AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF AIR POLLUTANT EMIS
FROM A
NATURAL GAS FIRED BOILER

Prepared for:

OX Paperboard WP, LLC
SRN B2024

ICT Project No.: 2100167
May 18, 2022

IMPACT
COMPLIANCE & TESTING

Report Certification

AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF AIR POLLUTANT EMISSIONS
FROM A
NATURAL GAS FIRED BOILER

OX Paperboard WP, LLC
White Pigeon, Michigan

The material and data in this document were prepared under the supervision and direction of the undersigned.

Impact Compliance & Testing, Inc.

Tyler J. Wilson
Senior Project Manager

Table of Contents

List of Tables

List of Appendices

1.0 Introduction

OX Paperboard WP, LLC (OX), State Registration No. (SRN): B2024, currently operates one (1) natural gas fired boiler at its facility in White Pigeon, Saint Joseph County, Michigan. The boiler is fueled by pipeline natural gas and used to provide steam to EUPAPERMACHINE.

The steam generation equipment consists of:

- One (1) 96.3 MMBtu/hr natural gas fired boiler (EUBOILER#3).

The testing described in this report consisted of triplicate, one-hour sampling periods for nitrogen oxides (NOx) and carbon monoxide (CO), as required, for Boiler No. 3 (EUBOILER#3).

The compliance testing was performed by Impact Compliance & Testing, Inc. (ICT) representatives Tyler Wilson and Blake Beddow. The exhaust gas sampling and analysis was performed using procedures specified in the Stack Test Protocol dated March 16, 2022, that was submitted to and approved by EGLE-AQD in the approval letter dated April 6, 2022. Mr. Trevor Drost of EGLE-AQD was on-site to observe portions of the test event.

Questions regarding this air emission test report should be directed to:

Tyler J. Wilson
Senior Project Manager
Impact Compliance & Testing, Inc.
37660 Hills Tech Drive
Farmington Hills, MI 48331
Tyler.Wilson@ImpactCandT.com
Ph: (734) 357-8046

Mr. Clay Staley
Vice President, EHS
OX INDUSTRIES
15781 River Street
White Pigeon, MI 49099
cstaley@oxindustries.com
Ph: (309) 613-3189

2.0 Summary of Test Results and Operating Conditions

2.1 Purpose and Objective of the Tests

The conditions for EUBOILER#3 in ROP No. MI-ROP-B2024-2021 state:

Within 12 mon s of permit issuance, the permittee shall verify NOx and CO emission rates from EUBOILER#3 by testing at owner's expense, in accordance with the Department requirements.

2.2 Operating Conditions During the Compliance Tests

The testing was performed while EUBOILER#3 was operated at routine operating conditions. The boiler is operated with regards to steam demand (which is generally a much lower capacity than maximum load). The boiler operating load during this test event (37.6%) is considered representative for the steam demand at the time of testing. OX representatives recorded boiler load (kpph) and fuel use rate (kscfh) data at 15-minute intervals for each test period. These data are appended in Appendix 1.

Fuel use rate (kscfh) was also recorded by OX representatives at 15-minute intervals for each test period.

Appendix 1 provides operating records recorded by OX representatives for the test periods.

Table 2.1 presents a summary of the average boiler operating conditions during the test periods.

2.3 Summary of Air Pollutant Sampling Results

The gases exhausted from each boiler were sampled for three (3) one-hour test periods during the compliance testing performed April 19, 2022.

Table 2.2 presents the verage measured CO and NOx exhaust gas emission rates for EUBOILER#3 (average of the three t st periods) and applicable emission limits.

Results of the boiler performance tests demonstrate compliance with emission limits specified in ROP No. MI-ROP-B2024-2021.

Results and data for each one-hour sampling period are presented in Section 6.0 of this report.

Table 2.1 Average boiler operating conditions during the test periods

Emission Unit	Fuel Use (kscfh)	Boiler Load (kpph)
EUBOILER#3	41.7	28.2

Table 2.2 Average measured pollutant emission rates for EUBOILER#3 (three-test average)

Emission Unit	NOx Emissions (lb/MMBtu)	CO Emissions (lb/MMBtu)
EUBOILER#3	0.031	0.008
Permit Limit	*0.05*	*0.08*

3.0 Source and Sampling Location Description

3.1 General Process Description

OX currently operates one (1) natural gas fired steam boiler at its White Pigeon, Saint Joseph County, Michigan facility. The unit is identified in ROP No. MI-ROP-B2024-2021 as EUBOILER#3.

The boiler is fired exclusively with natural gas and provide steam to the facility for EUPAPERMACHINE. The boiler is typically operated at the required load to meet the steam demand of the facility. Therefore, the actual natural gas use rate is dependent on the steam requirement of the facility and is variable.

3.2 Rated Capacities and Air Emission Controls

The boiler tested during this test event (EUBOILER#3) is rated at 96.3 MMBtu/hr.

EUBOILER#3 is equipped with flue gas recirculation to reduce emissions. Exhaust gas is exhausted directly to atmosphere through a vertical exhaust stack.

3.3 Sampling Locations

The EUBOILER#3 exhaust gas stream is released to the atmosphere through a dedicated exhaust stack with a vertical release point.

The sampling ports for EUBOILER#3 are ocated in the vertical exhaust stack with an inner diameter of 53.5 inches. The sample ports provide a sampling location >192 inches (>3.59 duct diameters) upstream and >192 inches (3.59 duct diameters) downstream from any flow disturbance and satisfies the USEPA Method 1 criteria for a representative sample location.

Appendix 2 provides a diagram of the emission test sampling location.

4.0 Sampling and Analytical Procedures

A stack test protocol for the air emission testing was r viewed and approved by EGLE-AQD. This section provides a summary of the sampling and analytical procedures that were used during the testing periods.

4.1 Summary of Sampling Methods

USEPA Method 3A	Exhaust gas O_2 and CO_2 content was determined using paramagnetic and infrared instrumental analyzers, respectively.
USEPA Method 7E	Exhaust gas NOx concentration was determined using chemiluminescence instrumental analyzers.
USEPA Method 10	Exhaust gas CO concentration was measured using an infrared instrumental analyzer
USEPA Method 19	Mass emission rate calculation based on fuel F-factor

In addition to the USEPA Methods mentioned above, USEPA Methods 1, 2, and 4 were performed during this test event for informational purposes. Since USEPA Method 19 was used for mass emission rate calculations, the data measured for USEPA Methods 1, 2, and 4 was not needed for the emissions calculations presented in this report.

4.2 Exhaust Gas Molecular Weight Determination (USEPA Method 3A)

O_2 and CO_2 content in the boiler exhaust gas stream was measured continuously throughout each test period in accordance with USEPA Method 3A. The O_2 content of the exhaust was monitored using a Servomex Model 1440D gas analyzer that uses a paramagnetic sensor. The CO_2 content of the exhaust gas was monitored using a Servomex Model 1440D gas analyzer that uses an infrared sensor.

During each sampling period, a continuous sample of the boiler exhaust gas stream was extracted from the stack using a stainless-steel probe connected to a Teflon® heated sample line. The sampled gas was conditioned by removing moisture prior to being introduced to the analyzers; therefore, O_2 and CO_2 content measurements corresponds to standard dry gas conditions. Instrument response data were recorded using an ESC Model 8816 data acquisition system that monitored the analog output of the instrumental analyzer continuously and logged data as one-minute averages.

Prior to, and at the conclusion of each test, the instrument was calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document). Sampling times were recorded on field data sheets.

Appendix 3 provides a summary of exhaust gas O2 and CO2 content measurements. Raw instrument response data are provided in Appendix 4.

4.3 NO_x and CO Concentration Measurements (USEPA Methods 7E and 10)

NO_x and CO pollutant concentrations in the boiler exhaust gas stream were determined using a Thermo Environmental Instruments, Inc. (TEI) Model 42i High Level chemiluminescence NOx analyzer and a TEI Model 48i infrared CO analyzer.

A continuous sample of the boiler exhaust gas was delivered to the instrumental analyzers using the sampling and conditioning system described previously in this section. Prior to, and at the conclusion of each test, the instruments were calibrated using appropriate upscale calibration and zero gas to determine analyzer calibration error and system bias.

Appendix 3 provides CO and NO_x calculation sheets. Raw instrument response data are provided in Appendix 4.

4.4 Mass Emission Rate Calculations (USEPA Method 19)

The NO_x and CO mass emission rates (lb/MMBtu) were calculated using the measured concentrations and natural gas fuel F factor (ratio of combustion gas volume to heat input) as described in USEPA Method 19.

The fuel used in the boiler is pipeline natural gas, which has a published default F-factor in USEPA Method 19, Table 19-2. Exhaust gas oxygen content, NO_x and CO concentrations were each measured on a dry gas basis. Therefore, the NO_x and CO emission factor, E (lb/MMBtu) were calculated using Equation 19-1:

$E = (C_d) \times (F_d) \times (20.9) / (20.9 - \%O_2)$

E	=	Calculated emission factor, lb/MMBtu
C_d	=	Measured concentration, dry basis, lb/scf
F_d	=	8,710 dscf/MMBtu for natural gas
$\%O_2$	=	Measured oxygen content, dry basis, %vol.

The boiler exhaust gas flowrate was calculated using the calculated boiler heat input (as described in Section 3.2) utilizing USEPA Method 19 Equation 19-1:

$Q_d = F_d * H * 20.9 / (20.9 - \%O_2) / 60$ min/hr

Q_d	=	Calculated flowrate, dscfm
H	=	Boiler heat input, MMBtu/hr
F_d	=	8,710 dscf/MMBtu for natural gas
$\%O_2$	=	Measured oxygen content, dry basis, %vol.

The heat input (MMBtu/hr) of the boiler was calculated using the measured natural gas use rate (scf/hr) and the higher heat content (HHV) of the fuel. The fuel used in the boiler is pipeline-quality natural gas which has a published heating value (e.g., 40 CFR Part 98 Table C-1). The default heating value for natural gas is 1.026E-03 MMBtu/scf.

Boiler Heat Input (MMBtu/hr) = fuel use (scf/hr) * (1.026E-3 MMBtu/scf)

5.0 QA/QC Activities

5.1 NO_x Converter Efficiency Test (USEPA Method 7E)

The NO_2 – NO conversion efficiency of the TEI Model 42i analyzer was verified prior to the testing program. A USEPA Protocol 1 certified concentration of NO_2 was injected directly into the analyzer, following the initial three-point calibration, to verify the analyzer's conversion efficiency. The analyzer's NO_2 – NO converter uses a catalyst at high temperatures to convert the NO_2 to NO for measurement. The conversion efficiency of the instrumental analyzer will be deemed acceptable if the measured NOx concentration is at least 90% of the expected value (within 10%).

The NO_2 – NO conversion efficiency test satisfied the USEPA Method 7E criteria (measured NO_x concentration was 99.9% of the expected value).

5.2 Gas Divider Certification (USEPA Method 205)

A STEC Model SGD-710C 10-step gas divider was used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified (within the last 12 months) with a primary flow standard in accordance with Method 205. When cut with an appropriate zero gas, the ten-step STEC gas divider delivered calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas that was introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 were followed prior to use of gas divider. The field evaluation yielded no errors greater than 2% of the triplicate measured average and no errors greater than 2% from the expected values.

5.3 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure NO_X, CO, O_2, and CO_2 have had an interference response test preformed prior to their use in the field, pursuant to the interference response test procedures specified in USEPA Method 7E. The appropriate interference test gases (i.e., gases that would be encountered in the exhaust gas stream) were introduced into each analyzer, separately and as a mixture with the analyte that each analyzer is designed to measure. All of analyzers exhibited a composite deviation of less than 2.5% of the span for all measured interferent gases. No major analytical components of the analyzers have been replaced since performing the original interference tests.

5.4 Instrument Calibration and System Bias Checks

At the beginning of each day of the testing program, initial three-point instrument calibrations were performed for the NO_x, CO, CO_2, and O_2 analyzers by injecting calibration gas directly into the inlet sample port for each instrument. System bias checks were performed prior to and at the conclusion of each sampling period by introducing the upscale calibration gas and zero gas into the sampling system (at the base of the stainless-steel sampling probe prior to the particulate filter and Teflon® heated sample line) and determining the instrument response against the initial instrument calibration readings.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO_2, O_2, NO_x, and CO in nitrogen and zeroed using hydrocarbon free nitrogen. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

5.5 Determination of Exhaust Gas Stratification

A stratification test for each boiler exhaust stack was performed during the first performance test sampling period. The stainless-steel sample probe was positioned at sample points correlating to 16.7, 50.0 (centroid), and 83.3% of the stack diameter. Pollutant concentration data were recorded at each sample point for a minimum of twice the maximum system response time.

The recorded data for the boiler exhaust stack gas indicates that the measured CO_2 and O2 concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the boiler stack gas was considered to be non-stratified, and the compliance test sampling was performed at a single sampling location within the boiler exhaust stack.

Appendix 5 presents test equipment quality assurance data (NO_2 – NO conversion efficiency test data, instrument calibration and system bias check records, calibration gas and gas divider certifications, interference test results, stratification checks, and field equipment calibration records).

6.0 Results

6.1 Test Results and Allowable Emission Limits

Boiler operating data and air pollutant emission measurement results for each one-hour test period are presented in Table 6.1.

Testing was performed to demonstrate compliance with the following air pollutant emission limits specified in ROP No. MI-ROP-B2024-2021 for the boiler:

Emission Unit	CO lb/MMBtu	NOx lb/MMBtu
EUBOILER#3	0.08	0.05

The measured CO and NOx exhaust gas concentrations and emission rates for the boiler demonstrate compliance with and are less than the limits specified in ROP No. MI-ROP-B2024-2021.

6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with USEPA methods and the approved stack test protocol.

The EUBOILER#3 exhaust gas flowrate was measured in the exhaust stack at the sampling location, using USEPA Method 2, for informational purposes.

Table 6.1 Measured exhaust gas conditions and air pollutant emission rates for Boiler No. 3 (EUBOILER#3)

Test No. Test date Test period (24-hr clock)	1 4/19/2022 0722-0822	2 4/19/2022 0836-0936	3 4/19/2022 0949-1049	Three Test Average
Boiler Operating Parameters				
Boiler Load (kpph)	29.4	28.9	26.2	28.2
Fuel Use Rate (kscfh)	43.2	41.6	40.3	41.7
Exhaust Gas Composition				
CO_2 content (% vol)	8.90	8.90	8.92	8.91
O_2 content (% vol)	6.13	6.11	6.10	6.11
Exhaust gas flowrate (dscfm)[1]	9,095	8,758	8,470	8,775
Exhaust gas flowrate (dscfm)[2]	9,713	9,229	9,169	9,370
Nitrogen Oxides				
NO_X conc. (ppmvd)	21.5	21.0	21.0	21.2
NO_X emissions (lb/MMBtu)	0.032	0.031	0.031	0.031
Permit Limit (lb/MMBtu)	-	-	-	*0.05*
Carbon Monoxide				
CO conc. (ppmvd)	8.96	8.92	8.35	8.75
CO emissions (lb/MMBtu)	0.008	0.008	0.007	0.008
Permit Limit (lb/MMBtu)	-	-	-	*0.08*

Notes:
1. Exhaust gas flowrate calculated using USEPA Method 19.
2. Exhaust gas flowrate measured in exhaust stack, using USEPA Method 2, for informational purposes.

APPENDIX 1

- Boiler Operating Records

Natural Gas Fueled Boiler
Process Operating Data

Facility: OX
Location: White Pigeon, MI
Date: 4/19/2022
Unit ID: Boiler No. 3

Date	Boiler No. 3	Test #	Boiler Load (kpph)	Fuel Use Rate (kscfh)
4/19/2022	7:22	1	30.0	45.6
	7:37	1	30.9	44.1
	7:52	1	29.6	42.7
	8:07	1	28.9	41.1
	8:22	1	27.8	42.3

Date	Boiler No. 3	Test #	Boiler Load (kpph)	Fuel Use Rate (kscfh)
4/19/2022	8:36	2	29.3	41.0
	8:51	2	29.6	42.8
	9:06	2	27.4	40.9
	9:21	2	30.9	41.9
	9:36	2	27.2	41.4

Date	Boiler No. 3	Test #	Boiler Load (kpph)	Fuel Use Rate (kscfh)
4/19/2022	9:49	3	28.0	41.4
	10:04	3	27.4	40.7
	10:19	3	25.2	39.5
	10:34	3	25.0	39.3
	10:49	3	25.4	40.5

RECEIVED
MAY 25 2022
AIR QUALITY DIVISION

Natural Gas Fueled Boiler Process Operating Data

Facility Name: OX
Location: White Pigeon, MI
Test Date: 4/19/2022

Boiler ID: Boiler No. 3

TEST NO. 1
Start Time: 7:22

	Boiler Load (KPPH)	Boiler Natural Gas Use (KSCFH)			
0 min	30.0	45.6			
15 min	~~29.1~~ 30.9	~~43.6~~ 44.1			
30 min	29.6	42.7			
45 min	28.9	41.1			
60 min	27.8	42.3			

Stop Time: 8:22

TEST NO. 2
Start Time: 8:36

	Boiler Load	Boiler Natural Gas Use			
0 min	29.3	41.0			
15 min	29.6	42.8			
30 min	27.4	40.9			
45 min	30.9	41.9			
60 min	27.2	41.4			

Stop Time: 9:36

TEST NO. 3
Start Time: 9:49

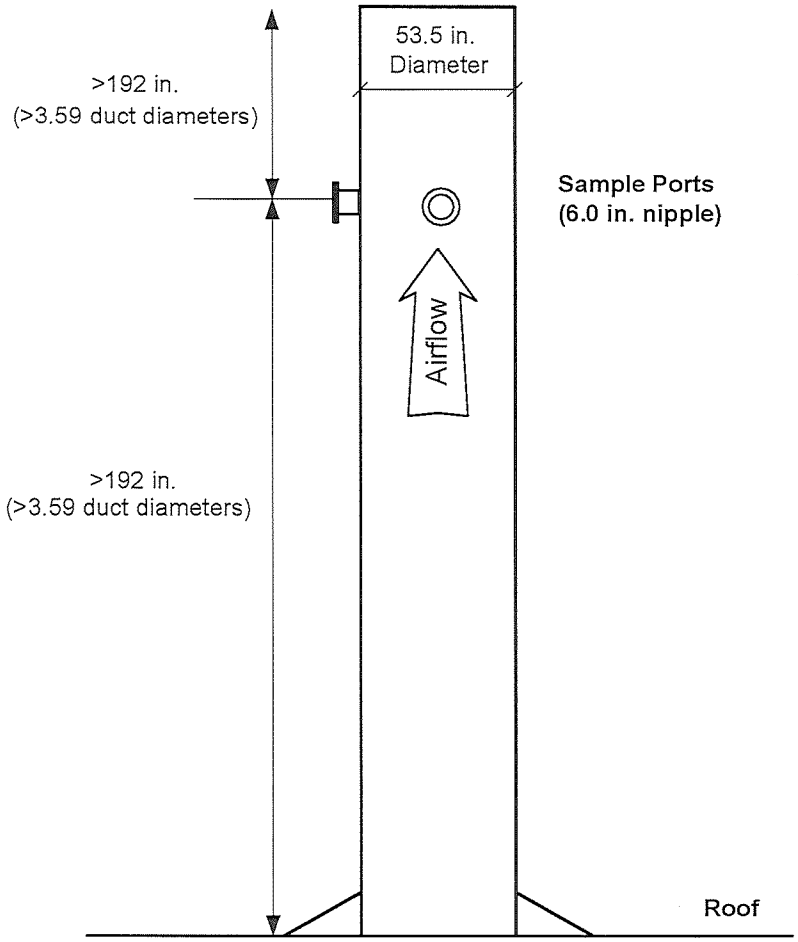
	Boiler Load	Boiler Natural Gas Use			
0 min	28.0	41.4			
15 min	27.4	40.7			
30 min	25.2	39.5			
45 min	25.0	39.3			
60 min	25.4	40.5			

Stop Time: 10:49

Operator Initials: KLK

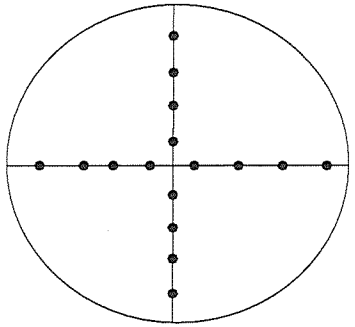
APPENDIX 2

- Boiler Exhaust Stack Diagram



Boiler #3 Sampling and Measurement Locations

Stack Diameter 53.5 in.



Traverse Points

Sampling Point	Distance from Stack Wall (in.)
1	1.7
2	5.6
3	10.4
4	17.2
5	36.2
6	43.1
7	47.9
8	51.8

OX Paperboard WP, LLC Boiler #3
Sampling Location Diagram

Scale	Sheet
None	1 of 1

IMPACT COMPLIANCE + TESTING