Derenzo Environmental Services
Consulting and Testing

EMISSION TEST REPORT

Report Title	TEST REPORT FOR THE VERIFICATION OF CARBON MONOXIDE EMISSIONS FROM A COAL FIRED BOILER
Report Date:	August 24, 2016
Test Dates	July 26-27, 2016

Facility Information	
Name Street Address City, County Phone	Neenah Paper Michigan, Inc. 501 E. Munising Avenue Munising, Alger (906) 387-7561

Facility Permit Information	
Permit To Install No.:	PTI 24-15
Operating Permit No.:	MI-ROP-B1470-2013a

Testing Contractor	
Company Mailing Address Phone Project No.	Derenzo Environmental Services 39395 Schoolcraft Road Livonia, Michigan 48150 (734) 464-3880 1604015

TEST REPORT FOR THE VERIFICATION OF CARBON MONOXIDE EMISSIONS FROM A COAL-FIRED BOILER

NEENAH PAPER MICHIGAN, INC.
MUNISING, MICHIGAN

1.0 INTRODUCTION

Neenah Paper Michigan, Inc. (Neenah Paper) has received a State of Michigan Permit to Install (PTI No. 24-15 issued April 20, 2015) and State of Michigan Renewable Operating Permit (ROP No. MI-ROP-B1470-2013a issued January 7, 2013) from the Michigan Department of Environmental Quality, Air Quality Division (MDEQ-AQD) for the operation of its fine paper and technical product manufacturing processes located in Munising, Alger County, Michigan.

Neenah Paper recently installed a sorbent dry absorber (SDA) to reduce air pollutant emissions from its coal-fired boiler that is identified in the permit as Boiler #1 and Emission Unit EU05. This test report presents the results for carbon monoxide (CO) emission measurements in the Boiler #1 exhaust gas following startup of the SDA. In addition, Neenah Paper collected boiler fuel samples (coal) during the test event that were analyzed for sulfur and chloride content and gross heating value.

The CO emission testing was performed by Derenzo Environmental Services (DES), a Michigan-based environmental consulting and testing company. DES representatives Tyler Wilson and Blake Beddow performed the field sampling and measurements on August 26-27, 2016.

The CO exhaust gas sampling and analysis was performed in accordance with the approved Test Plan dated June 7, 2016. The other air contaminant emissions included in the test plan (particulate matter, hydrogen chloride, and certain metals; arsenic, barium, chromium, lead, manganese, and phosphorus) will be tested at a later date.

Questions regarding this emission test report should be directed to:

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Ms. Natalie Kentner
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Report Certification

This test report was prepared by Derenzo Environmental Services based on field sampling data collected by DES. Facility process data were collected and provided by Neenah Paper employees or representatives. This test report has been reviewed by Neenah Paper representatives and approved for submittal to the MDEQ-AQD.

I certify that the testing was conducted in accordance with the specified test methods and submitted test plan unless otherwise specified in this report. I believe the information provided in this report and its attachments are true, accurate, and complete.

Report Prepared By:	Reviewed By:
Blake Beddow	Robert L. Harvey, P.E.
Environmental Consultant	General Manager
Derenzo Environmental Services	Derenzo Environmental Services

I certify that the facility and emission units were operated at the conditions specified in this test report and as presented in the operating data provided by Neenah Paper. Based on information and belief formed after reasonable inquiry, the statements and information in this report are true, accurate and complete.

Responsible Official Certification:

Natalie Kentner
Environmental Engineer
Neenah Paper Michigan, Inc.

2.0 SUMMARY OF TEST RESULTS AND OPERATING CONDITIONS

2.1 Purpose and Objective of the Tests

The provisions of 40 CFR Part 63, Subpart JJJJJ (area source boiler GACT) specify that existing coal-fired burners with a heat input capacity of 10 MMBtu/hr or greater that do not meet the definition of a limited-use boiler are required to demonstrate compliance with a CO emission limit of 420 ppm by volume on a dry basis corrected to 3 percent oxygen (ppmvd at 3% O_2).

2.2 Summary of Air Pollutant Sampling Results

The gases exhausted from Boiler #1 were sampled for six (6) one-hour test periods; three (3) during high load operating conditions and three (3) during low load operating conditions.

Table 2.1 presents a summary of the average CO emissions and operating conditions for each operating load.

The data presented in Table 2.1 are the average of the three test periods at each condition. The average measured CO concentration is less than the area source boiler GACT limit of 420 ppmvd at 3% O_2. Test results for each one-hour sampling period are presented in Tables 6.1 and 6.2.

Table 2.1 Average pollutant emissions and operating conditions during the test periods

Parameter	Boiler #1 (High Load)	Boiler #1 (Low Load)	Permit Limit
Steam Generated (kpph)	138	81.9	-
Coal Feed Rate (ton/hr)	6.7	3.8	-
Boiler Oxygen Content (%)	7.2	9.1	-
Opacity Monitor (%)	2.1	1.5	-
Spray Dry Reagent Flow Rate (gpm)	8.8	3.8	-
CO Emission Rate (lb/MMBtu)	0.0365	0.0402	-
CO Concentration (ppmvd @ 3% O_2)	40.3	42.1	420

kpph; thousand pounds per hour

3.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

3.1 General Process Description

Neenah Paper operates a boiler (Boiler #1) capable of burning coal and natural gas that provides steam for electricity generation and heat to support the paper production processes. The boiler is equipped with a baghouse to control particulate emissions and SDA to control hazardous air pollutant emissions. The boiler is identified as Emission Unit EU05 in PTI No. 24-15 and MI-ROP-B1470-2013a.

3.2 Rated Capacities and Air Emission Controls

Boiler #1 is a spreader stoker coal-fired boiler that has a rated heat input rate of 202 MMBTU/hour and an average throughput of 130 tons per day (tons/day) coal. Boiler #1 has a maximum output of 150,000 pounds steam per hour and typically operates at approximately 125,000 pounds steam per hour.

Two (2) coal scales measure and regulate coal supply to Boiler #1. The process operations are monitored and controlled by programmable controllers. The unit operates continuously and is only taken offline during periodic weekends and annual preventative maintenance. Each coal dump releases 200 lb. of fuel to the boiler.

The exhaust gas from Boiler #1 is directed to a baghouse for PM emission reduction and the SDA system for the reduction of SO_2, and HCl. The SDA exhaust gas is exhausted to atmosphere through stack SV05.

3.3 Sampling Locations

The SDA and baghouse exhaust gas is directed through a vertical exhaust stack (SV05) with a vertical release point to the atmosphere.

The exhaust stack sampling ports for Boiler #1 (EU05) are located in an individual exhaust stack with an inner diameter of 84 inches. The stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location 156 inches (1.9 duct diameters) upstream and 480 inches (5.7 duct diameters) downstream from any flow disturbance and satisfies USEPA Method 1 criteria for a representative sample location.

Individual traverse points were determined in accordance with USEPA Method 1.

Appendix 1 provides diagrams of the emission test sampling locations.

3.4 Operating Conditions During the Compliance Tests

The CO emission tests were performed at two Boiler #1 operating conditions:

- High load; in which steam production ranged from 136,100 to 141,100 pounds per hour
- Low load; in which steam production ranged from 80,400 to 83,000 pounds per hour.

Appendix 2 provides operating records provided by Neenah Paper representatives for the test periods.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A test protocol for the air emission testing was reviewed and approved by the MDEQ-AQD. This section provides a summary of the sampling and analytical procedures that were used during the Neenah Paper Boiler #1 test periods.

4.1 Summary of Sampling Methods

USEPA Method 1	Exhaust gas velocity measurement locations were determined based on the physical stack arrangement and requirements in USEPA Method 1
USEPA Method 2	Exhaust gas velocity pressure was determined using a Type-S Pitot tube connected to a red oil incline manometer; temperature was measured using a K-type thermocouple connected to the Pitot tube.
USEPA Method 3A	Exhaust gas O_2 and CO_2 content was determined using zirconia ion/paramagnetic and infrared instrumental analyzers, respectively.
USEPA Method 4	Exhaust gas moisture was determined based on the water weight gain in chilled impingers.
USEPA Method 10	Exhaust gas CO concentration was measured using an NDIR instrumental analyzer

4.2 Sampling Locations (USEPA Method 1)

The location of the sample ports meets the USEPA Method 1 criteria for a representative sample location. The inner diameter of the duct is 84 inches. The stack is equipped with two (2) sample ports, opposed 90°, that provided a sampling location 156 inches (1.9 duct diameters) upstream and 480 inches (5.7 duct diameters) downstream from any flow disturbance.

Appendix 3 presents the Method 1 field measurement sheet.

4.3 Exhaust Gas Velocity Determination (USEPA Method 2)

The boiler exhaust stack gas velocity and volumetric flow rate were determined using USEPA Method 2 during one run at each operating load. An S-type Pitot tube connected to a red-oil manometer was used to determine velocity pressure at each traverse point across the stack cross section. Gas temperature was measured using a K-type thermocouple mounted to the Pitot tube.

Appendix 3 provides exhaust gas flowrate calculations and field data sheets.

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

CO_2 and O_2 content in the boiler exhaust gas stream was measured continuously throughout each test period in accordance with USEPA Method 3A. The CO_2 content of the exhaust was monitored using a Servomex 1440D single beam single wavelength (SBSW) infrared gas analyzer. The O_2 content of the exhaust was monitored using a Servomex 1440D gas analyzer that uses a paramagnetic 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, measurement of O_2 and CO_2 concentrations correspond 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 analyzers continuously and logged data as one-minute averages.

Prior to, and at the conclusion of each test, the instruments were 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 4 provides O_2 and CO_2 calculation sheets. Raw instrument response data are provided in Appendix 5.

4.5 Exhaust Gas Moisture Content (USEPA Method 4)

Moisture content of the boiler exhaust gas was determined in accordance with USEPA Method 4 using a chilled impinger sampling train. The moisture sampling was performed concurrently with the instrumental analyzer sampling. During one sampling period for each operating load a gas sample was extracted at a constant rate from the source where moisture was removed from the sampled gas stream using impingers that were submersed in an ice bath. At the conclusion of each sampling period, the moisture gain in the impingers was determined gravimetrically by weighing each impinger to determine net weight gain.

4.6 CO Concentration Measurements (USEPA Method 10)

CO pollutant concentration in the boiler exhaust gas stream was determined using a Thermo Environmental Instruments, Inc. (TEI) Model 48i infrared CO analyzer.

Throughout each test period, a continuous sample of the boiler exhaust gas was extracted from the stack using the Teflon® heated sample line and gas conditioning system and delivered to the instrumental analyzers. Instrument response for each analyzer was recorded on an ESC Model 8816 data acquisition system that logged data as one-minute averages. Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias.

Appendix 4 provides CO calculation sheets. Raw instrument response data are provided in Appendix 5.

5.0 QA/QC ACTIVITIES

5.1 Exhaust Gas Flow

Prior to arriving onsite, the instruments used during the source test to measure exhaust gas properties and velocity (barometer, pyrometer, and Pitot tube) were calibrated to specifications outlined in the sampling methods.

The Pitot tube and connective tubing were leak-checked prior to each traverse to verify the integrity of the measurement system.

The absence of significant cyclonic flow for the exhaust configuration was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each velocity traverse point with the planes of the face openings of the Pitot tube perpendicular to the stack cross-sectional plane. The Pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

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 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 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, 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 was performed for the boiler exhaust stack. 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 concentration data for the boiler exhaust stack indicated that the measured O_2 and CO_2 concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the boiler exhaust gas was considered to be unstratified and the compliance test sampling was performed at a single sampling location within the boiler exhaust stack.

6.0 TEST RESULTS

6.1 Coal Properties and Use Rate

Neenah Paper provided analytical reports for coal samples that were representative of the coal used during the test periods. The analytical results indicated that the coal had a heat content (gross calorific value, GCV) of approximately 13,500 Btu/lb.

The coal analytical results are presented in Appendix 7.

The amount of coal used during each test period was determined by the number of coal dumps for each one-hour period (each coal dumps contains 200 pounds). The boiler used approximately 6.7 tons/hr coal at high load and 3.8 tons/hr at low load.

6.2 Boiler Exhaust Test Results and Allowable Emission Limits

Operating data and air pollutant emission measurement results for each one hour test period are presented in tables 6.1 and 6.2.

For the tests performed at high load conditions (136,100 to 141,100 pounds steam per hour) the average fuel (coal) heat input rate was 182 MMBtu/hr. The measured exhaust gas CO concentration was 40.3 ppmvd corrected to 3% O_2 and resulted in a calculated CO mass emission rate equivalent to 0.0365 lb/MMBtu.

For the test performed at low load conditions (80,400 to 83,300 pounds steam per hour) the average fuel (coal) heat input rate was 102 MMBtu/hr. The measured exhaust gas CO concentration was 42.1 ppmd corrected to 3% O_2 and resulted in a calculated CO mass emission rate equivalent to 0.0402 lb/MMBtu.

The measured CO pollutant emissions for Boiler #1 are less than the allowable limits specified in 40 CFR Part 63, Subpart JJJJJJ – Table 4, which is 420 ppmvd corrected to 3% O_2.

6.3 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with USEPA methods and the approved test protocol dated June 7, 2016. The facility was operated normally during the test periods as described in this report.

Table 6.1 Measured exhaust gas conditions and CO air pollutant emissions for High Load Boiler #1 exhaust at Neenah Paper

Test No. Test Date Test Period (24-hr clock)	1 7/26/16 11:50-12:50	2 7/26/16 13:14-14:14	3 7/26/16 14:45-15:45	Three Test Average
Steam Generated (kpph)	136.5	139.1	138.8	138.1
Coal Feed Rate (ton/hr)	6.5	6.9	6.7	6.7
Heat Input Rate (MMBtu/hr)	175	187	183	182
Boiler Oxygen Content (%)	7.3	7.2	7.3	7.2
Opacity Monitor (%)	2.1	2.1	2.0	2.1
Reagent Flow Rate (gpm)	8.8	8.7	9.0	8.8
Exhaust Gas Flowrate (dscfm)	54,457	54,457	54,457	54,457
Exhaust Gas Composition				
CO_2 content (%)	11.1	11.3	11.1	11.2
O_2 content (%)	8.60	8.39	8.67	8.56
Carbon Monoxide Emissions				
CO concentration (ppmvd)	31.0	23.5	28.9	27.8
CO conc. (ppmvd @ 3% O_2)	45.1	33.6	42.3	40.3
Permitted limit (ppmvd @ 3% O_2)		-	-	*420*
CO emissions (lb/hr)	7.37	5.58	6.88	6.61
CO emissions (lb/MMbtu)	0.0421	0.0299	0.0376	0.0365

Table 6.2 Measured exhaust gas conditions and CO air pollutant emissions for Low Load Boiler #1 exhaust at Neenah Paper

Test No. Test Date Test Period (24-hr clock)	1 7/27/16 08:00-09:00	2 7/27/16 09:20-10:20	3 7/27/16 10:40-11:40	Three Test Average
Steam Generated (kpph)	81.7	81.6	82.4	81.9
Coal Feed Rate (ton/hr)	3.7	3.7	3.9	3.8
Heat Input Rate (MMBtu/hr)	99.2	100	106	102
Boiler Oxygen Content (%)	9.0	9.0	9.1	9.1
Opacity Monitor (%)	1.4	1.5	1.8	1.5
Reagent Flow Rate (gpm)	3.7	3.9	4.0	3.8
Exhaust Gas Flowrate (dscfm)	37,960	37,960	37,960	37,960
Exhaust Gas Composition				
CO_2 content (%)	9.76	9.64	9.67	9.69
O_2 content (%)	10.4	10.5	10.5	10.4
Carbon Monoxide Emissions				
CO concentration (ppmvd)	25.7	26.2	22.0	24.6
CO conc. (ppmvd @ 3% O_2)	43.5	45.1	37.8	42.1
Permitted limit (ppmvd @ 3% O_2)		-	-	*420*
CO emissions (lb/hr)	4.25	4.34	3.65	4.08
CO emissions (lb/MMbtu)	0.0429	0.0434	0.0345	0.0402