

I. INTRODUCTION

Network Environmental, Inc. was retained by the Michigan Sugar Company to perform compliance emission sampling at their facility located in Croswell, Michigan. The purpose of the testing was to document compliance with the oxides of nitrogen (NO_x) emission limits for the #4 Riley Boiler (EU-RILEYBLR) established in Michigan Department of Environment, Great Lakes and Energy (EGLE) - Air Quality Division Renewable Operating Permit Number: MI-ROP-B2876-2019. MI-ROP-B2876-2019 has established the following NO_x emission limits for this boiler:

Pollutant	Limit	Time Period / Operating Scenario
NO _x	0.11 Lbs/MMBTU	Hourly
	0.20 Lbs/MMBTU	30 Day Rolling Average
	86.24 Tons/Year	12 Month Rolling Time Period As Determined At The End Of each Calendar Month

The following reference methods were employed to conduct the emission sampling:

- Oxides of Nitrogen (NO_x) – U.S. EPA Method 7E
- Exhaust Gas Parameters (Air Flow Rate, Temperature, Moisture & Density) – U.S. EPA Methods 1 through 4

The sampling was performed on December 9, 2020 by Stephan K. Byrd and David D. Engelhardt of Network Environmental, Inc. Assisting with the testing were Mr. Steven Smock and the operating staff of the facility. Mr. Ben Witkopp of the Michigan Department of Environment, Great Lakes and Energy (EGLE) - Air Quality Division was present to observe the sampling and source operation.

II. PRESENTATION OF RESULTS

**II.1 TABLE 1
OXIDES OF NITROGEN (NO_x) EMISSION RESULTS
#4 RILEY BOILER (EU-RILEYBLR)
MICHIGAN SUGAR COMPANY
CROSWELL, MICHIGAN
DECEMBER 9, 2020**

Sample	Time	Air Flow Rate DSCFM ⁽¹⁾	NO _x Concentration PPM ⁽²⁾	NO _x Mass Emission Rates	
				Lbs/Hr ⁽³⁾	Lbs/MMBTU ⁽⁴⁾
1	09:13-10:13	27,347	74.1	14.48	0.101
2	10:24-11:24	26,871	73.9	14.19	0.101
3	11:34-12:34	26,945	73.3	14.11	0.100
Average		27,054	73.8	14.26	0.101

- (1) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 In. Hg).
- (2) PPM = Parts Per Million (v/v) On A Dry Basis
- (3) Lbs/Hr = Pounds of NO_x Per Hour
- (4) Lbs/MMBTU = Pounds Of NO_x Per Million BTU Of Heat Input (Calculated Using Equation 2.1 From U. S. EPA Method 19 With An F-Factor of 8710 DSCF/MMBTU).

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III. DISCUSSION OF RESULTS

III.1 NO_x Emissions – The NO_x emissions are summarized in Table 1 (Section II.1) as follows:

- Sample
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (Standard Temperature and Pressure = 68 °F and 29.92 Inches Hg)
- NO_x Concentration (PPM) – Parts Per Million (v/v) On A Dry Basis
- NO_x Emission Rates –
 - Lbs/Hr – Pounds of NO_x Per Hour
 - Lbs/MMBTU – Pounds of NO_x Per Million BTU of Heat Input (Calculated Using Equation 2.1 From U.S. EPA Method 19 With An F-Factor of 8710 DSCF/MMBTU)

IV. SOURCE DESCRIPTION

The #4 Riley Boiler is a natural gas-fired boiler with a rated capacity of a maximum gas flow of 179,000 SCFH and a steam output of 150,000 pounds per hour. The boiler was manufactured by Riley and is equipped with an economizer. Boiler 4 is used to provide process steam and heat to the facility. During the testing period, the boiler was operated at approximately 76.33% of capacity based on natural gas flow. Gas Flow data during the sampling can be found in Appendix B.

V. SAMPLING AND ANALYTICAL PROTOCOL

The sampling methods used for the reference method determinations were as follows:

V.1 Oxides of Nitrogen – The NO_x sampling was conducted in accordance with U.S. EPA Reference Method 7E. A Thermo Environmental Model 42H gas analyzer was used to monitor the boiler exhaust. A heated probe was used to extract the sample gases from the exhaust stack. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces

instantaneous readouts of the NO_x concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 191.0 PPM was used to establish the initial instrument calibration. Calibration gases of 101.0 PPM and 54.6 PPM were used to determine the calibration error of the analyzer. A direct injection of 50.3 PPM nitrogen dioxide (NO₂) was performed to show the conversion efficiency of the monitor. The conversion efficiency data can be found in Appendix C. The sampling system (from the back of the stack probe to the analyzer) was injected using the 101.0 PPM gas to determine the system bias. After each sample, a system zero and system injection of 101.0 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler. Three (3) samples, each sixty (60) minutes in duration were collected from the boiler exhaust. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis. A diagram of the NO_x sampling train is shown in Figure 1.

V.2 Oxygen & Carbon Dioxide – The O₂ & CO₂ sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Model 1400M portable stack gas analyzers were used to monitor the boiler exhaust. A heated probe was used to extract the sample gases from the stack. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzers. The analyzers produce instantaneous readouts of the O₂ & CO₂ concentrations (%).

The analyzers were calibrated by direct injection prior to the testing. Span gases of 21.0% O₂ and 21.04% CO₂ were used to establish the initial instrument calibrations. Calibration gases of 12.0% O₂/5.95% CO₂ and 6.06% O₂/11.9% CO₂ were used to determine the calibration error of the analyzers. The sampling system (from the back of the stack probe to the analyzer) was injected using the 6.06% O₂/11.9% CO₂ gas to determine the system bias. After each sample, a system zero and system injection of 6.06% O₂/11.9% CO₂ were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler. Three (3) samples, each sixty (60) minutes in duration were collected from the boiler exhaust. All the quality assurance and quality control procedures listed in the methods were incorporated in

the sampling and analysis. A diagram of the O₂ and CO₂ sampling train is shown in Figure 1

V.3 Exhaust Gas Parameters – The exhaust gas parameters (air flow rate, temperature, moisture and density) were determined in conjunction with the other sampling by employing U.S. EPA Methods 1 through 4.

Air flow rates were determined by conducting three (3) velocity traverses (one for each sample). Moisture was determined by conducting one (1) moisture sample. Gas density was calculated using the moisture, O₂ and CO₂ readings from the analyzers.

All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis. A diagram of the air flow sampling train is shown in Figure 2. A diagram of the moisture sampling train is shown in Figure 3.

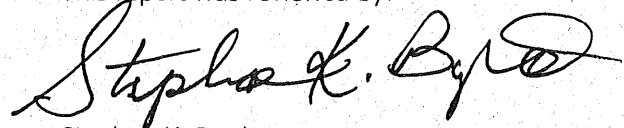
V.4 Sampling Locations – The sampling location for the boiler exhaust is on the 74.5 x 74.5 inch exhaust at a location approximately 5 duct diameter downstream and 2 duct diameters upstream from the nearest disturbances. Prior to the sampling (day before with the RATA) a three point stratification test (as described in U.S. EPA Method 7E) was performed for the exhaust stack. The stratification test showed no stratification (< 5%), so a single sampling point was used for the gas sampling. The results of the stratification tests can be found in Appendix C.

This report was prepared by:



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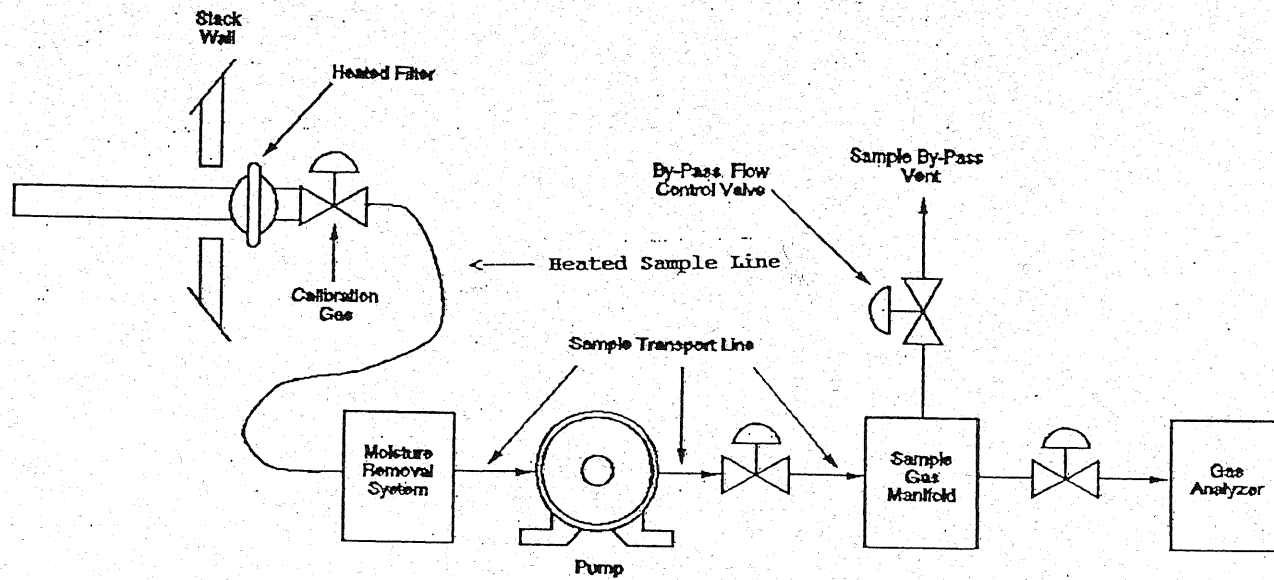
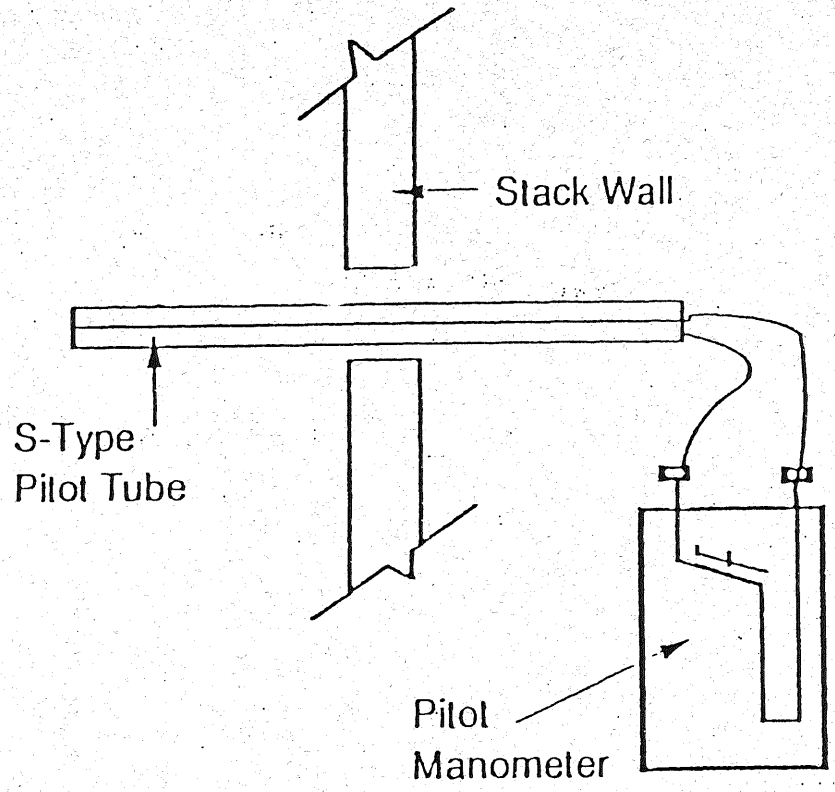


Figure 1

NO_x, O₂ & CO₂
Sampling Train



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Figure 2
Air Flow
Sampling Train

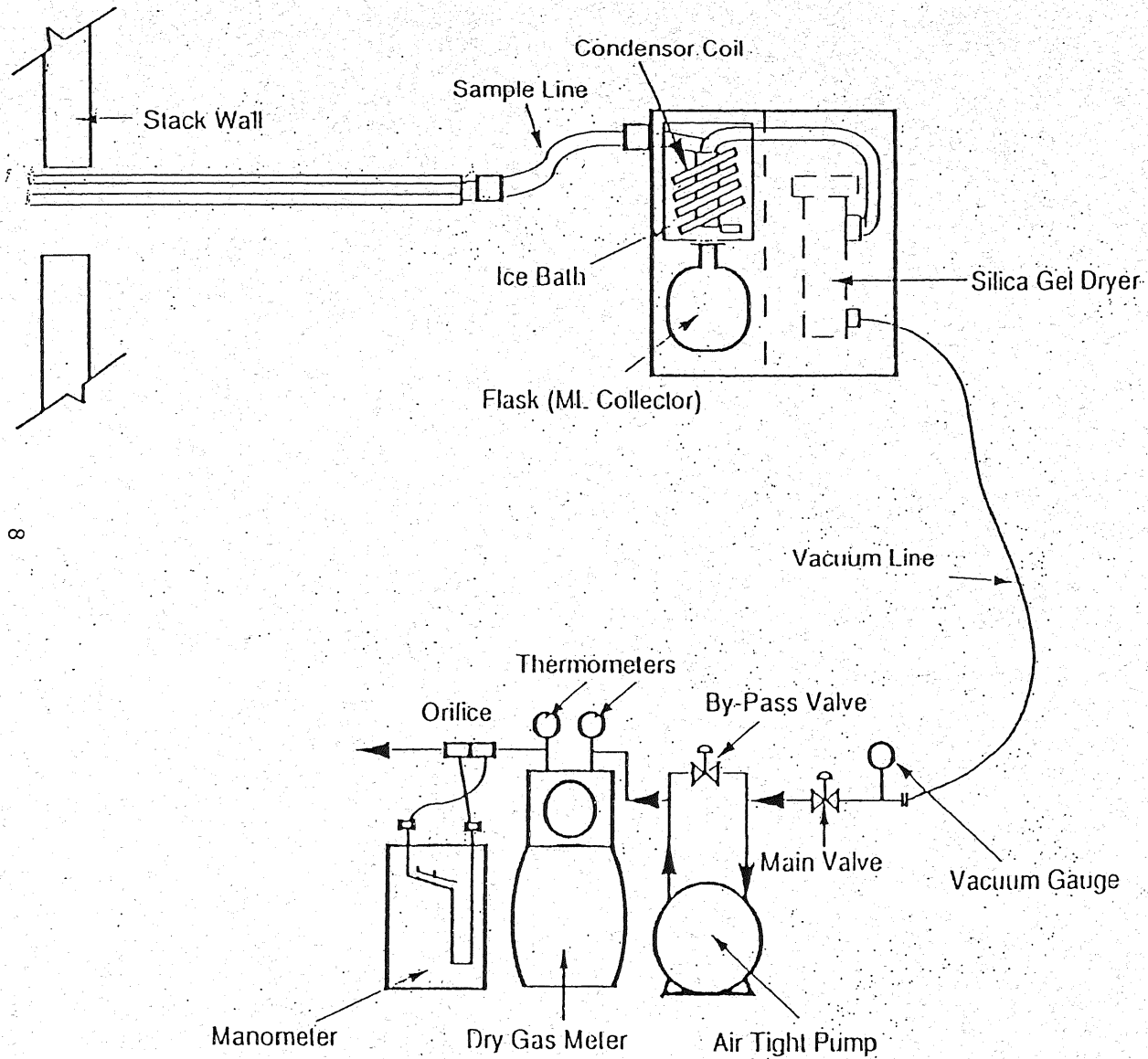


Figure 3
Moisture
Sampling Train