A COMPLIANCE EMISSION TEST REPORT

DETERMINATION OF NITROGEN OXIDES

DUAL-FUEL GENERATING UNITS
BOILER NOS. 1 AND 2

Prepared for...

GREINER, INCORPORATED
3950 SPARKS DRIVE
GRAND RAPIDS, MICHIGAN

Prepared by...

WW ENGINEERING & SCIENCE
5555 GLENWOOD HILLS PKWY, S.E.
GRAND RAPIDS, MICHIGAN

SEPTEMBER 2, 1993

PROJECT NO. 16526.00

Prepared by:

Robyn R. Vincent
Air Quality Administrative Support
Grand Rapids

Reviewed by:

Barry L. Hunter
Manager
Air Quality Services - Grand Rapids

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EXECUTIVE SUMMARY

WW Engineering & Science, Inc. (WWES) was retained by Greiner, Incorporated, Grand Rapids, Michigan to determine nitrogen oxides (NOx) emissions from two boilers, serial Nos. AH252405 and AH252406 located at Walter P. Reuther Hospital, Westland, Michigan. The testing was were conducted on May 11 and June 10 and 11, 1993. The results of the emission tests are summarized in the following table:

TABLE A

EMISSION TEST RESULTS FOR DUEL-FUEL GENERATING BOILERS

Boiler No. 1 Natural Gas	Gas Flow Data			NOx Emissions		
	acfm	scfm	dscfm	ppm	(lbs/hr)	lbs/mmbtu
Tests 1-3	3,744	2,879	2,726	76.2	1.6	0.129

Boiler No. 1 2 Fuel Oil	Gas Flow Data			NOx Emissions		
	acfm	scfm	dscfm	ppm	(lbs/hr)	lbs/mmbtu
Tests 1-3	4,468	3,297	2,867	149.4	3.5	0.166

Boiler No. 2 Natural Gas	Gas Flow Data			NOx Emissions		
	acfm	scfm	dscfm	ppm	(lbs/hr)	lbs/mmbtu
Tests 1-3	3,353	2,497	2,191	70.2	1.2	0.111

Boiler No. 2 1 Fuel Oil	Gas Flow Data			NOx Emissions		
	acfm	scfm	dscfm	ppm	(lbs/hr)	lbs/mmbtu
Tests 1-3	3,214	2,360	2,161	145	2.4	0.185

1.0
INTRODUCTION

1. INTRODUCTION

WW Engineering & Science, Inc. (WWES) was retained by Greiner, Incorporated, Grand Rapids, Michigan, to conduct Nitrogen Oxides (NO_X) emissions testing on the exhaust of two (2) 350 HP boilers (with natural gas and virgin No. 2 fuel oil capability) installed at the Walter P. Reuther Hospital, located in Westland, Michigan. The testing was performed to satisfy permit condition Nos. C-9565 and C-9566 that require verification of various emission rates. Monitored emissions were for oxides of nitrogen (NO_x) reported as pounds per million BTUs. Auxiliary exhaust gas data was also collected.

Testing was conducted on May 11, 1993, on boiler No. 1 while running on natural gas, by Mr. Bill Byczynski, Senior Air Quality Scientist and Mr. Barry Broering, Air Quality Technician of WWES. While switching over from natural gas to fuel oil, WWES' crew experienced boiler shutdown problems during test No. 3. To prevent reporting insufficient readings, all fuel oil data was excluded for all three tests.

The rescheduled testing commenced on June 10 and 11, 1993. Final testing on boiler No. 1, while running on fuel oil, was performed on June 10, 1993. The natural gas and fuel oil testing for boiler No. 2 was performed on June 11, 1993. Testing was conducted by Messrs. Barry Hunter, Air Quality Sampling Manager, Joe Mason, and Ed. Culver, Air Quality Technicians of WWES. Assisting in the study were Mr. Jim Sharf site contact and Mr. Jamal Naas of the Wayne County Air Pollution Control Division (WCAPCD).

2.0

PROCESS DESCRIPTION

2.0 PROCESS DESCRIPTION

W.J. O'Neil Company installed two (2) Cleaver Brooks Dual-Fuel Generating Boilers (No. 1 -- Serial No. AH252405, No. 2 -- Serial No. AH252406) for energy production at the Walter P. Reuther Hospital, Westland, Michigan. Each boiler is 350 horsepower with a maximum capacity steam load of 11,720 BTU's. The boilers have the capability of combusting natural gas or No. 2 fuel oil while in operation, which exhaust emissions to a common stack.

3.0

SUMMARY OF RESULTS

3.0 SUMMARY OF RESULTS

A summary of test results determined by the compliance testing on boiler Nos. 1 and 2 is presented in Table Nos. 3.1 and 3.2. Table No. 3.1 emissions are reported in parts per million (ppm), pounds per hour (Lbs/Hr) and pounds per million BTUs (lbs/MMBTU). Table No. 3.2 presents the auxiliary test results for exhaust gas flows provided in terms of actual cubic feet per minute (acfm), standard cubic feet per minute (scfm), and dry standard cubic feet per minute (dscfm). Exhaust-gas moisture content is presented in percent (%) by volume, and exhaust gas temperatures are presented in degrees Fahrenheit (°F).

BOILER NO. 1

Test No. 1 - Natural Gas

Nitrogen Oxide emissions for boiler No. 1, test No. 1, while running on natural gas averaged 75.4 ppm, 1.55 lbs/hr, and 0.131 lbs/MMBTU. The stack gas temperature averaged 231°F. Stack-gas flow rates averaged 3,821 acfm, 2,926 scfm, and 2,868 dscfm. Stack gas moisture content averaged 5.32%

Test No. 2 - Natural Gas

Nitrogen Oxide emissions for boiler No. 1, test No. 2, while running on natural gas averaged 74.5 ppm, 1.51 lbs/hr, and 0.125 lbs/MMBTU. The stack gas temperature averaged 228°F. Stack-gas flow rates averaged 3,743 acfm, 2,879 scfm, and 2,726 dscfm. Stack gas moisture content averaged 5.32%

Test No. 3 - Natural Gas

Nitrogen Oxide emissions for boiler No. 1, test No. 3, while running on natural gas averaged 80.1 ppm, 1.59 lbs/hr, and 0.135 lbs/MMBTU. The stack gas temperature averaged 225°F. Stack-gas flow rates averaged 3,643 acfm, 2,813 scfm, and 2,664 dscfm. Stack gas moisture content averaged 5.32%

BOILER NO. 1

Test No. 1 - Fuel Oil

Nitrogen Oxide emissions for boiler No. 1, test No. 1, while running on fuel oil averaged 145.5 ppm, 2.54 lbs/hr, and 0.179 lbs/MMBTU. The stack gas temperature averaged 255°F. Stack-gas flow rates averaged 3,412 acfm, 2,476 scfm, and 2,268 dscfm. Stack gas moisture content averaged 8.42%

Test No. 2 - Fuel Oil

Nitrogen Oxide emissions for boiler No. 1, test No. 2, while running on fuel oil averaged 145.5 ppm, 2.24 lbs/hr, and 0.188 lbs/MMBTU. The stack gas temperature averaged 236°F. Stack-gas flow rates averaged 2,935 acfm, 2,187 scfm, and 2,003 dscfm. Stack gas moisture content averaged 8.42%

Test No. 3 - Fuel Oil

Nitrogen Oxide emissions for boiler No. 1, test No. 3, while running on fuel oil averaged 145 ppm, 2.47 lbs/hr, and 0.188 lbs/MMBTU. The stack gas temperature averaged 247°F. Stack-gas flow rates averaged 3,295 acfm, 2,416 scfm, and 2,213 dscfm. Stack gas moisture content averaged 8.42%

BOILER NO. 2

Test No. 1 - Natural Gas

Nitrogen Oxide emissions for boiler No. 2, test No. 1, while running on natural gas averaged 68.5 ppm, 1.14 lbs/hr, and 0.111 lbs/MMBTU. The stack gas temperature averaged 242°F. Stack-gas flow rates averaged 3,183 acfm, 2,367 scfm, and 2,078 dscfm. Stack gas moisture content averaged 12.24%

Test No. 2 - Natural Gas

Nitrogen Oxide emissions for boiler No. 2, test No. 2, while running on natural gas averaged 71.5 ppm, 1.23 lbs/hr, and 0.111 lbs/MMBTU. The stack gas temperature averaged 241°F. Stack-gas flow rates averaged 3,285 acfm, 2,447 scfm, and 2,147 dscfm. Stack gas moisture content averaged 12.24%

Test No. 3 - Natural Gas

Nitrogen Oxide emissions for boiler No. 2, test No. 3, while running on natural gas averaged 72 ppm, 1.36 lbs/hr, and 0.112 lbs/MMBTU. The stack gas temperature averaged 240°F. Stack-gas flow rates averaged 3591 acfm, 2,677 scfm, and 2,350 dscfm. Stack gas moisture content averaged 12.24%

BOILER NO. 2

Test No. 1 - Fuel Oil

Nitrogen Oxide emissions for boiler No. 2, test No. 1, while running on fuel oil averaged 147.5 ppm, 3.84 lbs/hr, and 0.167 lbs/MMBTU. The stack gas temperature averaged 248°F. Stack-gas flow rates averaged 5,023 acfm, 3,701 scfm, and 3,218 dscfm. Stack gas moisture content averaged 13.05%

Test No. 2 - Fuel Oil

Nitrogen Oxide emissions for boiler No. 2, test No. 2, while running on fuel oil averaged 150.3 ppm, 3.37 lbs/hr, and 0.164 lbs/MMBTU. The stack gas temperature averaged 246°F. Stack-gas flow rates averaged 4,304 acfm, 3,182 scfm, and 2,767 dscfm. Stack gas moisture content averaged 13.05%

Test No. 3 - Fuel Oil

Nitrogen Oxide emissions for boiler No. 2, test No. 3, while running on fuel oil averaged 150.4 ppm, 3.19 lbs/hr, and 0.168 lbs/MMBTU. The stack gas temperature averaged 247°F. Stack-gas flow rates averaged 4,077 acfm, 3,008 scfm, and 2,616 dscfm. Stack gas moisture content averaged 13.05%

Table No. 3.1

Greiner, Incorporated
Walter P. Reuther Hospital
Boiler Exhaust Emissions - Nitrogen Oxides
May 11, June 10 and 11, 1993

Source Boiler No. 1	Test	NOx Emissions (ppm)	(lbs/hr)	(lbs/scf)	(lbs/MMBTU)
Natural Gas	1	75.4	1.56	9.003E-06	0.127
	2	74.5	1.51	8.895E-06	0.125
	3	80.1	1.59	9.564E-06	0.135
Average:		76.6667	1.553333		
		145.5	2.54	1.737E-05	0.179
Fuel Oil	1	145.5	2.24	1.737E-05	0.188
	2	145.0	2.47	1.731E-05	0.188
	3	145.3	2.42		
Average:					

Source Boiler No. 2	Test	NOx Emissions (ppm)	(lbs/hr)	(lbs/scf)	(lbs/MMBTU)
Natural Gas	1	68.5	1.14	8.179E-06	0.111
	2	71.5	1.23	8.537E-06	0.111
	3	72	1.36	8.597E-06	0.112
Average:		70.6667	1.243333		
Fuel Oil		147.5	3.84	1.761E-05	0.167
		150.3	3.37	1.795E-05	0.164
		150.4	3.19	1.796E-05	0.168
Average:		149.4	3.47		

Table No. 3.2

Greiner, Incorporated
Walter P. Reuther Hospital
Auxiliary Test Results
May 11, June 10 and 11, 1993

Source Boiler No. 1	Test	Volumetric Flow Rate (acfm)a	(scfm)b	(dscfm)c	Moisture (%)	Degrees Fahrenheit (oF)
Natural Gas	1	3,847	2,945	2,789	5.3	231.00
	2	3,743	2,879	2,726	5.3	228.00
	3	3,643	2,814	2,664	5.3	225.00
Average:		3,744	2,879	2,726	5.3	228.00
Fuel Oil	1	3,412	2,476	2,268	8.4	255.00
	2	2,935	2,187	2,003	8.4	236.30
	3	3,295	2,417	2,213	8.4	247.50
Average:		3,214	2,360	2,161	8.4	246.27

Source Boiler No. 2	Test	Volumetric Flow Rate (acfm)a	(scfm)b	(dscfm)c	Moisture (%)	Degrees Fahrenheit (oF)
Natural Gas	1	3,184	2,367	2,078	12.2	241.58
	2	3,285	2,446	2,147	12.2	240.58
	3	3,591	2,677	2,350	12.2	239.91
Average:		3,353	2,497	2,192	12.2	240.69
Fuel Oil	1	5,023	3,701	3,218	13.1	248.16
	2	4,304	3,182	2,767	13.1	245.66
	3	4,077	3,008	2,616	13.1	247.25
Average:		4,468	3,297	2,867	13.1	247.02

4.0

SAMPLING AND ANALYTICAL PROCEDURES

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Auxiliary Data

Exhaust Gas Parameters

Determinations for velocity pressures, temperature, gas density, and moisture in the exhaust gas stream were performed in accordance with EPA Reference Methods 1-4.

Traverse and Sampling Points

The number and location of traverse points for the boilers 1 and 2 exhaust velocity was determined using EPA Reference Method 1. The diameter of exhaust stack measured 36 inches. Six (6) sampling traverse points were selected for each of two (2) sampling ports, giving a total of 12 traverse points. The number and location of emission-measurement sample points were determined as specified by 40 CFR, Part 60, Subparts A and D_c.

Velocity Traverse

A velocity traverse was conducted for each fuel tested in accordance with EPA Reference Method 2. An "S" type Pitot tube with an attached "K" type thermocouple was used to conduct the velocity profiles.

Moisture Content

The exhaust-gas moisture content was determined in accordance with EPA Reference Method 4, using a sampling train consisting of a stainless-steel probe, ice-bath condenser, silica-gel module, Teflon sampling line, and a calibrated metering system and pump. A single moisture sample was collected during the testing for each fuel.

Gas Composition

The exhaust gas composition for oxygen, carbon dioxide, and nitrogen was determined in accordance with EPA Reference Method 3. Gas samples were taken during each moisture determination. An Orsat analyzer was used to determine the gas composition. The analyzer was calibrated with appropriate standards before conducting each test.

NITROGEN OXIDES

NO_x determinations were performed using a continuous stack gas analyzer in accordance with EPA Reference Method 7E. The stack gas analyzers are specifically made to determine, electrochemically, the amount of NO_x present in stack gases. The stack gas is collected through a stainless-steel probe, equipped with a filter to remove any particulate present and connected to a heated Teflon sample line that delivers the sample to a moisture-removal system and to the analyzer. The analyzers were attached to continuous strip-chart recorders and a datalogger during the testing. A coil condenser was installed in-line to aid in moisture removal from the sample gas stream. Gas samples were collected at the centerline of the stack.

Sample Duration and Frequency

The NO_x measurements were performed on boiler Nos. 1 and 2 for natural gas and fuel oil, with each of the three tests being one hour in duration.

Sample Collection

Nitrogen oxide determinations were performed employing EPA Reference Method 7E, using a continuous electrochemical analyzer. The stack gas analyzer, a Pace Environmental Products "PSC-302," is designed to determine the amount of NO_x present in stack gases on a continual basis. Readings are provided as parts per million, by volume, on a dry basis, converted to NO_x emission rate lbs/MMBTU based on a dry basis for lbs/scf of NO_x and on a wet basis for $\%CO_2$. The stack gas is collected through a stainless-steel probe, equipped with a filter to remove any particulate present. The gas is cooled and dried using a condenser before entering the analyzer. The analyzers were attached to a data logger and continuous strip-chart recorder during the testing.

Calibrations and Zeroing

The continuous stack gas analyzers were calibrated with EPA protocol gases. Calibration gases of 502.0, 245.4, and 91.36 ppm nitrogen oxide were used. All sampling and analytical equipment was calibrated according to the method procedures. Zero gas and three (3) span calibration gases, covering the span of each measurement cell, were used prior to testing. A system bias check was completed, using a mid-level gas, after the initial direct injection calibrations. A

baseline of zero was also determined at the same time the calibrations were conducted. At the conclusion of each fuel test, the units were checked for zero and calibration drift.

Data Reduction

The analyzer outputs were recorded on strip chart recorders and on a datalogger. All data reduction was performed using the data from the datalogger.

The analyzer output was recorded on a strip-chart recorder and a data logger. Collected data were averaged for each test, and a chart of the data produced through an "Excel" spreadsheet program. The data logger was set to a four-second acquisition interval throughout the test. All data reduction was performed using the data from the data logger. All emission concentrations were reduced using the data collected with the data logger and an "Excel" spreadsheet. Examples of the equations used in the data reduction are shown in the Appendix, Section A.

5.0

CONCLUSIONS

5.0. CONCLUSIONS

It was determined that boiler Nos. 1 and 2 are operating in compliance, with respect to the allowable permit limits of 6.90 lbs/hr NO_x and 0.24 lbs/MMBTU NO_x.

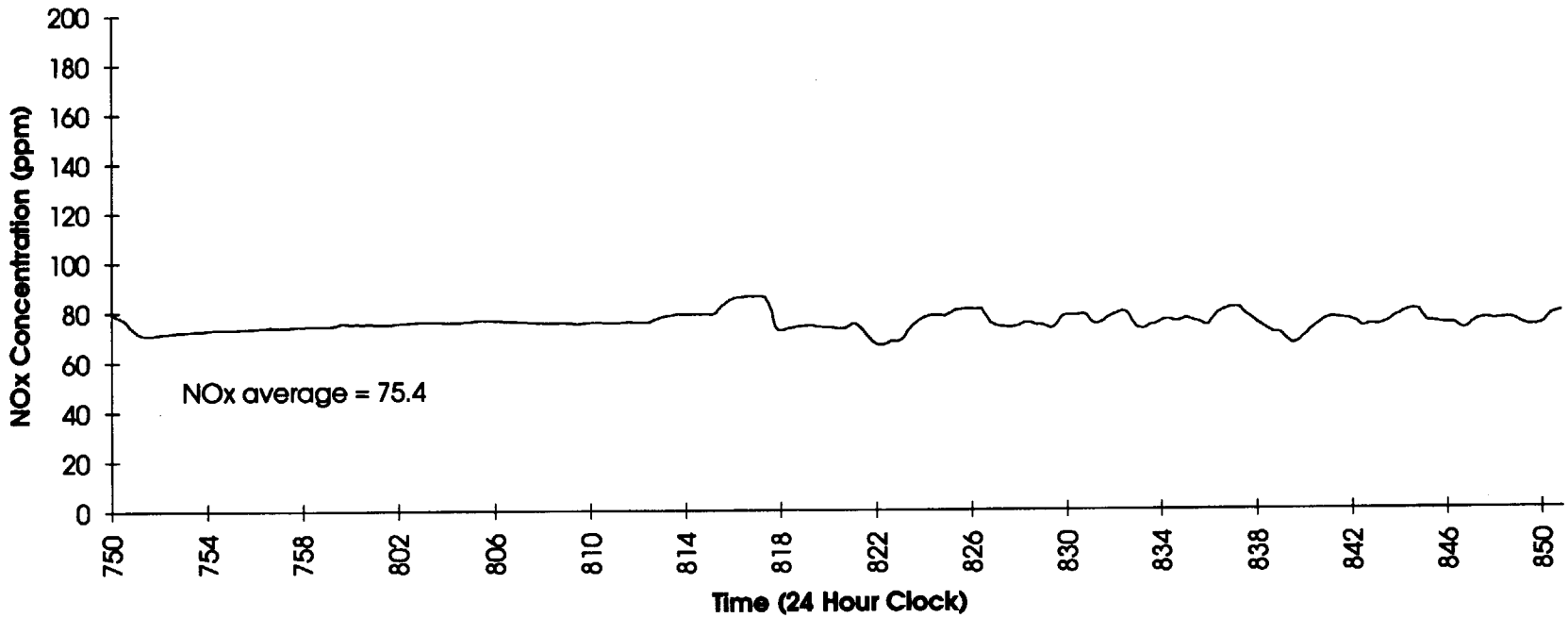
Project Information				
Client:	Greiner, Incorporated			
Project No.:	16526			
Date:	5/11/93			
Source:	Boiler No. 1 - Natural Gas			
Sampling Train Calculations				
Test No:	1	2	3	Averages
Percent Load:	100%	100%	100%	
Pitot Tube Calibration Factor:	0.84	0.84	0.84	
Meter Calibration Factor:	1.00285	1.00285	1.00285	
Stack Length:	0	0	0	
Stack Width:	0	0	0	
Stack Diameter:	36	36	36	
Nozzle Diameter, inches:	0	0	0	
Barometric Pressure, inches mercury:	29.87	29.87	29.87	
Static Pressure in Stack, Inches Water:	0	0	0	
Duration of Sample, minutes	60	60	60	
Meter Leak Rate:	0	0	0	
Meter Start Volume:	58.53	58.53	58.53	
Meter Final Volume:	88.07	88.07	88.07	
Average Meter Pressure, Inches Water:	1.9	1.9	1.9	
Average Meter Temperature, degrees F:	82.8	82.8	82.8	
Average Sqrt. Velocity Pressure:	0.1414	0.1379	0.1345	0.1
Stack Gas Temperature, degrees F:	231	228	225	228.0
Percent Carbon Dioxide:	7	7	7	7.00
Percent Oxygen:	10	10	10	10.00
Percent Carbon Monoxide:	0	0	0	
Liquid Volume Collected, milliliters:	34.4	34.4	34.4	
Sample Train Calculations				
Meter Volume, Actual:	29.54	29.54	29.54	
Meter Volume, STP:	29.012	29.012	29.012	
Volume of Water Vapor Condensed:	1.631	1.631	1.631	
Total Gas Sampled:	30.643	30.643	30.643	
Percent Moisture:	5.32	5.32	5.32	5.32
Area of Stack, Square Feet:	7.07	7.07	7.07	
Excess Air at Test Location:	83.95	83.95	83.95	
Density Dry at STP:	0.0763	0.0763	0.0763	
Density Wet at STP:	0.0747	0.0747	0.0747	
Density Wet at Stack Cond:	0.0572	0.0575	0.0577	
Molecular Weight, lb/lb-Mole	29.53	29.53	29.53	
Velocity and Flow Calculations				
Average Stack Gas Velocity FPM:	544.2	529.6	515.4	529.7
Stack Gas Flow Rate, ACFM:	3846.6	3743.2	3643.0	3744.3
Stack Gas Velocity, SCFM:	2945.4	2878.8	2813.9	2879.4
Stack Gas Velocity, DSCFM:	2788.7	2725.6	2664.2	2726.2
Pounds of Gas Sampled, Dry	2.214	2.214	2.214	
Pounds of Gas Sampled, Wet	2.290	2.290	2.290	

NOx Emission Data Calculated Using %CO2 and a Fuel Factor of 1,040scf/MMBTU				
NOx Concentration, ppm	75.4	74.5	80.1	
NOx Emission Rate, lb/hr	1.56	1.51	1.59	1.6
NOx Conversion to Lbs/scf	9.003E-06	8.895E-06	9.564E-06	
NOx Emission Rate, lbs/MMBTU	0.127	0.125	0.135	

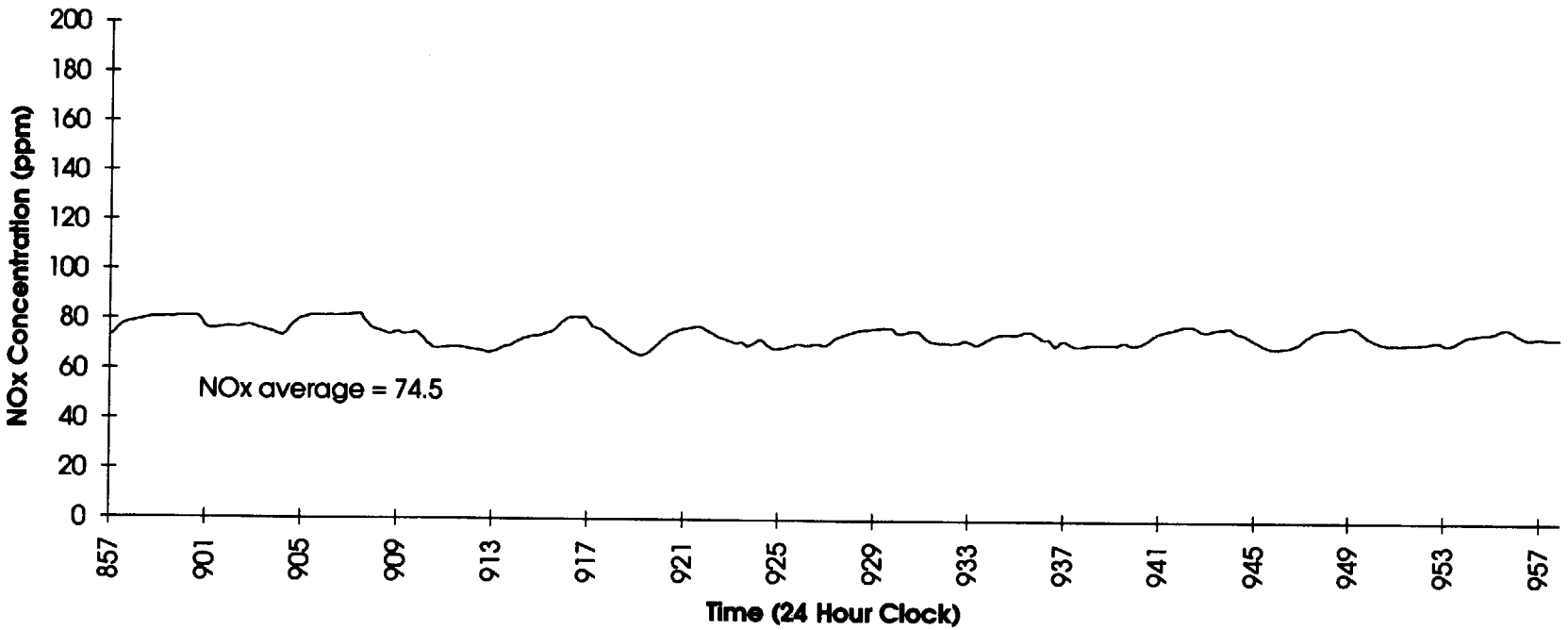
Conversion from ppm NOx to lbs/scf - multiplied ppm NOx by 1.94E-07

The conversion from NOx (lbs/scf) to NOx emission rate lbs/MMBTU
is based on a dry basis for lbs/scf of NOx and on a wet basis for (% CO2).

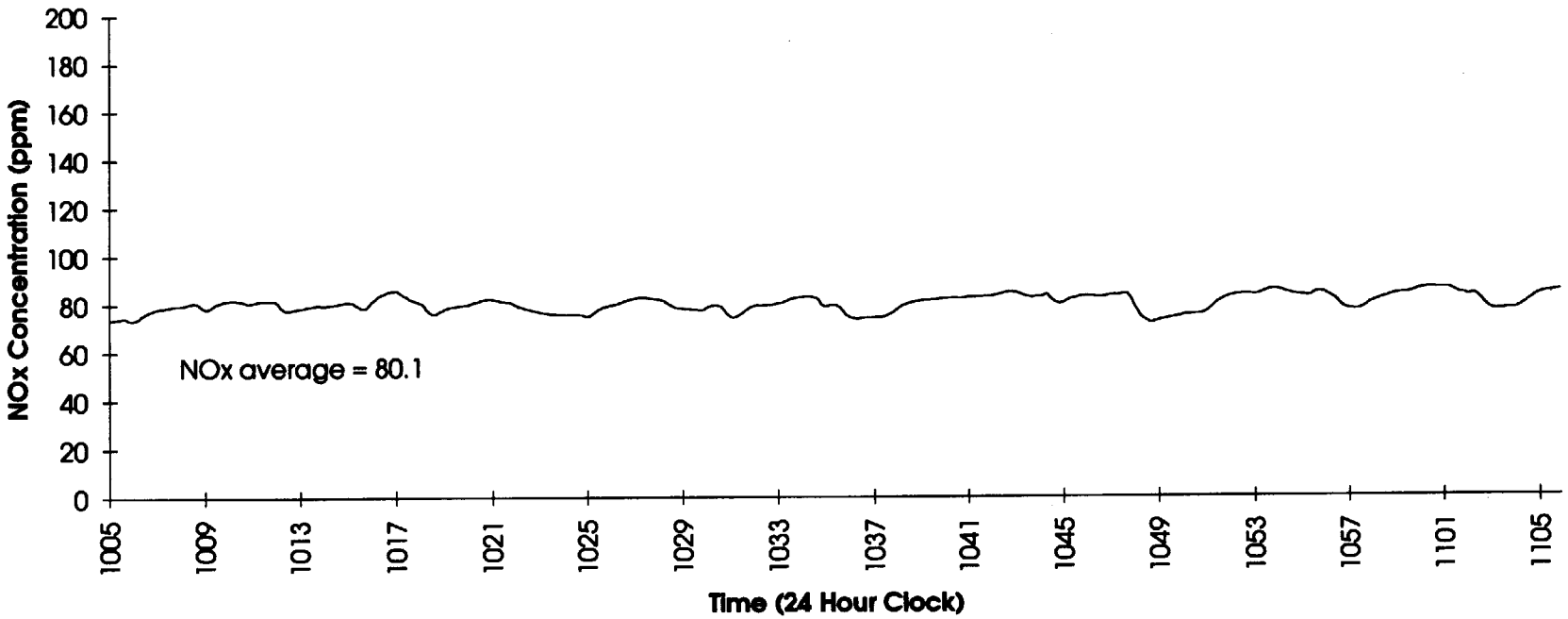
Walter P. Reuther Hospital
Greiner, Inc.
May 11, 1993
Boiler No. 1 - Natural Gas
Test No. 1



Walter P. Reuther Hospital
Greiner, Inc.
May 11, 1993
Boiler No. 1 - Natural Gas
Test No. 2



Walter P. Reuther Hospital
Greiner, Inc.
May 11, 1993
Boiler No. 1 - Natural Gas
Test No. 3



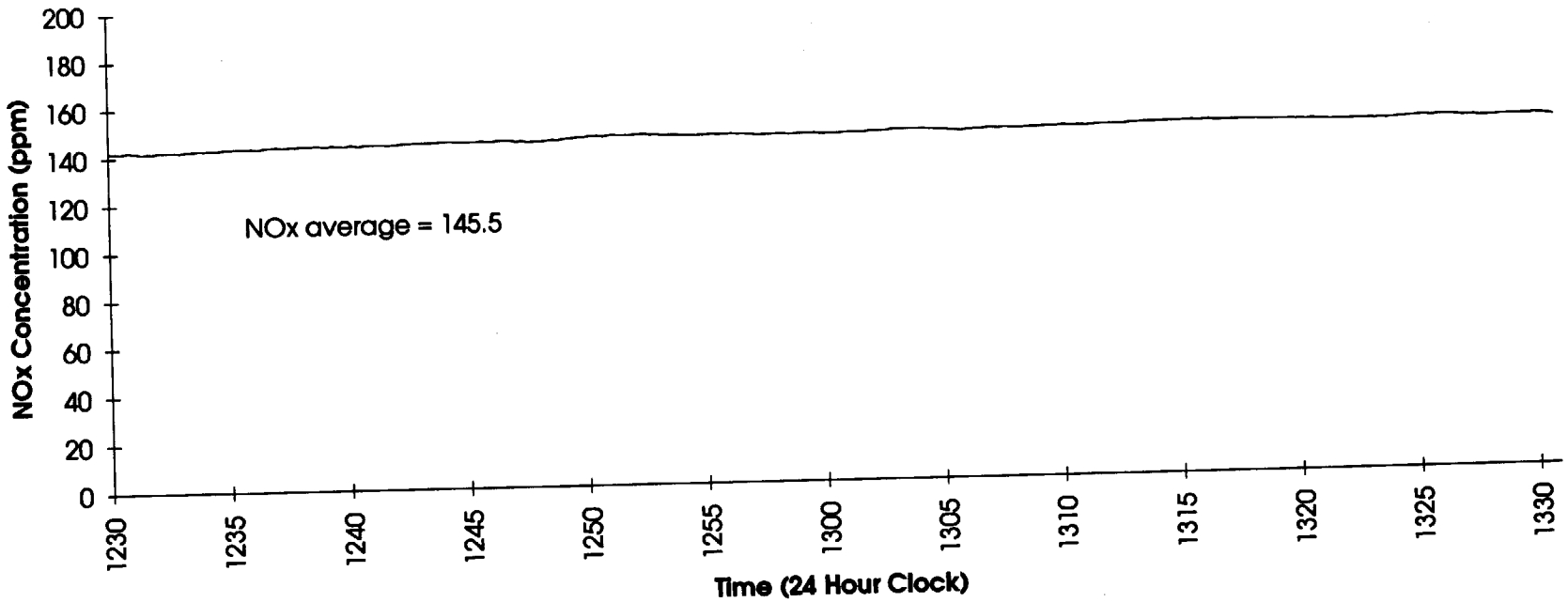
Project Information				
Client:	Greiner, Incorporated			
Project No.:	16526			
Date:	6/10/93			
Source:	Boiler No. 1 - Fuel Oil			
Sampling Train Calculations				
Test No:	1	2	3	Averages
Percent Load	100%	100%	100%	
Pitot Tube Calibration Factor:	0.85	0.85	0.85	
Meter Calibration Factor:	1.00513	1.00513	1.00513	
Stack Length:	0	0	0	
Stack Width:	0	0	0	
Stack Diameter:	36	36	36	
Nozzle Diameter, inches:	0	0	0	
Barometric Pressure, inches mercury:	29.29	29.29	29.29	
Static Pressure in Stack, Inches Water:	0.05	0.04	0.04	
Duration of Sample, minutes	60	60	60	
Meter Leak Rate:	0.015	0.015	0.015	
Meter Start Volume:	723.3	723.3	723.3	
Meter Final Volume:	748.64	748.64	748.64	
Average Meter Pressure, Inches Water:	1.76	1.76	1.76	
Average Meter Temperature, degrees F:	94.71	94.71	94.71	
Average Sqrt. Velocity Pressure:	0.1213	0.10562	0.11755	0.1
Stack Gas Temperature, degrees F:	255	236.3	247.5	246.3
Percent Carbon Dioxide:	12.6	12	12	12.20
Percent Oxygen:	5.7	6.2	5.3	5.73
Percent Carbon Monoxide:	0	0	0	1
Liquid Volume Collected, milliliters:	46.4	46.4	46.4	
Sample Train Calculations				
Meter Volume, Actual:	25.34	25.34	25.34	
Meter Volume, STP:	23.928	23.928	23.928	
Volume of Water Vapor Condensed:	2.199	2.199	2.199	
Total Gas Sampled:	26.128	26.128	26.128	
Percent Moisture:	8.42	8.42	8.42	8.42
Area of Stack, Square Feet:	7.07	7.07	7.07	
Excess Air at Test Location:	35.92	40.27	32.06	
Density Dry at STP:	0.0782	0.0780	0.0779	
Density Wet at STP:	0.0755	0.0753	0.0753	
Density Wet at Stack Cond:	0.0548	0.0561	0.0552	
Molecular Weight, lb/lb-Mole	30.25	30.18	30.14	
Velocity and Flow Calculations				
Average Stack Gas Velocity FPM:	482.7	415.3	466.1	454.7
Stack Gas Flow Rate, ACFM:	3411.9	2935.2	3294.8	3214.0
Stack Gas Velocity, SCFM:	2476.1	2187.4	2416.5	2360.0
Stack Gas Velocity, DSCFM:	2267.7	2003.3	2213.1	2161.3
Pounds of Gas Sampled, Dry	1.871	1.866	1.864	
Pounds of Gas Sampled, Wet	1.973	1.969	1.966	

NOx Emission Data Calculated Using %CO2 and a Fuel Factor of 1,420scf/MMBTU				
NOx Concentration, ppm	145.5	145.5	145	
NOx Emission Rate, lb/hr	2.54	2.24	2.47	2.4
NOx Conversion to Lbs/scf	1.737E-05	1.737E-05	1.731E-05	
NOx Emission Rate, lbs/MMBTU	0.179	0.188	0.188	

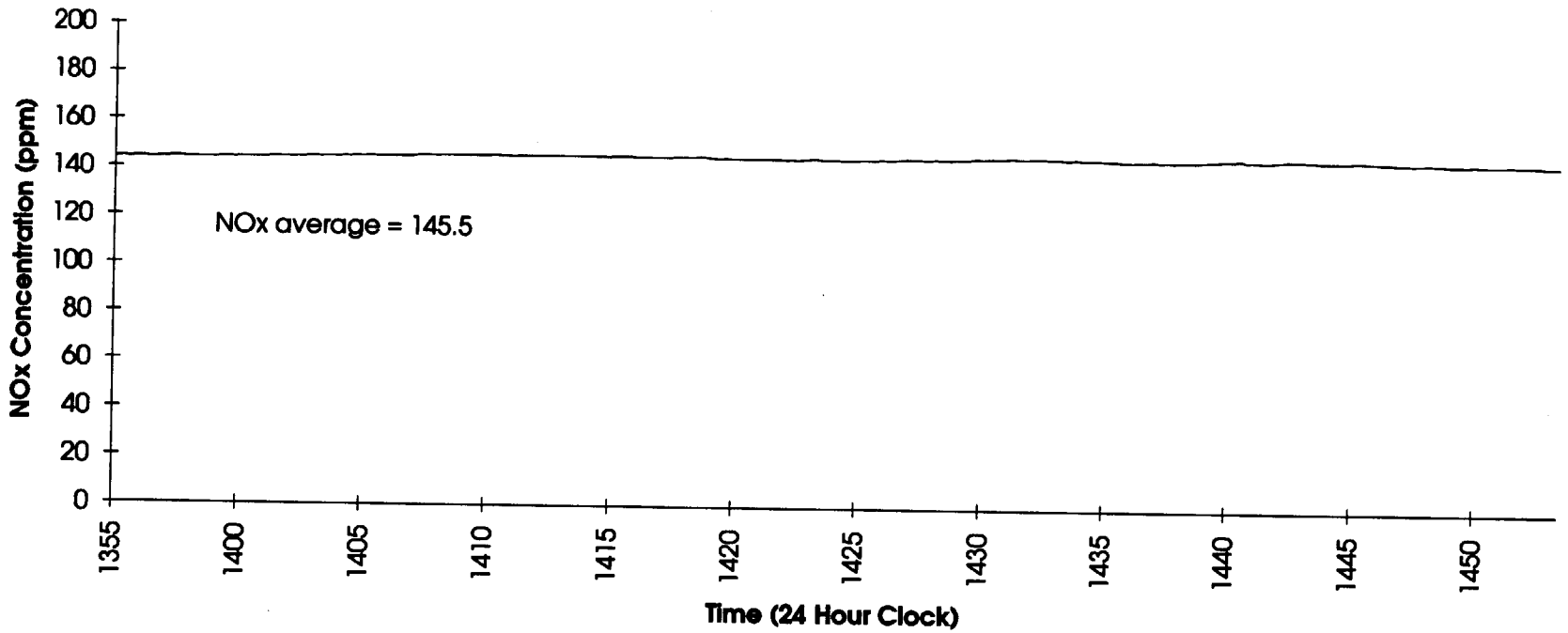
Conversion from ppm NOx to lbs/scf - multiplied ppm NOx by 1.94E-07

The conversion from NOx (lbs/scf) to NOx emission rate lbs/MMBTU is based on a dry basis for lbs/scf of NOx and on a wet basis for (% CO2).

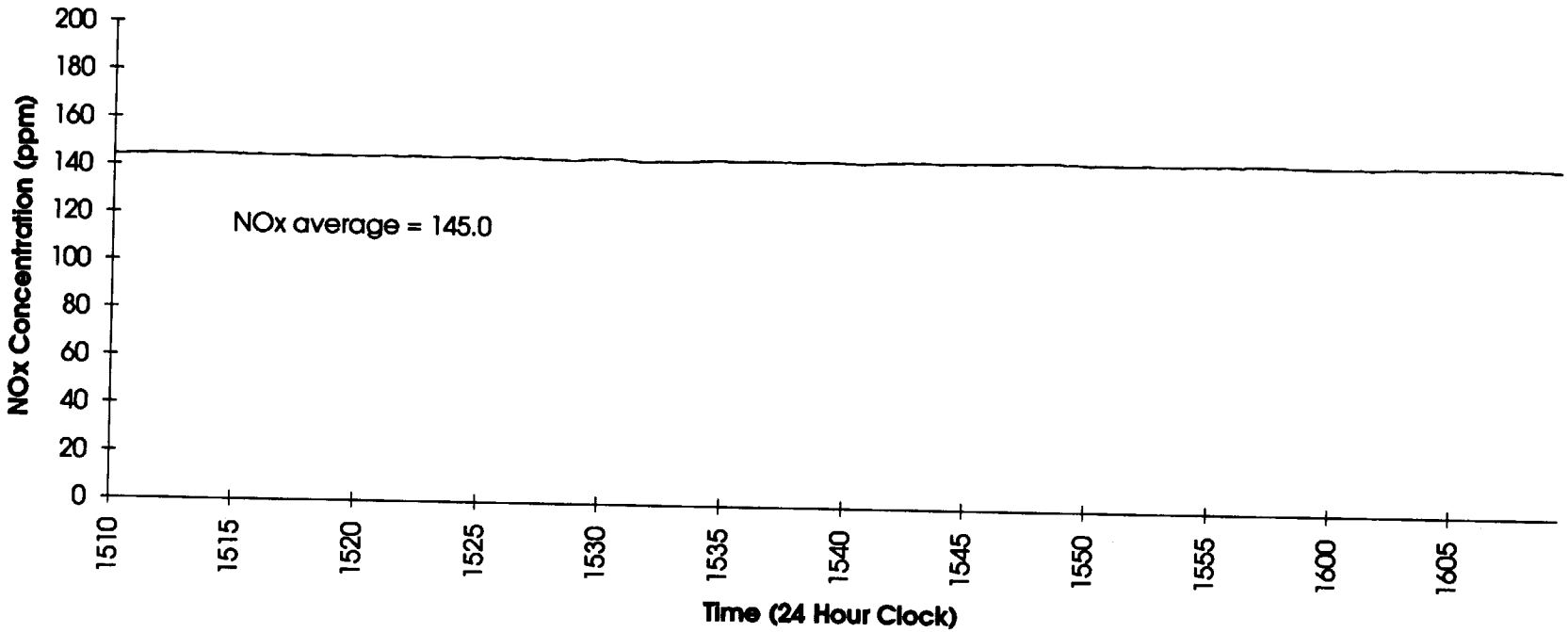
Walter P. Reuther Hospital
Greiner, Inc.
June 10, 1993
Boiler No. 1 - Fuel Oil
Test No. 1



Walter P. Reuther Hospital
Greiner, Inc.
June 10, 1993
Boiler No. 1 - Fuel Oil
Test No. 2



Walter P. Reuther Hospital
Greiner, Inc.
June 10, 1993
Boiler No. 1 - Fuel Oil
Test No. 3



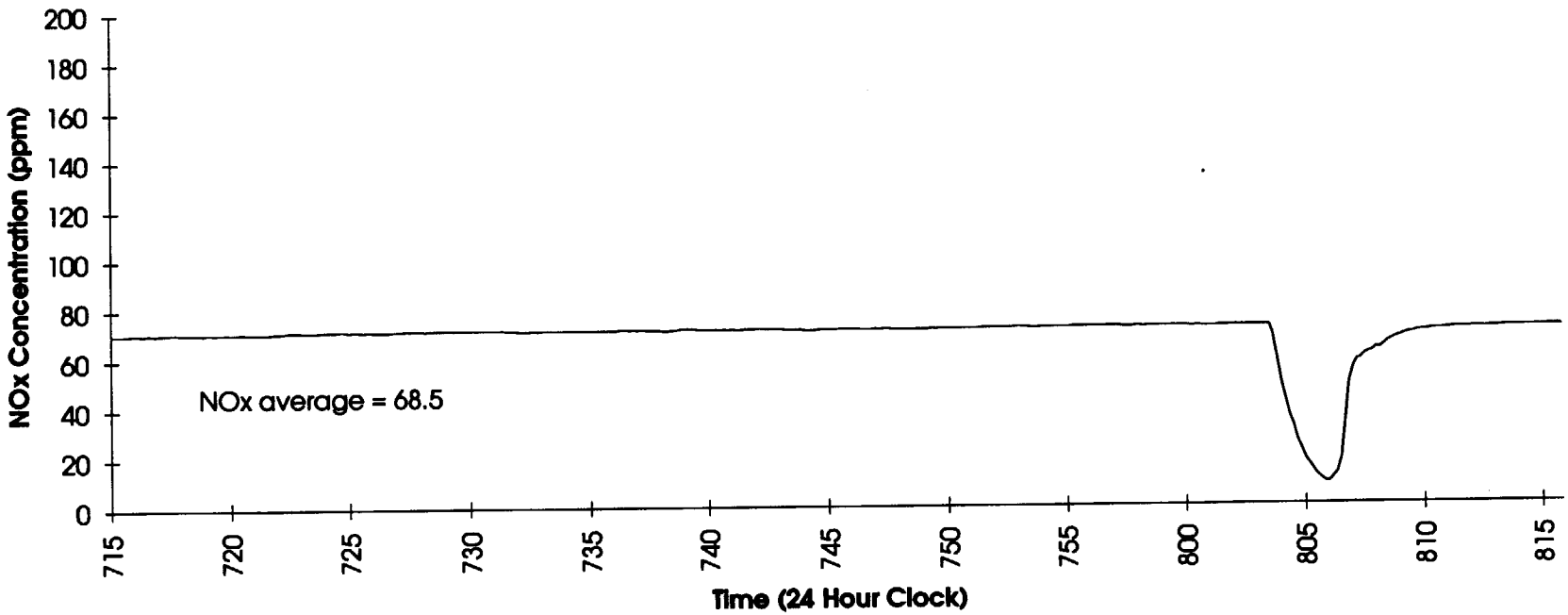
Project Information				
Client:	Greiner, Incorporated			
Project No.:	16526			
Date:	6/11/93			
Source:	Boiler No. 2 - Natural Gas			
Sampling Train Calculations				
Test No:	1	2	3	Averages
Percent Load:	100%	100%	100%	
Pitot Tube Calibration Factor:	0.85	0.85	0.85	
Meter Calibration Factor:	1.00513	1.00513	1.00513	
Stack Length:	0	0	0	
Stack Width:	0	0	0	
Stack Diameter:	36	36	36	
Nozzle Diameter, inches:	0	0	0	
Barometric Pressure, inches mercury:	29.45	29.45	29.45	
Static Pressure in Stack, Inches Water:	0.04	0.04	0.04	
Duration of Sample, minutes	60	60	60	
Meter Leak Rate:	0	0	0	
Meter Start Volume:	748.88	748.88	748.88	
Meter Final Volume:	778.36	778.36	778.36	
Average Meter Pressure, Inches Water:	1.76	1.76	1.76	
Average Meter Temperature, degrees F:	79.25	79.25	79.25	
Average Sqrt. Velocity Pressure:	0.11223	0.11597	0.12692	0.1
Stack Gas Temperature, degrees F:	241.58	240.58	239.91	240.7
Percent Carbon Dioxide:	6.7	7	7	6.90
Percent Oxygen:	9	8.7	9.7	9.13
Percent Carbon Monoxide:	0	0	0	
Liquid Volume Collected, milliliters:	84.7	84.7	84.7	
Sample Train Calculations				
Meter Volume, Actual:	29.48	29.48	29.48	
Meter Volume, STP:	28.791	28.791	28.791	
Volume of Water Vapor Condensed:	4.015	4.015	4.015	
Total Gas Sampled:	32.806	32.806	32.806	
Percent Moisture:	12.24	12.24	12.24	12.24
Area of Stack, Square Feet:	7.07	7.07	7.07	
Excess Air at Test Location:	67.90	64.18	78.92	
Density Dry at STP:	0.0761	0.0762	0.0763	
Density Wet at STP:	0.0725	0.0726	0.0727	
Density Wet at Stack Cond:	0.0539	0.0540	0.0542	
Molecular Weight, lb/lb-Mole	29.44	29.48	29.52	
Velocity and Flow Calculations				
Average Stack Gas Velocity FPM:	450.4	464.8	508.1	474.4
Stack Gas Flow Rate, ACFM:	3183.5	3285.4	3591.4	3353.4
Stack Gas Velocity, SCFM:	2367.4	2446.6	2677.3	2497.1
Stack Gas Velocity, DSCFM:	2077.7	2147.2	2349.6	2191.5
Pounds of Gas Sampled, Dry	2.191	2.194	2.197	
Pounds of Gas Sampled, Wet	2.378	2.380	2.383	

NOx Emission Data Calculated Using %CO2 and a Fuel Factor of 1,040scf/MMBTU				
NOx Concentration, ppm	68.5	71.5	72	
NOx Emission Rate, lb/hr	1.14	1.23	1.36	1.2
NOx Conversion to Lbs/scf	8.179E-06	8.537E-06	8.597E-06	
NOx Emission Rate, lbs/MMBTU	0.111	0.111	0.112	

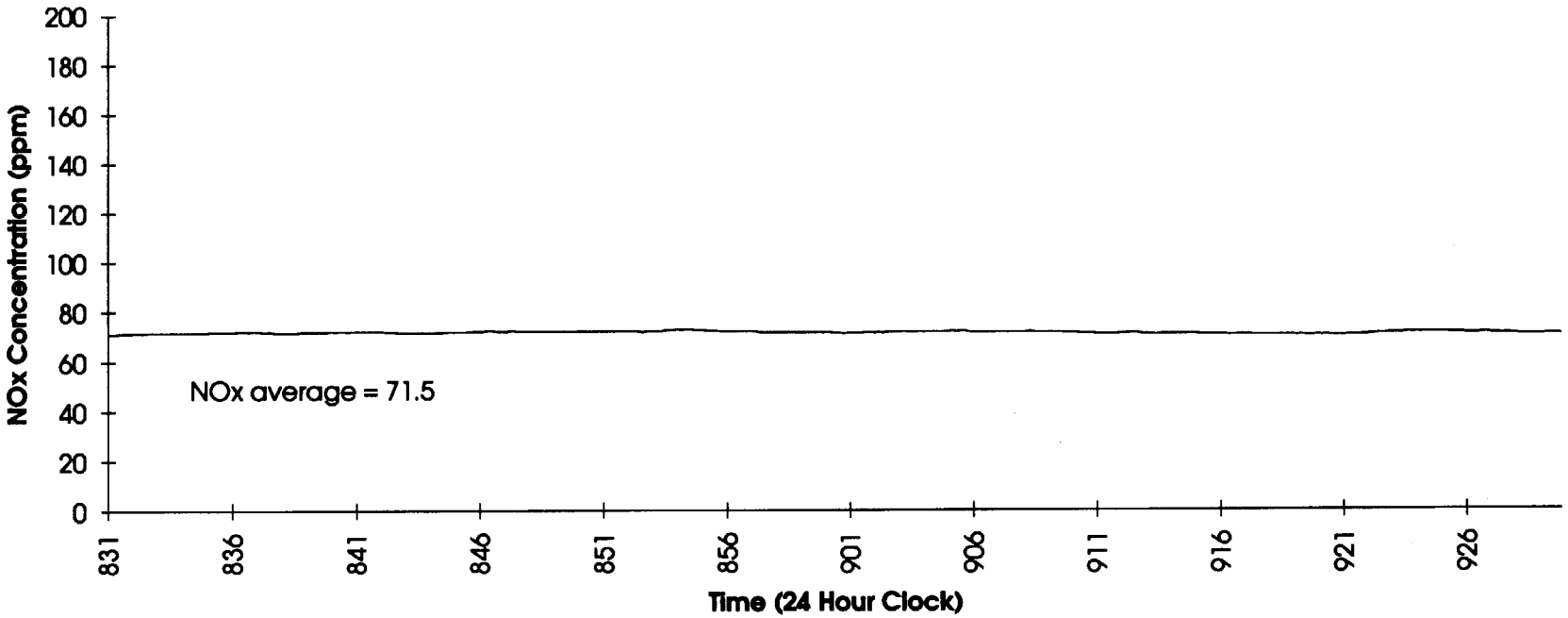
Conversion from ppm NOx to lbs/scf - multiplied ppm NOx by 1.94E-07

The conversion from NOx (lbs/scf) to NOx emission rate lbs/MMBTU is based on a dry basis for lbs/scf of NOx and on a wet basis for (% CO2).

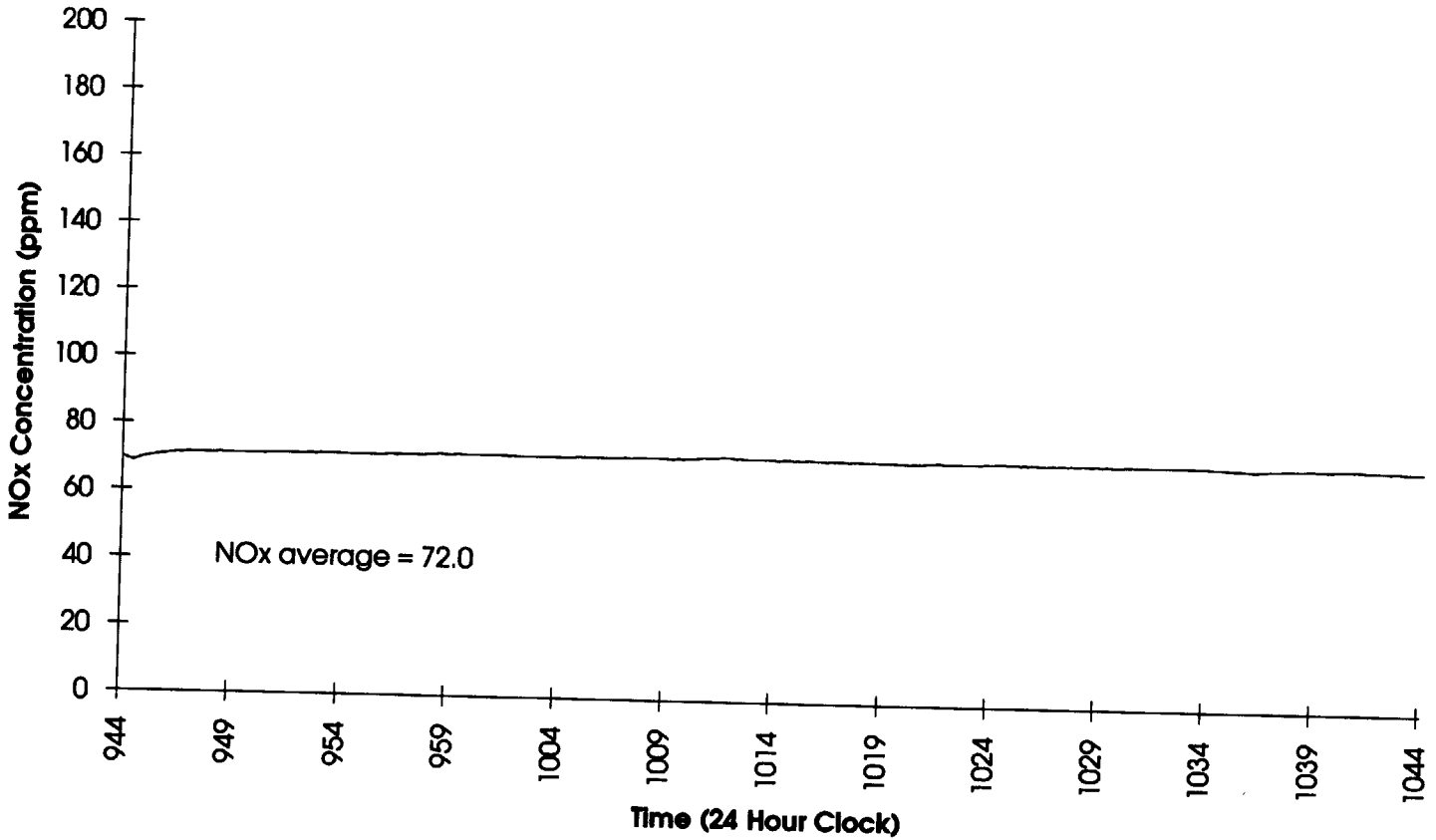
Walter P. Reuther Hospital
Greiner, Inc.
June 11, 1993
Boiler No. 2 - Natural Gas
Test No. 1



Walter P. Reuther Hospital
Greiner, Inc.
June 11, 1993
Boiler No. 2 - Natural Gas
Test No. 2



Walter P. Reuther Hospital
Greiner, Inc.
June 11, 1993
Boiler No. 2 - Natural Gas
Test No. 3



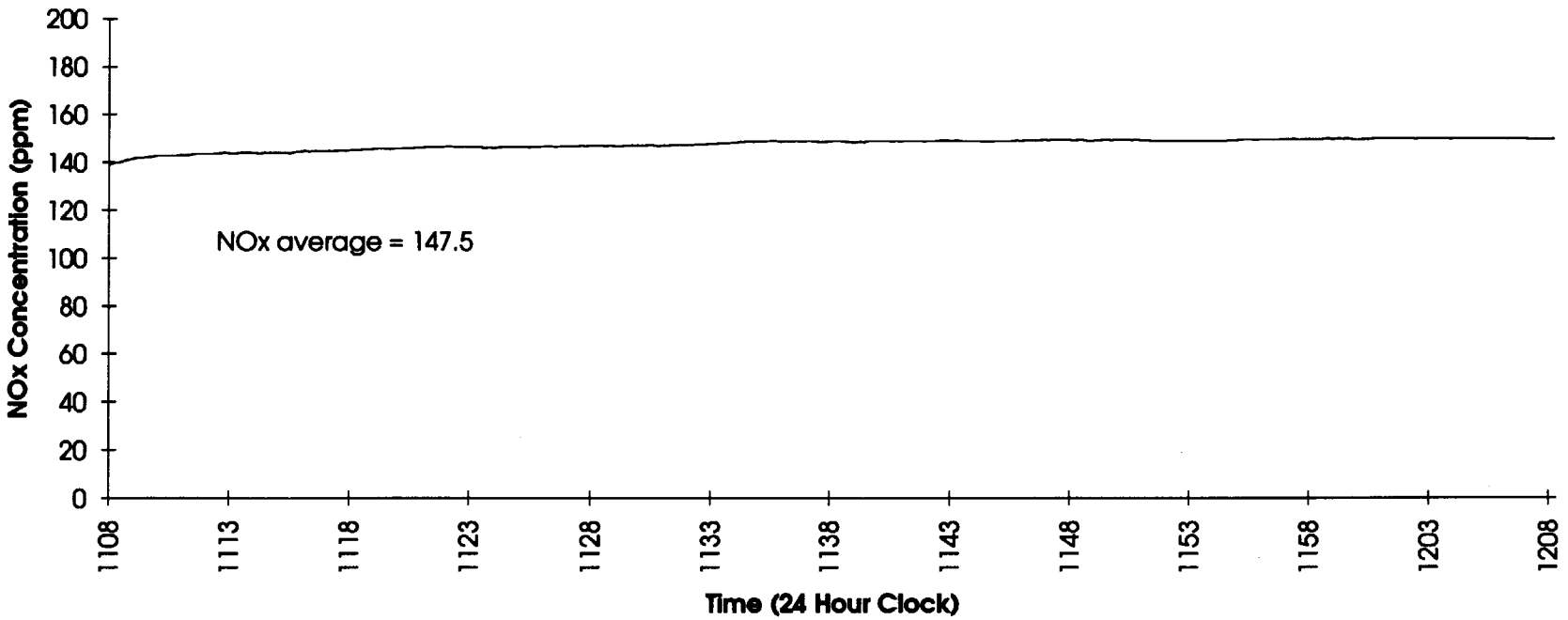
Project Information				
Client:	Greiner, Incorporated			
Project No.:	16526			
Date:	6/11/93			
Source:	Boiler No. 2 - Fuel Oil			
Sampling Train Calculations				
Test No:	1	2	3	Averages
Percent Load	100%	100%	100%	
Pitot Tube Calibration Factor:	0.99	0.99	0.99	
Meter Calibration Factor:	1.00513	1.00513	1.00513	
Stack Length:	0	0	0	
Stack Width:	0	0	0	
Stack Diameter:	36	36	36	
Nozzle Diameter, inches:	0	0	0	
Barometric Pressure, inches mercury:	29.45	29.45	29.45	
Static Pressure in Stack, Inches Water:	0.04	0.1	0.1	
Duration of Sample, minutes	60	60	60	
Meter Leak Rate:	0.015	0.015	0.015	
Meter Start Volume:	778.54	778.54	778.54	
Meter Final Volume:	803.18	803.18	803.18	
Average Meter Pressure, Inches Water:	1.76	1.76	1.76	
Average Meter Temperature, degrees F:	87.14	87.14	87.14	
Average Sqrt. Velocity Pressure:	0.15312	0.13165	0.12446	0.1
Stack Gas Temperature, degrees F:	248.16	245.66	247.25	247.0
Percent Carbon Dioxide:	13	13.5	13.2	13.23
Percent Oxygen:	5.7	6.4	5.9	6.00
Percent Carbon Monoxide:	0	0	0	
Liquid Volume Collected, milliliters:	75.1	75.1	75.1	
Sample Train Calculations				
Meter Volume, Actual:	24.64	24.64	24.64	
Meter Volume, STP:	23.717	23.717	23.717	
Volume of Water Vapor Condensed:	3.560	3.560	3.560	
Total Gas Sampled:	27.277	27.277	27.277	
Percent Moisture:	13.05	13.05	13.05	13.05
Area of Stack, Square Feet:	7.07	7.07	7.07	
Excess Air at Test Location:	36.16	43.40	38.17	
Density Dry at STP:	0.0784	0.0786	0.0785	
Density Wet at STP:	0.0742	0.0744	0.0743	
Density Wet at Stack Cond:	0.0547	0.0550	0.0548	
Molecular Weight, lb/lb-Mole	30.32	30.42	30.36	
Velocity and Flow Calculations				
Average Stack Gas Velocity FPM:	710.6	608.8	576.8	632.1
Stack Gas Flow Rate, ACFM:	5022.9	4303.6	4077.4	4468.0
Stack Gas Velocity, SCFM:	3700.6	3182.3	3008.2	3297.0
Stack Gas Velocity, DSCFM:	3217.6	2767.0	2615.7	2866.8
Pounds of Gas Sampled, Dry	1.858	1.865	1.861	
Pounds of Gas Sampled, Wet	2.024	2.031	2.026	

NOx Emission Data Calculated Using %CO2 and a Fuel Factor of 1,420scf/MMBTU				
NOx Concentration, ppm	147.5	150.3	150.4	
NOx Emission Rate, lb/hr	3.84	3.37	3.19	3.5
NOx Conversion to Lbs/scf	1.761E-05	1.795E-05	1.796E-05	
NOx Emission Rate, lbs/MMBTU	0.167	0.164	0.168	

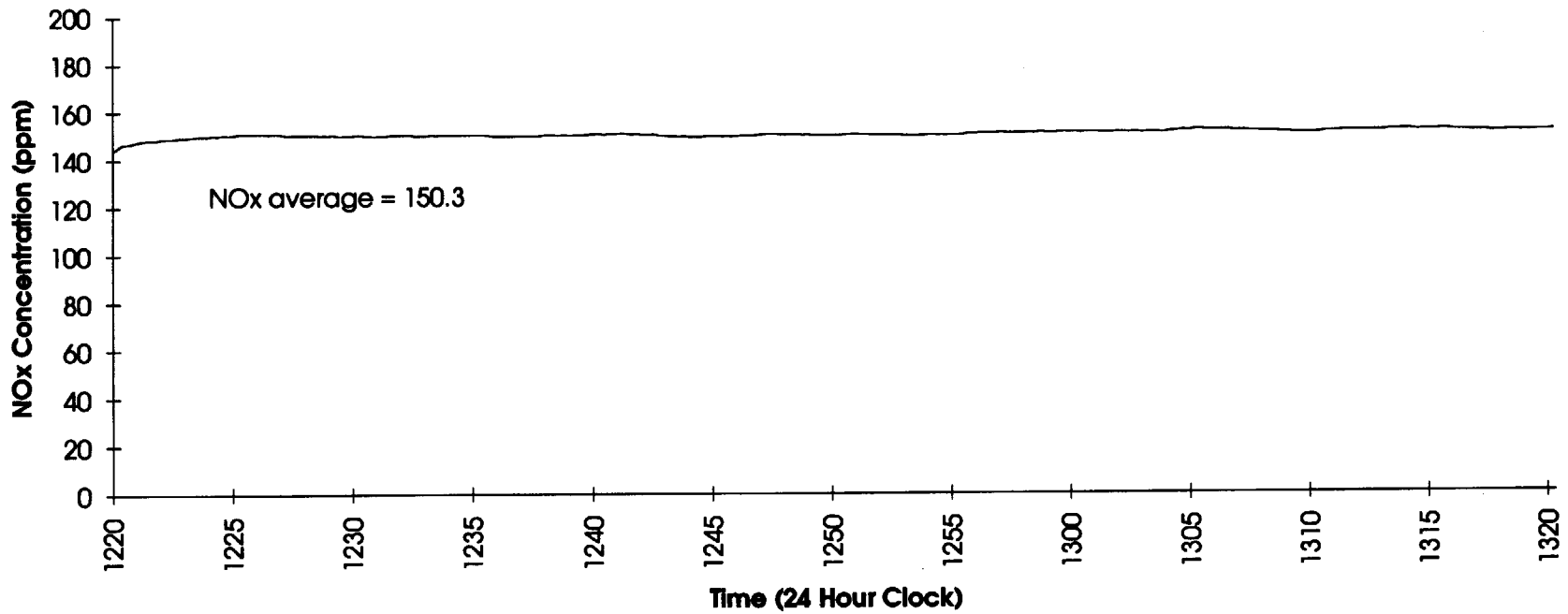
Conversion from ppm NOx to lbs/scf - multiplied ppm NOx by 1.94E-07

The conversion from NOx (lbs/scf) to NOx emission rate lbs/MMBTU
is based on a dry basis for lbs/scf of NOx and on a wet basis for (% CO2).

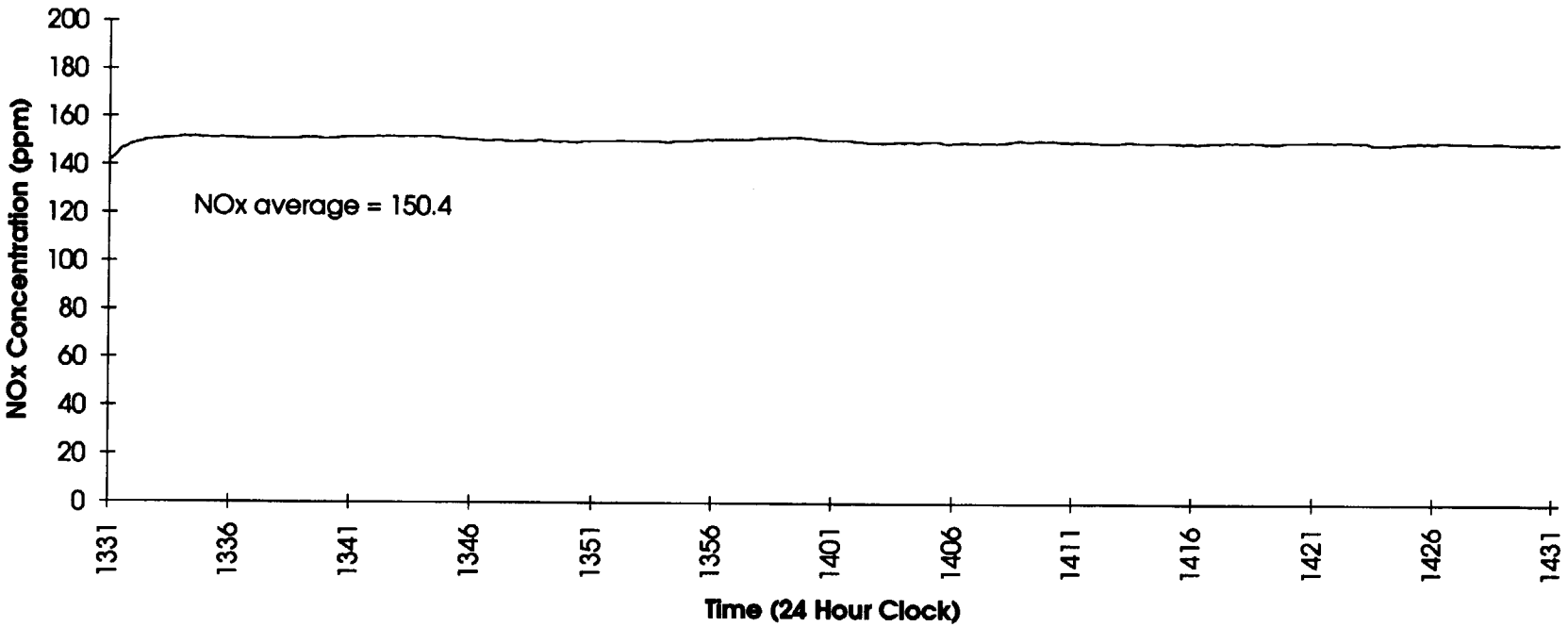
Walter P. Reuther Hospital
Greiner, Inc.
June 11, 1993
Boiler No. 2 - Fuel Oil
Test No. 1



Walter P. Reuther Hospital
Greiner, Inc.
June 11, 1993
Boiler No. 2 - Fuel Oil
Test No. 2



Walter P. Reuther Hospital
Greiner, Inc.
June 11, 1993
Boiler No. 2 - Fuel Oil
Test No. 3



WW Engineering & Science, Inc.
Environmental Services Division

EMISSION TESTING DATA

Client: GREINER
Project Number: 16526.00
Source: BOILER #2
Sampling Site: OUTLET
Test Number: 1
Sample Type: M4
NATURAL GAS

Pitot Tube I.D.: NA C_p:
Probe Length.: NA
Meter Box Number: Unit 1
Meter Y Factor: 1.00285
Meter K_{iso}: 1605.145
Meter Factor: NA

Barometric Pressure: 29.87
Static Pressure: 0.0
Estimated Moisture: 2%
Nozzle Diameter: NA
Initial Leak Check: 0.00
Final Leak Check:

Date: 5-11 Page 1 of 1
Staff: BB, BLB
Stack Size: 36"
Orsat Leak Check Pre: ✓ Post: ✓
Pitot Leak Check Pre: NA Post:
Filter Number(s): NA

Sample Point/Port	Test Time (minutes)	Time (24 Hr.)	Meter Volume	Pitot Tube ΔP	Orifice ΔH	Pump Vacuum	Meter Temperature Inlet (°F)	Meter Temperature Outlet (°F)	Stack Temp. (°F)	Probe Temp (°F)	Filter Temp. (°F)	Impinger Temp. (°F)
	0	1015	~~58.53~~ ~~58.56~~									
NA	5	1020	61.97	NA	1.9	1	70	71		NA	NA	
	10	1025	65.47			1	76	72				
	15	1030	68.82			1	80	72				
	20	1035	71.97			1	85	75				
	25	1040	75.13			1	90	80				
	30	1045	79.45			1	96	83				
	35	1050	84.27			1	101	85				
	40	1055	88.07			1	104	85				

Averages: √ΔP: N/A ΔH: 1.9 T_m: 82.8 T_s:

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WW Engineering & Science, Inc.
Environmental Services Division

MOISTURE AND MOLECULAR WEIGHT DATA

Client:_____ Date:_____ Project Number:_____
Source:_____ Site:_____ Run Number:_____
Staff:_____

MOISTURE DATA

	Container 1	Container 2	Container 3	Container 4	Container 5
Final Weight or Volume	930.4	28			
Tare Weight or Volume	924.0	0			
Gain	6.4	28			
Contents (ie silica gel)	Silicagel	Flask			

34.4 total

MOLECULAR WEIGHT DATA

Analysis Method:_____ Analysis Date:_____ Sample Type:_____

Run Number	Oxygen	Carbon Dioxide	Carbon Monoxide
1			
2			
3			
Average			

WW Engineering & Science
A Summit Company
Environmental Services

Velocity Data Sheet

Client: GREINER
Project Number: 16526.00
Source: Boiler #2 TEST No. 2
Pitot Tube I.D.: 22 Coefficient .84
Staff: BB, BLB
Wet Bulb Temp.: C ~~0800~~ 0750

Date: 5-11-93
Barometric Pressure: 29.87
Location: Outlet
Pitot Leak Check Pre: ✓
Pitor Leak Check Post: ✓
Static Pressure: 0.0 "H2O"

Port/Point	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port	Pitot Tube ΔP	Stack Temperature (°F)
A - 1	.02	230			
2	.02	232			
3	.02	234			
4	.02	235			
5	.02	233			
6	.02	230			
B - 1	.02	220			
2	.02	232			
3	.02	233			
4	.02	232			
5	.02	232			
6	.02	230			

%O2: _____ %CO2: _____ Average ΔP .1414214 Average Stack Temp: 231

.24 #/mm BTU
3.45 MW
15 TPH

V_s = 543.7
ACFM = 3,843 SCFM 2,948

WW Engineering & Science
A Summit Company
Environmental Services

Velocity Data Sheet

Client: GREINER
Project Number: 16526.00
Source: Boiler #2 TEST No. 2
Pitot Tube I.D.: 22 Coefficient: .84
Staff: BB, BLB
Wet Bulb Temp.: 0859

Date: 5-11-93
Barometric Pressure: 29.87
Location: Outlet
Pitot Leak Check Pre: ✓
Pitor Leak Check Post: ✓
Static Pressure: 0.0 "H2O"

Port/Point	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port	Pitot Tube ΔP	Stack Temperature (°F)
A - 1	.01	222			
2	.02	227			
3	.02	230			
4	.02	230			
5	.02	225			
6	.02	224			
B - 1	.02	227			
2	.02	233			
3	.02	235			
4	.02	235			
5	.02	235			
6	.02	213			

%O2: _____ %CO2: _____ Average ΔP .13796 Average Stack Temp: 228

WW Engineering & Science
A Summit Company
Environmental Services

Velocity Data Sheet

Client: GREINER
Project Number: 16526.00
Source: BOILER #2 TEST NO. 3
Pitot Tube I.D.: 22 Coefficient .84
Staff: BG, BLB
Wet Bulb Temp.: PRE TEST 3 @ 1005

Date: 5-11-93
Barometric Pressure: 29.87
Location: Outlet
Pitot Leak Check Pre: ✓
Pitor Leak Check Post: ✓
Static Pressure: "H2O"

Port/Point	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port	Pitot Tube ΔP	Stack Temperature (°F)
A - 1	.01	212			
2	.01	220			
3	.02	221			
4	.02	226			
5	.02	226			
6	.02	226			
B - 1	.02	220			
2	.02	222			
3	.02	231			
4	.02	237			
5	.02	235			
6	.02	220			

%O2: _____ %CO2: _____ Average ΔP .13451 Average Stack Temp: 225

WW Engineering & Science, Inc.
Environmental Services Division

EMISSION TESTING DATA

Client: Greiner
Project Number: 16526
Source: BOILER #2
Sampling Site: OUTLET
Test Number: 1
Sample Type: M-4 [redacted] FUEL OIL

Pitot Tube I.D.: STYPE C_p: .85
Probe Length.: 48"
Meter Box Number: 1
Meter Y Factor: 1.00513
Meter K_{iso}: —
Meter Factor: NA

Barometric Pressure: 29.29
Static Pressure: +.04
Estimated Moisture: NA
Nozzle Diameter: NA
Initial Leak Check: 0.01 @ 5" Hg
Final Leak Check: 0.02 @ 5" Hg

Date: 6-10-93 Page 1 of 1
Staff: MASON / HUNTER / CULVER
Stack Size: 36"
Orsat Leak Check Pre: — Post: —
Pitot Leak Check Pre: — Post: —
Filter Number(s): NA

Sample Point/Port	Test Time (minutes)	Time (24 Hr.)	Meter Volume	Pitot Tube ΔP	Orifice ΔH	Pump Vacuum	Meter Temperature Inlet (°F)	Meter Temperature Outlet (°F)	Stack Temp. (°F)	Probe Temp (°F)	Filter Temp. (°F)	Impinger Temp. (°F)
	0	1250	723.30									
	5	1255	727.03	—	1.76	1.5	93	96	—		—	60
	10	1300	730.65	—	1.76	1.5	88	88	—		—	60
	15	1305	734.26	—	1.76	1.5	90	95	—		—	60
	20	1310	737.86	—	1.76	1.5	91	98	—		—	60
	25	1315	740.98	—	1.76	1.5	93	100	—		—	61
	30	1320	745.03	—	1.76	1.5	94	101	—		—	60
	39	1329	748.64	—	1.76	1.5	95	101	—		—	60

Averages: V_M 25.34 √ΔP: NA ΔH: 1.76 T_m: 94.71 T_s: —

WW Engineering & Science, Inc.
Environmental Services Division

MOISTURE AND MOLECULAR WEIGHT DATA

Client: Greiner
Source: BOILER #1 F.O.
Staff: LULVER/MASON

Date: 6-10-93
Site: OUTLET

Project Number: 16526
Run Number: 1 F.O.

MOISTURE DATA

	Container 1	Container 2	Container 3	Container 4	Container 5
Final Weight or Volume	907.2	40			
Tare Weight or Volume	901.8	0			
Gain	6.4	40			
Contents (ie silica gel)	S.G	FLASK			

46.4 total gain

MOLECULAR WEIGHT DATA

Analysis Method:_____ Analysis Date:_____ Sample Type:_____

Run Number	Oxygen	Carbon Dioxide	Carbon Monoxide
1			
2			
3			
Average			

WW Engineering & Science, Inc.
Environmental Services Division

Velocity Data Sheet

Client: Greider
Project Number: 16526
Source: Boiler #1 Fuel oil
Pitot Tube I.D.: std Coefficient .85
Staff: MASON/CULVER
Wet Bulb Temp.: NA

Date: 6-10-93
Barometric Pressure: 29.29
Location: OUTLET
Pitot Leak Check Pre: ✓
Pitot Leak Check Post: ✓
Static Pressure: +.05 "H_2O

Velocity #1

Port/Point	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port	Pitot Tube ΔP	Stack Temperature (°F)
1	.010	255	1	.015	270
2	.01	256	2	.015	271
3	.01	254	3	.02	269
4	.015	246	4	.02	261
5	.015	241	5	.02	256
6	.01	233	6	.02	248

$\%O_2$:: 5.7 $\%CO_2$: 12.6% Average $\sqrt{\Delta P}$ .1213 Average Stack Temp.: ~~468~~ 255 °F

DSCFM = 2235

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WW Engineering & Science, Inc.
Environmental Services Division

Velocity Data Sheet

Client: Greiner
Project Number: 6526
Source: Boiler #1 Fuel oil
Pitot Tube I.D.: STYPE Coefficient .85
Staff: MASON/COWER
Wet Bulb Temp.: NA

Date: 6-10-93
Barometric Pressure: 29.29
Location: OUTLET
Pitot Leak Check Pre: ✓
Pitot Leak Check Post: ✓
Static Pressure: .04 "H_2O

Velocity #2 1500

Port/Point	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port	Pitot Tube ΔP	Stack Temperature (°F)
1	.01	218	1	.01	243
2	.01	229	2	.01	243
3	.01	230	3	.01	246
4	.015	232	4	.015	244
5	.01	248	5	.015	236
6	.01	240	6	.01	227

$\%O_2$: 6.2 $\%CO_2$: 12.0% 1520 Average $\sqrt{\Delta P}$ .10562 Average Stack Temp.: 236.3

DSCFM = 2327.7

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WW Engineering & Science, Inc.
Environmental Services Division

Velocity Data Sheet

Client: Greiner
Project Number: 16526
Source: Boiler #1 Fuel oil
Pitot Tube I.D.: Stype Coefficient .85
Staff: MASON / CULVER
Wet Bulb Temp.: NA

Date: 6-10-93
Barometric Pressure: 29.29
Location: OUTLET
Pitot Leak Check Pre: ✓
Pitot Leak Check Post: ✓
Static Pressure: .04 "H_2O

Velocity #3 1553

Port/Point 1547	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port 1553	Pitot Tube ΔP	Stack Temperature (°F)
1	.01	242	1	.01	237
2	.015	246	2	.01	242
3	.02	252	3	.01	244
4	.02	251	4	.015	243
5	.02	250	5	.01	240
6	.02	244	6	.01	232

%O_2:: 5.3 %CO_2: 12% Average $\sqrt{\Delta P}$ .11755 Average Stack Temp.: 247.5

DSCFM = 2,570

WW Engineering & Science, Inc.
Environmental Services Division

EMISSION TESTING DATA

Client: Greiner
Project Number: 16526
Source: Boiler #2 F.Oil
Sampling Site: OUTLET
Test Number: 1
Sample Type: M-4

Pitot Tube I.D.: — C_p: —
Probe Length.: 36"
Meter Box Number: 1
Meter Y Factor: 1.00513
Meter K_{iso}: —
Meter Factor: NA

Barometric Pressure: 29.50
Static Pressure: +.04
Estimated Moisture: NA
Nozzle Diameter: —
Initial Leak Check: 0.0 @ 6" Hg
Final Leak Check: 0.0 @ 6" Hg

Date: 6-11-93 Page 1 of 1
Staff: MASON/CULVER
Stack Size: 56"
Orsat Leak Check Pre: — Post: —
Pitot Leak Check Pre: — Post: —
Filter Number(s): —

Sample Point/Port	Test Time (minutes)	Time (24 Hr.)	Meter Volume	Pitot Tube ΔP	Orifice ΔH	Pump Vacuum	Meter Temperature Inlet (°F)	Meter Temperature Outlet (°F)	Stack Temp. (°F)	Probe Temp (°F)	Filter Temp. (°F)	Impinger Temp. (°F)
	0	1110	778.54									
	5	1115	782.16	—	1.76	1	78	81	—		—	60
	10	1120	785.66	—		1	78	83	—		—	60
	15	1125	789.06	—		1	81	89	—		—	61
	20	1130	792.48	—		1	83	93	—		—	62
	25	1135	795.90	—		1	85	96	—		—	63
	30	1140	799.53	—		1	87	98	—		—	64
	35	1145	803.18	—		1	89	99	—		—	65

Averages: VM 24.64 √ΔP: — ΔH: 1.76 T_m: 87.14 T_s: —

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WW Engineering & Science, Inc.
Environmental Services Division

MOISTURE AND MOLECULAR WEIGHT DATA

Client: Greiner
Source: Boiler #2 F.O.
Staff: MASON/OLIVER

Date: 6-11-93
Site: OUTLET

Project Number: 16526
Run Number: 1

MOISTURE DATA

	Container 1	Container 2	Container 3	Container 4	Container 5
Final Weight or Volume	962.2	70.5			
Tare Weight or Volume	857.6	0			
Gain	4.6	70.5			
Contents (ie silica gel)	SG	FLASK			

75.1 TOTAL GAIN

MOLECULAR WEIGHT DATA

Analysis Method:_____ Analysis Date:_____ Sample Type:_____

Run Number	Oxygen	Carbon Dioxide	Carbon Monoxide
1			
2			
3			
Average			

WW Engineering & Science, Inc.
Environmental Services Division

Velocity Data Sheet

Client: Greiner
Project Number: 16526
Source: BF2 Fuel oil
Pitot Tube I.D.: Std Coefficient .99
Staff: MASON / CULVER
Wet Bulb Temp.: NA

Date: 6-11-93
Barometric Pressure: 29.45
Location: OUTLET
Pitot Leak Check Pre: ✓
Pitot Leak Check Post: ✓
Static Pressure: .04 "H_2O

#1

Port/Point E/W 1/12 hr	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port N/S 1/20	Pitot Tube ΔP	Stack Temperature (°F)
1	.025	247	1	.02	230
2	.025	252	2	.02	246
3	.02	254	3	.02	253
4	.03	254	4	.02	253
5	.04	250	5	.025	250
6	.02	243	6	.02	246

%O_2:: 5.7 %CO_2: 1129 hrs 13% 1204 hrs 13% Average $\sqrt{\Delta P}$ .15312 Average Stack Temp.: 248.16

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WW Engineering & Science, Inc.
Environmental Services Division

Velocity Data Sheet

Client: Greiner
Project Number: 16526
Source: B#2 Fuel oil
Pitot Tube I.D.: Std Coefficient: .99
Staff: MASON / CULVER
Wet Bulb Temp.: NA

Date: FRI June 11 93
Barometric Pressure: 29.45
Location: OUTLET
Pitot Leak Check Pre: ✓
Pitot Leak Check Post: ✓
Static Pressure: .010 1223 hrs "H_2O

#2

Port/Point N/S 1220	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port E/W 1224 hrs	Pitot Tube ΔP	Stack Temperature (°F)
1	.02	238	1	.010	241
2	.02	246	2	.015	253
3	.02	247	3	.015	252
4	.02	248	4	.020	250
5	.02	247	5	.015	249
6	.02	239	6	.015	238

%O_2: 16.4 %CO_2: 1231 hrs 13.5% Average $\sqrt{\Delta P}$ .13165 Average Stack Temp.: 245.66

1312 13.2%

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WW Engineering & Science, Inc.
Environmental Services Division

Velocity Data Sheet

Client: Greiner
Project Number: 16526
Source: B#2 Fuel oil
Pitot Tube I.D.: Std Coefficient: .99
Staff: MASON / CULVER
Wet Bulb Temp.: NA

Date: FRI June 11 93
Barometric Pressure: 29.45
Location: OUTLET
Pitot Leak Check Pre: ✓
Pitot Leak Check Post: ✓
Static Pressure: .010 1313 "H_2O

#3

Port/Point E/W 1315	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port N/S 1319	Pitot Tube ΔP	Stack Temperature (°F)
1	.010	238	1	.020	236
2	.010	240	2	.020	247
3	.010	247	3	.020	249
4	.010	258	4	.020	249
5	.015	256	5	.020	249
6	.015	248	6	.020	250

%O_2:: 5.9 %CO_2: 1334 hrs 13.2% Average $\sqrt{\Delta P}$ .12446 Average Stack Temp.: 247.25

WW Engineering & Science, Inc.
Environmental Services Division

EMISSION TESTING DATA

Client: Greider | Pitot Tube I.D.: S | C_p: — | Barometric Pressure: 29.45 | Date: 6-11-93 Page 1 of 1
Project Number: 16526 | Probe Length.: 36" | Static Pressure: .04 | Staff: MASON/CULVER
Source: Boiler #2 NATGAS | Meter Box Number: 1 | Estimated Moisture: NA | Stack Size: 36"
Sampling Site: OUTLET | Meter Y Factor: 1.00513 | Nozzle Diameter: NA | Orsat Leak Check Pre: — Post: —
Test Number: 1 | Meter K_{iso}: — | Initial Leak Check: 0.00 @ 5" Hg | Pitot Leak Check Pre: — Post: —
Sample Type: M-4 | Meter Factor: NA | Final Leak Check: 0.00 @ 4" Hg | Filter Number(s): —

Sample Point/Port	Test Time (minutes)	Time (24 Hr.)	Meter Volume	Pitot Tube ΔP	Orifice ΔH	Pump Vacuum	Meter Temperature Inlet (°F)	Meter Temperature Outlet (°F)	Stack Temp. (°F)	Probe Temp (°F)	Filter Temp. (°F)	Impinger Temp. (°F)
	0	0751	748.88									
	5	0756	752.53	—	1.76	1.5	66	66	—	—	—	50
	10	0801	755.08	—	1.76	1.5	67	73	—	—	—	52
	15	0806	759.79	—	1.76	1.5	70	80	—	—	—	52
	20	0811	763.50	—	1.76	1.5	72	87	—	—	—	53
	25	0816	768.41	—	1.76	1.5	74	89	—	—	—	53
	30	0821	772.02	—	1.76	1.5	77	93	—	—	—	54
	35	0826	775.73	—	1.76	1.5	80	96	—	—	—	54
	40	0831	778.36	—	1.76	1.5	81	97	—	—	—	55

Averages: V_M 29.48 | √ΔP: — | ΔH: 1.76 | T_m: 79.25 | T_s: —

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WW Engineering & Science, Inc.
Environmental Services Division

MOISTURE AND MOLECULAR WEIGHT DATA

Client: Greiner
Source: Boiler #2 NG
Staff: MASON/CULVER

Date: 6-11-93
Site: OUTLET

Project Number: 16526
Run Number: 1

MOISTURE DATA

	Container 1	Container 2	Container 3	Container 4	Container 5
Final Weight or Volume	857.6	77			
Tare Weight or Volume	849.9	0			
Gain	7.7	77			
Contents (ie silica gel)	SG	FLASK			

TOTAL GAIN 84.7

MOLECULAR WEIGHT DATA

Analysis Method:_____ Analysis Date:_____ Sample Type:_____

Run Number	Oxygen	Carbon Dioxide	Carbon Monoxide
1			
2			
3			
Average			

WW Engineering & Science, Inc.
Environmental Services Division

Velocity Data Sheet

Client: Greiner
Project Number: 16526
Source: OUTLET Boiler #2 NG
Pitot Tube I.D.: STYPE Coefficient .85
Staff: MASON/COLVER
Wet Bulb Temp.: NA

Date: 6-11-93
Barometric Pressure: 29.43
Location: OUTLET
Pitot Leak Check Pre: ✓
Pitot Leak Check Post: ✓
Static Pressure: .04 "H_2O

Velocity #1

Port/Point N/S 0715	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port E/W 0722	Pitot Tube ΔP	Stack Temperature (°F)
1	.01	235	1	.01	234
2	.015	241	2	.01	245
3	.01	247	3	.01	247
4	.02	246	4	.01	247
5	.02	242	5	.01	241
6	.02	240	6	.01	234

$\%O_2$: 9.0 $\%CO_2$: 6.7 Average $\sqrt{\Delta P}$ .11223 Average Stack Temp.: 241.58

WW Engineering & Science, Inc.
Environmental Services Division

Velocity Data Sheet

Client: Greiner
Project Number: 16526
Source: Boiler #2 NG
Pitot Tube I.D.: Styr Coefficient .85
Staff: MASON/OLVER
Wet Bulb Temp.: NA

Date: 6-11-93
Barometric Pressure: 29.45
Location: OUTLET
Pitot Leak Check Pre: ✓
Pitot Leak Check Post: ✓
Static Pressure: .04 "H_2O

Velocity #2

Port/Point E/W 0921	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port N/S 0911	Pitot Tube ΔP	Stack Temperature (°F)
1	.01	239	1	.02	233
2	.01	243	2	.02	243
3	.01	245	3	.015	245
4	.01	245	4	.015	245
5	.01	243	5	.015	240
6	.01	233	6	.02	233

%O_2: 8.7 %CO_2: 7 0926 Average $\sqrt{\Delta P}$ .11597 Average Stack Temp.: 240.58

WW Engineering & Science, Inc.
Environmental Services Division

Velocity Data Sheet

Client: Greiner
Project Number: 16526
Source: Boiler #2 NG
Pitot Tube I.D.: Style Coefficient .85
Staff: MASON/~~BECKERCULVER~~
Wet Bulb Temp.: NA

Date: 6-11-93
Barometric Pressure: 29.45
Location: OUTLET
Pitot Leak Check Pre: —
Pitot Leak Check Post: —
Static Pressure: .04 "H_2O

Velocity #3

Port/Point E/W 0947	Pitot Tube ΔP	Stack Temperature (°F)	Point/Port N/S 0955	Pitot Tube ΔP	Stack Temperature (°F)
1	.01	234	1	.015	237
2	.015	242	2	.015	240
3	.02	244	3	.015	242
4	.02	245	4	.015	240
5	.02	242	5	.015	242
6	.02	239	6	.015	232

$\%O_2$: 9.7 $\%CO_2$: 7 Average $\sqrt{\Delta P}$ .12692 Average Stack Temp.: 239.91

WW Engineering & Science, Inc.
Environmental Services Division

TRAVERSE POINT LOCATION DATA
CIRCULAR DUCTS

Client: GRAUER
Project Number: 16526.00
Site: RUETHER HOSPITAL

Date: 5-11-93
Source: BOILER EXHAUST
Calculated by: BJB

Inside of far wall to outside of nipple: 42"

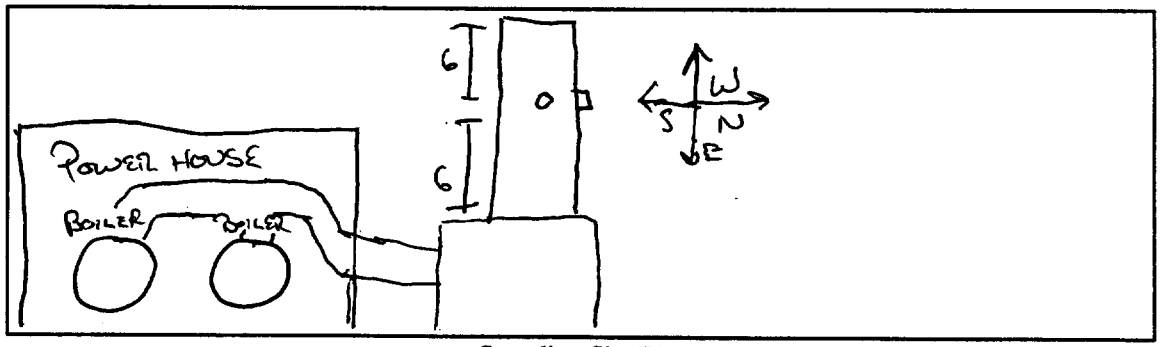
Inside of near wall to outside of nipple: 6"

Stack Diameter: 36"

Nearest disturbance upstream of port: 8 6

Nearest disturbance downstream of port: 6

Traverse Point Number	Fraction of Stack Diameter (Y)	Stack Diameter (Ø)	Y x Ø	Nipple Depth	Traverse Point Location
1	.044	36	1.584	6"	7 1/2
2	.146		5.256		11 1/4
3	.296		10.656		16 5/8
4	.704		25.344		31 3/8
5	.854		30.744		36 3/4
6	.956		34.414		40 1/2



Sampling Site Diagram

SECTION C
Calibration Data

Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : Scott Michigan

Our Project # : 540084

Your P.O. # : 518

Expiration Date : 2-13-94

Cylinder Number : BLM002774

Cylinder Pressure 1700 psig

1 of 1 Component(s)

Customer :
NW ENGINEERING & SCIENCE
5730 EAGLE DRIVE
GRAND RAPIDS MI 49508

CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES # # #
PERFORMED ACCORDING TO SECTION 3.0.4

Certified For Traceability Procedure # G1
Protocol # 1

File # FO-4382

Certified Accuracy 1 % NBS Traceable

ANALYZED CYLINDER

COMPONENT	CERTIFIED CONC.
NITRIC OXIDE	91.36 PPM

BALANCE GAS : NITROGEN

REFERENCE STD

SRM # (CRM #)	CYLINDER NUMBER	CONC.
1684	ALM-013312	95.26 PPM
2629A	FF-28612	19.40 PPM

INSTRUMENTATION

INSTR/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
HORIBA OPE-235 483814	6-25-92	CHEMILUMINESCENCE

NITROGEN DIOXIDE 0.30 PPM (FROM SECOND ANALYSIS)

FIRST ANALYSIS

DATE : 8-8-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	91.30	91.31	95.26 PPM	95.30	95.31
0.00	91.30	91.31		95.30	95.31
0.00	91.30	91.31		95.30	95.31

CALCULATED RESULTS 91.26
91.26
91.26

AVERAGE : 91.26 PPM

SECOND ANALYSIS

DATE : 8-13-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	91.50	91.51	95.26 PPM	95.30	95.31
0.00	91.50	91.51		95.30	95.31
0.00	91.50	91.51		95.30	95.31
0.00	91.90 NOX	91.91			

CALCULATED RESULTS 91.46
91.46
91.46

91.76 PPM NOX

AVERAGE : 91.46 PPM

CALIBRATION CURVE 1 st DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
1684	95.26	100	95.30	95.31	0.05
2629A	19.40	20	19.40	19.40	0.01
	0.00	0	0.00	0.00	0.00
		0		0.00	0.00
		0		0.00	0.00
		0		0.0000	0.00
		0		0.00	0.00
2629A	19.40	LOW	19.40	19.40	0.01
1684	95.26	HIGH	95.25	95.26	-0.00

Analyst: [signature] Approved By: [signature]

GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : Scott Michigan

Our Project # : 540084

Your P.O. # : 518

Expiration Date : 2-17-94

Cylinder Number : BLM002763

Cylinder Pressure 1900 psig

1 of 1 Component(s)

Customer :
MW ENGINEERING & SCIENCE
5730 EAGLE DRIVE
GRAND RAPIDS MI 49508

**** CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES ****
PERFORMED ACCORDING TO SECTION 3.0.4

Certified For Traceability Procedure # G1
Protocol # 1

File # PO-4384

Certified Accuracy 1 % NBS Traceable

ANALYZED CYLINDER		REFERENCE STD			INSTRUMENTATION		
COMPONENT	CERTIFIED CONC.	SRM # (CRM #)	CYLINDER NUMBER	CONC.	INSTR/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
NITRIC OXIDE	245.4 PPM	1685	ALM-003715	250.3 PPM	BECKMAN	6-25-92	CHEMILUMINESCENCE
		1684	ALM-010464	95.26 PPM	951A		
					270-0822778		

BALANCE GAS : NITROGEN

NITROGEN DIOXIDE 1.50 PPM (FROM SECOND ANALYSIS)

FIRST ANALYSIS DATE : 8-8-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	98.10	245.5	250.3 PPM	100.00	250.3
0.00	98.10	245.5		100.00	250.3
0.00	98.10	245.5		100.00	250.3

CALCULATED RESULTS 245.5, 245.5, 245.5

AVERAGE : 245.5 PPM

SECOND ANALYSIS DATE : 8-17-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	98.00	245.3	250.3 PPM	100.00	250.3
0.00	98.00	245.3		100.00	250.3
0.00	98.00	245.3		100.00	250.3
0.00	98.60 NOX	246.8			

CALCULATED RESULTS 245.3, 245.3, 245.3

246.8 PPM NOX

AVERAGE : 245.3 PPM

CALIBRATION CURVE 1 st DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT FT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
1685	250.3	100	100.00	250.3	0.00
1684	95.26	38	38.05	95.24	-0.02
	0.0000	0	0.00	0.0000	0.00
		0		0.00	0.00
		0		0.00	0.00
		0		0.0000	0.00
		0		0.00	0.00
1685	250.3 HIGH		100.00	250.3	0.00
1684	95.26 LOW		38.05	95.24	-0.02

† GMIS - GAS MANUFACTURER'S INTERNATIONAL STANDARD

Approved for this Company

Scott Specialty Gases

a division of
Scott Environmental Technology, Inc.

1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : [illegible]

Our Project # : 540365

Your P.O. # : 518

Customer :
W.W. ENGINEERING & SCIENCE
5730 EAGLE DRIVE
GRAND RAPIDS, MI. 49508

Expiration Date : 3-1-94

Cylinder Number : BAL-4395

Cylinder Pressure 1900 psig

1 of 1 Component(s)

*** * * * CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES * * * ***
PERFORMED ACCORDING TO SECTION 3.0.4

Certified Per Traceability Protocol # 1

Procedure # G1

File # PO-4550

Certified Accuracy 1 % NBS Traceable

ANALYZED CYLINDER		REFERENCE STD			INSTRUMENTATION		
COMPONENT	CERTIFIED CONC.	SRM # (CRM #)	CYLINDER NUMBER	CONC.	INSTR/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
NITRIC OXIDE	502.0 PPM	1687	ALM-014665	965.5 PPM	BECKMAN 951A 270-082899	6-25-92	CHEMILUMINESCENCE
		1685	ALM-008709	250.3 PPM			

BALANCE GAS : NITROGEN

NITROGEN DIOXIDE 0.00 PPM (FROM SECOND ANALYSIS)

FIRST ANALYSIS DATE : 8-24-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	50.20	502.0	965.5 PPM	96.50	965.5
0.00	50.20	502.0		96.50	965.5
0.00	50.20	502.0		96.50	965.5
CALCULATED RESULTS		502.0			
		502.0			
		502.0			
AVERAGE :		502.0 PPM			

SECOND ANALYSIS DATE : 9-1-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	50.20	502.0	965.5 PPM	96.50	965.5
0.00	50.20	502.0		96.50	965.5
0.00	50.20	502.0		96.50	965.5
0.00	50.20 NON	502.0			
CALCULATED RESULTS		502.0			
		502.0			
		502.0	502.0 PPM NON		
AVERAGE :		502.0 PPM			

CALIBRATION CURVE 1 ST DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
1687	965.5	100	96.50	965.5	0.00
GMIS	748.0	77	75.00	750.3	0.30
GMIS	395.0	41	39.60	395.9	0.22
1685	250.3	26	25.10	250.7	0.16
	0.0000	0	0.00	0.0000	0.00
		0		0.0000	0.00
		0		0.00	0.00
1685	250.3	LOW	25.10	250.7	0.16
1684B	965.5	HIGH	96.50	965.5	0.00

\# GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : L Doran

Approved By : L Shapiro

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.