mostardi platt

Relative Accuracy Test Audit Test Report

Billerud Quinnesec LLC
Quinnesec Mill
Package Boiler Outlet Duct, Waste Fuel Boiler Outlet Duct, Recovery Boiler Outlet Duct, and Lime Kiln Stack
Quinnesec, Michigan
Test Dates: May 9 through 11, 2023

Report Submittal Date
June 16, 2023

Project No. M231804B

Corporate Headquarters
888 Industrial Drive
Elmhurst, Illinois 60126
630-993-2100

Crown Point, IN | Mendota Heights, MN | Denver, CO | Henderson, NV

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1.0 EXECUTIVE SUMMARY

Mostardi Platt conducted a Relative Accuracy Test Audit (RATA) test program for Billerud Quinnesec LLC at the Quinnesec, Michigan facility. This report summarizes the results of the test program and test methods used.

The test locations, test dates, and test parameters are summarized below.

TEST INFORMATION		
Test Locations	**RATA Test Dates**	**Test Parameters**
Package Boiler Outlet Duct	May 10, 2023	Nitrogen Oxides (NO_X), Carbon Monoxide (CO), and Oxygen (O_2)
Waste Fuel Boiler Outlet Duct	May 11, 2023	NO_X, Sulfur Dioxide (SO_2), Carbon Dioxide (CO_2), O_2, and Volumetric Flow
Recovery Boiler Outlet Duct	May 10 and 11, 2023	NO_X, SO_2, O_2, CO, Total Reduced Sulfur (TRS), and Volumetric Flow
Lime Kiln Stack	May 9 and 10, 2023	TRS and O_2

The purpose of the test program was to demonstrate the relative accuracy of the parameters listed above. Selected results of the test program are summarized below. A complete summary of emission test results, for each location, follows the narrative portion of this report.

TRS results were corrected to eight percent O_2 on the Recovery Boiler and ten percent O_2 on the Lime Kiln.

PACKAGE BOILER OUTLET DUCT				
Date	**Parameter**	**Units**	**Acceptance Criteria**	**Relative Accuracy**
5/10/2023	NO_X	lb/mmBtu	< 20% of the mean reference method value	12.92%
	NO_X	lb/hr	< 20% of the mean reference method value	1.08%
	O_2	% dry	< 20% of the mean reference method value	2.34%
	CO	lb/mmBtu	< 10% of the mean reference method value	0.00%
	CO	ppm	< 5 ppm mean difference + confidence coefficient	0.55 ppm mean difference + confidence coefficient
	CO	lb/hr	< 5% of applicable standard of 25.5 lb/hr	0.29% of applicable standard of 25.5 lb/hr

Also note that this RATA serves as a portion of the initial certifications for a new Waste Fuel Boiler SO2 analyzer (Thermo 43iQ, SN 1180930080), which was installed on 4/25/2021, and a new Recovery Furnace flue gas flow meter (OSI OFS2000-W, SN 15110807E), which was installed on 4/26/23 – the additional certification requirements for these analyzers will be included in the 2nd Quarter 2023 CEMS/COMS Excess Emission and Quality Assurance Report.

WASTE FUEL BOILER OUTLET DUCT				
Date	**Parameter**	**Units**	**Acceptance Criteria**	**Relative Accuracy**
5/11/2023	NO_X	lb/mmBtu	< 20% of the mean reference method value	10.49%
	NO_X	lb/hr	< 20% of the mean reference method value	15.60%
	CO_2	% dry	< 20% of the mean reference method value	0.63%
	O_2	% dry	< 20% of the mean reference method value	3.98%
	SO_2	lb/mmBtu	< 10% of applicable standard of 1.2 lb/mmBtu	8.33% of applicable standard of 1.2 lb/mmBtu
	SO_2	lb/hr	< 10% of applicable standard of 476 lb/hr	5.16% of applicable standard of 476 lb/hr
	Volumetric Flow	dscfm	< 20% of the mean reference method value	5.85%

RECOVERY BOILER OUTLET DUCT				
Date	**Parameter**	**Units**	**Acceptance Criteria**	**Relative Accuracy**
5/10/2023	NO_X	ppmvd @ 8% O_2	< 20% of the mean reference method value	3.61%
	O_2	% dry	< 20% of the mean reference method value	3.35%
	SO_2	ppmvd @ 8% O_2	< 10% of applicable standard of 50 ppmvd@ 8% O_2	0.45% of applicable standard of 50 ppmvd@ 8% O_2
	CO	ppmvd @ 8% O_2	< 5% of applicable standard of 500 ppmvd@ 8% O_2	0.33% of applicable standard of 500 ppmvd@ 8% O_2
5/11/2023	TRS	ppmvd @ 8% O_2	≤ 10.0% of App. Standard of 5 ppmvd @ 8% O_2	4.42% of App. Standard of 5 ppmvd @ 8% O_2
5/9/2023	Volumetric Flow	dscfm	< 20% of the mean reference method value	5.68%

LIME KILN STACK				
Date	**Parameter**	**Units**	**Acceptance Criteria**	**Relative Accuracy**
5/9/2023 & 5/10/2023	TRS	ppmvd @ 10% O_2	< 20% of the mean reference method value	9.70%
	O_2	% dry	< 20% of the mean reference method value	12.93%

The gas cylinders used to perform the RATA are summarized below.

GAS CYLINDER INFORMATION				
Parameter	**Gas Vendor**	**Cylinder Serial Number**	**Cylinder Value**	**Expiration Date**
NO_X	Airgas	CC82975	124.3 ppm	4/5/2030
NO_X	Airgas	CC14792X	241.5 ppm	2/19/2029
SO_2	Airgas	CC502390	49.95 ppm	2/28/2031
SO_2	Airgas	CC310555	90.56 ppm	2/26/2030
SO_2	Airgas	CC1505161	254.3 ppm	10/29/2027
SO_2	Airgas	CC500227	482.4 ppm	12/13/2024
O_2	Airgas	EB0162279	10.14%	3/21/2031
O_2	Airgas	CC743660	19.35%	6/18/2029
O_2	Airgas	CC12390	5.064%	3/11/2030
O_2	Airgas	CC431939	9.034%	3/21/2030
CO_2	Airgas	EB0162279	9.743%	3/21/2031
CO_2	Airgas	CC743660	18.76%	6/18/2029
CO	Airgas	CC445058	250.7 ppm	6/21/2030
CO	Airgas	CC194994	434.0 ppm	3/23/2030
CO	Airgas	CC713835	920.9 ppm	8/12/2027

The identifications of the individuals associated with the test program are summarized below.

Location	**Address**	**Contact**
Test Facility	Billerud Quinnesec LLC W-679 U. S. Highway 2 Quinnesec, Michigan 49876	Ms. Paula LaFleur Environmental Engineer (906) 779-3494 (phone) paula.lafleur@billerud.com
Testing Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Mr. Daniel Kossack Project Manager (630) 993-2100 (phone) dkossack@mp-mail.com

The test crew consisted of Messrs. C. Trezak, M. Sather, V. Vang, and D. Kossack of Mostardi Platt.

2.0 TEST METHODOLOGY

Emissions testing was conducted following the methods specified in 40CFR, Part 40 CFR, Part 60, Appendix A. Schematics of the test section diagrams and sampling trains used are included in Appendix A and B, respectively. Copies of example calculation and nomenclature are included in Appendix C. Copies of analyzer print-outs for each test run are included in Appendix D. CEM data and process data as provided by Billerud Quinnesec, LLC are included in Appendix E.

The following methodologies were used during the test program:

Method 1 Traverse Point Determination

Test measurement points were selected in accordance with Method 1. The characteristics of the measurement locations are summarized below.

Location	Upstream Distance	Downstream Distance	Test Parameter	Number of Sampling Points
Waste Fuel Boiler Outlet Duct	20 feet	100 feet	Volumetric Flow	18
Recovery Boiler Outlet Duct	2 x Diameter	9 x Diameter		

Method 2 Volumetric Flowrate Determination

Gas velocity was measured following Method 2, for purposes of calculating stack gas volumetric flow rate at the Waste Fuel Boiler Outlet Duct and Recovery Boiler Outlet Duct. An S-type pitot tube, differential pressure gauge, thermocouple and temperature readout were used to determine gas velocity at each sample point at each test location. Copies of field data sheets are included in Appendix F. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G. This testing met the performance specifications as outlined in the Method.

Method 3A Oxygen (O_2)/ Carbon Dioxide (CO_2) Determination

Stack gas O_2 and/or CO_2 concentrations were determined in accordance with USEPA Method 3A. Servomex analyzers were used to determine the O_2 and/or CO_2 concentrations in the manner specified in the Method. Each instrument has a paramagnetic detector and the O_2 operates in the nominal range of 0% to 25% with the specific range determined by the high-level calibration gas and the CO_2 operates in the nominal range of 0 to 20% with the specific range determined by the high-level calibration gas. High-range calibrations were performed using USEPA Protocol gas. Zero nitrogen (a low ppm pollutant in balance nitrogen calibration gases) was introduced during other instrument calibrations to check instrument zero. High- and a mid-range % O_2 and/or CO_2 levels in balance nitrogen were also introduced. Zero and mid-range calibrations were performed using USEPA Protocol gas after each test run. Copies of the gas cylinder certifications are found in Appendix H. This testing met the performance specifications as outlined in the Method.

Method 4 Moisture Determination

USEPA Method 4, 40CFR60, Appendix A, was utilized to determine water (H_2O) content of the exhaust gas Waste Fuel Boiler Outlet Duct and Recovery Boiler Outlet Duct. 100 milliliters (ml) of water were added to each of the first two impingers, the third impinger was left empty, and the fourth impinger was charged with approximately 200 grams of silica gel. The impingers were placed in an ice bath to maintain the sampled gas passed through the silica gel impinger outlet below 68°F in order to increase the accuracy of the sampled dry gas volume measurement. The water volumes

of the impinger train were measured and the silica gel was weighed before and after each test run to determine the mass of moisture condensed.

Each sample was extracted through a heated stainless-steel probe and filter assembly at a constant sample rate of approximately 0.75 cubic feet per minute, which was maintained throughout the course of the test run. Approximately 21 dry standard cubic feet (dscf) were sampled for, each moisture run. After each run, a leak check of the sampling train was performed at a vacuum greater than the sampling vacuum to determine if any leakage had occurred during sampling. Following the leak check, the impingers were removed from the ice bath, water levels were measured, and the silica gel weight was recorded.

All of the equipment used was calibrated in accordance with the specifications of the Method.

Copies of field data sheets are included in Appendix F. Calibration data is presented in Appendix G. This testing met the performance specifications as outlined in the Method.

Method 6C Sulfur Dioxide (SO_2) Determination

Stack gas SO_2 concentrations and emission rates were determined in accordance with USEPA Method 6C, 40CFR60, Appendix A at the Waste Fuel Boiler Outlet Duct and Recovery Boiler Outlet Duct. A Thermo Scientific Model 43C Pulsed Fluorescence Sulfur Dioxide Analyzer was used to determine sulfur dioxide concentrations, in the manner specified in the Method. The instrument for the Recovery Boiler operated in the nominal range of 0 ppm to 100 ppm with the specific range determined by the high-level span calibration gas of 90.56 ppm. The instrument for the Waste Fuel Boiler operated in the nominal range of 0 ppm to 500 ppm with the specific range determined by the high-level span calibration gas of 482.4 ppm.

The Model 43C High Level is based on the principle that SO_2 molecules absorb ultraviolet (UV) light and become excited at one wavelength, then decay to a lower energy state emitting UV light at a different wavelength. Specifically,

$$SO_2 + hv_1 \rightarrow SO_2^* \rightarrow SO_2 + hv_2$$

The sample is drawn into the Model 43C High Level through the sample bulkhead. The sample passes a pressure sensor then flows through a capillary and a flow sensor. The sample then flows into the fluorescence chamber, where pulsating UV light excites the SO_2 molecules. The condensing lens focuses the pulsating UV light into the mirror assembly. The mirror assembly contains four selective mirrors that reflect only the wavelengths which excite SO_2 molecules. As the excited SO_2 molecules decay to lower energy states they emit UV light that is proportional to the SO_2 concentration. The bandpass filter allows only the wavelengths emitted by the excited SO_2 molecules to reach the photomultiplier tube (PMT). The PMT detects the UV light emission from the decaying SO_2 molecules. The photodetector, located at the back of the fluorescence chamber, continuously monitors the pulsating UV light source and is connected to a circuit that compensates for fluctuations in the UV light.

The sample then flows to the pump and is exhausted out the exhaust bulkhead of the analyzer. The Model 43C High Level outputs the SO_2 concentration to the front panel display and the analog outputs.

Stack gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 250°F. Excess moisture in the stack gas was removed using a refrigerated

condenser. The entire system was calibrated in accordance with the Method, using certified calibration gases introduced at the probe, before and after each test run.

A list of calibration gases used and the results of all calibration and other required quality assurance checks are found in Appendix F. Copies of the gas cylinder certifications are found in Appendix G. This testing met the performance specifications as outlined in the Method.

Method 7E Nitrogen Oxide (NO_X) Determination

Stack gas NO_X concentrations and emission rates were determined in accordance with USEPA Method 7E, 40CFR60, Appendix A, at the Package Boiler Outlet Duct, Waste Fuel Boiler Outlet Duct, and Recovery Boiler Outlet Duct. A Thermo Scientific Model 42i Chemiluminescence Nitrogen Oxides Analyzer was used to determine nitrogen oxides concentrations, in the manner specified in the Method. The instrument operated in the nominal range of 0 ppm to 500 ppm with the specific range determined by the high-level span calibration gas of 241.5 ppm.

The Model 42i operates on the principle that nitric oxide (NO) and ozone (O_3) react to produce a characteristic luminescence with an intensity linearly proportional to the NO concentration. Infrared light emission results when electronically excited NO_2 molecules decay to lower energy states. Specifically,

$$NO+O_3 \rightarrow NO_2+O_2+h\upsilon$$

Nitrogen dioxide (NO_2) must first be transformed into NO before it can be measured using the chemiluminescent reaction. NO_2 is converted to NO by a stainless steel NO_2-to-NO converter heated to about 625°C. The flue gas sample is drawn into the Model 42*i* through the sample bulkhead. The sample flows through a capillary, and then to the mode solenoid valve. The solenoid valve routes the sample either straight to the reaction chamber (NO mode) or through the NO_2-to-NO converter and then to the reaction chamber (NO_X mode). A flow sensor prior to the reaction chamber measures the sample flow. Dry air enters the Model 42*i* through the dry air bulkhead, passes through a flow switch, and then through a silent discharge ozonator. The ozonator generates the ozone needed for the chemiluminescent reaction. At the reaction chamber, the ozone reacts with the NO in the sample to produce excited NO_2 molecules. A photomultiplier tube (PMT) housed in a thermoelectric cooler detects the luminescence generated during this reaction. From the reaction chamber, the exhaust travels through the ozone (O_3) converter to the pump, and is released through the vent.

The NO and NO_X concentrations calculated in the NO and NO_X modes are stored in memory. The difference between the concentrations is used to calculate the NO_2 concentration. The Model 42i outputs NO, NO_2, and NO_X concentrations to the front panel display, the analog outputs, and also makes the data available over the serial or ethernet connection.

Stack gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 250°F. Excess moisture in the stack gas was removed using a refrigerated condenser. The entire system was calibrated in accordance with the Method, using certified calibration gases introduced at the probe, before and after each test run. This testing met the performance specifications as outlined in the Method.

A list of calibration gases used and the results of all calibration and other required quality assurance checks are found in Appendix G. Copies of the gas cylinder certifications are found in Appendix H. The NO_2 to NO converter tests can be found in Appendix I. This testing met the performance specifications as outlined in the Method.

Method 10 Carbon Monoxide (CO) Determination

Stack gas CO concentrations and emission rates were determined in accordance with USEPA Method 10, 40CFR60, Appendix A at the Package Boiler Outlet Duct and Recovery Boiler Outlet Duct. A Fischer Scientific Model 48C Gas Filter Correlation Carbon Monoxide was used to determine carbon monoxide concentrations, in the manner specified in the Method. The instrument operated in the nominal range of 0 ppm to 500 ppm or 1,000 ppm with the specific range determined by the high-level span calibration gas of 434.0 ppm and 920.9 ppm.

The Model 48C High Level is based on the principle that CO absorbs infrared radiation at a wavelength of 4.6 microns. Because infrared absorption is a nonlinear measurement technique, it is necessary for the instrument electronics to transform the basic analyzer signal into a linear output. The Model 48C High Level uses an exact calibration curve to accurately linearize the instrument output over any range up to a concentration of 20,000 ppm. The sample is drawn into the analyzer through the sample bulkhead. The sample flows through the optical bench. Radiation from an infrared source is chopped and then passed through a gas filter alternating between CO and N2. The radiation then passes through a narrow bandpass interference filter and enters the optical bench where absorption by the sample gas occurs. The infrared radiation then exits the optical bench and falls on an infrared detector. The CO gas filter acts to produce a reference beam which cannot be further attenuated by CO in the sample cell. The N_2 side of the filter wheel is transparent to the infrared radiation and therefore produces a measure beam which can be absorbed by CO in the cell. The chopped detector signal is modulated by the alternation between the two gas filters with an amplitude related to the concentration of CO in the sample cell. Other gases do not cause modulation of the detector signal since they absorb the reference and measure beams equally. Thus, the GFC system responds specifically to CO. The Model 48C High Level outputs the CO concentration to the front panel display and the analog outputs.

Stack gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 250°F. Excess moisture in the stack gas was removed using a refrigerated condenser. The entire system was calibrated in accordance with the Method, using certified calibration gases introduced at the probe, before and after each test run.

A list of calibration gases used and the results of all calibration and other required quality assurance checks are found in Appendix G. Copies of the gas cylinder certifications are found in Appendix H. This testing met the performance specifications as outlined in the Method.

Method 16A Total Reduced Sulfur (TRS) Determination

Integrated gas samples were extracted from the Lime Kiln and Recovery Boiler Outlet Duct gas streams in accordance with Method 16A (impinger technique), 40CFR60, for the determination of total reduced sulfur (TRS) emissions from stationary sources. This method selectively removed sulfur dioxide (SO_2) by bubbling the gas sample through a citrate buffer solution, then thermally oxidizing TRS compounds present to SO_2. The SO_2 was then collected in hydrogen peroxide as sulfate and analyzed by the Method 6 barium-thorin titration procedure, 40CFR60.

Interferences caused by particulate matter entering the sampling train were eliminated by the use of a heated filter medium placed at the end of the heated Teflon®-lined (or glass-lined) probe.

Sampling included three 1-hour tests followed by one 30-minute system validation to be completed as one test run. A description of the test train utilized is appended. Sampling train preparation was in accordance with Method 16A, 40CFR60, and included the following:

1. All probes, filter holders, and sampling lines were cleaned prior to each test.

2. The SO_2 scrubber was charged with 100 mls of citrate buffer solution into each of the first two impingers prior to each test. Citrate buffer solution was prepared by dissolving 300 g of potassium citrate (or 284 g of sodium citrate) and 41 g of anhydrous citric acid in one liter of water. The pH of the solution was then adjusted to between 5.4 and 5.6 with potassium citrate or citric acid, as required.

3. The probe and heated filter media were maintained at approximately 250°F to prevent moisture condensation.

4. The thermal oxidation furnace was maintained at 800°C±100°C during the test time.

5. The SO_2 portion of the train was prepared and analyzed in accordance with the methods described for sulfur dioxide testing listed previously.

The validations involved sampling a known concentration of hydrogen sulfide (H_2S) and comparing the analyzed concentration with the known concentration. The H_2S recovery gas was mixed with combustion gas in a dilution system. The flowrates were adjusted to generate an H_2S concentration in the range of the stack gas. The samples were collected and analyzed in the same manner as a normal stack test. The sample was collected through the end of the probe to ensure extraction of a representative sample. System validations were performed following each set of three 1-hour tests.

A list of calibration gases used and the results of all calibration and other required quality assurance checks can be found in Appendix F. Copies of calibration gas certifications can be found in Appendix G.

3.0 TEST RESULT SUMMARIES

Client: Billerud Quinnesec, LLC
Facility: Quinnesec Mill
Project #: M231804
Fuel Type: Natural Gas

Location: Package Boiler Outlet Duct
Date: 5/10/23
Test Method: 7E, 3A
Fuel Factor: 8710

O2 based NOx lb/mmBtu RATA

CEM Analyzer Information

NO_x Monitor/Model:	Thermo 42iQ	**NO_x Serial # :**	1180090011
O2 Monitor/Model:	Thermo CTL902C	**O2 Serial # :**	1180390002

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM NO_x lb/MMBtu	CEM NO_x lb/MMBtu	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/10/23	08:05	08:25	0.05	0.05	0.00	0.0000
1	2	05/10/23	08:43	09:03	0.05	0.05	0.00	0.0000
1	3	05/10/23	10:45	11:05	0.06	0.05	0.01	0.0001
1	4	05/10/23	11:31	11:51	0.06	0.05	0.01	0.0001
1	5	05/10/23	12:14	12:34	0.06	0.06	0.00	0.0000
1	6	05/10/23	12:51	13:11	0.06	0.06	0.00	0.0000
1	7	05/10/23	13:25	13:45	0.06	0.05	0.01	0.0001
0	8	05/10/23	14:01	14:21	0.06	0.05	0.01	0.0001
1	9	05/10/23	14:36	14:56	0.05	0.05	0.00	0.0000
1	10	05/10/23	15:11	15:31	0.05	0.05	0.00	0.0000
				n	**9**			
				t(0.975)	**2.306**			
				Mean Reference Method Value	**0.056**		**RM avg**	
				Mean CEM Value	**0.052**		**CEM avg**	
				Sum of Differences	**0.030**		**di**	
				Mean Difference	**0.003**		**d**	
				Sum of Differences Squared	**0.000**		**di^2**	
				Standard Deviation	**0.005**		**sd**	
				Confidence Coefficient 2.5% Error (1-tail)	**0.004**		**cc**	
				Relative Accuracy	**12.92**		**RA**	

Client: Billerud Quinnesec, LLC **Location:** Package Boiler Outlet Duct
Facility: Quinnesec Mill **Date:** 5/10/23
Project #: M231804 **Test Method:** 7E, 2
Applicable Standard: 41.9

NO_x lb/hr RATA

CEM Analyzer Information

NO_x Monitor/Model:	Thermo 42iQ	NO_x Serial # :	1180090011

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM NO_x lb/hr	CEM NO_x lb/hr	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/10/23	08:05	08:25	8.7	8.8	-0.1	0.01
1	2	05/10/23	08:43	09:03	8.8	8.9	-0.1	0.01
1	3	05/10/23	10:45	11:05	9.2	9.0	0.2	0.04
1	4	05/10/23	11:31	11:51	9.1	9.0	0.1	0.01
0	5	05/10/23	12:14	12:34	9.2	9.0	0.2	0.04
1	6	05/10/23	12:51	13:11	9.0	9.0	0.0	0.00
1	7	05/10/23	13:25	13:45	9.0	9.0	0.0	0.00
1	8	05/10/23	14:01	14:21	9.1	9.0	0.1	0.01
1	9	05/10/23	14:36	14:56	9.0	9.0	0.0	0.00
1	10	05/10/23	15:11	15:31	8.9	8.9	0.0	0.00

n	**9**	
t(0.975)	**2.306**	
Mean Reference Method Value	**8.978**	**RM avg**
Mean CEM Value	**8.956**	**CEM avg**
Sum of Differences	**0.200**	**di**
Mean Difference	**0.022**	**d**
Sum of Differences Squared	**0.080**	**di^2**
Standard Deviation	**0.097**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.075**	**cc**
Relative Accuracy	**1.08**	**RA**

Client: Billerud Quinnesec, LLC **Location:** Package Boiler Outlet Duct
Facility: Quinnesec Mill **Date:** 5/10/23
Project #: M231804 **Test Method:** 3A

O_2 % (dry) RATA

CEM Analyzer Information

O_2 Monitor/Model:			Thermo CTL902C		O_2 Serial # :		1180390002	
1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM O_2 % (dry)	CEM O_2 % (dry)	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/10/23	08:05	08:25	4.0	4.0	0.0	0.00
0	2	05/10/23	08:43	09:03	3.9	4.1	-0.2	0.04
1	3	05/10/23	10:45	11:05	4.2	4.4	-0.2	0.04
1	4	05/10/23	11:31	11:51	4.4	4.4	0.0	0.00
1	5	05/10/23	12:14	12:34	4.4	4.4	0.0	0.00
1	6	05/10/23	12:51	13:11	4.4	4.4	0.0	0.00
1	7	05/10/23	13:25	13:45	4.3	4.4	-0.1	0.01
1	8	05/10/23	14:01	14:21	4.3	4.4	-0.1	0.01
1	9	05/10/23	14:36	14:56	4.3	4.3	0.0	0.00
1	10	05/10/23	15:11	15:31	4.3	4.3	0.0	0.00
				n	9			
				t(0.975)	2.306			
				Mean Reference Method Value	4.289		RM avg	
				Mean CEM Value	4.333		CEM avg	
				Sum of Differences	-0.400		di	
				Mean Difference	-0.044		d	
				Sum of Differences Squared	0.060		di^2	
				Standard Deviation	0.073		sd	
				Confidence Coefficient 2.5% Error (1-tail)	0.056		cc	
				Relative Accuracy	2.34		RA	

Client: Billerud Quinnesec, LLC | **Location:** Package Boiler Outlet Duct
Facility: Quinnesec Mill | **Date:** 5/10/23
Project #: M231804 | **Test Method:** 10, 3A
Fuel Type: Natural Gas | **Fuel Factor:** 8710

Applicable Standard: 0.12

O2 based CO lb/mmBtu RATA

CEM Analyzer Information

CO Monitor/Model:	Thermo 48iQ	**CO Serial # :**	1180930081
O2 Monitor/Model:	Thermo CTL902C	**O2 Serial # :**	1180390002

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM CO lb/MMBtu	CEM CO lb/MMBtu	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/10/23	08:05	08:25	0.00	0.00	0.00	0.0000
1	2	05/10/23	08:43	09:03	0.00	0.00	0.00	0.0000
1	3	05/10/23	10:45	11:05	0.00	0.00	0.00	0.0000
1	4	05/10/23	11:31	11:51	0.00	0.00	0.00	0.0000
1	5	05/10/23	12:14	12:34	0.00	0.00	0.00	0.0000
1	6	05/10/23	12:51	13:11	0.00	0.00	0.00	0.0000
1	7	05/10/23	13:25	13:45	0.00	0.00	0.00	0.0000
1	8	05/10/23	14:01	14:21	0.00	0.00	0.00	0.0000
1	9	05/10/23	14:36	14:56	0.00	0.00	0.00	0.0000
1	10	05/10/23	15:11	15:31	0.00	0.00	0.00	0.0000

n	**10**	
t(0.975)	**2.262**	
Mean Reference Method Value	**0.000**	**RM avg**
Mean CEM Value	**0.000**	**CEM avg**
Sum of Differences	**0.000**	**di**
Mean Difference	**0.000**	**d**
Sum of Differences Squared	**0.000**	**di^2**
Standard Deviation	**0.000**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.000**	**cc**
Relative Accuracy	**0.00**	**RA**

Client: Billerud Quinnesec, LLC **Location:** Package Boiler Outlet Duct
Facility: Quinnesec Mill **Date:** 5/10/23
Project #: M231804 **Test Method:** 10
Applicable Standard: 195

CO ppmvd RATA

CEM Analyzer Information

CO Monitor/Model:			Thermo 48iQ		CO Serial # :		1180930081	
1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM CO ppmvd	CEM CO ppmvd	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
0	1	05/10/23	08:05	08:25	0.0	1.7	-1.7	2.89
1	2	05/10/23	08:43	09:03	0.0	0.1	-0.1	0.01
1	3	05/10/23	10:45	11:05	0.0	0.2	-0.2	0.04
1	4	05/10/23	11:31	11:51	0.0	0.5	-0.5	0.25
1	5	05/10/23	12:14	12:34	0.0	-0.3	0.3	0.09
1	6	05/10/23	12:51	13:11	0.0	-0.5	0.5	0.25
1	7	05/10/23	13:25	13:45	0.0	-0.4	0.4	0.16
1	8	05/10/23	14:01	14:21	0.0	-0.5	0.5	0.25
1	9	05/10/23	14:36	14:56	0.0	-0.9	0.9	0.81
1	10	05/10/23	15:11	15:31	0.0	-0.2	0.2	0.04
				n	9			
				t(0.975)	2.306			
				Mean Reference Method Value	0.000		RM avg	
				Mean CEM Value	-0.222		CEM avg	
				Sum of Differences	2.000		di	
				Mean Difference	0.222		d	
				Sum of Differences Squared	1.900		di^2	
				Standard Deviation	0.427		sd	
				Confidence Coefficient 2.5% Error (1-tail)	0.328		cc	
				Relative Accuracy - APS	0.55		ppm + cc difference[A]	

[A] Relative accuracy based upon alternate performance standard of +/- 5 ppm CO plus the confidence coefficient.

Client: Billerud Quinnesec, LLC **Location:** Package Boiler Outlet Duct
Facility: Quinnesec Mill **Date:** 5/10/23
Project #: M231804 **Test Method:** 10, 2
Applicable Standard: 25.5

CO lb/hr RATA

CEM Analyzer Information

CO Monitor/Model:		Thermo 48iQ			CO Serial # :		1180930081	
1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM CO lb/hr	CEM CO lb/hr	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
0	1	05/10/23	08:05	08:25	0.0	0.2	-0.2	0.04
1	2	05/10/23	08:43	09:03	0.0	0.0	0.0	0.00
1	3	05/10/23	10:45	11:05	0.0	0.0	0.0	0.00
1	4	05/10/23	11:31	11:51	0.0	0.1	-0.1	0.01
1	5	05/10/23	12:14	12:34	0.0	0.0	0.0	0.00
1	6	05/10/23	12:51	13:11	0.0	-0.1	0.1	0.01
1	7	05/10/23	13:25	13:45	0.0	0.0	0.0	0.00
1	8	05/10/23	14:01	14:21	0.0	-0.1	0.1	0.01
1	9	05/10/23	14:36	14:56	0.0	-0.1	0.1	0.01
1	10	05/10/23	15:11	15:31	0.0	0.0	0.0	0.00
				n	**9**			
				t(0.975)	**2.306**			
				Mean Reference Method Value	**0.000**		**RM avg**	
				Mean CEM Value	**-0.022**		**CEM avg**	
				Sum of Differences	**0.200**		**di**	
				Mean Difference	**0.022**		**d**	
				Sum of Differences Squared	**0.040**		**di^2**	
				Standard Deviation	**0.067**		**sd**	
				Confidence Coefficient 2.5% Error (1-tail)	**0.051**		**cc**	
				Relative Accuracy - APS	**0.29**		**RA**	

[A] Relative accuracy based upon +/- 5% of applicable standard

Client: Billerud Quinnesec, LLC | **Location:** Waste Fuel Boiler Outlet Duct
Facility: Quinnesec Mill | **Date:** 5/11/23
Project #: M231804 | **Test Method:** 7E, 3A
Fuel Type: Other | **Fuel Factor:** 9518

O2 based NOx lb/mmBtu RATA

CEM Analyzer Information

NO_x Monitor/Model:	Thermo 42iQ	NO_x Serial # :	1180030057
O2 Monitor/Model:	Thermo CTL902C	O2 Serial # :	1180530001

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM NO_x lb/MMBtu	CEM NO_x lb/MMBtu	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/11/23	14:00	14:20	0.15	0.14	0.01	0.0001
1	2	05/11/23	14:55	15:15	0.15	0.14	0.01	0.0001
1	3	05/11/23	15:40	16:00	0.13	0.12	0.01	0.0001
1	4	05/11/23	16:20	16:40	0.17	0.16	0.01	0.0001
1	5	05/11/23	17:00	17:20	0.15	0.13	0.02	0.0004
1	6	05/11/23	17:40	18:00	0.14	0.13	0.01	0.0001
1	7	05/11/23	18:25	18:45	0.15	0.13	0.02	0.0004
0	8	05/11/23	19:05	19:25	0.15	0.13	0.02	0.0004
1	9	05/11/23	19:45	20:05	0.14	0.13	0.01	0.0001
1	10	05/11/23	20:25	20:45	0.16	0.15	0.01	0.0001

n	9	
t(0.975)	2.306	
Mean Reference Method Value	0.149	RM avg
Mean CEM Value	0.137	CEM avg
Sum of Differences	0.110	di
Mean Difference	0.012	d
Sum of Differences Squared	0.002	di^2
Standard Deviation	0.004	sd
Confidence Coefficient 2.5% Error (1-tail)	0.003	cc
Relative Accuracy	10.49	RA

Client: Billerud Quinnesec, LLC **Location:** Waste Fuel Boiler Outlet Duct
Facility: Quinnesec Mill **Date:** 5/11/23
Project #: M231804 **Test Method:** 7E, 2
Applicable Standard: 437

NO_x lb/hr RATA

CEM Analyzer Information

NO_x Monitor/Model:	Thermo 42iQ	NO_x Serial # :	1180030057

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM NO_x lb/hr	CEM NO_x lb/hr	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/11/23	14:00	14:20	62.7	54.8	7.9	62.41
1	2	05/11/23	14:55	15:15	59.7	50.5	9.2	84.64
1	3	05/11/23	15:40	16:00	53.9	44.9	9.0	81.00
1	4	05/11/23	16:20	16:40	63.3	56.9	6.4	40.96
1	5	05/11/23	17:00	17:20	60.5	49.9	10.6	112.36
1	6	05/11/23	17:40	18:00	55.3	46.7	8.6	73.96
1	7	05/11/23	18:25	18:45	56.2	49.5	6.7	44.89
0	8	05/11/23	19:05	19:25	58.5	47.9	10.6	112.36
1	9	05/11/23	19:45	20:05	57.3	49.0	8.3	68.89
1	10	05/11/23	20:25	20:45	63.2	57.1	6.1	37.21

n	9	
t(0.975)	2.306	
Mean Reference Method Value	59.122	RM avg
Mean CEM Value	51.033	CEM avg
Sum of Differences	72.800	di
Mean Difference	8.089	d
Sum of Differences Squared	606.320	di^2
Standard Deviation	1.477	sd
Confidence Coefficient 2.5% Error (1-tail)	1.135	cc
Relative Accuracy	15.60	RA

Client: Billerud Quinnesec, LLC | **Location:** Waste Fuel Boiler Outlet Duct
Facility: Quinnesec Mill | **Date:** 5/11/23
Project #: M231804 | **Test Method:** 3A

CO_2 % (dry) RATA

CEM Analyzer Information

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM CO_2 % (dry)	CEM CO_2 % (dry)	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/11/23	14:00	14:20	13.8	13.8	0.0	0.00
1	2	05/11/23	14:55	15:15	13.8	13.8	0.0	0.00
1	3	05/11/23	15:40	16:00	13.8	13.8	0.0	0.00
0	4	05/11/23	16:20	16:40	12.9	12.7	0.2	0.04
1	5	05/11/23	17:00	17:20	14.2	14.2	0.0	0.00
1	6	05/11/23	17:40	18:00	14.0	14.0	0.0	0.00
1	7	05/11/23	18:25	18:45	13.6	13.6	0.0	0.00
1	8	05/11/23	19:05	19:25	14.3	14.1	0.2	0.04
1	9	05/11/23	19:45	20:05	14.1	14.0	0.1	0.01
1	10	05/11/23	20:25	20:45	13.6	13.6	0.0	0.00

n	9	
t(0.975)	2.306	
Mean Reference Method Value	13.911	RM avg
Mean CEM Value	13.878	CEM avg
Sum of Differences	0.300	di
Mean Difference	0.033	d
Sum of Differences Squared	0.050	di^2
Standard Deviation	0.071	sd
Confidence Coefficient 2.5% Error (1-tail)	0.054	cc
Relative Accuracy	0.63	RA

Client: Billerud Quinnesec, LLC | **Location:** Waste Fuel Boiler Outlet Duct
Facility: Quinnesec Mill | **Date:** 5/11/23
Project #: M231804 | **Test Method:** 3A

O_2 % (dry) RATA

CEM Analyzer Information

O_2 Monitor/Model:	Thermo CTL902C	O_2 Serial # :	1180530001

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM O_2 % (dry)	CEM O_2 % (dry)	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/11/23	14:00	14:20	5.9	6.1	-0.2	0.04
1	2	05/11/23	14:55	15:15	5.9	6.1	-0.2	0.04
0	3	05/11/23	15:40	16:00	5.8	6.1	-0.3	0.09
1	4	05/11/23	16:20	16:40	6.8	7.1	-0.3	0.09
1	5	05/11/23	17:00	17:20	5.6	5.8	-0.2	0.04
1	6	05/11/23	17:40	18:00	5.7	5.9	-0.2	0.04
1	7	05/11/23	18:25	18:45	6.2	6.4	-0.2	0.04
1	8	05/11/23	19:05	19:25	5.6	5.8	-0.2	0.04
1	9	05/11/23	19:45	20:05	5.7	5.9	-0.2	0.04
1	10	05/11/23	20:25	20:45	6.2	6.4	-0.2	0.04

n	9	
t(0.975)	2.306	
Mean Reference Method Value	5.956	RM avg
Mean CEM Value	6.167	CEM avg
Sum of Differences	-1.900	di
Mean Difference	-0.211	d
Sum of Differences Squared	0.410	di^2
Standard Deviation	0.033	sd
Confidence Coefficient 2.5% Error (1-tail)	0.026	cc
Relative Accuracy	3.98	RA

Client: Billerud Quinnesec, LLC | **Location:** Waste Fuel Boiler Outlet Duct
Facility: Quinnesec Mill | **Date:** 5/11/23
Project #: M231804 | **Test Method:** 6C, 3A
Fuel Type: Other | **Fuel Factor:** 9518

Applicable Standard: 1.2

O2 based SO2 lb/mmBtu RATA

CEM Analyzer Information

SO_2 Monitor/Model:	Thermo 43iQ	SO_2 Serial # :	1180930080
O2 Monitor/Model:	Thermo CTL902C	O2 Serial # :	1180530001

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM SO_2 lb/mmBtu	CEM SO_2 lb/mmBtu	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/11/23	14:00	14:20	0.1	0.0	0.1	0.01
1	2	05/11/23	14:55	15:15	0.1	0.0	0.1	0.01
1	3	05/11/23	15:40	16:00	0.1	0.0	0.1	0.01
1	4	05/11/23	16:20	16:40	0.1	0.0	0.1	0.01
1	5	05/11/23	17:00	17:20	0.1	0.0	0.1	0.01
1	6	05/11/23	17:40	18:00	0.1	0.0	0.1	0.01
1	7	05/11/23	18:25	18:45	0.1	0.0	0.1	0.01
1	8	05/11/23	19:05	19:25	0.1	0.0	0.1	0.01
1	9	05/11/23	19:45	20:05	0.1	0.0	0.1	0.01
0	10	05/11/23	20:25	20:45	0.0	0.0	0.0	0.00

n	9	
t(0.975)	2.306	
Mean Reference Method Value	0.100	RM avg
Mean CEM Value	0.000	CEM avg
Sum of Differences	0.900	di
Mean Difference	0.100	d
Sum of Differences Squared	0.090	di^2
Standard Deviation	0.000	sd
Confidence Coefficient 2.5% Error (1-tail)	0.000	cc
Relative Accuracy - APS	8.33	RA[A]

[A] Relative accuracy based upon +/- 10% of applicable standard of 1.2 ln/mmBtu

Client: Billerud Quinnesec, LLC **Location:** Waste Fuel Boiler Outlet Duct
Facility: Quinnesec Mill **Date:** 5/11/23
Project #: M231804 **Test Method:** 6C, 2
Applicable Standard: 476

SO2 lb/hr RATA

CEM Analyzer Information

SO_2 Monitor/Model:			Thermo 43iQ		SO_2 Serial # :		1180930080	
1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM SO_2 lb/hr	CEM SO_2 lb/hr	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/11/23	14:00	14:20	44.1	15.5	28.6	817.96
0	2	05/11/23	14:55	15:15	46.8	15.5	31.3	979.69
1	3	05/11/23	15:40	16:00	32.6	12.8	19.8	392.04
1	4	05/11/23	16:20	16:40	19.3	10.5	8.8	77.44
1	5	05/11/23	17:00	17:20	40.8	13.9	26.9	723.61
1	6	05/11/23	17:40	18:00	28.8	10.6	18.2	331.24
1	7	05/11/23	18:25	18:45	23.7	8.2	15.5	240.25
1	8	05/11/23	19:05	19:25	39.3	14.9	24.4	595.36
1	9	05/11/23	19:45	20:05	28.9	9.5	19.4	376.36
1	10	05/11/23	20:25	20:45	15.5	10.2	5.3	28.09
				n	**9**			
				t(0.975)	**2.306**			
				Mean Reference Method Value	**30.333**		**RM avg**	
				Mean CEM Value	**11.789**		**CEM avg**	
				Sum of Differences	**166.900**		**di**	
				Mean Difference	**18.544**		**d**	
				Sum of Differences Squared	**3582.350**		**di^2**	
				Standard Deviation	**7.805**		**sd**	
				Confidence Coefficient 2.5% Error (1-tail)	**5.999**		**cc**	
				Relative Accuracy - APS	**5.16**		**RA[A]**	

[A] Relative accuracy based upon +/- 10% of applicable standard of 476 lb/hr

Client: Billerud Quinnesec, LLC					**Test Location:** Waste Fuel Boiler Outlet Duct			
Facility: Quinnesec Mill					**Test Date:** 5/11/2023			
Project #: M231804					**Test Method:** 2			
					CEM Analyzer Information			
Volumetric Flow RATA - Normal Load								
Flow Monitor/Model:				Deterich		**Flow Serial # :**	22-F-C-179, 274797.01.1	
1=accept 0=reject	**Test Run**	**Test Date**	**Start Time**	**End Time**	**Reference Method Flow DSCFM**	**CEM Flow DSCFM**	**(RM-CEM) Difference (di)**	**(RM-CEM) Difference ^{2} (di^2)**
1	1	05/11/23	14:00	14:08	90,083	85,894	4,189	17,547,070
1	2	05/11/23	14:55	15:02	87,523	83,157	4,366	19,062,542
1	3	05/11/23	15:40	15:47	87,934	82,562	5,372	28,857,147
1	4	05/11/23	16:20	16:27	88,175	89,401	-1,226	1,501,962
0	5	05/11/23	17:00	17:07	88,192	81,529	6,663	44,396,511
1	6	05/11/23	17:40	17:47	86,808	82,333	4,475	20,029,060
1	7	05/11/23	18:25	18:32	86,259	85,313	946	894,730
1	8	05/11/23	19:05	19:13	85,162	79,001	6,161	37,956,761
1	9	05/11/23	19:45	19:52	87,677	83,729	3,948	15,590,364
1	10	05/11/23	20:25	20:32	87,176	87,404	-228	51,984
				n	**9**			
				t(0.975)	**2.306**			
				Mean Reference Method Value	**87421.998**		**RM avg**	
				Mean CEM Value	**84310.444**		**CEM avg**	
				Sum of Differences	**28003.984**		**di**	
				Mean Difference	**3111.554**		**d**	
				Sum of Differences Squared	**141491619.403**		**di^2**	
				Standard Deviation	**2606.619**		**sd**	
				Confidence Coefficient 2.5% Error (1-tail)	**2003.621**		**cc**	
				Relative Accuracy	**5.85**		**RA**	

Client: Billerud Quinnesec, LLC **Location:** Recovery Boiler Outlet Duct
Facility: Quinnesec Mill **Date:** 5/10/23
Project #: M231804 **Test Method:** 7E, 3A

Applicable Standard: 110

NOx ppmvd @ 8% O2 RATA

CEM Analyzer Information

NO_x Monitor/Model:	Thermo 42iQ	NO_x Serial # :	1180090013
O_2 Monitor/Model:	Thermo CTL902C	O_2 Serial # :	1180240002

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM NOx ppmvd @ 8 %O2	CEM NOx ppmvd @ 8 %O2	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/10/23	09:52	10:12	80.0	82.8	-2.8	7.7
1	2	05/10/23	10:36	10:56	80.0	82.8	-2.8	7.7
1	3	05/10/23	11:23	11:43	80.7	83.6	-2.9	8.5
1	4	05/10/23	12:10	12:30	84.6	87.4	-2.8	7.8
1	5	05/10/23	12:47	13:07	83.1	85.7	-2.6	6.8
1	6	05/10/23	13:28	13:48	84.1	87.1	-3.0	8.8
1	7	05/10/23	14:20	14:40	80.7	83.9	-3.2	10.1
0	8	05/10/23	14:57	15:17	83.5	86.9	-3.4	11.6
1	9	05/10/23	15:37	15:57	84.6	87.1	-2.5	6.4
1	10	05/10/23	16:25	16:45	81.7	83.8	-2.1	4.5

n	9	
t(0.975)	2.306	
Mean Reference Method Value	82.171	RM avg
Mean CEM Value	84.911	CEM avg
Sum of Differences	-24.660	di
Mean Difference	-2.740	d
Sum of Differences Squared	68.285	di^2
Standard Deviation	0.299	sd
Confidence Coefficient 2.5% Error (1-tail)	0.230	cc
Relative Accuracy	3.61	RA

Client: Billerud Quinnesec, LLC | **Location:** Recovery Boiler Outlet Duct
Facility: Quinnesec Mill | **Date:** 5/10/23
Project #: M231804 | **Test Method:** 3A

O_2 % (dry) RATA

CEM Analyzer Information

O_2 Monitor/Model:	Thermo CTL902C	O_2 Serial # :	1180240002

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM O_2 % (dry)	CEM O_2 % (dry)	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/10/23	09:52	10:12	4.7	4.8	-0.1	0.01
1	2	05/10/23	10:36	10:56	4.7	4.9	-0.2	0.04
1	3	05/10/23	11:23	11:43	4.8	5.0	-0.2	0.04
1	4	05/10/23	12:10	12:30	4.6	4.7	-0.1	0.01
1	5	05/10/23	12:47	13:07	4.6	4.7	-0.1	0.01
1	6	05/10/23	13:28	13:48	4.6	4.7	-0.1	0.01
1	7	05/10/23	14:20	14:40	4.6	4.7	-0.1	0.01
0	8	05/10/23	14:57	15:17	4.6	4.8	-0.2	0.04
1	9	05/10/23	15:37	15:57	4.7	4.8	-0.1	0.01
1	10	05/10/23	16:25	16:45	4.6	4.7	-0.1	0.01

n	9	
t(0.975)	2.306	
Mean Reference Method Value	4.656	RM avg
Mean CEM Value	4.778	CEM avg
Sum of Differences	-1.100	di
Mean Difference	-0.122	d
Sum of Differences Squared	0.150	di^2
Standard Deviation	0.044	sd
Confidence Coefficient 2.5% Error (1-tail)	0.034	cc
Relative Accuracy	3.35	RA

Client: Billerud Quinnesec, LLC **Location:** Recovery Boiler Outlet Duct
Facility: Quinnesec Mill **Date:** 5/10/23
Project #: M231804 **Test Method:** 6C, 3A
Applicable Standard: 50

SO2 ppmvd @ 8% O2 RATA

CEM Analyzer Information

SO_2 Monitor/Model:	Thermo 43iQ	SO_2 Serial # :	1180090009
O_2 Monitor/Model:	Thermo CTL902C	O_2 Serial # :	1180240002

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM SO2 ppmvd @ 8 %O2	CEM SO2 ppmvd @ 8 %O2	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/10/23	09:52	10:12	0.0	0.1	-0.1	0.01
1	2	05/10/23	10:36	10:56	0.1	0.1	0.0	0.00
1	3	05/10/23	11:23	11:43	0.4	0.1	0.3	0.09
1	4	05/10/23	12:10	12:30	0.4	0.1	0.3	0.09
1	5	05/10/23	12:47	13:07	0.3	0.1	0.2	0.04
1	6	05/10/23	13:28	13:48	0.2	0.1	0.1	0.01
1	7	05/10/23	14:20	14:40	0.1	0.1	0.0	0.00
1	8	05/10/23	14:57	15:17	0.3	0.1	0.2	0.04
0	9	05/10/23	15:37	15:57	0.5	0.1	0.4	0.16
1	10	05/10/23	16:25	16:45	0.1	0.1	0.0	0.00

n	9	
t(0.975)	2.306	
Mean Reference Method Value	0.211	RM avg
Mean CEM Value	0.100	CEM avg
Sum of Differences	1.000	di
Mean Difference	0.111	d
Sum of Differences Squared	0.280	di^2
Standard Deviation	0.145	sd
Confidence Coefficient 2.5% Error (1-tail)	0.112	cc
Relative Accuracy - APS	0.45	RA[A]

[A] Relative accuracy based upon +/- 10% of applicable standard of 50 ppmvd @ 8% O_2

Client: Billerud Quinnesec, LLC **Location:** Recovery Boiler Outlet Duct
Facility: Quinnesec Mill **Date:** 5/10/23
Project #: M231804 **Test Method:** 10, 3A

Applicable Standard: 425

CO ppmvd @ 8% O2 RATA

CEM Analyzer Information

CO Monitor/Model:	Thermo 48iQ	**CO Serial # :**	1170680002
O_2 Monitor/Model:	Thermo CTL902C	**O_2 Serial # :**	1180240002

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM CO ppmvd @ 8 %O2	CEM CO ppmvd @ 8 %O2	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/10/23	09:52	10:12	2.7	2.1	0.6	0.36
1	2	05/10/23	10:36	10:56	3.9	3.2	0.7	0.49
1	3	05/10/23	11:23	11:43	16.8	18.9	-2.1	4.41
1	4	05/10/23	12:10	12:30	3.1	2.2	0.9	0.81
1	5	05/10/23	12:47	13:07	3.9	3.8	0.1	0.01
1	6	05/10/23	13:28	13:48	1.0	0.1	0.9	0.81
1	7	05/10/23	14:20	14:40	1.0	1.9	-0.9	0.81
1	8	05/10/23	14:57	15:17	1.4	2.3	-0.9	0.81
1	9	05/10/23	15:37	15:57	4.6	7.2	-2.6	6.76
0	10	05/10/23	16:25	16:45	25.3	33.5	-8.2	67.24

n	**9**	
t(0.975)	**2.306**	
Mean Reference Method Value	**4.267**	**RM avg**
Mean CEM Value	**4.633**	**CEM avg**
Sum of Differences	**-3.300**	**di**
Mean Difference	**-0.367**	**d**
Sum of Differences Squared	**15.270**	**di^2**
Standard Deviation	**1.326**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**1.019**	**cc**
Relative Accuracy - APS	**0.33**	**RA**

[A] Relative accuracy based upon +/- 10% of applicable standard of 500 ppmvd @ 8% O_2

Client: Billerud Quinnesec, LLC
Facility: Quinnesec Mill
Project #: M2231804

Location: Recovery Boiler Outlet Duct
Date: 5/11/23
Test Method: 16A, 3A

Applicable Standard: 5

TRS as SO_2 ppmvd @ 8% O_2 RATA

Primary CEM Monitor Information

TRS Monitor Model:	Thermo 43iQ	TRS Monitor Serial # :	1180090010

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM TRS as SO_2 ppmvd @ 8% O_2	CEM TRS as SO_2 ppmvd @ 8% O_3	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/11/23	8:32	9:32	1.9	1.6	0.3	0.09
1	2	05/11/23	9:47	10:47	1.9	1.8	0.1	0.01
1	3	05/11/23	10:58	11:58	1.7	1.5	0.2	0.04
1	4	05/11/23	12:58	13:58	1.6	2.0	-0.4	0.16
1	5	05/11/23	14:09	15:09	1.3	1.8	-0.5	0.25
1	6	05/11/23	15:19	16:19	1.9	1.8	0.1	0.01
1	7	05/11/23	17:19	18:19	1.9	1.9	0.0	0.00
1	8	05/11/23	18:30	19:30	2.2	1.9	0.3	0.09
1	9	05/11/23	19:40	20:40	1.8	1.9	-0.1	0.01

n	**9**	
t(0.975)	**2.306**	
Mean Reference Method Value	**1.800**	**RM avg**
Mean CEM Value	**1.800**	**CEM avg**
Sum of Differences	**0.000**	**di**
Mean Difference	**0.000**	**d**
Sum of Differences Squared	**0.660**	**di^2**
Standard Deviation	**0.287**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.221**	**cc**
Relative Accuracy - APS	**4.42**	**RA[A]**

[A] Relative accuracy based upon alternate standard of 5 ppmvd @ 8 % O2

Client: Billerud Quinnesec, LLC					**Test Location:** Recovery Boiler Outlet Duct			
Facility: Quinnesec Mill					**Test Date:** 5/9/2023			
Project #: M231804					**Test Method:** 2			
Volumetric Flow RATA - Normal Load								
CEM Analyzer Information								
Flow Monitor/Model:			OFS-2000W			**Flow Serial # :**	15110807E	
1=accept 0=reject	**Test Run**	**Test Date**	**Start Time**	**End Time**	**Reference Method Flow DSCFM**	**CEM Flow DSCFM**	**(RM-CEM) Difference (di)**	**(RM-CEM) Difference ^{2} (di^2)**
1	1	05/09/23	13:35	13:45	185,871	178,334	7,537	56,810,346
1	2	05/09/23	13:46	13:53	184,736	178,780	5,956	35,478,460
1	3	05/09/23	14:23	14:30	185,965	179,373	6,592	43,449,454
1	4	05/09/23	16:20	16:27	182,369	177,111	5,258	27,646,451
1	5	05/09/23	16:28	16:34	186,266	177,027	9,240	85,372,626
1	6	05/09/23	17:05	17:13	188,270	176,911	11,358	129,012,692
1	7	05/09/23	17:28	17:34	187,367	176,439	10,928	119,420,710
1	8	05/09/23	17:35	17:41	187,896	176,451	11,445	130,998,521
0	9	05/09/23	17:42	17:48	190,348	176,570	13,778	189,827,122
1	10	05/09/23	18:05	18:10	187,097	176,982	10,115	102,313,223
				n	**9**			
				t(0.025)	**2.306**			
Mean Reference Method Value					**186204.088**		**RM avg**	
Mean CEM Value					**177489.667**		**CEM avg**	
Sum of Differences					**78429.796**		**di**	
Mean Difference					**8714.422**		**d**	
Sum of Differences Squared					**730502483.430**		**di^2**	
Standard Deviation					**2424.669**		**sd**	
Confidence Coefficient 2.5% Error (1-tail)					**1863.762**		**cc**	
Relative Accuracy					**5.68**		**RA**	

Client: Billerud Quinnesec, LLC **Location:** Lime Kiln Stack
Facility: Quinnesec Mill **Date:** 5/9/23 and 5/10/23
Project #: M231804 **Test Method:** 16A, 3A

Applicable Standard: 10

TRS as SO_2 ppmvd @ 10% O_2 RATA

Primary CEM Monitor Information

TRS Monitor Model:	Thermo 43iQ	TRS Monitor Serial # :	1180090014

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM TRS asSO_2 ppmvd @ 10% O_2	CEM TRS asSO_2 ppmvd @ 10% O_3	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/09/23	11:55	12:55	4.1	3.8	0.3	0.09
1	2	05/09/23	15:02	16:02	4.0	4.0	0.0	0.00
1	3	05/09/23	16:07	17:07	4.2	4.3	-0.1	0.01
1	4	05/10/23	7:39	8:39	4.7	4.7	0.0	0.00
1	5	05/10/23	8:45	9:45	5.0	4.9	0.1	0.01
1	6	05/10/23	9:55	10:55	5.6	4.9	0.7	0.49
1	7	05/10/23	13:06	14:06	4.5	4.2	0.3	0.09
1	8	05/10/23	14:18	15:18	4.3	4.1	0.2	0.04
1	9	05/10/23	15:23	16:23	4.8	4.2	0.6	0.36

n	**9**	
t(0.975)	**2.306**	
Mean Reference Method Value	**4.578**	**RM avg**
Mean CEM Value	**4.344**	**CEM avg**
Sum of Differences	**2.100**	**di**
Mean Difference	**0.233**	**d**
Sum of Differences Squared	**1.090**	**di^2**
Standard Deviation	**0.274**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.211**	**cc**
Relative Accuracy	**9.70**	**RA**

Client: Billerud Quinnesec, LLC **Location:** Lime Kiln Stack
Facility: Quinnesec Mill **Date:** 5/9/23 and 5/10/23
Project #: M231804 **Test Method:** 3A

O_2 % (dry) RATA

CEM Analyzer Information

O_2 Monitor/Model:	Thermo CTL902C	O_2 Serial # :	1180570001

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM O2 % (dry)	CEM O2 % (dry)	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	05/09/23	11:55	12:55	4.17	3.72	0.45	0.20
1	2	05/09/23	15:02	16:02	3.28	3.55	-0.27	0.07
1	3	05/09/23	16:07	17:07	2.95	3.21	-0.26	0.07
1	4	05/10/23	7:39	8:39	3.73	4.15	-0.42	0.18
1	5	05/10/23	8:45	9:45	3.56	3.97	-0.41	0.17
1	6	05/10/23	9:55	10:55	3.65	3.97	-0.32	0.10
1	7	05/10/23	13:06	14:06	3.40	3.78	-0.38	0.14
1	8	05/10/23	14:18	15:18	3.33	3.69	-0.36	0.13
1	9	05/10/23	15:23	16:23	4.10	4.42	-0.32	0.10

n	9	
t(0.975)	2.306	
Mean Reference Method Value	3.57	RM avg
Mean CEM Value	3.83	CEM avg
Sum of Differences	-2.29	di
Mean Difference	-0.25	d
Sum of Differences Squared	1.17	di^2
Standard Deviation	0.270	sd
Confidence Coefficient 2.5% Error (1-tail)	0.208	cc
Relative Accuracy	12.93	RA

4.0 CERTIFICATION

Mostardi Platt is pleased to have been of service to Billerud Quinnesec, LLC. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

MOSTARDI PLATT

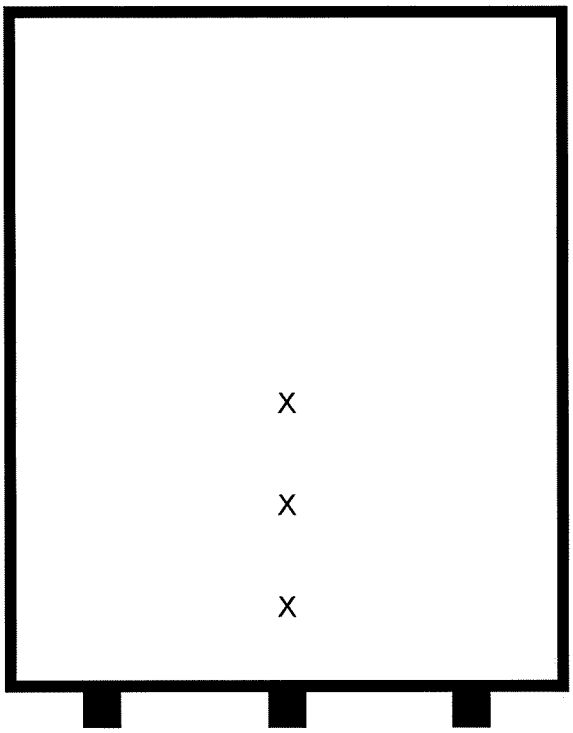
Daniel Kossack — Program Manager

Scott W. Banach — Quality Assurance

APPENDICES

Appendix A - Test Section Diagrams

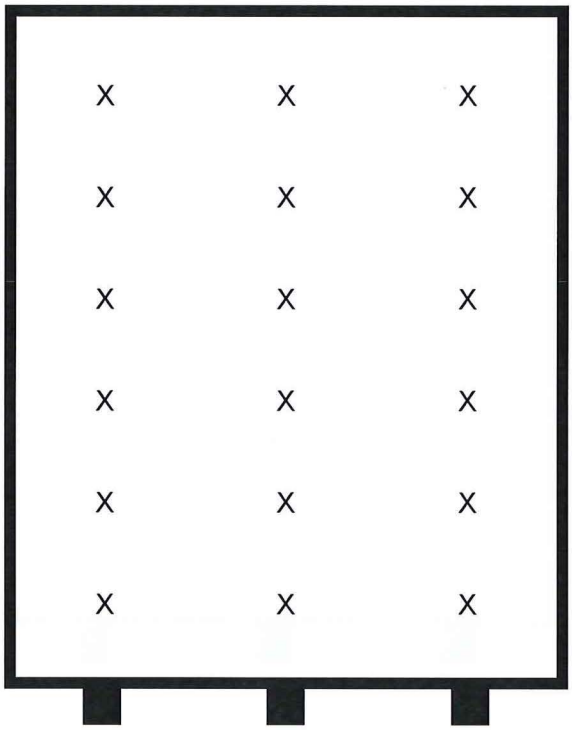
THREE POINT GASEOUS TRAVERSE FOR RECTANGULAR DUCTS



Job:	Billerud Quinnesec LLC Quinnesec, Michigan
Date:	May 10, 2023
Test Location:	Package Boiler Duct
Length:	5.5 Feet
Width:	7.5 Feet
Area:	41.25 Square Feet
Upstream Distance:	75 Feet
Downstream Distance:	40 Feet
No. Test Ports:	1
Tests Points per Port:	3

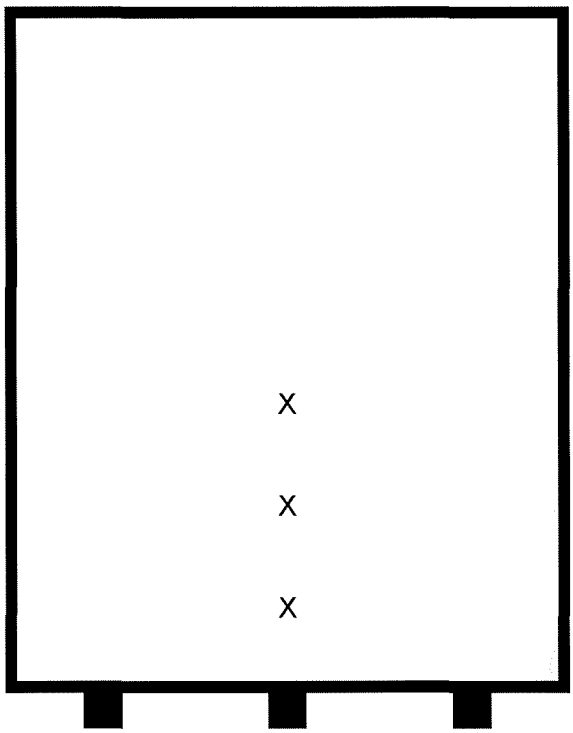
Distance from Inside Wall
To Traverse Point:
1. 2.0 Meters
2. 1.2 Meters
3. 0.4 Meters

EQUAL AREA TRAVERSE
FOR RECTANGULAR DUCTS



Job:	Billerud Quinnesec LLC Quinnesec, Michigan
Date:	May 11, 2023
Test Location:	Waste Fuel Boiler Duct
Length:	7 Feet
Width:	10 Feet
Area:	70 Square Feet
No. Test Ports:	3
Tests Points per Port:	6

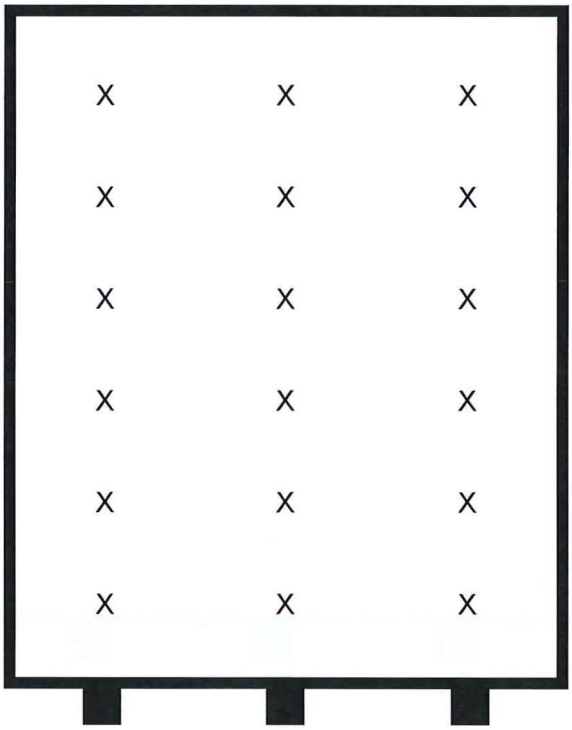
THREE POINT GASEOUS TRAVERSE FOR RECTANGULAR DUCTS



Job:	Billerud Quinnesec LLC Quinnesec, Michigan
Date:	May 11, 2023
Test Location:	Waste Fuel Boiler Duct
Length:	7 Feet
Width:	10 Feet
Area:	70 Square Feet
Upstream Distance:	~20 Feet
Downstream Distance:	~100 Feet
No. Test Ports:	1
Tests Points per Port:	3

Distance from Inside Wall
To Traverse Point:
1. 2.0 Meters
2. 1.2 Meters
3. 0.4 Meters

EQUAL AREA TRAVERSE
FOR RECTANGULAR DUCTS



Job: Billerud Quinnesec LLC
Quinnesec, Michigan

Date: May 9, 2023

Test Location: Recovery Boiler Duct

Length: 8 Feet

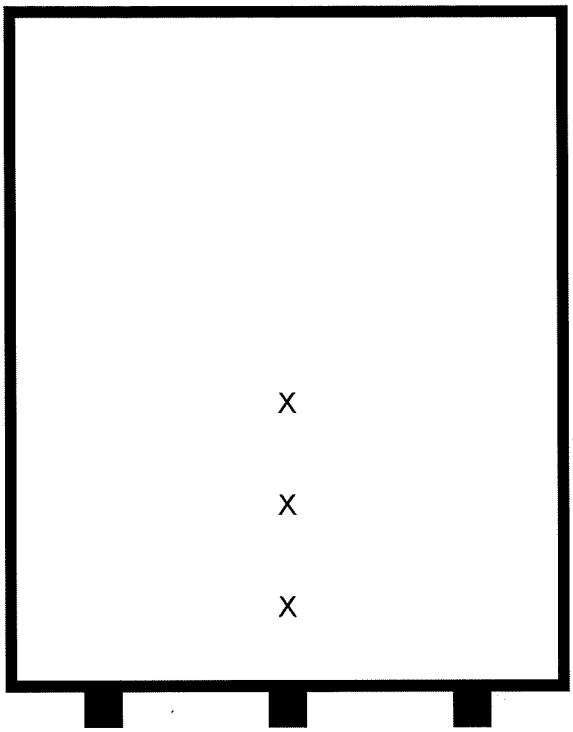
Width: 12.25 Feet

Area: 98 Square Feet

No. Test Ports: 3

Tests Points per Port: 6

THREE POINT GASEOUS TRAVERSE
FOR RECTANGULAR DUCTS



Job: Billerud Quinnesec LLC
Quinnesec, Michigan

Date: May 10, 2023

Test Location: Recovery Boiler Duct

Length: 8 Feet

Width: 12.25 Feet

Area: 98 Square Feet

Upstream Distance: ~20 Feet

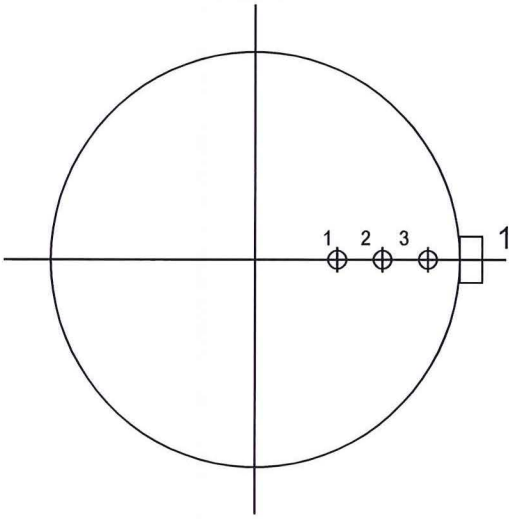
Downstream Distance: ~20 Feet

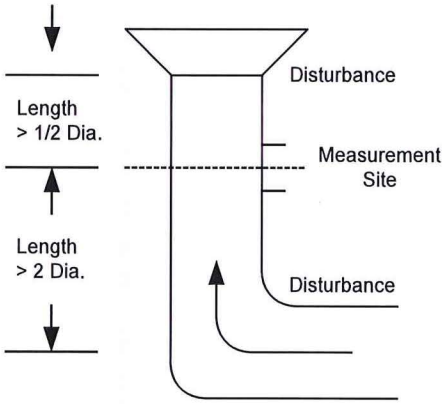
No. Test Ports: 1

Tests Points per Port: 3

Distance from Inside Wall
To Traverse Point:
1. 2.0 Meters
2. 1.2 Meters
3. 0.4 Meters

THREE POINT GASEOUS TRAVERSE FOR ROUND DUCTS





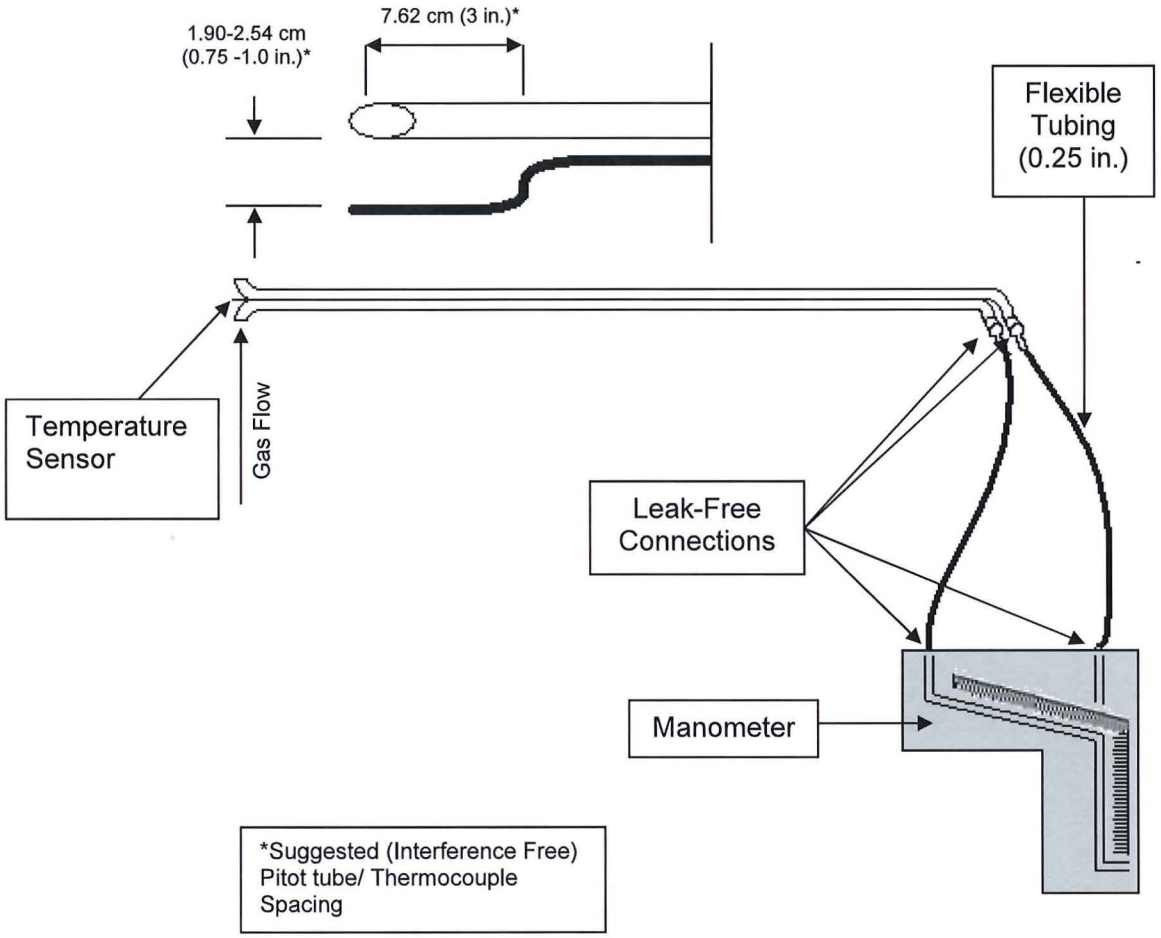
Job:	Billerud Quinnesec LLC Quinnesec, Michigan
Date:	May 9 and 10, 2023
Test Location:	Lime Kiln Stack
Stack Diameter:	8.0 Feet
Stack Area:	50.265 Square Feet
No. Sample Points:	3
Upstream Disturbance:	Approximately 75 Feet
Downstream Disturbance	Approximately 40 Feet

Distance from Inside Wall
To Traverse Point:

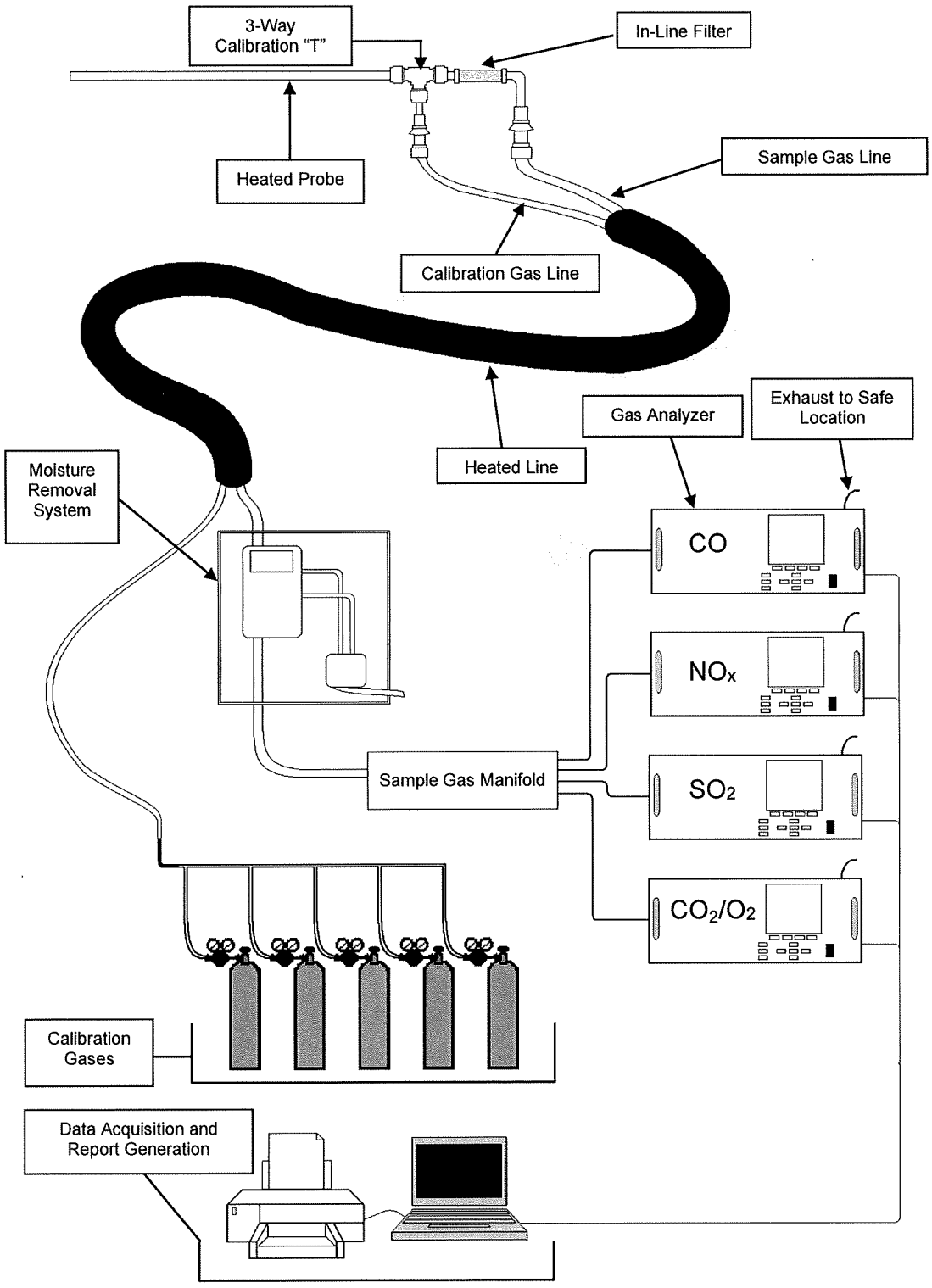
1. 2.0 Meters
2. 1.2 Meters
3. 0.4 Meters

Appendix B - Sample Train Diagrams

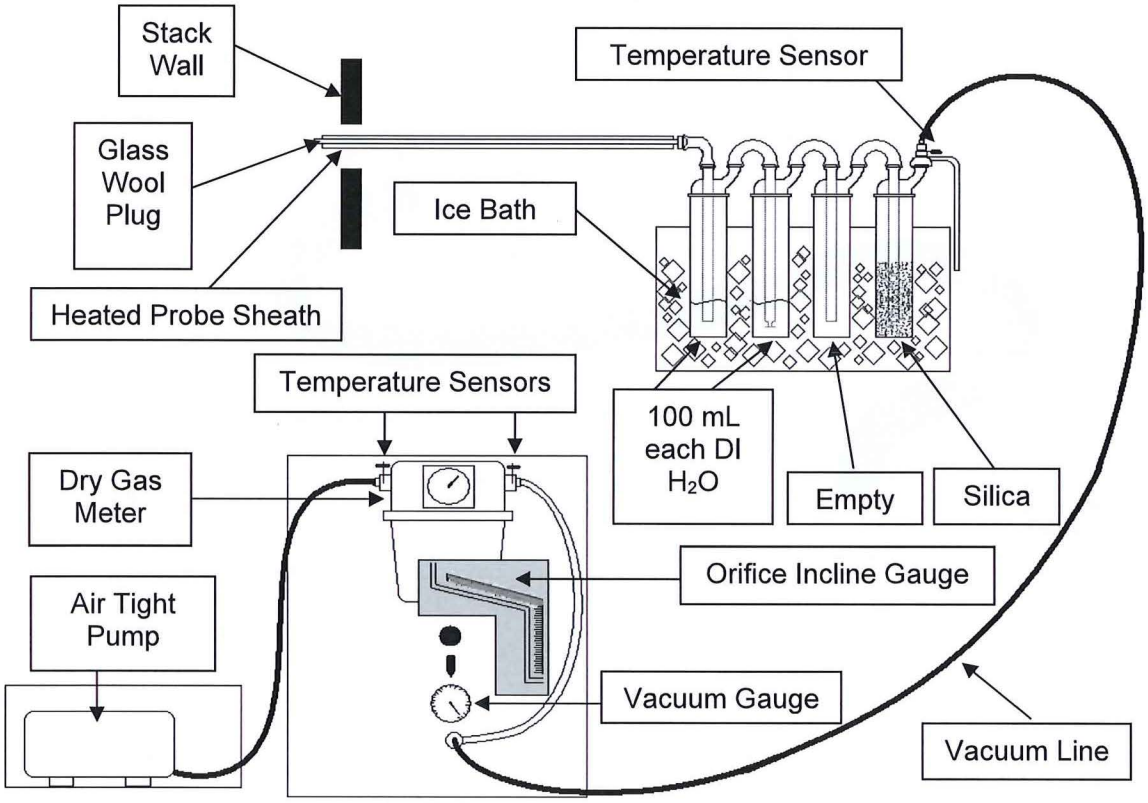
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



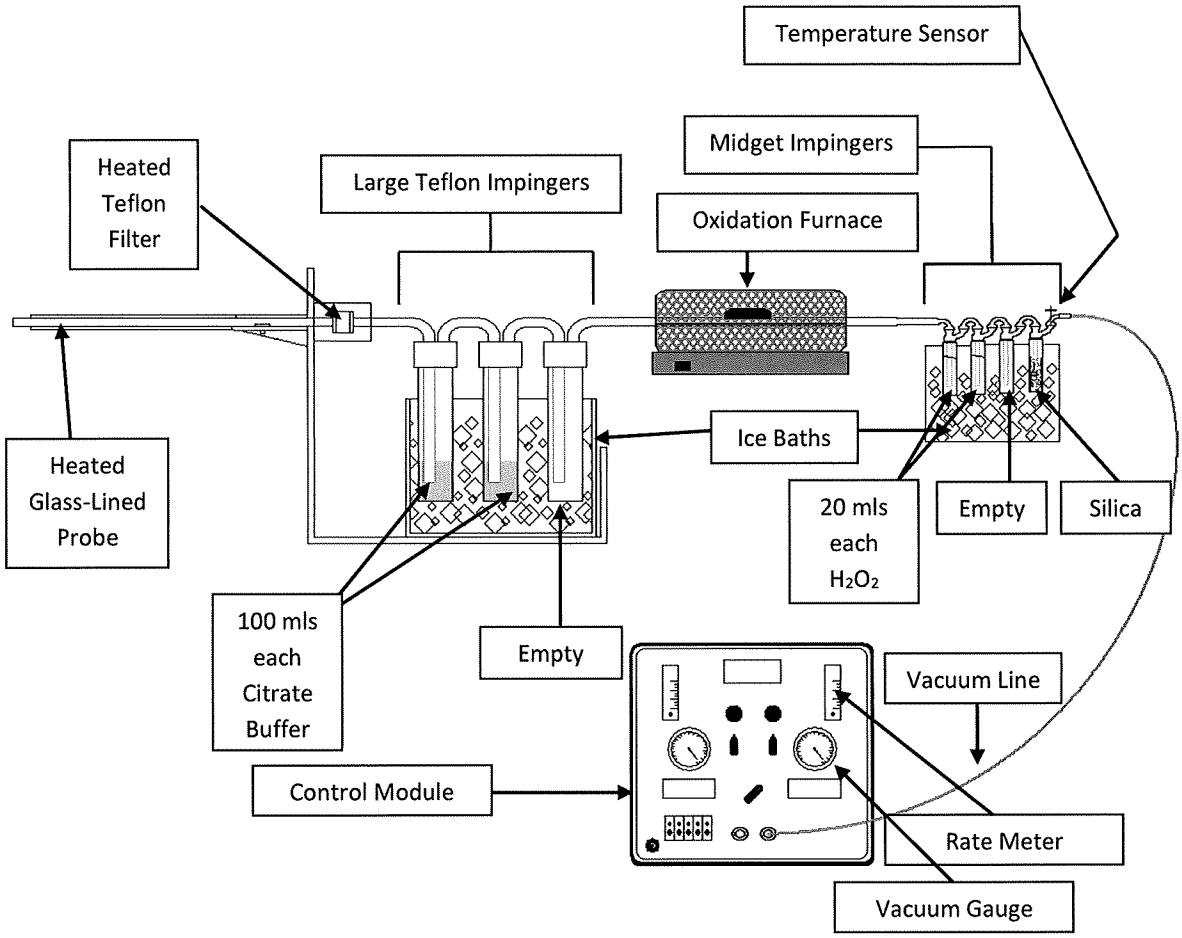
USEPA Methods 3A, 6C, 7E, and 10 Extractive Gaseous Sampling Diagram



USEPA Method 4- Moisture Content Sample Train Diagram



USEPA Method 16A – Total Reduced Sulfur Sample Train Diagram



Appendix C - Calculation Nomenclature and Formulas