



**Industrial Boiler Maximum Achievable
Control Technology Test Report**

**Billerud Quinnesec LLC
Waste Fuel (Hog) Boiler Outlet Duct
Quinnesec, Michigan
May 2, 2023**

**Report Submittal Date
June 16, 2023**

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Mostardi Platt

Project No. M231804A

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1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted an Industrial Boiler Maximum Achievable Control Technology (IB MACT) test program for Billerud Quinnesec LLC at the Quinnesec Mill on Waste Fuel (Hog) Boiler Outlet Duct on May 2, 2023. This report summarizes the results of the test program and test methods used.

Test location, test date, and test parameters are summarized below.

TEST INFORMATION		
Test Location	Test Date	Test Parameters
Waste Fuel (Hog) Boiler Outlet Duct	May 2, 2023	Filterable Particulate Matter (FPM), Hydrogen Chloride (HCl), Mercury (Hg), and Carbon Monoxide (CO)

The purpose of the test program was to evaluate the FPM, HCl, and Hg emissions against the IB MACT standards under the stoker/sloped grate wet biomass fuel category. Selected results of the test program are summarized below. A complete summary of emission test results follows the narrative portion of this report.

TEST RESULTS				
Test Location	Test Date	Test Parameter	Emission Limit	Emission Rate
Waste Fuel (Hog) Boiler Outlet Duct	5/2/2023	FPM	0.034 lb/mmBtu	0.0033 lb/mmBtu (Fd-Factor)
		HCl	0.020 lb/mmBtu	0.0020 lb/mmBtu (Fd-Factor)
		Hg	0.0000054 lb/mmBtu	0.0000008 lb/mmBtu (Heat Input)
		CO	360 lb/hr*	146.33 lb/hr
			1100 ppmvd @ 3% O ₂	393.48 ppmvd @ 3% O ₂

*Title V Limit

Calculated Fd-Factors supplied by Billerud Quinnesec were used to calculate the emissions on a lb/mmBtu basis. Plant operating data as provided by Billerud Quinnesec is included in Appendix A.

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

TEST PERSONNEL INFORMATION		
Location	Address	Contact
Test Facility	Billerud Quinnesec LLC 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. Jacob Howe Project Manager (630) 993-2100 (phone) jhowe@mp-mail.com

The test crew consisted of Messrs. A. Diaz, D. Kossack, V. Vang, and J. Howe of Mostardi Platt.

2.0 TEST METHODOLOGY

Emissions testing were conducted following the methods specified in 40 CFR, Part 60, Appendix A. Schematics of the test section diagram and sampling trains used are found in Appendix B and C, respectively. Calculation nomenclature and sample calculations are found in Appendix D. Sample analysis data are found in Appendix E. Copies of reference method data and field data sheets for each test run are included in Appendix F and G, respectively.

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 location are summarized below.

TEST POINT INFORMATION						
Location	Stack Diameter (Feet)	Stack Area (Square Feet)	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points
Waste Fuel (Hog) Boiler Outlet Duct	8.235	70	>0.5	>2.0	FPM, HCl	24
					CO	12 (Run 1-Stratification, Runs 2 and 3)

Gaseous Stratification Test

A 12-point stratification test was performed during Run 1. The results were not less than 10% difference so 12 test points were run for both Runs 2 and 3.

Method 2 Volumetric Flowrate Determination

Gas velocity was measured following Method 2, for purposes of calculating stack gas volumetric flow rate. An S-type pitot tube, differential pressure gauge, thermocouple and temperature readout were used to determine gas velocity at each sample point. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Method 3A Oxygen (O₂)/Carbon Dioxide (CO₂) Determination

Stack gas molecular weight was determined in accordance with Method 3A, 40 CFR, Part 60, Appendix A. A Servomex analyzer was used to determine stack gas oxygen and carbon dioxide content and, by difference, nitrogen content. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H and gas cylinder certifications are presented in Appendix I.

Method 5 Filterable Particulate Matter (FPM) Determination

Stack gas FPM concentrations and emission rates were determined in accordance with USEPA Method 5, 40CFR60, Appendix A with filter and probe temperatures between 248 and 273 degrees Fahrenheit. An Environmental Supply Company, Inc. sampling train was used to sample stack gas at an isokinetic rate, as specified in the Method utilizing Pallflex TX40HI45 filters. Particulate matter in the sample probe was recovered using an acetone rinse. The probe wash and filter catch were analyzed by Mostardi Platt in accordance with the Method in the Elmhurst, Illinois laboratory. Sample analysis data are found in Appendix E. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Method 10 Carbon Monoxide (CO) Determination

Stack gas carbon monoxide concentrations and emission rates were determined in accordance with Method 10. A Thermo Scientific carbon monoxide analyzer was used to determine carbon monoxide concentrations, in the manner specified in the Method.

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 can be found in Appendix G. Copies of calibration gas certifications can be found in Appendix H.

Method 26A Hydrogen Chloride (HCl) Determination

Stack gas hydrogen chloride concentrations and emission rates were determined in accordance with Method 26A, 40CFR60, Appendix A in conjunction with the USEPA Method 5 sampling. An Environmental Supply Company sampling train was used to sample stack gas, in the manner specified in the Method utilizing Pallflex TX40HI45 filters. Analyses of the samples collected were conducted by Mostardi Platt in the Elmhurst laboratory. Sample analysis data are found in Appendix F. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix I.

Mercury Determination by Method 30B (Sorbent Trap Method)

Paired trains were utilized sampling three test points per test run.

Per Method 30B sampling, each sample was collected on the paired in-situ sorbent traps. A tube of silica was used to capture remaining moisture prior to the sample reaching the gas metering system.

The sample train used for this test program was designed by APEX, Inc. and meets all requirements for Method 30B sampling. Samples were analyzed onsite utilizing an Ohio Lumex, Inc. analyzer for total gaseous mercury. Mercury quality assurance and control data are found in Appendix J. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

3.0 TEST RESULTS SUMMARIES

Client: Billerud Quinnesec LLC
Facility: Quinnesec Mill
Test Location: Waste Fuel Boiler Outlet Duct
Test Method: 5/26A

Source Condition	Normal	Normal	Normal	
Date	5/2/23	5/2/23	5/2/23	
Start Time	9:15	11:55	14:40	
End Time	11:31	14:06	16:48	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	410.2	413.1	392.3	405.2
Flue Gas Moisture, percent by volume	17.9%	17.7%	20.2%	18.6%
Average Flue Pressure, in. Hg	28.40	28.40	28.40	28.40
Gas Sample Volume, dscf	77.788	81.845	82.065	80.566
Average Gas Velocity, ft/sec	73.420	72.816	71.435	72.557
Gas Volumetric Flow Rate, acfm	308,366	305,827	300,027	304,740
Gas Volumetric Flow Rate, dscfm	145,850	144,498	140,754	143,701
Gas Volumetric Flow Rate, scfm	177,607	175,556	176,445	176,536
Average %CO ₂ by volume, dry basis	13.9	13.7	13.3	13.6
Average %O ₂ by volume, dry basis	6.8	6.5	6.9	6.7
Isokinetic Variance	94.3	100.2	103.1	99.2
Calculated Fuel Factor F _d , dscf/mmBtu	9,615.0	9,614.0	9,614.0	9,614.3
Filterable Particulate Matter (Method 5)				
grams collected	0.00959	0.00890	0.00712	0.00854
mg/dscm	4.353	3.840	3.064	3.7522
grains/acf	0.0009	0.0008	0.0006	0.0008
grains/dscf	0.0019	0.0017	0.0013	0.0016
lb/hr	2.377	2.078	1.615	2.023
lb/mmBtu (Calculated F _d Factor)	0.0039	0.0033	0.0027	0.0033

Client: Billerud Quinnesec LLC
 Facility: Quinnesec Mill
 Test Location: Waste Fuel Boiler Outlet Duct
 Test Method: 5/26A

	Source Condition	Normal	Normal	Normal	
	Date	5/2/23	5/2/23	5/2/23	
	Start Time	9:15	11:55	14:40	
	End Time	11:31	14:06	16:48	
		Run 1	Run 2	Run 3	Average
Stack Conditions					
Average Gas Temperature, °F		410.2	413.1	392.3	405.2
Flue Gas Moisture, percent by volume		17.9%	17.7%	20.2%	18.6%
Average Flue Pressure, in. Hg		28.40	28.40	28.40	28.40
Gas Sample Volume, dscf		77.788	81.845	82.065	80.566
Average Gas Velocity, ft/sec		73.420	72.816	71.435	72.557
Gas Volumetric Flow Rate, acfm		308,366	305,827	300,027	304,740
Gas Volumetric Flow Rate, dscfm		145,850	144,498	140,754	143,701
Gas Volumetric Flow Rate, scfm		177,607	175,556	176,445	176,536
Average %CO ₂ by volume, dry basis		13.9	13.7	13.3	13.6
Average %O ₂ by volume, dry basis		6.8	6.5	6.9	6.7
Isokinetic Variance		94.3	100.2	103.1	99.2
Calculated Fuel Factor Fd, dscf/mmBtu		9,615.0	9,614.0	9,614.0	9,614.3
Hydrogen Chloride (HCl) Emissions					
ug of sample collected		4837.00	4797.00	5844.00	5159.33
ppm		1.45	1.36	1.66	1.49
mg/dscm		2.20	2.07	2.51	2.26
lb/hr		1.200	1.120	1.326	1.215
lb/mmBtu (Calculated Fd Factor)		0.0020	0.0018	0.0023	0.0020

Billerud Quinnesec LLC Quinnesec Mill Waste Fuel (HOG) Boiler Outlet Duct Gaseous Summary Normal Load												
Test No.	Date	Start Time	End Time	CO ppmvd	CO ₂ % (dry)	O ₂ % (dry)	Moisture, %	Flowrate, DSCFM	Fd Factor, dscf/MMBtu	O2 based CO lb/MMBtu	CO lb/hr	CO ppmvd @3% O ₂
1	05/02/23	09:15	10:30	302.7	13.7	6.8	17.9	145,850	9,615.0	0.313	192.47	384.28
2	05/02/23	11:54	12:54	323.6	13.5	6.7	17.7	144,498	9,615.0	0.333	203.85	407.92
3	05/02/23	14:39	15:39	308.0	13.4	6.7	20.2	140,754	9,615.0	0.317	189.00	388.25
Average				311.4	13.5	6.7	18.6	143,701	9,615.0	0.321	146.33	393.48

Method 30B (Sorbent Trap) Mercury Test Results Summary

Billerud Quinnesec LLC

Quinnesec Mill

Waste Fuel Boiler Duct

Test No.	Date	Start Time	End Time	V _m (standard L)	ng detected	ppb	ug/dscm	ug/wscm	lb/MMBtu (Fd Factor)	lb/Tbtu (Heat Input)
1A	5/2/2023	9:43	10:43	58.999	48.2	0.098	0.817	0.671	0.00000073	0.888
1B				58.969	41.9	0.085	0.711	0.583	0.00000063	0.770
Average				58.984	45.1	0.092	0.764	0.627	0.00000068	0.829
2A	5/2/2023	12:41	13:41	59.101	52.5	0.106	0.888	0.888	0.0000008	1.008
2B				58.856	45.3	0.092	0.770	0.770	0.0000007	0.873
Average				58.979	48.9	0.099	0.829	0.829	0.0000007	0.941
3A	5/2/2023	15:24	16:24	59.423	38.7	0.078	0.651	0.520	0.0000006	0.630
3B				59.144	38.4	0.078	0.649	0.518	0.0000006	0.628
Average				59.283	38.6	0.078	0.650	0.519	0.0000006	0.629

Emmissions Limit 0.0000057 lb/mmBtu (Heat Input)	ng detected	ppb	ug/dscm	ug/wscm	lb/Tbtu (Heat Input)
Average of Runs 1-3	44.2	0.090	0.748	0.658	0.00000080

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.

CERTIFICATION

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



Jacob Howe

Program Manager



Scott W. Banach

Quality Assurance

APPENDICES

Appendix A - Plant Operating Data

Waste Fuel Boiler Process Data:

Test/Run	Date/time	Hog Fuel (tons/hr) short belt scale	Hog Fuel adjusted belt scale tons/hr*	Hog Fuel adjusted heat input MMBtu/hr*	Coal (lb/hr)	Coal heat input (MMBtu/hr)	Nat gas flow (kscfh)	Nat gas heat input (MMBtu/hr)	Total adjusted heat input (MMBtu/hr)	Average steaming rate (KPPH)	O ₂ Trim (% O ₂)	F-Factor	Opacity %
CO #1	5/2/2023 9:15 5/2/2023 10:30	59.4	59.4	497.5	3732	44.8	0.00	0.00	542	362	4	9615	8
CO #2	5/2/2023 11:54 5/2/2023 12:54	60.4	60.5	506.1	3732	44.8	0.00	0.00	551	363	4	9615	8
CO #3	5/2/2023 14:39 5/2/2023 15:39	60.8	60.9	509.7	3739	44.9	0.00	0.00	555	374	4	9615	7
Hg #1	5/2/2023 9:43 5/2/2023 10:43	60.2	60.3	504.8	3732	44.8	0.00	0.00	550	364	NA	9615	8
Hg #2	5/2/2023 12:41 5/2/2023 13:41	63.9	64.0	535.4	3732	44.8	0.00	0.00	580	371	NA	9614	8
Hg #3	5/2/2023 15:24 5/2/2023 16:24	60.0	60.0	502.6	3704	44.4	0.00	0.00	547	365	NA	9615	7
FPM & HCl #1	5/2/2023 9:15 5/2/2023 11:31	59.9	60.0	502.2	3732	44.8	0.00	0.00	547	362	NA	9615	8
FPM & HCl #2	5/2/2023 11:55 5/2/2023 14:06	62.2	62.3	521.1	3732	44.8	0.00	0.00	566	367	NA	9614	8
FPM & HCl #3	5/2/2023 14:40 5/2/2023 16:48	61.4	61.4	514.3	3721	44.6	0.00	0.00	559	374	NA	9614	7

Waste Fuel Boiler Operating Parameters:

Maximum 30 day steam flow limit:	412 KPPH	= max hourly boiler steam flow x 110%
Minimum O ₂ trim setpoint:	4%	= min hourly boiler O ₂

***Hog Fuel Adjustment Ratio**

Tons hog fuel in per bark to bin weightometer, YTD
Tons hog fuel per Accounting, YTD

1.0013

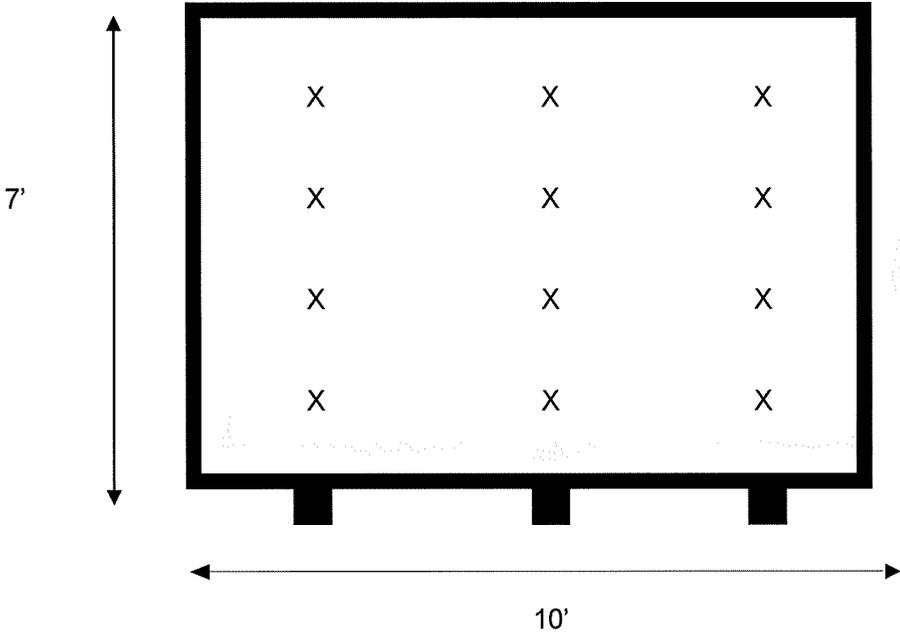
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102807.35

Waste Fuel Boiler Pollutant Loading:

Pollutant	Pollutant lb/MMBtu Max Input	Hog Fuel Concentration lb/MMBtu	Coal Fuel Concentration lb/MMBtu	Nat. Gas Concentration lb/MMBtu	% Heat Input Hog Fuel	% Heat Input Coal	% Heat Input Nat. Gas
Mercury	1.31E-06	1.01E-06	4.71E-06	0	92%	8%	0%
Chloride	2.35E-02	1.83E-02	8.33E-02	0	92%	8%	0%

Appendix B - Test Section Diagram

EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS



Job: Billerud Quinnesec LLC
Quinnesec, Michigan

Date: May 2, 2023

Area: 70 Square Feet

Test Location: Waste Fuel (Hog) Boiler
Outlet Duct

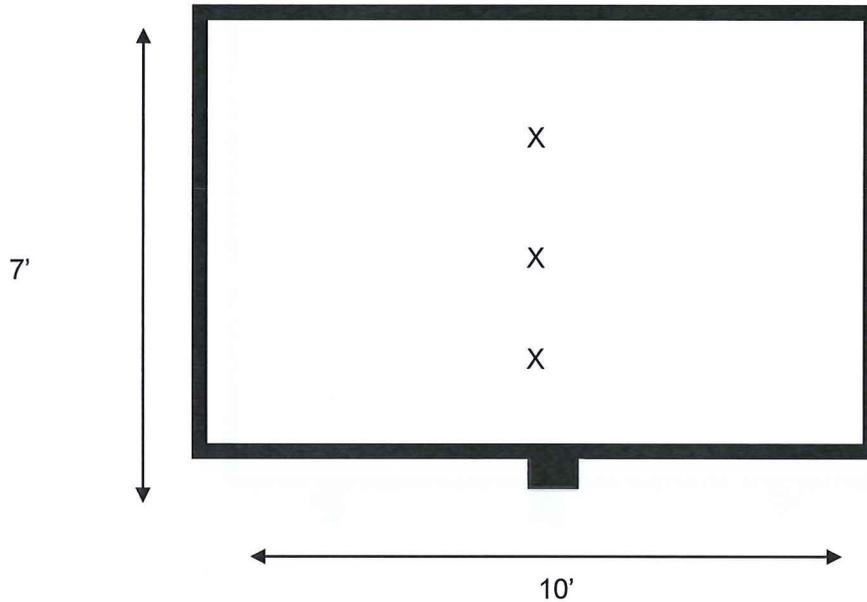
No. Test Ports: 3

Length: 7 Feet

Tests Points per Port: 4

Width: 10 Feet

MERCURY TRAVERSE FOR RECTANGULAR DUCTS



Job: Billerud Quinnesec LLC
Quinnesec, Michigan

Date: May 2, 2023

Area: 70 Square Feet

Test Location: Waste Fuel (Hog) Boiler
Outlet Duct

No. Test Ports: 1

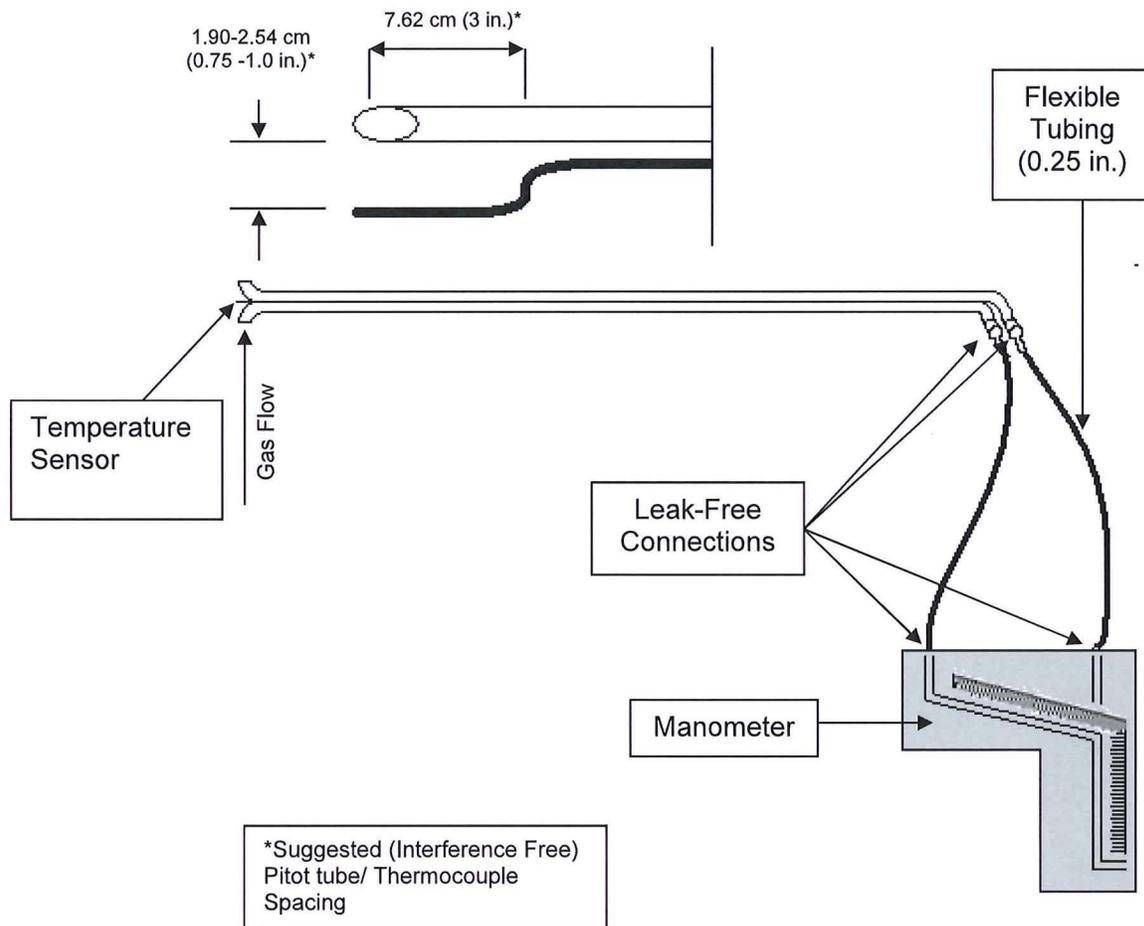
Length: 7 Feet

Tests Points per Port: 3

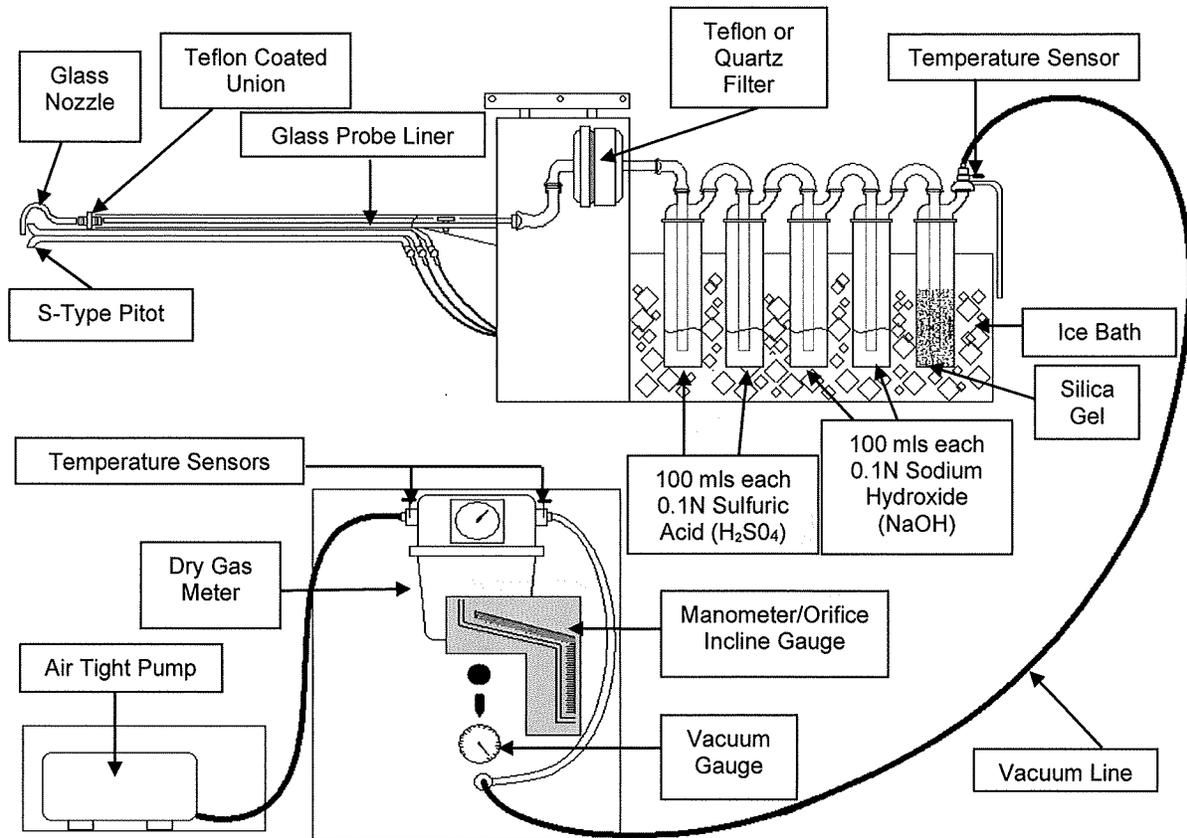
Width: 10 Feet

Appendix C - Sample Train Diagrams

USEPA Method 2 – Type S Pitot Tube Manometer Assembly



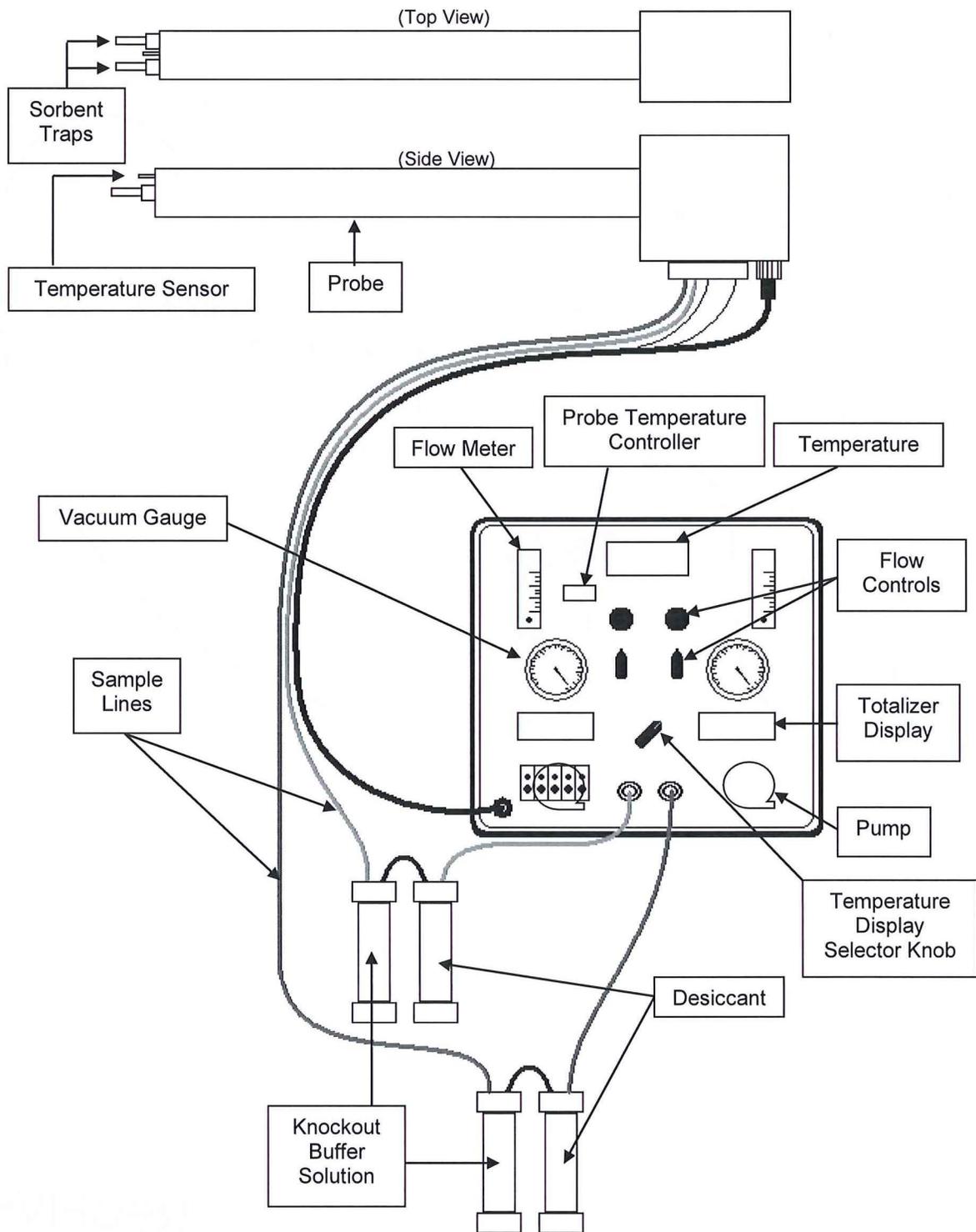
USEPA Method 5/26A –Particulate Matter/ HCl Sample Train Diagram



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USEPA Method 30B- Mercury Sorbent Trap Sampling Train

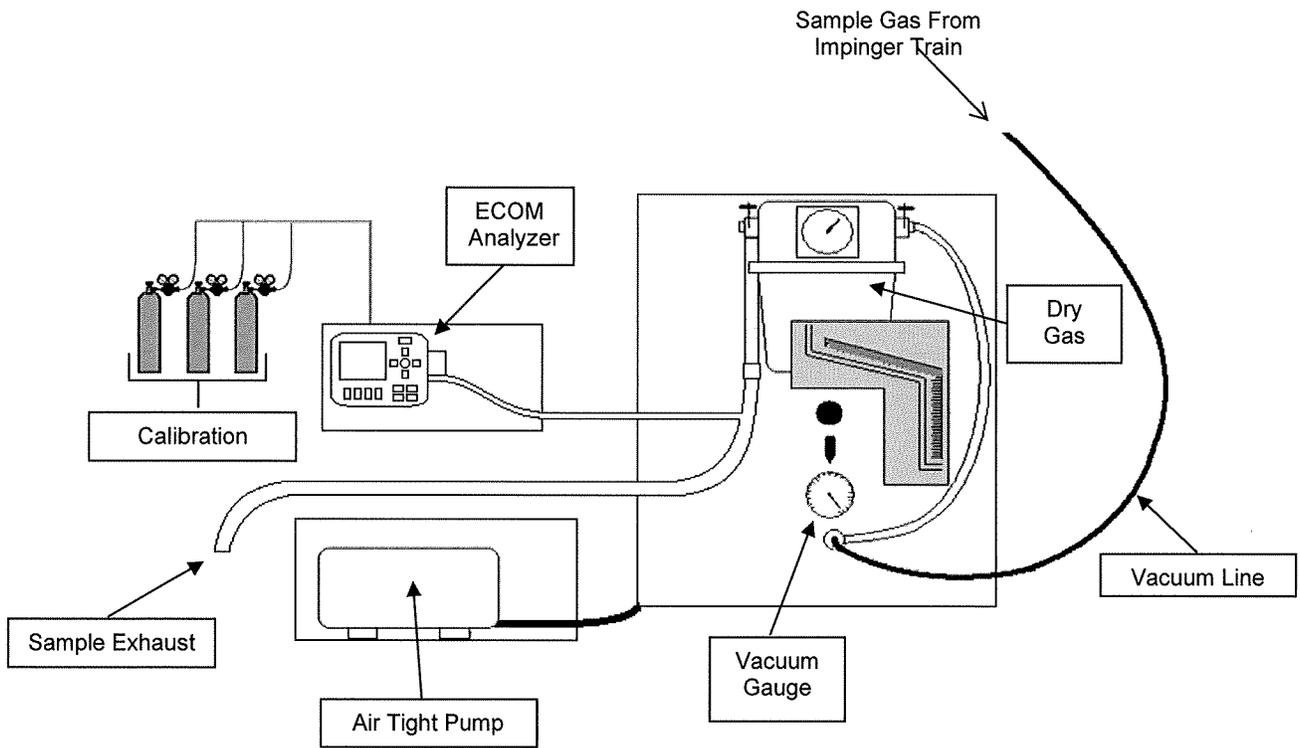


ATD-071 USEPA Method 30B

Rev. 1.2

1/1/2021

USEPA Method 3A - Integrated Oxygen/Carbon Dioxide Sample Train Diagram Utilizing ECOM To Measure from Sample Exhaust



Appendix D - Calculation Nomenclature and Formulas