both sources which is approximately 2 duct diameters downstream of the furnace exit. This location indicated little velocity stratification during previous NO_x baseline testing and was previously approved by the DER.

U.S. Environmental Protection Agency (EPA) source testing reference methods and *PADERs Source Testing Manual* will be the guidelines used. Stack gas concentrations of O_2 will be determined by method 3B using a Fyrite analyzer or by Method 3A using an instrumental analyzer. NO_x measurements will be made using a chemiluminescent analyzer (Method 7E). For each hour test, an average ppm concentration (adjusted to 3 % excess O_2) of NO_x and an emission factor in pounds per million British Thermal Units (lbs/MMBtu) will be determined. The Pennzoil project contact is Mr. Lee E. Wilson who can be reached at 814-678-4649.

2.0 Sampling Methodology and Quality Assurance

The following sections will describe the process data to be collected, the test procedures, and the quality assurance procedures to be employed.

2.1 Process Data

Pennzoil will obtain process and fuel consumption data during testing. Fuel samples will be collected during the testing (one gas sample during each hour test and one representative sample for fuel oil) for ultimate analysis and gross heating value analysis. Gas samples analysis will be performed on-site by Pennzoil's Laboratory using Gas Chromatography (ASTM D1945) to obtain fuel composition. The heating value of the gas will be calculated from the composition analysis as per *API Technical Data Book - Petroleum Refining Procedure 14A1.3.* The fuel oil analysis will be performed by an off-site

laboratory. Fuel oil composition will be determined by methods AOAC 972, ASTM 4629, and ASTM D2622. The heating value will be determined ASTM D240-76. These fuel analyses will be used to determine F-factors in accordance with EPA Method 19.

Pennzoil will collect process information that will include boiler load (pounds of steam per hour), fuel consumption, stack oxygen concentrations (wet basis), and economizer exit temperature.

2.2 Sampling Locations

Sampling will be performed at each of the two stacks using existing sampling ports. A continuous sample will be drawn from the exit of the economizers for both sources which is approximately 2 duct diameters downstream of the furnace exit (See Attachment B). This location indicated little velocity stratification during previous NO_x baseline testing and was previously approved by the DER. Sampling will be performed at approximately the center of the stack.

2.3 Stack Oxygen Analysis

Oxygen concentrations will be determined by either Method 3B using a Fyrite analyzer or by Method 3A using an instrumental analyzer. A single point integrated sampling procedure will be used under Method 3B. Although on a wet basis, the process oxygen analyzers can be used to compare to O_2 test results for verification by assuming a flue gas moisture content. Fyrite absorbing solutions will be verified for freshness and replaced if ambient air does not indicate 21 % O_2.

2.4 Nitrogen Oxides

Slip stream gas samples will be withdrawn from the stack and analyzed using EPA sources testing Method 7E as a guideline. Stack gas concentrations of NO_x will be determined continuously on a dry basis. The following exceptions are noted:

- The calibration gases (EPA Protocol NO in N_2) may be 80-100 % of a maximum expected NO_x level (500 ppm) for the high-level cal gas as opposed to 80-100 % of span. The mid-level cal gas may be 40-60 % of a maximum expected NOx level (500 ppm) as opposed to 40-60 % of span. This should allow for a better calibration for the measurement of normal expected NOx levels.
- Analyzer manufacturers interference response data may be used in lieu of a field interference response test.
- As ECOM Portable NOx testing indicates that the NO_2 contribution to total NO_x is less than 1 percent, no NO_2 to NO conversion efficiency test will be performed.

3.0 Calculation Methodology

Sufficient test information will be collected to independently report emissions in ppm adjusted to 3 % excess O_2 and the calculated lb/MMBtu factor for each hourly test. Per each method used for NO_x and O_2, the raw data will be reduced to an average gas concentration, dry basis. The ppm data will be intermediately converted to lb/MMBtu and lbs/hr using F-factors as specified by EPA method 19.

4.0 Report

A letter-type report will be issued summarizing the results of testing within 30 days after testing. The report will include all field data sheets, equipment calibration results, process data, fuels data, and tabulated test results.

ATTACHMENT A

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

Post Office Box 8468
Harrisburg, Pennsylvania 17105-8468

October 1, 1993

Bureau of Air Quality Control

RECEIVED
OCT 08 1993

Mr. Dan Nadzam
IT Corporation
2790 Mosside Blvd.
Monroeville, PA 15146-2792

Dear Mr. Nadzam:

I have reviewed the pretest procedures submitted for the NO_x and carbon monoxide test program to be conducted at the Pennzoil Products Company. The tests are to be conducted on their three boilers and one crude atmospheric furnace which is located in Rouseville. The tests have been referred to the Department for review and is acceptable.

The final acceptance of the test report is contingent upon its meeting all the requirements of Chapter 139 of the Pennsylvania Department of Environmental Resources' Rules and Regulations and any stipulation that might be imposed by the Northwest Regional Office. Please feel free to contact me if you have any questions or require additional formation at 717-787-9483.

Sincerely,

Bryon M Richwine

Bryon M. Richwine
Air Pollution Control Engineer
Source Testing Section
Division of Source Testing and Monitoring

EMISSION TEST PROTOCOL
NO_x and CO
PENNZOIL PRODUCTS COMPANY
ROUSEVILLE, PA

1.0 Introduction

Pennzoil Products Company (Pennzoil) operates an oil refinery at their facility in Rouseville, PA. In preparation for the upcoming Reasonably Available Control Technology (RACT) regulation and RACT plan submittal, Pennzoil will perform stack testing on four combustion sources. These four units are fired with byproduct refinery oil and fuel gas from the process.

Pennzoil has contracted IT Corporation (IT) to perform nitrogen oxides (NO_x) and carbon monoxide (CO) emission measurements on three boilers (2A and 3A, rated at 144 MMBtu/hr each and 4A rated at 94 MMBtu/hr) and one furnace (crude atmospheric furnace rated at 52 MMBtu/hr) at their Petroleum Refinery in Rouseville, PA. During testing all sources will be operated under typical loads (40 to 60 percent of maximum capacity). This protocol defines the emission testing procedures that IT will follow.

1.1 Sampling Plan Summary

The sources to be tested are located at the Pennzoil facility in Rouseville, Pennsylvania. Each of the four sources will be tested, during a one-hour time period, three times. For each of the three one-hour time periods IT will determine (for both NO_x and CO) an average emission concentration in parts per million (ppm) and an emission factor in pounds per million British thermal units (lb/MMBtu).

U.S. Environmental Protection Agency (EPA) source testing reference methods will be the guidelines used. Stack gas concentrations of carbon dioxide (CO_2) and oxygen (O_2) will be determined by Method 3. NO_x measurements will be made using a chemiluminescent analyzer (Method 7E). CO measurements will be made using a non-dispersive infrared (NDIR) analyzer (Method 10).

1.2 Project Contacts

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1.3 Proposed Test Date

The proposed test date for sampling is during the week of September 20, 1993. Pennzoil will notify the Pennsylvania Department of Environmental Resources (PADER) of the exact date of testing at least one week in advance of the test.

2.0 Sampling Methodology and Quality Assurance

The following sections will describe the process data to be collected, the test procedures, and the quality assurance procedures to be employed.

2.1 Process Data

IT will perform the emissions testing while Pennzoil obtains process and fuel consumption data. Fuel samples will be collected during the test (on the half-hour for gases, one representative sample for fuel oil) for ultimate analysis and higher heating value analysis. Gas sample analysis will be performed by Pennzoil Laboratory using Gas Chromatography (ASTM D1945) to obtain fuel composition. The heating value of the gas will be calculated from the composition analysis on a dry basis (as per API Technical Data Book - Petroleum Refining Procedure 14A1.3). The fuel oil analysis will be performed by PARC Laboratories of Pittsburgh. Composition will be determined by methods AOAC 972, ASTM D4629, and ASTM D2622. The heating value will be determined by ASTM D240-76. The fuel analysis will be used to determine F-factors in accordance with EPA Method 19.

Pennzoil will collect process information that includes boiler load (expressed as percent of rated capacity or in terms of Btu/hr input) and fuel consumption (cubic feet or gallons per hour).

2.2 Sampling Locations

IT will sample at each of the four stacks using existing sampling ports. Sampling ports on the 3 boilers are located at the economizer, approximately 2 duct diameters downstream of the burner. The sampling port for the crude furnace is located at the base of the stack, also about 2 duct diameters downstream of the burner. IT will sample each stack at the center of the duct.

2.3 Oxygen and Carbon Dioxide

Oxygen and CO_2 will be determined by EPA Method 3. IT will use the integrated grab sampling and analytical procedure. Integrated gas samples will be drawn from the stack during each one-hour test run for CO and NOx. Oxygen and CO_2 measurements will be made by an Orsat or Fyrite analyzer in accordance with EPA Method 3. A stack sampling data sheet will be used during the test to record the gas analysis information. A sample stack sampling data sheet is contained in attachment A to this is protocol.

Orsat or Fyrite absorbing solutions will be verified for freshness and replaced if an analysis of ambient air does not indicate 21 percent O_2 and 0 percent CO_2.

2.4 Nitrogen Oxides

NO_x measurements and quality assurance methods will be identical to those contained in EPA Method 7E. The following exceptions are noted:

- The calibration gases for the NO_x analyzer may be NO in nitrogen (N_2), or NO_2 in N_2, or NO and NO_2 in N_2. The reported value by the span gas manufacturer will be used as the absolute value.
- No interference response test will have been performed on the analyzer prior to its initial use in the field.

2.5 Carbon Monoxide

CO measurements and quality assurance methods will be identical to those contained in EPA Method 10.

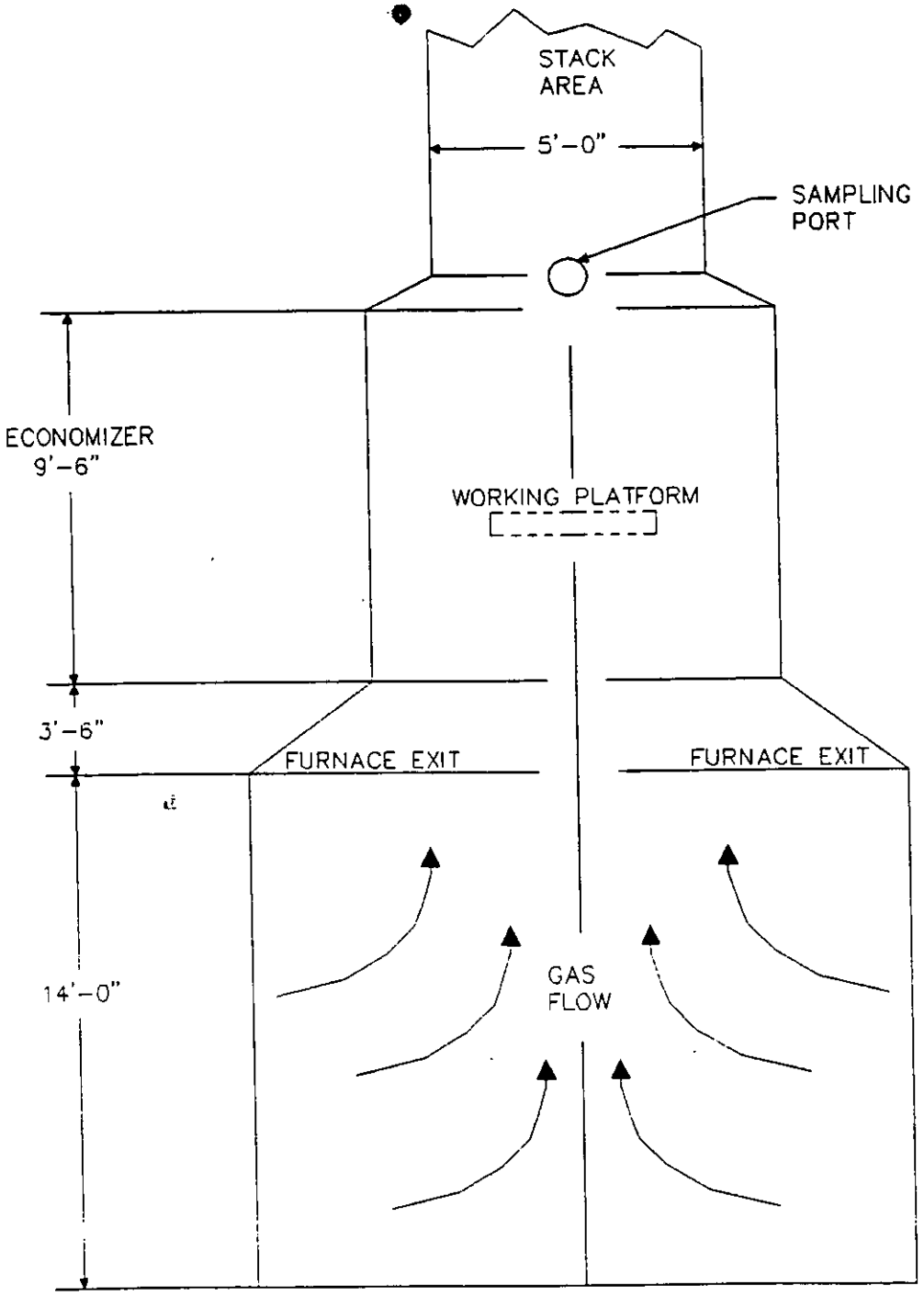
3.0 Calculation Methodology

Sufficient test information will be collected to independently report emissions in ppm at 7% O_2 and the calculated lb/MMBTU factor for each of the 12 one-hour tests. Per each method used for NO_x and CO, the raw data will be reduced to an average gas concentration, dry basis, expressed in ppm at 7% O_2. The ppm data will be intermediately converted to lb/MMBTU using the lb/dscf F-factor (EPA Method 19).

4.0 Report

A letter-type report will be issued summarizing the results of testing within 15 working days after testing. The report will include all field data sheets, equipment calibration results, and tabulated test results.

ATTACHMENT B



PENNZOIL PRODUCTS COMPANY
REFINERY ENGINEERING–ROUSEVILLE, PA.

ATTACHMENT "B"
SAMPLING PORT LOCATION
BOILER NO 2A. & 3A X-SECTION

6/29/95

LWILSON.DWG

APPENDIX B

Laboratory Data
and
F-Factor Calculations

Fuel Gas Characteristics for NOx Testing 6/5/96 – Boiler #2A Runs

Composition

Mol Percent (Volume Percent)

	#2A 10:45 Run #1	#2A 12:47 Run #2	#2A 2:10 Run #3	Mol Wt	Heating Value (Btu/lb)
Nitrogen	0.57	0.70	0.76	28.02	0
Oxygen	0.05	0.05	0.05	32.00	0.00
Hydrogen	36.74	35.19	33.23	2.02	61,100
Methane	28.66	29.07	31.07	16.04	23,879
Ethane	9.74	9.64	9.14	30.07	22,320
H2S	0.17	0.42	0.71	34.08	7,100
Propane	12.36	12.68	12.18	44.09	21,661
Isobutane	5.08	5.20	5.12	58.12	21,257
N-Butane	5.33	5.72	6.08	58.12	21,308
Butene, 1-	0.00	0.00	0.00	56.10	20,840
Butene, 2-	0.01	0.00	0.00	56.10	20,730
Isopentane	0.84	0.86	1.02	72.15	21,052
N-Pentane	0.31	0.32	0.45	72.15	21,091
N-Hexane	0.00	0.00	0.02	86.17	20,940
CO2	0.14	0.15	0.17	44.01	0.00
	100.00	100.00	100.00		

Partial Molecular Weights

	#2A 10:45 Run #1	#2A 12:47 Run #2	#2A 2:10 Run #3
Nitrogen	0.16	0.20	0.21
Oxygen	0.02	0.02	0.02
Hydrogen	0.74	0.71	0.67
Methane	4.60	4.66	4.98
Ethane	2.93	2.90	2.75
H2S	0.06	0.14	0.24
Propane	5.45	5.59	5.37
Isobutane	2.95	3.02	2.98
N-Butane	3.10	3.32	3.53
Butene, 1-	0.00	0.00	0.00
Butene, 2-	0.01	0.00	0.00
Isopentane	0.61	0.62	0.74
N-Pentane	0.22	0.23	0.32
N-Hexane	0.00	0.00	0.02
CO2	0.06	0.07	0.07
Tot MW	**20.90**	**21.48**	**21.91**

Fuel Gas Characteristics for NOx Testing 6/5/96 -- Boiler #2A Runs

Weight Percent

	#2A 10:45 Run #1	#2A 12:47 Run #2	#2A 2:10 Run #3
Nitrogen	0.76	0.91	0.97
Oxygen	0.08	0.07	0.07
Hydrogen	3.54	3.30	3.06
Methane	22.00	21.71	22.75
Ethane	14.02	13.49	12.55
H2S	0.28	0.67	1.10
Propane	26.08	26.03	24.52
Isobutane	14.13	14.07	13.58
N-Butane	14.82	15.48	16.13
Butene, 1-	0.00	0.00	0.00
Butene, 2-	0.03	0.00	0.00
Isopentane	2.90	2.89	3.36
N-Pentane	1.07	1.07	1.48
N-Hexane	0.00	0.00	0.08
CO2	0.29	0.31	0.34
	100.00	100.00	100.00

BTU Values (Dry Basis) (BTU/LB)

	#2A 10:45 Run #1	#2A 12:47 Run #2	#2A 2:10 Run #3
Nitrogen	0	0	0
Oxygen	0	0	0
Hydrogen	2,166	2,018	1,869
Methane	5,253	5,183	5,433
Ethane	3,128	3,012	2,800
H2S	20	47	78
Propane	5,649	5,637	5,310
Isobutane	3,003	2,991	2,888
N-Butane	3,159	3,298	3,437
Butene, 1-	0	0	0
Butene, 2-	6	0	0
Isopentane	611	608	707
N-Pentane	226	227	313
N-Hexane	0	0	16
CO2	0	0	0
Totals:	**23,219**	**23,021**	**22,852**
BTU/scf =	**1,280**	**1,305**	**1,321**

Fuel Gas Characteristics for NOx Testing 6/5/96 -- Boiler #2A Runs					
Fuel Components -- Elemental Composition					
	%C	**%H**	**%N**	**%O**	**%S**
Nitrogen	0.00	0.00	100.00	0.00	0.00
Oxygen	0.00	0.00	0.00	100.00	0.00
Hydrogen	0.00	100.00	0.00	0.00	0.00
Methane	74.88	25.14	0.00	0.00	0.00
Ethane	79.88	20.11	0.00	0.00	0.00
H2S	0.00	5.92	0.00	0.00	94.10
Propane	81.72	18.29	0.00	0.00	0.00
Isobutane	82.66	17.34	0.00	0.00	0.00
N-Butane	82.66	17.34	0.00	0.00	0.00
Butene, 1-	85.63	14.37	0.00	0.00	0.00
Butene, 2-	85.63	14.37	0.00	0.00	0.00
Isopentane	83.23	16.77	0.00	0.00	0.00
N-Pentane	83.23	16.77	0.00	0.00	0.00
N-Hexane	83.63	16.38	0.00	0.00	0.00
CO2	27.29	0.00	0.00	72.71	0.00
2A Run #1	**Elemental Fuel Composition (Weight Percent)**				
AVG.					
	%C	**%H**	**%N**	**%O**	**%S**
Nitrogen	0.00	0.00	0.76	0.00	0.00
Oxygen	0.00	0.00	0.00	0.08	0.00
Hydrogen	0.00	3.54	0.00	0.00	0.00
Methane	16.47	5.53	0.00	0.00	0.00
Ethane	11.20	2.82	0.00	0.00	0.00
H2S	0.00	0.02	0.00	0.00	0.26
Propane	21.31	4.77	0.00	0.00	0.00
Isobutane	11.68	2.45	0.00	0.00	0.00
N-Butane	12.25	2.57	0.00	0.00	0.00
Butene, 1-	0.00	0.00	0.00	0.00	0.00
Butene, 2-	0.02	0.00	0.00	0.00	0.00
Isopentane	2.41	0.49	0.00	0.00	0.00
N-Pentane	0.89	0.18	0.00	0.00	0.00
N-Hexane	0.00	0.00	0.00	0.00	0.00
CO2	0.08	0.00	0.00	0.21	0.00
Totals:	**76.32**	**22.37**	**0.76**	**0.29**	**0.26**

Fuel Gas Characteristics for NOx Testing 6/5/96 -- Boiler #2A Runs					
2A Run #2 AVG.	**Elemental Fuel Composition (Weight Percent)**				
	%C	**%H**	**%N**	**%O**	**%S**
Nitrogen	0.00	0.00	0.91	0.00	0.00
Oxygen	0.00	0.00	0.00	0.07	0.00
Hydrogen	0.00	3.30	0.00	0.00	0.00
Methane	16.25	5.46	0.00	0.00	0.00
Ethane	10.78	2.71	0.00	0.00	0.00
H2S	0.00	0.04	0.00	0.00	0.63
Propane	21.27	4.76	0.00	0.00	0.00
Isobutane	11.63	2.44	0.00	0.00	0.00
N-Butane	12.79	2.68	0.00	0.00	0.00
Butene, 1-	0.00	0.00	0.00	0.00	0.00
Butene, 2-	0.00	0.00	0.00	0.00	0.00
Isopentane	2.40	0.48	0.00	0.00	0.00
N-Pentane	0.89	0.18	0.00	0.00	0.00
N-Hexane	0.00	0.00	0.00	0.00	0.00
CO2	0.08	0.00	0.00	0.22	0.00
Totals:	**76.10**	**22.06**	**0.91**	**0.30**	**0.63**
2A Run #3 AVG.	**Elemental Fuel Composition (Weight Percent)**				
	%C	**%H**	**%N**	**%O**	**%S**
Nitrogen	0.00	0.00	0.97	0.00	0.00
Oxygen	0.00	0.00	0.00	0.07	0.00
Hydrogen	0.00	3.06	0.00	0.00	0.00
Methane	17.03	5.72	0.00	0.00	0.00
Ethane	10.02	2.52	0.00	0.00	0.00
H2S	0.00	0.07	0.00	0.00	1.04
Propane	20.03	4.48	0.00	0.00	0.00
Isobutane	11.23	2.36	0.00	0.00	0.00
N-Butane	13.33	2.80	0.00	0.00	0.00
Butene, 1-	0.00	0.00	0.00	0.00	0.00
Butene, 2-	0.00	0.00	0.00	0.00	0.00
Isopentane	2.80	0.56	0.00	0.00	0.00
N-Pentane	1.23	0.25	0.00	0.00	0.00
N-Hexane	0.07	0.01	0.00	0.00	0.00
CO2	0.09	0.00	0.00	0.25	0.00
Totals:	**75.84**	**21.83**	**0.97**	**0.32**	**1.04**

Fuel Gas Characteristics for NOx Testing 6/5/96 – Boiler #2A Runs					
Boiler 2A F Factor Calculations					
	K Values	Run #1	Run #2	Run #3	
Element	(scf/lb)/(%)	(Wt %)	(Wt %)	(Wt %)	
C	1.53	76.32	76.10	75.84	
H	3.64	22.37	22.06	21.83	
N	0.14	0.76	0.91	0.97	
O	0.46	0.29	0.30	0.32	
S	0.57	0.26	0.63	1.04	
Totals		100.00	100.00	100.00	
Boiler 2A					
F Factors (Dry Basis) (dscf/10E6 Btu)					
Run #1	**Run #2**	**Run #3**			
8,541	8,561	8,580			

Fuel Gas Characteristics for NOx Testing 6/6/96 – Boiler #3A Runs

Composition
Mol Percent (Volume Percent)

	#3A 10:45 Run #1	#3A 12:47 Run #2	#3A 2:10 Run #3	Mol Wt	Heating Value (Btu/lb)
Nitrogen	0.79	0.57	0.58	28.02	0
Oxygen	0.07	0.06	0.06	32.00	0.00
Hydrogen	35.40	33.53	34.52	2.02	61,100
Methane	28.18	32.65	33.70	16.04	23,879
Ethane	10.21	9.56	9.05	30.07	22,320
H2S	0.19	0.23	0.20	34.08	7,100
Propane	12.94	12.18	11.35	44.09	21,661
Isobutane	5.29	4.95	4.63	58.12	21,257
N-Butane	5.48	5.07	4.85	58.12	21,308
Butene, 1-	0.00	0.00	0.00	56.10	20,840
Butene, 2-	0.00	0.00	0.00	56.10	20,730
Isopentane	0.94	0.66	0.57	72.15	21,052
N-Pentane	0.36	0.30	0.28	72.15	21,091
N-Hexane	0.01	0.06	0.02	86.17	20,940
CO2	0.14	0.18	0.19	44.01	0.00
	100.00	100.00	100.00		

Partial Molecular Weights

	#3A 10:45 Run #1	#3A 12:47 Run #2	#3A 2:10 Run #3
Nitrogen	0.22	0.16	0.16
Oxygen	0.02	0.02	0.02
Hydrogen	0.71	0.68	0.70
Methane	4.52	5.24	5.41
Ethane	3.07	2.87	2.72
H2S	0.06	0.08	0.07
Propane	5.71	5.37	5.00
Isobutane	3.07	2.88	2.69
N-Butane	3.18	2.95	2.82
Butene, 1-	0.00	0.00	0.00
Butene, 2-	0.00	0.00	0.00
Isopentane	0.68	0.48	0.41
N-Pentane	0.26	0.22	0.20
N-Hexane	0.01	0.05	0.02
CO2	0.06	0.08	0.08
Tot MW	**21.59**	**21.06**	**20.30**

Fuel Gas Characteristics for NOx Testing 6/6/96 -- Boiler #3A Runs

Weight Percent

	#3A 10:45 Run #1	#3A 12:47 Run #2	#3A 2:10 Run #3
Nitrogen	1.03	0.76	0.80
Oxygen	0.10	0.09	0.09
Hydrogen	3.31	3.21	3.43
Methane	20.94	24.86	26.63
Ethane	14.22	13.65	13.41
H2S	0.30	0.37	0.34
Propane	26.43	25.50	24.65
Isobutane	14.24	13.66	13.26
N-Butane	14.76	13.99	13.89
Butene, 1-	0.00	0.00	0.00
Butene, 2-	0.00	0.00	0.00
Isopentane	3.14	2.26	2.03
N-Pentane	1.20	1.03	1.00
N-Hexane	0.04	0.25	0.08
CO2	0.29	0.38	0.41
	100.00	100.00	100.00

BTU Values (Dry Basis) (BTU/LB)

	#3A 10:45 Run #1	#3A 12:47 Run #2	#3A 2:10 Run #3
Nitrogen	0	0	0
Oxygen	0	0	0
Hydrogen	2,020	1,961	2,095
Methane	5,000	5,937	6,358
Ethane	3,175	3,046	2,992
H2S	21	26	24
Propane	5,725	5,523	5,340
Isobutane	3,028	2,904	2,818
N-Butane	3,144	2,981	2,959
Butene, 1-	0	0	0
Butene, 2-	0	0	0
Isopentane	661	476	426
N-Pentane	254	217	210
N-Hexane	8	51	18
CO2	0	0	0
Totals:	**23,037**	**23,123**	**23,239**
BTU/scf =	**1,312**	**1,285**	**1,245**

Fuel Gas Characteristics for NOx Testing 6/6/96 -- Boiler #3A Runs					
Fuel Components -- Elemental Composition					
	%C	**%H**	**%N**	**%O**	**%S**
Nitrogen	0.00	0.00	100.00	0.00	0.00
Oxygen	0.00	0.00	0.00	100.00	0.00
Hydrogen	0.00	100.00	0.00	0.00	0.00
Methane	74.88	25.14	0.00	0.00	0.00
Ethane	79.88	20.11	0.00	0.00	0.00
H2S	0.00	5.92	0.00	0.00	94.10
Propane	81.72	18.29	0.00	0.00	0.00
Isobutane	82.66	17.34	0.00	0.00	0.00
N-Butane	82.66	17.34	0.00	0.00	0.00
Butene, 1-	85.63	14.37	0.00	0.00	0.00
Butene, 2-	85.63	14.37	0.00	0.00	0.00
Isopentane	83.23	16.77	0.00	0.00	0.00
N-Pentane	83.23	16.77	0.00	0.00	0.00
N-Hexane	83.63	16.38	0.00	0.00	0.00
CO2	27.29	0.00	0.00	72.71	0.00
3A Run #1	**Elemental Fuel Composition (Weight Percent)**				
AVG.					
	%C	**%H**	**%N**	**%O**	**%S**
Nitrogen	0.00	0.00	1.03	0.00	0.00
Oxygen	0.00	0.00	0.00	0.10	0.00
Hydrogen	0.00	3.31	0.00	0.00	0.00
Methane	15.68	5.26	0.00	0.00	0.00
Ethane	11.36	2.86	0.00	0.00	0.00
H2S	0.00	0.02	0.00	0.00	0.28
Propane	21.60	4.83	0.00	0.00	0.00
Isobutane	11.77	2.47	0.00	0.00	0.00
N-Butane	12.20	2.56	0.00	0.00	0.00
Butene, 1-	0.00	0.00	0.00	0.00	0.00
Butene, 2-	0.00	0.00	0.00	0.00	0.00
Isopentane	2.62	0.53	0.00	0.00	0.00
N-Pentane	1.00	0.20	0.00	0.00	0.00
N-Hexane	0.03	0.01	0.00	0.00	0.00
CO2	0.08	0.00	0.00	0.21	0.00
Totals:	**76.34**	**22.05**	**1.03**	**0.31**	**0.28**

Fuel Gas Characteristics for NOx Testing 6/6/96 – Boiler #3A Runs					
3A Run #2	**Elemental Fuel Composition (Weight Percent)**				
AVG.					
	%C	**%H**	**%N**	**%O**	**%S**
Nitrogen	0.00	0.00	0.76	0.00	0.00
Oxygen	0.00	0.00	0.00	0.09	0.00
Hydrogen	0.00	3.21	0.00	0.00	0.00
Methane	18.62	6.25	0.00	0.00	0.00
Ethane	10.90	2.75	0.00	0.00	0.00
H2S	0.00	0.02	0.00	0.00	0.35
Propane	20.84	4.66	0.00	0.00	0.00
Isobutane	11.29	2.37	0.00	0.00	0.00
N-Butane	11.56	2.43	0.00	0.00	0.00
Butene, 1-	0.00	0.00	0.00	0.00	0.00
Butene, 2-	0.00	0.00	0.00	0.00	0.00
Isopentane	1.88	0.38	0.00	0.00	0.00
N-Pentane	0.86	0.17	0.00	0.00	0.00
N-Hexane	0.21	0.04	0.00	0.00	0.00
CO2	0.10	0.00	0.00	0.27	0.00
Totals:	**76.25**	**22.28**	**0.76**	**0.36**	**0.35**
3A Run #3	**Elemental Fuel Composition (Weight Percent)**				
AVG.					
	%C	**%H**	**%N**	**%O**	**%S**
Nitrogen	0.00	0.00	0.80	0.00	0.00
Oxygen	0.00	0.00	0.00	0.09	0.00
Hydrogen	0.00	3.43	0.00	0.00	0.00
Methane	19.94	6.69	0.00	0.00	0.00
Ethane	10.71	2.70	0.00	0.00	0.00
H2S	0.00	0.02	0.00	0.00	0.32
Propane	20.14	4.51	0.00	0.00	0.00
Isobutane	10.96	2.30	0.00	0.00	0.00
N-Butane	11.48	2.41	0.00	0.00	0.00
Butene, 1-	0.00	0.00	0.00	0.00	0.00
Butene, 2-	0.00	0.00	0.00	0.00	0.00
Isopentane	1.69	0.34	0.00	0.00	0.00
N-Pentane	0.83	0.17	0.00	0.00	0.00
N-Hexane	0.07	0.01	0.00	0.00	0.00
CO2	0.11	0.00	0.00	0.30	0.00
Totals:	**75.92**	**22.57**	**0.80**	**0.39**	**0.32**

Fuel Gas Characteristics for NOx Testing 6/6/96 -- Boiler #3A Runs					
Boiler 3A F Factor Calculations					
	K Values	Run #1	Run #2	Run #3	
Element	(scf/lb)/(%)	(Wt %)	(Wt %)	(Wt %)	
C	1.53	76.34	76.25	75.92	
H	3.64	22.05	22.28	22.57	
N	0.14	1.03	0.76	0.80	
O	0.46	0.31	0.36	0.39	
S	0.57	0.28	0.35	0.32	
Totals		100.00	100.00	100.00	
Boiler 3A					
F Factors (Dry Basis) (dscf/10E6 Btu)					
Run #1	**Run #2**	**Run #3**			
8,561	8,559	8,539			

APPENDIX C

Field Data
and
Strip Charts

FORM 01-46 (1)
DATE 6/5/96

PAGE ___ OF ___

BOILER 2A NOx COMPLIANCE TEST

8:00AM - 8:30 SETUP & NOx WARM-UP
8:45 - CHECK FYRITE, ADJUST FLUID & CHECK AGAINST AIR
- READS 21% O2 OK
9:15 START CALS
2-3 SCFH to atm. dump @ analyzer intake
SCOTT EPA PROTOCOL 859.7 total NOx
9:20AM FIRST - Zero cal using air - reading 1 PPM
Let sit for a few minutes
9:23 adjust to zero OK 0.0
9:24 add High Gas reading 861 (863) vs 860, adjust to 860 OK
9:30 back to zero OK
9:31 Mid Gas check MATHESON EPA P1 447 ppm TOTAL NOx
9:33 2-3 SCFH READS 450 PPM vs 447 OK
9:35 Cal Error check 9:38 Zero reads 1 PPM OK
9:39 Mid check READS 454 vs 447 OK
9:44 High check 9:46 READS 865 vs 860 OK
9:50 Put Ice in cooler
10:00 Bias check CAL FLOW 20-30 SCFH Dumped & Probe and ~5LPM to NOx
Mid Gas READS 450PPM OK 450PPM OK; Zero reads 1 PPM
10:10 Response time upscale 10:10 → 10:12:12 744PPM OK
max @ 450 Downscale 10:13 → 10:16:09 6PPM OK
10:20 on stack flushing O_2 bag then empty rid of air
10:25 adjusting flows to ~500 cc/m to O_2 bag
~5 L/m NOx
10:30 stabilizing boiler load @ ~ 80K lbs/HR

FORM 01-46 (1)
DATE _____ PAGE _____ OF _____

2A NOx Continued

10:45 start Run + take Gas sample HOOK UP O_2 BAG

10:37 NO_x climbing to 165 ppm

10:45	162 PPM NO_x	O_2	2.1 met %	11:22 check Fyrite
11:00	163 PPM	O_2	2.1 met %	on 2% O_2 reads
11:10	158 PPM	O_2	2.2	2.5% OK
11:26	160 PPM	O_2	2.0	

11:30 Flare 29.5% position natural Gas make-up reading 0.0 MMCF/d

11:40 154 PPM 2.1% O_2
11:45 end of Run 159 PPM NO_x 2.1% O_2

Fyrite readings Run 1 1st 4.0% dry O_2 } took
2nd 3.5% } good
3rd 3.5%
3.7

11:54 switched cal valve on stack for Post-test cal

11:57 EVAC O_2 BAG for next run

Post cal zero reads 1 PPM
11:59 add mid Gas reads 447 PPM @ 12:04
shut off Gas 12:05

12:12 switch back to Stack for Run 2

FORM 01-46 (1)
DATE _____ PAGE _____ OF _____

2A NO_x COND

12:15 start Run 2

NO_x 161 ppm O_2 2.1% met

12:29 155 ppm 2.3% O_2

12:45 165 ppm 2.1% O_2

12:47 Gas sample
1:04 160 ppm 2.1%
1:10 160 ppm 2.1%
1:15 end of run 162 ppm 2.1% O_2

1:17 Fyrite O_2 readings for run 2

1) 3.0% O_2 dry
2) 3.5%
3 3.0%
3.2

1:25 Turn cal valve on stack + re-pack ice

Post-test cal check Run 2

Zero check — reads 1 ppm 1:34
Mid check — reads 446 1:40 pm

FORM 01-46 (1)

DATE _____

PAGE _____ OF _____

2A - RUN 3 - Start 2:05 PM

DEP visit next week 10:00 AM

:05 NO_x 163 ppm 2.1% O_2 wet

:27 NO_x 161 ppm 2.1% O_2 wet

:38 NO_x 163 ppm 2.1

:47 162 ppm 2.2

:54 165 ppm 2.0%

3:05 end of run 159 ppm 2.1%

Fyrite @ 3:10 1) 3.0% O_2 Dry

2) 3.0%

3) ~~3.0%~~

3.0

Final cal check

3:16 zero reads 1 ppm

FORM 01-46 (1)
DATE _____ PAGE _____ OF _____

3A Test start calc @ 9:10 AM

Zero — reads 0.0 OK

9:12 — High Cal 860 ppm reading 860–862 Cal flow ~ 5 SCFH
cal to High of 860 9:20 OK

Cal Error test 9:23

Zero — reads 1.0 ppm

9:32 Mid — reads 456 OK @ 9:38 am

High — reads 865 OK

9:44 Bias check + response time

upscale - 9:46 → 9:47:30 95% of scale or max @ 454 ppm

Down - 9:50 → 9:51:30 10 ppm OK

Zero Check @ 9:53 2 ppm

Start 3A RUN-1 @ 10:15

~77-78 K lb/HR
w no Econ
∴ Boiler is wide open

10:50 checked Fyrite OK reads 21% on air

10:15	- 304 ppm	7%	1.6 O2%
10:25	- 308 ppm		1.8 O2
10:35	- 313 ppm		1.7 O2
10:45	- 308 ppm		1.7 O2
10:55	- 317 ppm		1.7
11:05	324 ppm		1.7
11:15	324 ppm		1.7

(O2 meter from Boiler O2 analyzer)

Fyrite @ 11:17

1) 2% O_2 dry
2) 2%
3) 1.75

1.92

Post test calc

11:30 zero check → 2 ppm
Mid check → 444 ppm OK

FORM 01-46 (1)
DATE _____ PAGE _____ OF _____

3A - RUN 2

11:45 NOx = 300 ppm 2% O_2

12:05	296	1.9%
12:15	308	1.8%
12:37	303	1.7%
12:43	311	1.5% O_2
12:45	End of run 305	1.6%

Fyrite run 2
1) 2%
2) 1.5%
3) 1.75%
1.75

Post-Test cal
Zero check 3 ppm OK
1:00 pm High check 438 ppm

3A - RUN 3 6/6/96 1:15 pm START

1:15	301 ppm NOx	1.8% O_2 met
1:21	309	1.6% O_2
1:32	292	1.9%
2:02	296	1.8
2:10	305	1.8
2:15	291 end of run	

2:20 Post-test cal
zero check — 2 ppm
2:20 mid check 433 ppm } OK

* 1:40 Gas sample

Fyrite reading 2:20 pm
1) 2%
2) 2%
3) 1.75%
1.92

Boiler 2A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm				
"06/05/96"	"08:30:00"	0				
"06/05/96"	"08:31:00"	0				
"06/05/96"	"08:32:00"	0				
"06/05/96"	"08:33:00"	0				
"06/05/96"	"08:34:00"	0				
"06/05/96"	"08:35:00"	0				
"06/05/96"	"08:36:00"	0				
"06/05/96"	"08:37:00"	0				
"06/05/96"	"08:38:00"	0				
"06/05/96"	"08:39:00"	0				
"06/05/96"	"08:40:00"	0				
"06/05/96"	"08:41:00"	0				
"06/05/96"	"08:42:00"	0				
"06/05/96"	"08:43:00"	0				
"06/05/96"	"08:44:00"	0				
"06/05/96"	"08:45:00"	0				
"06/05/96"	"08:46:00"	0				
"06/05/96"	"08:47:00"	0				
"06/05/96"	"08:48:00"	0				
"06/05/96"	"08:49:00"	0				
"06/05/96"	"08:50:00"	0				
"06/05/96"	"08:51:00"	0				
"06/05/96"	"08:52:00"	0				
"06/05/96"	"08:53:00"	0				
"06/05/96"	"08:54:00"	0				
"06/05/96"	"08:55:00"	0				
"06/05/96"	"08:56:00"	0				
"06/05/96"	"08:57:00"	0				
"06/05/96"	"08:58:00"	0				
"06/05/96"	"08:59:00"	0				
"06/05/96"	"09:00:00"	0				
"06/05/96"	"09:01:00"	0				
"06/05/96"	"09:02:00"	0				
"06/05/96"	"09:03:00"	0				
"06/05/96"	"09:04:00"	0				
"06/05/96"	"09:05:00"	0				
"06/05/96"	"09:06:00"	0				
"06/05/96"	"09:07:00"	0				
"06/05/96"	"09:08:00"	0				
"06/05/96"	"09:09:00"	0				
"06/05/96"	"09:10:00"	0				
"06/05/96"	"09:11:00"	0				
"06/05/96"	"09:12:00"	0				
"06/05/96"	"09:13:00"	0				
"06/05/96"	"09:14:00"	0				
"06/05/96"	"09:15:00"	0				
"06/05/96"	"09:16:00"	0				
"06/05/96"	"09:17:00"	63				
"06/05/96"	"09:18:00"	617				
"06/05/96"	"09:19:00"	40				

Boiler 2A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm				
"06/05/96"	"09:20:00"	1				
"06/05/96"	"09:21:00"	1				
"06/05/96"	"09:22:00"	1	Initial Analyzer Zero Cal			
"06/05/96"	"09:23:00"	90				
"06/05/96"	"09:24:00"	820				
"06/05/96"	"09:25:00"	864				
"06/05/96"	"09:26:00"	865				
"06/05/96"	"09:27:00"	864	Initial High Cal			
"06/05/96"	"09:28:00"	607				
"06/05/96"	"09:29:00"	12				
"06/05/96"	"09:30:00"	1				
"06/05/96"	"09:31:00"	324				
"06/05/96"	"09:32:00"	447				
"06/05/96"	"09:33:00"	452	Mid Cal Check			
"06/05/96"	"09:34:00"	431				
"06/05/96"	"09:35:00"	176				
"06/05/96"	"09:36:00"	2				
"06/05/96"	"09:37:00"	1	Cal Error Zero			
"06/05/96"	"09:38:00"	121				
"06/05/96"	"09:39:00"	449				
"06/05/96"	"09:40:00"	456				
"06/05/96"	"09:41:00"	456	Cal Error Mid			
"06/05/96"	"09:42:00"	296				
"06/05/96"	"09:43:00"	5				
"06/05/96"	"09:44:00"	632				
"06/05/96"	"09:45:00"	864				
"06/05/96"	"09:46:00"	866				
"06/05/96"	"09:47:00"	868				
"06/05/96"	"09:48:00"	864	High Error Check			
"06/05/96"	"09:49:00"	166				
"06/05/96"	"09:50:00"	2				
"06/05/96"	"09:51:00"	1				
"06/05/96"	"09:52:00"	1				
"06/05/96"	"09:53:00"	1				
"06/05/96"	"09:54:00"	0				
"06/05/96"	"09:55:00"	1				
"06/05/96"	"09:56:00"	0				
"06/05/96"	"09:57:00"	0				
"06/05/96"	"09:58:00"	1				
"06/05/96"	"09:59:00"	1				
"06/05/96"	"10:00:00"	0				
"06/05/96"	"10:01:00"	30				
"06/05/96"	"10:02:00"	356				
"06/05/96"	"10:03:00"	445				
"06/05/96"	"10:04:00"	450	Bias Check - Mid			
"06/05/96"	"10:05:00"	451				
"06/05/96"	"10:06:00"	424				
"06/05/96"	"10:07:00"	376				
"06/05/96"	"10:08:00"	181				
"06/05/96"	"10:09:00"	8				

Boiler 2A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm				
"06/05/96"	"10:10:00"	2	Bias Check - Zero & Response Time - Upscale			
"06/05/96"	"10:11:00"	266				
"06/05/96"	"10:12:00"	448				
"06/05/96"	"10:13:00"	451	Response Time - Downscale			
"06/05/96"	"10:14:00"	434				
"06/05/96"	"10:15:00"	97				
"06/05/96"	"10:16:00"	4				
"06/05/96"	"10:17:00"	2				
"06/05/96"	"10:18:00"	2				
"06/05/96"	"10:19:00"	2				
"06/05/96"	"10:20:00"	1	On Stack Gas			
"06/05/96"	"10:21:00"	49				
"06/05/96"	"10:22:00"	135				
"06/05/96"	"10:23:00"	135				
"06/05/96"	"10:24:00"	135				
"06/05/96"	"10:25:00"	144				
"06/05/96"	"10:26:00"	150				
"06/05/96"	"10:27:00"	150				
"06/05/96"	"10:28:00"	149				
"06/05/96"	"10:29:00"	153				
"06/05/96"	"10:30:00"	156				
"06/05/96"	"10:31:00"	153				
"06/05/96"	"10:32:00"	153				
"06/05/96"	"10:33:00"	156				
"06/05/96"	"10:34:00"	158				
"06/05/96"	"10:35:00"	156				
"06/05/96"	"10:36:00"	155				
"06/05/96"	"10:37:00"	165				
"06/05/96"	"10:38:00"	168				
"06/05/96"	"10:39:00"	165				
"06/05/96"	"10:40:00"	165				
"06/05/96"	"10:41:00"	167				
"06/05/96"	"10:42:00"	162				
"06/05/96"	"10:43:00"	160				
"06/05/96"	"10:44:00"	160				
Boiler 2A Run 1						
"06/05/96"	"10:45:00"	166	Start Run 1			
"06/05/96"	"10:46:00"	166				
"06/05/96"	"10:47:00"	164				
"06/05/96"	"10:48:00"	167				
"06/05/96"	"10:49:00"	168				
"06/05/96"	"10:50:00"	163				
"06/05/96"	"10:51:00"	161				
"06/05/96"	"10:52:00"	166				
"06/05/96"	"10:53:00"	169				
"06/05/96"	"10:54:00"	164				
"06/05/96"	"10:55:00"	161				
"06/05/96"	"10:56:00"	164				
"06/05/96"	"10:57:00"	164				

Boiler 2A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm				
"06/05/96"	"10:58:00"	162				
"06/05/96"	"10:59:00"	162				
"06/05/96"	"11:00:00"	166				
"06/05/96"	"11:01:00"	164				
"06/05/96"	"11:02:00"	161				
"06/05/96"	"11:03:00"	162				
"06/05/96"	"11:04:00"	165				
"06/05/96"	"11:05:00"	162				
"06/05/96"	"11:06:00"	158				
"06/05/96"	"11:07:00"	159				
"06/05/96"	"11:08:00"	158				
"06/05/96"	"11:09:00"	155				
"06/05/96"	"11:10:00"	156				
"06/05/96"	"11:11:00"	159				
"06/05/96"	"11:12:00"	156				
"06/05/96"	"11:13:00"	155				
"06/05/96"	"11:14:00"	158				
"06/05/96"	"11:15:00"	158				
"06/05/96"	"11:16:00"	156				
"06/05/96"	"11:17:00"	154				
"06/05/96"	"11:18:00"	158				
"06/05/96"	"11:19:00"	161				
"06/05/96"	"11:20:00"	158				
"06/05/96"	"11:21:00"	158				
"06/05/96"	"11:22:00"	160				
"06/05/96"	"11:23:00"	162				
"06/05/96"	"11:24:00"	162				
"06/05/96"	"11:25:00"	158				
"06/05/96"	"11:26:00"	161				
"06/05/96"	"11:27:00"	162				
"06/05/96"	"11:28:00"	160				
"06/05/96"	"11:29:00"	157				
"06/05/96"	"11:30:00"	157				
"06/05/96"	"11:31:00"	159				
"06/05/96"	"11:32:00"	151				
"06/05/96"	"11:33:00"	148				
"06/05/96"	"11:34:00"	151				
"06/05/96"	"11:35:00"	152				
"06/05/96"	"11:36:00"	152				
"06/05/96"	"11:37:00"	154				
"06/05/96"	"11:38:00"	156				
"06/05/96"	"11:39:00"	154				
"06/05/96"	"11:40:00"	154				
"06/05/96"	"11:41:00"	154				
"06/05/96"	"11:42:00"	157				
"06/05/96"	"11:43:00"	158				
"06/05/96"	"11:44:00"	158				
"06/05/96"	"11:45:00"	160	End Run 1			
	Average	159				

Boiler 2A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm				
"06/05/96"	"11:46:00"	159				
"06/05/96"	"11:47:00"	155				
"06/05/96"	"11:48:00"	156				
"06/05/96"	"11:49:00"	161				
"06/05/96"	"11:50:00"	159				
"06/05/96"	"11:51:00"	156				
"06/05/96"	"11:52:00"	159				
"06/05/96"	"11:53:00"	161				
"06/05/96"	"11:54:00"	158				
"06/05/96"	"11:55:00"	41				
"06/05/96"	"11:56:00"	2				
"06/05/96"	"11:57:00"	2				
"06/05/96"	"11:58:00"	2	Post Test Cal - Zero			
"06/05/96"	"11:59:00"	211				
"06/05/96"	"12:00:00"	436				
"06/05/96"	"12:01:00"	441				
"06/05/96"	"12:02:00"	443				
"06/05/96"	"12:03:00"	444				
"06/05/96"	"12:04:00"	445	Post Test Cal - Span			
"06/05/96"	"12:05:00"	376				
"06/05/96"	"12:06:00"	19				
"06/05/96"	"12:07:00"	2				
"06/05/96"	"12:08:00"	2				
"06/05/96"	"12:09:00"	2				
"06/05/96"	"12:10:00"	2				
"06/05/96"	"12:11:00"	2				
"06/05/96"	"12:12:00"	9				
"06/05/96"	"12:13:00"	147				
"06/05/96"	"12:14:00"	164				
Boiler 2A Run 2						
"06/05/96"	"12:15:00"	163	Start Run 2			
"06/05/96"	"12:16:00"	159				
"06/05/96"	"12:17:00"	160				
"06/05/96"	"12:18:00"	163				
"06/05/96"	"12:19:00"	159				
"06/05/96"	"12:20:00"	155				
"06/05/96"	"12:21:00"	162				
"06/05/96"	"12:22:00"	164				
"06/05/96"	"12:23:00"	160				
"06/05/96"	"12:24:00"	156				
"06/05/96"	"12:25:00"	160				
"06/05/96"	"12:26:00"	162				
"06/05/96"	"12:27:00"	159				
"06/05/96"	"12:28:00"	156				
"06/05/96"	"12:29:00"	159				
"06/05/96"	"12:30:00"	160				
"06/05/96"	"12:31:00"	158				
"06/05/96"	"12:32:00"	159				
"06/05/96"	"12:33:00"	164				

Boiler 2A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm				
"06/05/96"	"12:34:00"	165				
"06/05/96"	"12:35:00"	161				
"06/05/96"	"12:36:00"	161				
"06/05/96"	"12:37:00"	162				
"06/05/96"	"12:38:00"	162				
"06/05/96"	"12:39:00"	159				
"06/05/96"	"12:40:00"	163				
"06/05/96"	"12:41:00"	166				
"06/05/96"	"12:42:00"	161				
"06/05/96"	"12:43:00"	159				
"06/05/96"	"12:44:00"	162				
"06/05/96"	"12:45:00"	165				
"06/05/96"	"12:46:00"	162				
"06/05/96"	"12:47:00"	161				
"06/05/96"	"12:48:00"	165				
"06/05/96"	"12:49:00"	165				
"06/05/96"	"12:50:00"	162				
"06/05/96"	"12:51:00"	161				
"06/05/96"	"12:52:00"	165				
"06/05/96"	"12:53:00"	164				
"06/05/96"	"12:54:00"	160				
"06/05/96"	"12:55:00"	161				
"06/05/96"	"12:56:00"	165				
"06/05/96"	"12:57:00"	162				
"06/05/96"	"12:58:00"	159				
"06/05/96"	"12:59:00"	160				
"06/05/96"	"13:00:00"	160				
"06/05/96"	"13:01:00"	155				
"06/05/96"	"13:02:00"	154				
"06/05/96"	"13:03:00"	160				
"06/05/96"	"13:04:00"	160				
"06/05/96"	"13:05:00"	155				
"06/05/96"	"13:06:00"	156				
"06/05/96"	"13:07:00"	160				
"06/05/96"	"13:08:00"	162				
"06/05/96"	"13:09:00"	160				
"06/05/96"	"13:10:00"	160				
"06/05/96"	"13:11:00"	163				
"06/05/96"	"13:12:00"	162				
"06/05/96"	"13:13:00"	158				
"06/05/96"	"13:14:00"	160				
"06/05/96"	"13:15:00"	164	End Run 2			
Average		161				
"06/05/96"	"13:16:00"	161				
"06/05/96"	"13:17:00"	160				
"06/05/96"	"13:18:00"	161				
"06/05/96"	"13:19:00"	163				
"06/05/96"	"13:20:00"	164				
"06/05/96"	"13:21:00"	161				

Boiler 2A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm				
"06/05/96"	"13:22:00"	158				
"06/05/96"	"13:23:00"	159				
"06/05/96"	"13:24:00"	160				
"06/05/96"	"13:25:00"	160				
"06/05/96"	"13:26:00"	53				
"06/05/96"	"13:27:00"	2				
"06/05/96"	"13:28:00"	2				
"06/05/96"	"13:29:00"	1				
"06/05/96"	"13:30:00"	1				
"06/05/96"	"13:31:00"	1				
"06/05/96"	"13:32:00"	1				
"06/05/96"	"13:33:00"	1				
"06/05/96"	"13:34:00"	1	Post Test Cal - Zero			
"06/05/96"	"13:35:00"	1				
"06/05/96"	"13:36:00"	76				
"06/05/96"	"13:37:00"	430				
"06/05/96"	"13:38:00"	446				
"06/05/96"	"13:39:00"	448	Post Test Cal - Span			
"06/05/96"	"13:40:00"	254				
"06/05/96"	"13:41:00"	5				
"06/05/96"	"13:42:00"	2				
"06/05/96"	"13:43:00"	2				
"06/05/96"	"13:44:00"	2				
"06/05/96"	"13:45:00"	1				
"06/05/96"	"13:46:00"	1				
"06/05/96"	"13:47:00"	1				
"06/05/96"	"13:48:00"	1				
"06/05/96"	"13:49:00"	1				
"06/05/96"	"13:50:00"	1				
"06/05/96"	"13:51:00"	1				
"06/05/96"	"13:52:00"	19				
"06/05/96"	"13:53:00"	158				
"06/05/96"	"13:54:00"	160				
"06/05/96"	"13:55:00"	159				
"06/05/96"	"13:56:00"	163				
"06/05/96"	"13:57:00"	158				
"06/05/96"	"13:58:00"	163				
"06/05/96"	"13:59:00"	179				
"06/05/96"	"14:00:00"	170				
"06/05/96"	"14:01:00"	148				
"06/05/96"	"14:02:00"	165				
"06/05/96"	"14:03:00"	178				
"06/05/96"	"14:04:00"	163				
Boiler 2A - Run 3						
"06/05/96"	"14:05:00"	164	Start Run 3			
"06/05/96"	"14:06:00"	162				
"06/05/96"	"14:07:00"	161				
"06/05/96"	"14:08:00"	161				
"06/05/96"	"14:09:00"	159				

Boiler 2A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm				
"06/05/96"	"14:10:00"	156				
"06/05/96"	"14:11:00"	157				
"06/05/96"	"14:12:00"	162				
"06/05/96"	"14:13:00"	160				
"06/05/96"	"14:14:00"	158				
"06/05/96"	"14:15:00"	161				
"06/05/96"	"14:16:00"	164				
"06/05/96"	"14:17:00"	162				
"06/05/96"	"14:18:00"	160				
"06/05/96"	"14:19:00"	162				
"06/05/96"	"14:20:00"	162				
"06/05/96"	"14:21:00"	158				
"06/05/96"	"14:22:00"	156				
"06/05/96"	"14:23:00"	161				
"06/05/96"	"14:24:00"	162				
"06/05/96"	"14:25:00"	159				
"06/05/96"	"14:26:00"	160				
"06/05/96"	"14:27:00"	163				
"06/05/96"	"14:28:00"	163				
"06/05/96"	"14:29:00"	159				
"06/05/96"	"14:30:00"	160				
"06/05/96"	"14:31:00"	162				
"06/05/96"	"14:32:00"	159				
"06/05/96"	"14:33:00"	156				
"06/05/96"	"14:34:00"	162				
"06/05/96"	"14:35:00"	164				
"06/05/96"	"14:36:00"	160				
"06/05/96"	"14:37:00"	160				
"06/05/96"	"14:38:00"	164				
"06/05/96"	"14:39:00"	163				
"06/05/96"	"14:40:00"	157				
"06/05/96"	"14:41:00"	159				
"06/05/96"	"14:42:00"	163				
"06/05/96"	"14:43:00"	163				
"06/05/96"	"14:44:00"	161				
"06/05/96"	"14:45:00"	162				
"06/05/96"	"14:46:00"	166				
"06/05/96"	"14:47:00"	162				
"06/05/96"	"14:48:00"	159				
"06/05/96"	"14:49:00"	163				
"06/05/96"	"14:50:00"	164				
"06/05/96"	"14:51:00"	161				
"06/05/96"	"14:52:00"	160				
"06/05/96"	"14:53:00"	164				
"06/05/96"	"14:54:00"	166				
"06/05/96"	"14:55:00"	161				
"06/05/96"	"14:56:00"	160				
"06/05/96"	"14:57:00"	162				
"06/05/96"	"14:58:00"	162				
"06/05/96"	"14:59:00"	160				

Boiler 2A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm				
"06/05/96"	"15:00:00"	160				
"06/05/96"	"15:01:00"	162				
"06/05/96"	"15:02:00"	161				
"06/05/96"	"15:03:00"	159				
"06/05/96"	"15:04:00"	160				
"06/05/96"	"15:05:00"	162	End Run 3			
	Average	161				
"06/05/96"	"15:06:00"	160				
"06/05/96"	"15:07:00"	160				
"06/05/96"	"15:08:00"	162				
"06/05/96"	"15:09:00"	164				
"06/05/96"	"15:10:00"	163				
"06/05/96"	"15:11:00"	163				
"06/05/96"	"15:12:00"	165				
"06/05/96"	"15:13:00"	136				
"06/05/96"	"15:14:00"	7				
"06/05/96"	"15:15:00"	2				
"06/05/96"	"15:16:00"	2	Post Test Cal - Zero			
"06/05/96"	"15:17:00"	201				
"06/05/96"	"15:18:00"	446				
"06/05/96"	"15:19:00"	448	Post Test Cal - Span			
"06/05/96"	"15:20:00"	178				
"06/05/96"	"15:21:00"	3				
"06/05/96"	"15:22:00"	2				
"06/05/96"	"15:23:00"	2				
"06/05/96"	"15:24:00"	1				
"06/05/96"	"15:25:00"	1				
"06/05/96"	"15:26:00"	1				
"06/05/96"	"15:27:00"	1				
"06/05/96"	"15:28:00"	1				
"06/05/96"	"15:29:00"	1				
"06/05/96"	"15:30:00"	1				

Boiler 3A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm					
"06/06/96"	"08:30:00"	0					
"06/06/96"	"08:31:00"	0					
"06/06/96"	"08:32:00"	0					
"06/06/96"	"08:33:00"	0					
"06/06/96"	"08:34:00"	0					
"06/06/96"	"08:35:00"	0					
"06/06/96"	"08:36:00"	7					
"06/06/96"	"08:37:00"	0					
"06/06/96"	"08:38:00"	0					
"06/06/96"	"08:39:00"	0					
"06/06/96"	"08:40:00"	0					
"06/06/96"	"08:41:00"	0					
"06/06/96"	"08:42:00"	0					
"06/06/96"	"08:43:00"	0					
"06/06/96"	"08:44:00"	0					
"06/06/96"	"08:45:00"	0					
"06/06/96"	"08:46:00"	0					
"06/06/96"	"08:47:00"	0					
"06/06/96"	"08:48:00"	0					
"06/06/96"	"08:49:00"	0					
"06/06/96"	"08:50:00"	0					
"06/06/96"	"08:51:00"	0					
"06/06/96"	"08:52:00"	0					
"06/06/96"	"08:53:00"	0					
"06/06/96"	"08:54:00"	0					
"06/06/96"	"08:55:00"	0					
"06/06/96"	"08:56:00"	0					
"06/06/96"	"08:57:00"	0					
"06/06/96"	"08:58:00"	0					
"06/06/96"	"08:59:00"	0					
"06/06/96"	"09:00:00"	0					
"06/06/96"	"09:01:00"	0					
"06/06/96"	"09:02:00"	0					
"06/06/96"	"09:03:00"	1					
"06/06/96"	"09:04:00"	0					
"06/06/96"	"09:05:00"	0					
"06/06/96"	"09:06:00"	0					
"06/06/96"	"09:07:00"	0					
"06/06/96"	"09:08:00"	0					
"06/06/96"	"09:09:00"	0					
"06/06/96"	"09:10:00"	0	Initial Analyzer Zero Cal				
"06/06/96"	"09:11:00"	45					
"06/06/96"	"09:12:00"	730					
"06/06/96"	"09:13:00"	738					
"06/06/96"	"09:14:00"	778					
"06/06/96"	"09:15:00"	842					
"06/06/96"	"09:16:00"	856					
"06/06/96"	"09:17:00"	862					

Boiler 3A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm					
"06/06/96"	"09:18:00"	863					
"06/06/96"	"09:19:00"	863					
"06/06/96"	"09:20:00"	864					
"06/06/96"	"09:21:00"	861	Initial High Cal				
"06/06/96"	"09:22:00"	863					
"06/06/96"	"09:23:00"	556					
"06/06/96"	"09:24:00"	8					
"06/06/96"	"09:25:00"	0	Cal Error Zero				
"06/06/96"	"09:26:00"	0					
"06/06/96"	"09:27:00"	0					
"06/06/96"	"09:28:00"	0					
"06/06/96"	"09:29:00"	0					
"06/06/96"	"09:30:00"	0					
"06/06/96"	"09:31:00"	13					
"06/06/96"	"09:32:00"	412					
"06/06/96"	"09:33:00"	455					
"06/06/96"	"09:34:00"	456					
"06/06/96"	"09:35:00"	456					
"06/06/96"	"09:36:00"	457					
"06/06/96"	"09:37:00"	456	Cal Error Mid				
"06/06/96"	"09:38:00"	68					
"06/06/96"	"09:39:00"	256					
"06/06/96"	"09:40:00"	855					
"06/06/96"	"09:41:00"	867	High Error Check				
"06/06/96"	"09:42:00"	806					
"06/06/96"	"09:43:00"	52					
"06/06/96"	"09:44:00"	2					
"06/06/96"	"09:45:00"	1	Response Time - Upscale				
"06/06/96"	"09:46:00"	83					
"06/06/96"	"09:47:00"	433					
"06/06/96"	"09:48:00"	452					
"06/06/96"	"09:49:00"	455	Bias Check - Mid & Response Time - Downscale				
"06/06/96"	"09:50:00"	387					
"06/06/96"	"09:51:00"	19					
"06/06/96"	"09:52:00"	2					
"06/06/96"	"09:53:00"	2					
"06/06/96"	"09:54:00"	2					
"06/06/96"	"09:55:00"	1	Bias Check - Zero				
"06/06/96"	"09:56:00"	1					
"06/06/96"	"09:57:00"	1					
"06/06/96"	"09:58:00"	1					
"06/06/96"	"09:59:00"	1					
"06/06/96"	"10:00:00"	1					
"06/06/96"	"10:01:00"	1					
"06/06/96"	"10:02:00"	1					
"06/06/96"	"10:03:00"	1					
"06/06/96"	"10:04:00"	1					
"06/06/96"	"10:05:00"	1					

Boiler 3A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm					
"06/06/96"	"10:06:00"	3	On Stack Gas				
"06/06/96"	"10:07:00"	264					
"06/06/96"	"10:08:00"	309					
"06/06/96"	"10:09:00"	317					
"06/06/96"	"10:10:00"	328					
"06/06/96"	"10:11:00"	329					
"06/06/96"	"10:12:00"	317					
"06/06/96"	"10:13:00"	311					
"06/06/96"	"10:14:00"	320					
Start Run 1							
"06/06/96"	"10:15:00"	301	Start Run 1				
"06/06/96"	"10:16:00"	290					
"06/06/96"	"10:17:00"	311					
"06/06/96"	"10:18:00"	313					
"06/06/96"	"10:19:00"	316					
"06/06/96"	"10:20:00"	308					
"06/06/96"	"10:21:00"	307					
"06/06/96"	"10:22:00"	315					
"06/06/96"	"10:23:00"	316					
"06/06/96"	"10:24:00"	307					
"06/06/96"	"10:25:00"	309					
"06/06/96"	"10:26:00"	316					
"06/06/96"	"10:27:00"	315					
"06/06/96"	"10:28:00"	305					
"06/06/96"	"10:29:00"	306					
"06/06/96"	"10:30:00"	308					
"06/06/96"	"10:31:00"	301					
"06/06/96"	"10:32:00"	301					
"06/06/96"	"10:33:00"	312					
"06/06/96"	"10:34:00"	313					
"06/06/96"	"10:35:00"	308					
"06/06/96"	"10:36:00"	310					
"06/06/96"	"10:37:00"	315					
"06/06/96"	"10:38:00"	317					
"06/06/96"	"10:39:00"	315					
"06/06/96"	"10:40:00"	316					
"06/06/96"	"10:41:00"	318					
"06/06/96"	"10:42:00"	310					
"06/06/96"	"10:43:00"	304					
"06/06/96"	"10:44:00"	307					
"06/06/96"	"10:45:00"	311					
"06/06/96"	"10:46:00"	307					
"06/06/96"	"10:47:00"	308					
"06/06/96"	"10:48:00"	309					
"06/06/96"	"10:49:00"	305					
"06/06/96"	"10:50:00"	302					
"06/06/96"	"10:51:00"	311					

Boiler 3A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm					
"06/06/96"	"10:52:00"	319					
"06/06/96"	"10:53:00"	321					
"06/06/96"	"10:54:00"	322					
"06/06/96"	"10:55:00"	317					
"06/06/96"	"10:56:00"	317					
"06/06/96"	"10:57:00"	321					
"06/06/96"	"10:58:00"	320					
"06/06/96"	"10:59:00"	313					
"06/06/96"	"11:00:00"	309					
"06/06/96"	"11:01:00"	314					
"06/06/96"	"11:02:00"	322					
"06/06/96"	"11:03:00"	323					
"06/06/96"	"11:04:00"	323					
"06/06/96"	"11:05:00"	325					
"06/06/96"	"11:06:00"	331					
"06/06/96"	"11:07:00"	331					
"06/06/96"	"11:08:00"	325					
"06/06/96"	"11:09:00"	319					
"06/06/96"	"11:10:00"	317					
"06/06/96"	"11:11:00"	315					
"06/06/96"	"11:12:00"	322					
"06/06/96"	"11:13:00"	324					
"06/06/96"	"11:14:00"	322					
"06/06/96"	"11:15:00"	317	End Run 1				
	Average	314					
"06/06/96"	"11:16:00"	314					
"06/06/96"	"11:17:00"	320					
"06/06/96"	"11:18:00"	319					
"06/06/96"	"11:19:00"	318					
"06/06/96"	"11:20:00"	318					
"06/06/96"	"11:21:00"	314					
"06/06/96"	"11:22:00"	314					
"06/06/96"	"11:23:00"	313					
"06/06/96"	"11:24:00"	301					
"06/06/96"	"11:25:00"	36					
"06/06/96"	"11:26:00"	3					
"06/06/96"	"11:27:00"	2					
"06/06/96"	"11:28:00"	2					
"06/06/96"	"11:29:00"	2					
"06/06/96"	"11:30:00"	2	Post Test Cal - Zero				
"06/06/96"	"11:31:00"	235					
"06/06/96"	"11:32:00"	436					
"06/06/96"	"11:33:00"	439					
"06/06/96"	"11:34:00"	440					
"06/06/96"	"11:35:00"	441					
"06/06/96"	"11:36:00"	440					
"06/06/96"	"11:37:00"	439					

Boiler 3A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm					
"06/06/96"	"11:38:00"	441					
"06/06/96"	"11:39:00"	442	Post Test Cal - Span				
"06/06/96"	"11:40:00"	163					
"06/06/96"	"11:41:00"	4					
"06/06/96"	"11:42:00"	2					
"06/06/96"	"11:43:00"	94					
"06/06/96"	"11:44:00"	300					
Run 2							
"06/06/96"	"11:45:00"	300	Start Run 2				
"06/06/96"	"11:46:00"	300					
"06/06/96"	"11:47:00"	299					
"06/06/96"	"11:48:00"	302					
"06/06/96"	"11:49:00"	308					
"06/06/96"	"11:50:00"	309					
"06/06/96"	"11:51:00"	308					
"06/06/96"	"11:52:00"	309					
"06/06/96"	"11:53:00"	308					
"06/06/96"	"11:54:00"	294					
"06/06/96"	"11:55:00"	298					
"06/06/96"	"11:56:00"	305					
"06/06/96"	"11:57:00"	308					
"06/06/96"	"11:58:00"	307					
"06/06/96"	"11:59:00"	305					
"06/06/96"	"12:00:00"	304					
"06/06/96"	"12:01:00"	310					
"06/06/96"	"12:02:00"	312					
"06/06/96"	"12:03:00"	306					
"06/06/96"	"12:04:00"	301					
"06/06/96"	"12:05:00"	298					
"06/06/96"	"12:06:00"	300					
"06/06/96"	"12:07:00"	304					
"06/06/96"	"12:08:00"	305					
"06/06/96"	"12:09:00"	309					
"06/06/96"	"12:10:00"	312					
"06/06/96"	"12:11:00"	313					
"06/06/96"	"12:12:00"	310					
"06/06/96"	"12:13:00"	307					
"06/06/96"	"12:14:00"	303					
"06/06/96"	"12:15:00"	305					
"06/06/96"	"12:16:00"	305					
"06/06/96"	"12:17:00"	302					
"06/06/96"	"12:18:00"	301					
"06/06/96"	"12:19:00"	310					
"06/06/96"	"12:20:00"	311					
"06/06/96"	"12:21:00"	303					
"06/06/96"	"12:22:00"	294					
"06/06/96"	"12:23:00"	295					

Boiler 3A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm					
"06/06/96"	"12:24:00"	300					
"06/06/96"	"12:25:00"	293					
"06/06/96"	"12:26:00"	290					
"06/06/96"	"12:27:00"	299					
"06/06/96"	"12:28:00"	302					
"06/06/96"	"12:29:00"	294					
"06/06/96"	"12:30:00"	296					
"06/06/96"	"12:31:00"	307					
"06/06/96"	"12:32:00"	306					
"06/06/96"	"12:33:00"	294					
"06/06/96"	"12:34:00"	296					
"06/06/96"	"12:35:00"	307					
"06/06/96"	"12:36:00"	308					
"06/06/96"	"12:37:00"	304					
"06/06/96"	"12:38:00"	306					
"06/06/96"	"12:39:00"	306					
"06/06/96"	"12:40:00"	304					
"06/06/96"	"12:41:00"	302					
"06/06/96"	"12:42:00"	309					
"06/06/96"	"12:43:00"	310					
"06/06/96"	"12:44:00"	308					
"06/06/96"	"12:45:00"	302	End Run 2				
	Average	304					
"06/06/96"	"12:46:00"	302					
"06/06/96"	"12:47:00"	305					
"06/06/96"	"12:48:00"	296					
"06/06/96"	"12:49:00"	290					
"06/06/96"	"12:50:00"	301					
"06/06/96"	"12:51:00"	307					
"06/06/96"	"12:52:00"	296					
"06/06/96"	"12:53:00"	290					
"06/06/96"	"12:54:00"	305					
"06/06/96"	"12:55:00"	142					
"06/06/96"	"12:56:00"	4					
"06/06/96"	"12:57:00"	3					
"06/06/96"	"12:58:00"	4					
"06/06/96"	"12:59:00"	2	Post Test Cal - Zero				
"06/06/96"	"13:00:00"	123					
"06/06/96"	"13:01:00"	426					
"06/06/96"	"13:02:00"	436					
"06/06/96"	"13:03:00"	438					
"06/06/96"	"13:04:00"	436					
"06/06/96"	"13:05:00"	438	Post Test Cal - Span				
"06/06/96"	"13:06:00"	387					
"06/06/96"	"13:07:00"	24					
"06/06/96"	"13:08:00"	138					
"06/06/96"	"13:09:00"	314					

Boiler 3A Runs 1-3 Raw Data (ppm Minute Averages)

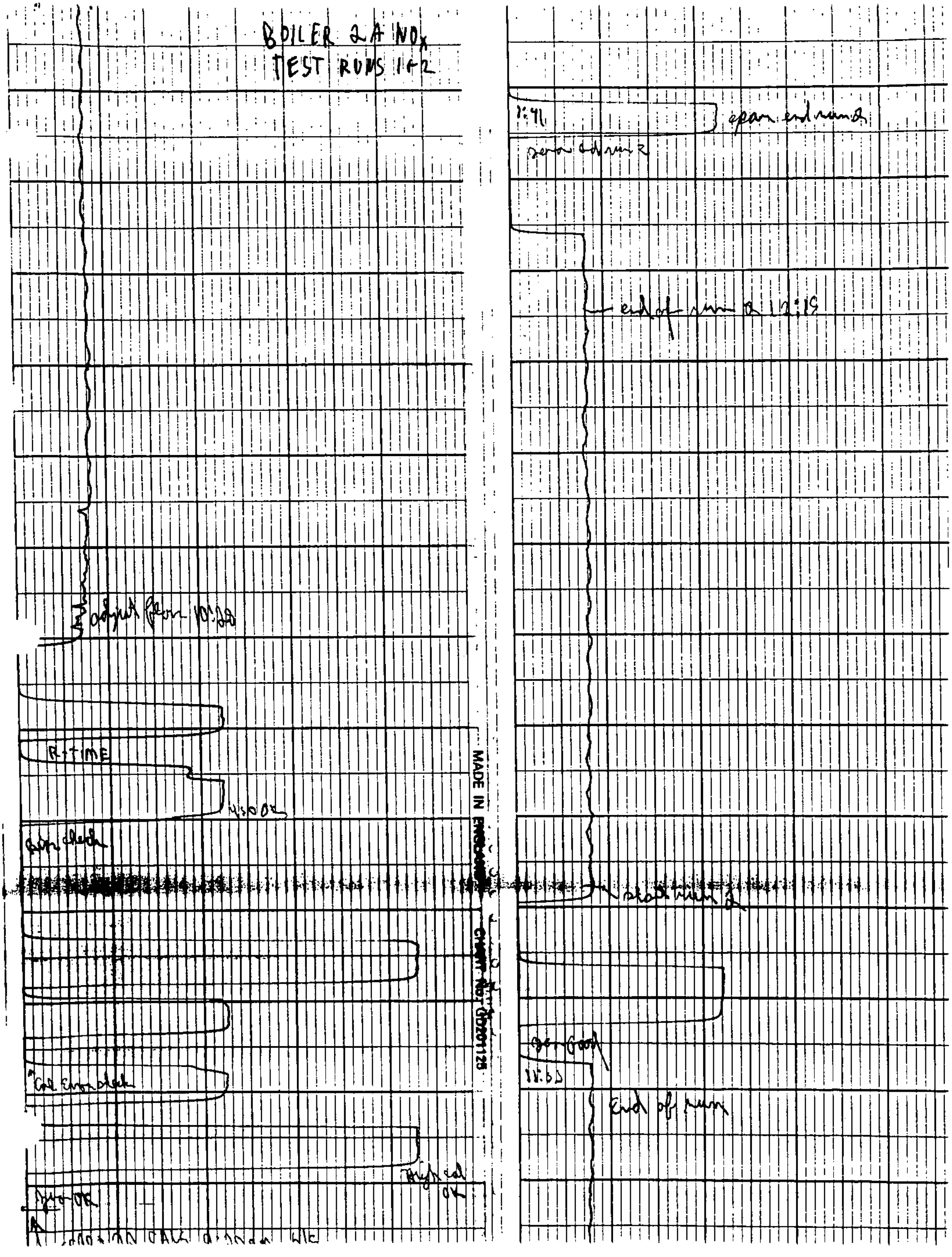
Date	Time	NOx ppm					
"06/06/96"	"13:10:00"	320					
"06/06/96"	"13:11:00"	308					
"06/06/96"	"13:12:00"	295					
"06/06/96"	"13:13:00"	305					
"06/06/96"	"13:14:00"	310					
Run 3							
"06/06/96"	"13:15:00"	304	Start Run 3				
"06/06/96"	"13:16:00"	296					
"06/06/96"	"13:17:00"	308					
"06/06/96"	"13:18:00"	315					
"06/06/96"	"13:19:00"	310					
"06/06/96"	"13:20:00"	301					
"06/06/96"	"13:21:00"	310					
"06/06/96"	"13:22:00"	312					
"06/06/96"	"13:23:00"	303					
"06/06/96"	"13:24:00"	293					
"06/06/96"	"13:25:00"	302					
"06/06/96"	"13:26:00"	309					
"06/06/96"	"13:27:00"	305					
"06/06/96"	"13:28:00"	291					
"06/06/96"	"13:29:00"	299					
"06/06/96"	"13:30:00"	308					
"06/06/96"	"13:31:00"	303					
"06/06/96"	"13:32:00"	290					
"06/06/96"	"13:33:00"	295					
"06/06/96"	"13:34:00"	305					
"06/06/96"	"13:35:00"	302					
"06/06/96"	"13:36:00"	291					
"06/06/96"	"13:37:00"	291					
"06/06/96"	"13:38:00"	296					
"06/06/96"	"13:39:00"	288					
"06/06/96"	"13:40:00"	277					
"06/06/96"	"13:41:00"	293					
"06/06/96"	"13:42:00"	300					
"06/06/96"	"13:43:00"	290					
"06/06/96"	"13:44:00"	282					
"06/06/96"	"13:45:00"	299					
"06/06/96"	"13:46:00"	305					
"06/06/96"	"13:47:00"	288					
"06/06/96"	"13:48:00"	280					
"06/06/96"	"13:49:00"	298					
"06/06/96"	"13:50:00"	303					
"06/06/96"	"13:51:00"	283					
"06/06/96"	"13:52:00"	282					
"06/06/96"	"13:53:00"	297					
"06/06/96"	"13:54:00"	292					
"06/06/96"	"13:55:00"	275					

Boiler 3A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm					
"06/06/96"	"13:56:00"	276					
"06/06/96"	"13:57:00"	296					
"06/06/96"	"13:58:00"	296					
"06/06/96"	"13:59:00"	283					
"06/06/96"	"14:00:00"	281					
"06/06/96"	"14:01:00"	297					
"06/06/96"	"14:02:00"	297					
"06/06/96"	"14:03:00"	281					
"06/06/96"	"14:04:00"	283					
"06/06/96"	"14:05:00"	299					
"06/06/96"	"14:06:00"	301					
"06/06/96"	"14:07:00"	285					
"06/06/96"	"14:08:00"	284					
"06/06/96"	"14:09:00"	302					
"06/06/96"	"14:10:00"	301					
"06/06/96"	"14:11:00"	284					
"06/06/96"	"14:12:00"	292					
"06/06/96"	"14:13:00"	303					
"06/06/96"	"14:14:00"	302					
"06/06/96"	"14:15:00"	288	End Run 3				
	Average	295					
"06/06/96"	"14:16:00"	292					
"06/06/96"	"14:17:00"	303					
"06/06/96"	"14:18:00"	266					
"06/06/96"	"14:19:00"	19					
"06/06/96"	"14:20:00"	4					
"06/06/96"	"14:21:00"	2	Post Test Cal - Zero				
"06/06/96"	"14:22:00"	261					
"06/06/96"	"14:23:00"	424					
"06/06/96"	"14:24:00"	428					
"06/06/96"	"14:25:00"	430					
"06/06/96"	"14:26:00"	430					
"06/06/96"	"14:27:00"	430					
"06/06/96"	"14:28:00"	433					
"06/06/96"	"14:29:00"	433	Post Test Cal - Span				
"06/06/96"	"14:30:00"	138					
"06/06/96"	"14:31:00"	6					
"06/06/96"	"14:32:00"	4					
"06/06/96"	"14:33:00"	6					
"06/06/96"	"14:34:00"	5					
"06/06/96"	"14:35:00"	4					
"06/06/96"	"14:36:00"	4					
"06/06/96"	"14:37:00"	3					
"06/06/96"	"14:38:00"	1					
"06/06/96"	"14:39:00"	1					
"06/06/96"	"14:40:00"	1					
"06/06/96"	"14:41:00"	1					

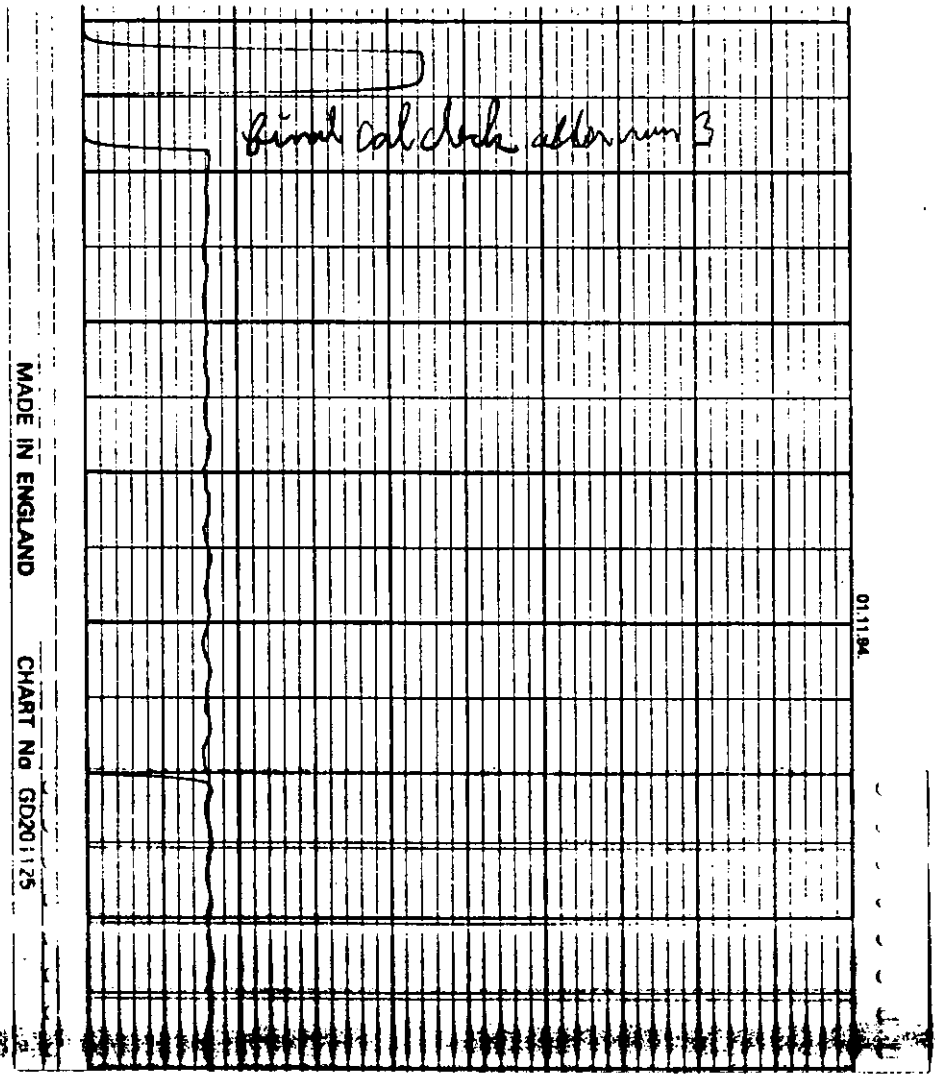
Boiler 3A Runs 1-3 Raw Data (ppm Minute Averages)

Date	Time	NOx ppm					
"06/06/96"	"14:42:00"	1					
"06/06/96"	"14:43:00"	1					
"06/06/96"	"14:44:00"	0					
"06/06/96"	"14:45:00"	0					
"06/06/96"	"14:46:00"	2					
"06/06/96"	"14:47:00"	0					
"06/06/96"	"14:48:00"	0					
"06/06/96"	"14:49:00"	0					
"06/06/96"	"14:50:00"	0					
"06/06/96"	"14:51:00"	0					
"06/06/96"	"14:52:00"	0					
"06/06/96"	"14:53:00"	0					
"06/06/96"	"14:54:00"	0					
"06/06/96"	"14:55:00"	0					
"06/06/96"	"14:56:00"	0					
"06/06/96"	"14:57:00"	0					
"06/06/96"	"14:58:00"	0					
"06/06/96"	"14:59:00"	0					
"06/06/96"	"15:00:00"	0					

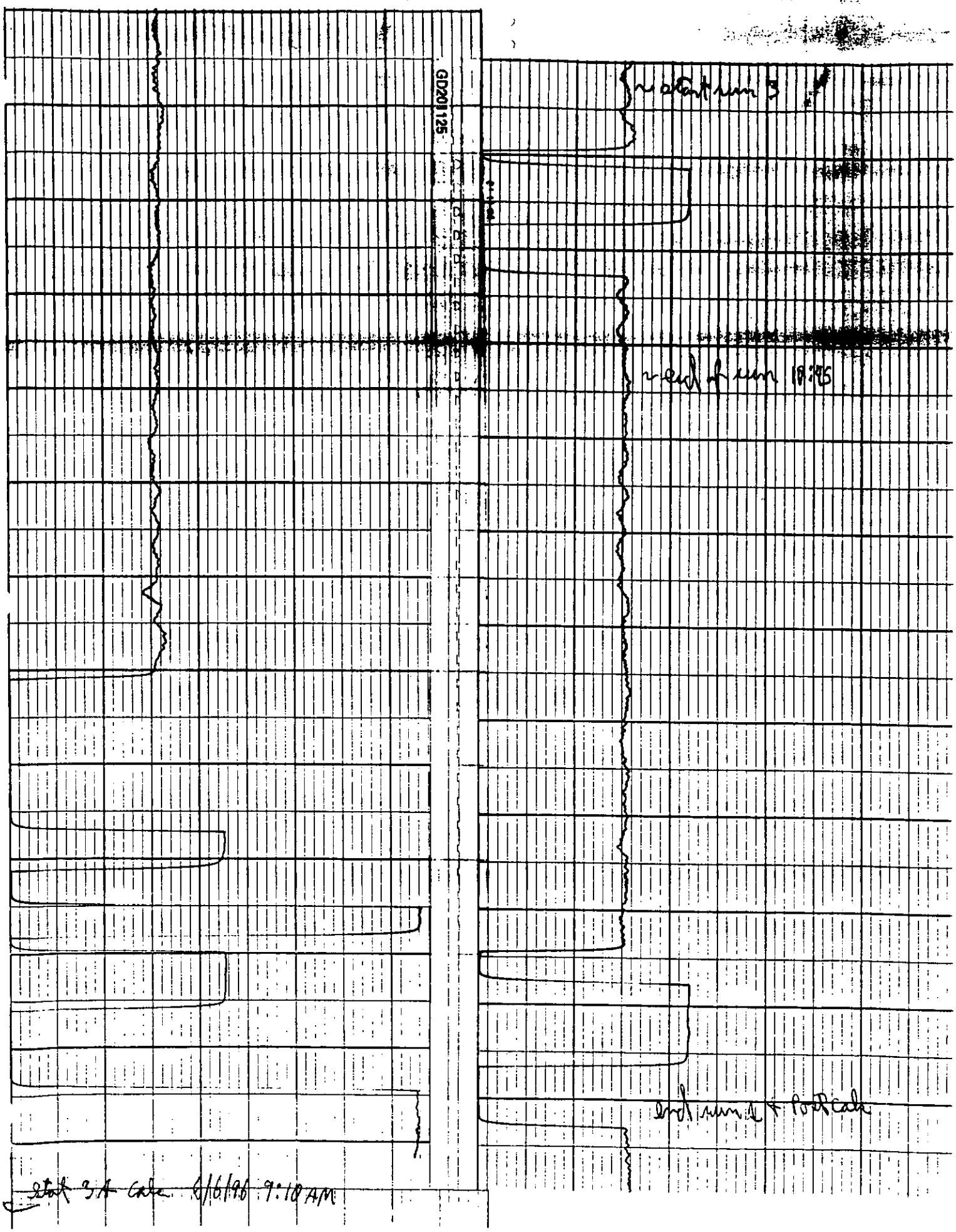


BOILER 2A NOx
TEST RUNS 1&2
adjust span 10:20
R-TIME
450 OK
span check
cal error check
high cal OK
zero OK
MADE IN ENGLAND
span end run 2
zero end run 2
end of run 2 12:15
start run 2
zero good
End of run

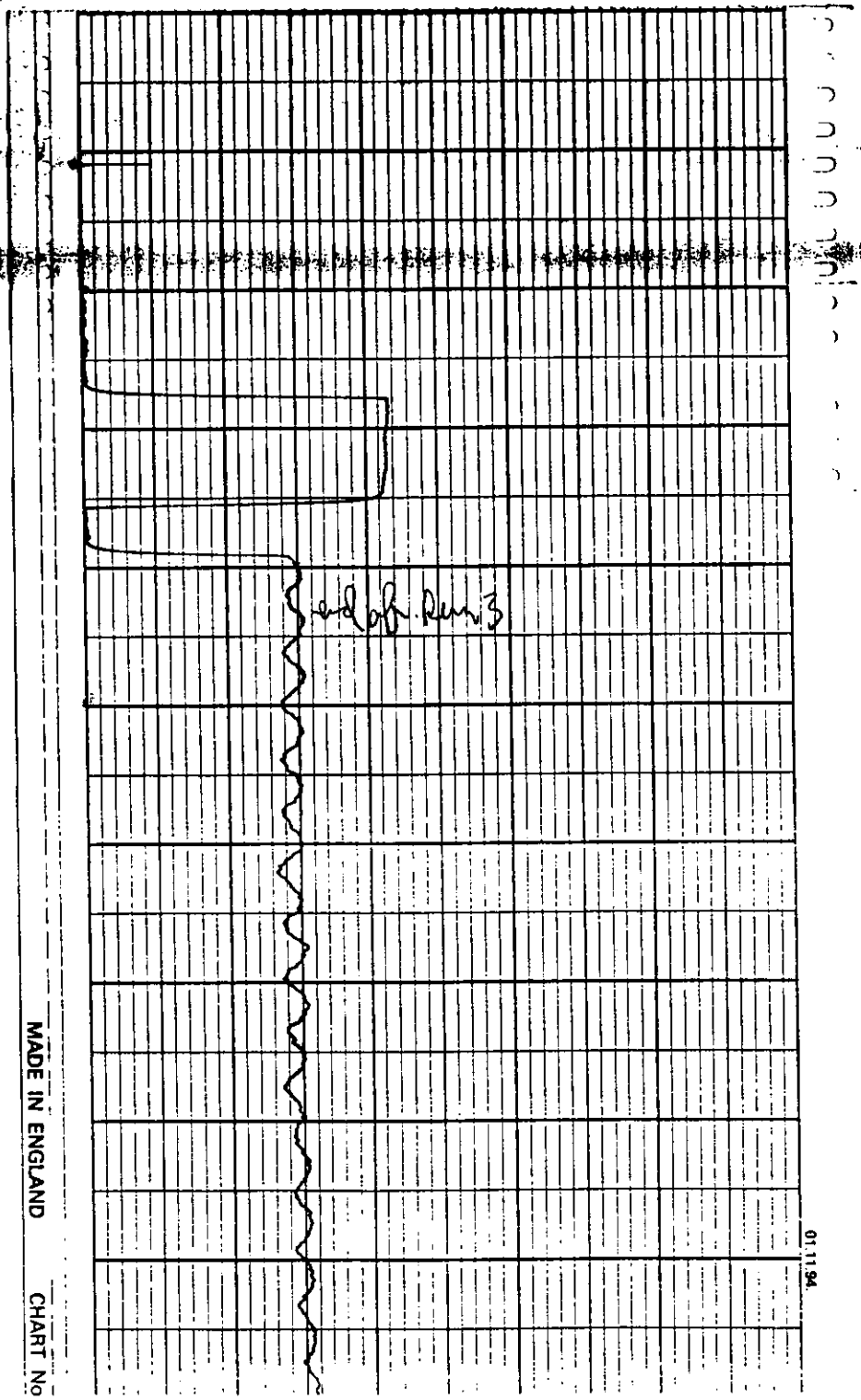
BOILER 2A NO_x TEST RUN 3



BOILER 3A NOx TEST RUNS 1+2



BOILER 3A NO_x TEST RUN 3



APPENDIX D

Calibration Gas Certifications

Matheson®
GAS PRODUCTS, INC.

EPA PROTOCOL GAS ANALYSIS

COMPONENT	AMOUNT
NITRIC OXIDE	445 ppm
TOTAL NOx	447 ppm
NITROGEN	BALANCE

ASSAY DATE 5·2·95

EXPIRATION DATE 5·2·97

PRESSURE 2000 PSIG @ 70°F

REFERENCE NO. 109-39202

CYLINDER NO. SB-12916

CGA OUTLET 660

ANALYST John Hurley

Scott Specialty Gases, Inc.

1290 COMBERMERE STREET, TROY, MI 48083 (810) 589-2950 FAX:(810) 589-2134

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
C A E INSTRUMENT RENTAL
246 WOODWORK LANE
PALATINE, IL 60067

Assay Laboratory
Scott Specialty Gases, Inc
1290 Combermere
Troy, MI 48083

Purchase Order : 14740-71500
Scott Project # : 593100

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay and Certification of Gaseous Calibration Standards; Procedure G1; September, 1993.

Cylinder Number : ALM059613
Cylinder Pressure + : 2000 psig
Certificate Date : 3/4/96
Previous Certificate Date : None
Expiration Date : 3/4/98

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
Nitric Oxide	858.4 ppm	±1% NIST Directly Traceable
Total Oxides of Nitrogen	859.7 ppm	Reference Value Only

Balance Gas: Nitrogen

+Do not use when cylinder pressure is below 150 psig.
*Analytical accuracy is inclusive of usual known error sources which at least include precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
NTRM 1687	3/27/97	ALM049010	976 ppm Nitric Oxide in Nitrogen

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
NO: Beckman/951/0101177	3/5/96	Chemiluminescence

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

Components: Nitric Oxide

First Triad Analysis

Date: 2/26/96	Response Units: mv	
Z1=0.00	R1=90.00	T1=79.00
R2=90.00	Z2=0.00	T2=79.10
Z3=0.00	T3=79.10	R3=90.00
Avg. Conc. of Cust. Cyl. 857.2 ppm		

Second Triad Analysis

Date: 3/4/96	Response Units: mv	
Z1=0.00	R1=90.00	T1=79.30
R2=90.00	Z2=0.00	T2=79.30
Z3=0.00	T3=79.30	R3=90.00
Avg. Conc. of Cust. Cyl. 859.7 ppm		

Calibration Curve

Concentration = A+Bx+Cx²+Dx³+Ex⁴	
r=1.00000	NTRM 1687
Constants:	A=-0.929670000
B=10.953000000	C=0.000000000
D=0.000000000	E=0.000000000

Special Notes

Mail

Analyst

MRP/P-1

APPENDIX E

Process Data

BOILER: 2A - RUN 1 Start 10:45 DATE: 6/5/96

	TIME	%O2	STEAM LOAD	STACK TEMP	FUEL FLOW
10 MIN	10:55 AM	2.1	80.70	372.0°	1.6915
20 MIN	11:05 AM	2.2	80.18	373.8°	1.7071
30 MIN	11:15 AM	2.1	80.24	372.1°	1.6619
40 MIN	11:25 AM	2.1	81.25	374.8°	1.6824
50 MIN	11:35 AM	2.5	80.44	375.1°	1.7263
60 MIN	11:45 AM	2.0	81.07	373.8°	1.6777
			80.647		1.691

BOILER: 2A RUN 2 START 12:25 PM DATE: 6/5/96

	TIME	%O2	STEAM LOAD	STACK TEMP	FUEL FLOW
10 MIN	12:25 PM	2.2	79.45	374.3°	1.6667
20 MIN	12:35 PM	2.2	79.85	373.6°	1.6529
30 MIN	12:45 PM	2.1	80.34	372.6°	1.6817
40 MIN	12:55 PM	2.2	79.71	373.6°	1.6429
50 MIN	1:05 PM	2.1	80.49	373.2°	1.6824
60 MIN	1:15 PM	2.2	80.95	373.4°	1.6867
			80.132		1.662

BOILER: 2A RUN 3 START 2:00 PM DATE: 6/5/96

	TIME	%O2	STEAM LOAD	STACK TEMP	FUEL FLOW
10 MIN	2:10 PM	2.3	78.70	372.2	1.6393
20 MIN	[illegible]	2.1	78.63	371.0	1.5988
30 MIN	[illegible]	2.2	79.33	371.7	1.6569
40 MIN	[illegible]	2.2	79.26	372.7	1.6313
50 MIN	[illegible]	2.1	80.04	372.5	1.6355
60 MIN	[illegible]	2.2	79.55	372.5	1.6498
	3:10 PM	2.1	80.14	371.4	1.6556
			79.38		

BOILER: DATE:

	TIME	%O2	STEAM LOAD	STACK TEMP	FUEL FLOW
10 MIN					
20 MIN					
30 MIN					
40 MIN					
50 MIN					
60 MIN					

BOILER: 3A Run 4 start 10:15 AM DATE: 6/6/96

	TIME	%O2	STEAM LOAD	STACK TEMP	FUEL FLOW
10 MIN	10:25 AM	1.703	77.31	595.6°	2.0117
20 MIN	10:35 AM	1.112	77.72	600.3°	2.0441
30 MIN	10:45 AM	1.750	77.46	603.4°	2.0461
40 MIN	10:55 AM	1.811	77.34	605.2°	2.0333
50 MIN	11:05 AM	1.750	77.87	605.3°	2.0184
60 MIN	11:15 AM	1.831	76.81	605.9°	2.0104

BOILER: 3A RUN 2 START 11:45 AM DATE: 6-6-96

	TIME	%O2	STEAM LOAD	STACK TEMP	FUEL FLOW
10 MIN	11:55 AM	1.987	76.16	606.3°	2.0227
20 MIN	12:05 PM	1.957	76.71	605.7°	2.0254
30 MIN	12:15 PM	1.960	77.26	605.9°	2.0252
40 MIN	12:25 PM	1.991	76.58	605.7°	2.0423
50 MIN	12:35 PM	1.869	77.52	605.4°	2.0344
60 MIN	12:45 PM	2.029	78.12	609.9°	2.0251

BOILER: 3A RUN 3 START 1:15 PM DATE: 6-6-96

	TIME	%O2	STEAM LOAD	STACK TEMP	FUEL FLOW
10 MIN	1:25 PM	.917	77.01	606.3°	2.0446
20 MIN	1:35 PM	2.002	77.36	605.6°	2.0637
30 MIN	1:45 PM	2.058	76.55	605.0°	2.0683
40 MIN	1:55 PM	2.012	76.67	604.2°	2.0314
50 MIN	2:05 PM	2.106	77.50	603.2°	2.0004
60 MIN	2:15 PM	2.093	76.65	603.3°	2.0344

BOILER: DATE:

	TIME	%O2	STEAM LOAD	STACK TEMP	FUEL FLOW
10 MIN					
20 MIN					
30 MIN					
40 MIN					
50 MIN					
60 MIN					

APPENDIX F

NOx Analyzer Interference Test Data

ADVANCED POLLUTION INSTRUMENTATION, INC.
8815 PRODUCTION AVENUE
SAN DIEGO, CA 92121-2219
PHONE: (619)578-2154 FAX: (619)578-1833/1422

DATE: June 18, 1996 **API FAX LOG # 96-2879.jj**

TO: Lee Wilson, Pennzoil **FAX # 1-814-678-4690**

FROM: Bill Duncan **PAGES: 03**

CC: EE, MAC, MT

MESSAGE:

RE: CFR Part 60, Appendix A, Method 20, 5.4

Lee,

Attached is a certification for the API Model 200AH as well as the test data for the Model 200 when tested for interferents in accordance with Method 20, section 5.4.

The 200 series of API analyzers differ only in the software and electronic configuration. The results should be consistent for all models due to the similarity of measurement technique.

Best Regards,

Bill Duncan

Applicant A.P.I. Analyst P. GRIFFITH, E. HOOPES

Analyzer MOD 500, NITROGEN OXIDES, S/N 10

Range 0 - 500 PPB NO_2

PERFORMANCE PARAMETER		Table B-1 spec.	TEST 1	2	3	4	5	6	7	TEST 8	9	10	11	12	13	14	15	No. of test failures	Pass or fail
NOISE, PPB	0% URL (S_0)	5	0.86	0.92	0.80	0.79	0.89	0.90	0.72										P
	80% URL (S_{80})	5	0.89	1.00	1.30	1.13	0.95	1.03	1.32										P
LDL (must be 2 x noise[a])			8	9	9	10	9	10	10										P
INTERFERENCE EQUIVALENT, PPB	IE_1 (NO)	±20	4	6	4	3	5	3	4										P
	IE_2 (NH_3)	±20	-2	-1	-1	1	0	1	-1										P
	IE_3 (SO_2)	±20	3	2	9	5	0	0	1										P
	IE_4 (H_2O)	±20	-4	-3	-2	-3	-3	-3	-4										P
	IE_5																		
	TOTAL (IE_T)	40	13	12	16	12	8	7	10										P
ZERO DRIFT, PPB	12 hour (12ZD)	±20	9.5	9.0	7.0	6.0	3.5	6.0	7.0										P
	24 hour (24ZD)	±20	-1.25	0.50	-0.75	1.25	-3.0	1.25	0.50										P
SPAN DRIFT, %	20% URL (20SD)	±20	-0.3	-4.1	3.7	-0.3	-1.6	-2.2	2.5										P
	80% URL (80SD)	±5	1.76	-3.4	3.8	2.9	1.2	-1.7	0.35										P
LAG TIME, min		20	0.45	0.4	0.55	0.4	0.4	0.5	0.3										P
RISE TIME, min		15	0.75	0.75	0.75	0.9	0.8	0.7	0.9										P
FALL TIME, min		15	1.2	1.5	1.5	1.35	1.65	1.2	1.2										P
PRECISION, PPB	20% URL (P_{20})	20	0.8	0.7	0.9	0.9	0.8	0.8	0.9										P
	80% URL (P_{80})	30	2.2	1.6	2.3	1.9	1.8	2.0	0.8										P

[a]Compare each test LDL reading with the corresponding noise measurements; LDL reading must exceed the 0% URL noise value by a factor of 2 to pass the test for LDL.

TABLE 1

TABLE 1, summary of test results.

[40 FR 7049 Feb. 18, 1975, as amended at 40 FR 18169, Apr. 25, 1975]

ADVANCED POLLUTION INSTRUMENTATION, INC.
8815 Production Ave. San Diego, CA 92121 (619)578-2154 Fax (619)578-1833

February 21, 1996

TO WHOM IT MAY CONCERN:

This is to certify that the Advanced Pollution Instrumentation, Inc. Model 200H has been tested for interferences as per Federal Regulation Part 60, Appendix A, Method 20, Section 5.4

The interferent gases and concentrations used for the tests are as follows:

CO	500 ± 50 ppm	CO_2	10 ± 1 percent
SO_2	200 ± 20 ppm	O_2	20.9 ± 1 percent

The Model 200H on a 100 ppm full scale range did not show more than 2% or 2 ppm interference from the sum of the interferences.

Yours very truly,

Neil Charlton, Director of Sales
Advanced Pollution Instrumentation, Inc.