1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Packaging Corporation of America (Facility ID: B3692) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance test program on the Bubbling Fluidized Bed Boiler (EUBOILER5) at the Packaging Corporation of America facility located in F iler City, Michigan. Testing was performed on July 28-29, 2021, for the purpose of satisfying the emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Permit No. 209-18A and 40 CFR Part 63 Subpart DDDDD.

The specific objectives were to:

- Verify the concentrations of filterable particulate matter (FPM), hydrogen chloride (HCl), mercury (Hg)
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

TABLE 1-1
SUMMARY OF TEST PROGRAM

Test Date(s)	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
7/28/2021	EUBOILER5	Velocity/Volumetric Flow Rate	EPA 1, 2	3	62.5
7/28/2021	EUBOILER5	O_2, CO_2	EPA 3A	3	62.5
7/28/2021	EUBOILER5	Moisture	EPA 4	3	62.5
7/28/2021	EUBOILER5	FPM	EPA 5	3	62.5
7/28/2021	EUBOILER5	HCl	EPA 26A	3	62.5
7/28/2021	EUBOILER5	Hg	EPA 30B	3	60
7/29/2021	EUBOILER5	Velocity/Volumetric Flow Rate	EPA 1, 2	3	62.5
7/29/2021	EUBOILER5	O_2, CO_2	EPA 3A	3	62.5
7/29/2021	EUBOILER5	Moisture	EPA 4	3	62.5
7/29/2021	EUBOILER5	FPM	EPA 5	3	62.5

To simplify this report, a list of Units and Abbreviations is included in Appendix D.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized in Table 1-2. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-3. The tests were conducted according to the Test Plan dated May 25, 2021.

TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS - EUBOILER5

Parameter/Units	Average Results	Emission Limits
Filterable Particulate Matter (FPM) - July 28,2021		
lb/MMBtu*	<0.00138	0.00980
Filterable Particulate Matter (FPM) - July 29, 2021		
lb/MMBtu	0.00135	0.00980
Hydrogen Chloride (HCl)		
lb/MMBtu	0.00043	0.022
Mercury (Hg)		
lb/MMBtu	1.64E-07	8.00E-07

* The "<" symbol indicates that compound was below the Minimum Detection Limit (MDL) of the analytical method. See Section 4.2 for details.

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location:	Packaging Corporation of America 2246 Udell Street Filer City, MI 49634	
Project Contact:	Josh Kosmowski	Angela Wang
Role:	Environmental Manager	Environmental Engineer Sr.
Company:	Packaging Corporation of America	Packaging Corporation of America
Telephone:	231-510-4689	231-723-9951 ex 347
Email:	joshkosmowski@packagingcorp.com	angelawang@packagingcorp.com

Agency Information

Regulatory Agency:	EGLE
Agency Contact:	Karen Kajiya-Mills
Telephone:	517-335-3122
Email:	Kajiya-millk@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC	
Contact:	Matt Young	David Trahan
Title:	District Manager	Filed Project Manager
Telephone:	248-548-8070	248-548-8070
Email:	myoung@montrose-env.com	ssmith@montrose-env.com

Laboratory Information

Laboratory:	Montrose
City, State:	Royal Oak, MI
Method:	EPA 5
Laboratory:	Enthalpy Analytical, LLC
City, State:	Durham, NC 27713
Method:	EPA 26A
Laboratory:	Ohio Lumex
City, State:	Solon, OH
Method:	EPA 30B

Test personnel and observers are summarized in Table 1-3.

TABLE 1-3
TEST PERSONNEL AND OBSERVERS

Name	Affiliation	Role/Responsibility
Steven Smith	Montrose	Client Project Manager, QI
David Trahan	Montrose	Field Project Manager, QI
Ben Durham	Montrose	Field Technician
Scott Dater	Montrose	Field Technician
Josh Kosmowski	PCA	Client Liaison/Test Coordinator
Angela Wang	PCA	Client Liaison/Test Coordinator/Observer
Jeremy Howe	EGLE	Observer

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

Packaging Corporation of America operates a bubbling fluidized bed boiler (EUBOILER5) which is permitted to burn a combination of wood, wood waste, primary clarifier residuals, paper recycling residuals, tire derived fuel (TDF), and natural gas. Emissions from EUBOILER5 are controlled by a baghouse.

2.2 FLUE GAS SAMPLING LOCATION

Information regarding the sampling location is presented in Table 2-1.

TABLE 2-1
SAMPLING LOCATION

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EUBOILER5 Exhaust Stack	88.0 X 72.0 Rectangle	171.5 / 2.2	169.0 / 2.1	Isokinetic: 25 (5/port) Gaseous: 1

The sampling location was verified in the field to conform to EPA Method 1. See Appendix A.1 for more information.

2.3 OPERATING CONDITIONS AND PROCESS DATA

The EUBOILER5 and baghouse was tested when operating normally.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B. Data collected during the July 28-29, 2021 test event includes the following parameters:

- Steaming Rate, 1000 lb/hr,
- Total Heat Input, MMBtu/hr
- F-Factor, dscf/MMBtu
- Primary Sludge, ton/hr and MMBtu/hr
- Wood Waste, ton/hr and MMBtu/hr
- Tire Derived Fuel, ton/hr and MMBtu/hr
- Natural Gas, Kscfh and MMBtu/hr

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TEST METHODS

The test methods for this test program were presented previously in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 1, Sample and Velocity Traverses for Stationary Sources

EPA Method 1 is used to assure that representative measurements of volumetric flow rate are obtained by dividing the cross-section of the stack or duct into equal areas, and then locating a traverse point within each of the equal areas. Acceptable sample locations must be located at least two stack or duct equivalent diameters downstream from a flow disturbance and one-half equivalent diameter upstream from a flow disturbance.

3.1.2 EPA Method 2, Determination of Stack gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

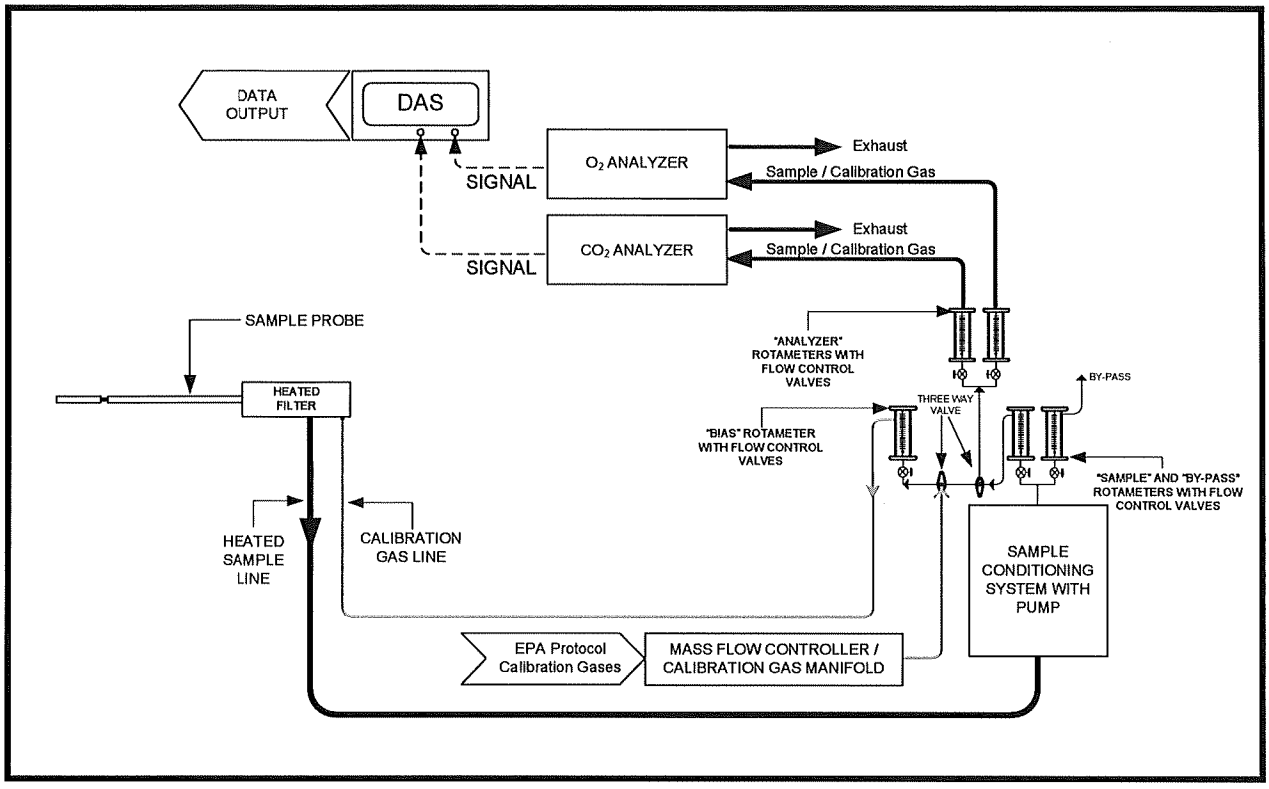
EPA Method 2 is used to measure the gas velocity using an S-type pitot tube connected to a pressure measurement device, and to measure the gas temperature using a calibrated thermocouple connected to a thermocouple indicator. Typically, Type S (Stausscheibe) pitot tubes conforming to the geometric specifications in the test method are used, along with an inclined manometer. The measurements are made at traverse points specified by EPA Method 1. The molecular weight of the gas stream is determined from independent measurements of O_2, CO_2, and moisture. The stack gas volumetric flow rate is calculated using the measured average velocity head, the area of the duct at the measurement plane, the measured average temperature, the measured duct static pressure, the molecular weight of the gas stream, and the measured moisture.

3.1.3 EPA Method 3A, Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 3A is an instrumental test method used to measure the concentration of O_2 and CO_2 in stack gas. The effluent gas is continuously or intermittently sampled and sent to analyzers that measure the concentration of O_2 and CO_2. The performance requirements of the method must be met to validate data.

The typical sampling system is detailed in Figure 3-1.

FIGURE 3-1
EPA METHOD 3A SAMPLING TRAIN



3.1.4 EPA Method 4, Determination of Moisture Content in Stack Gas

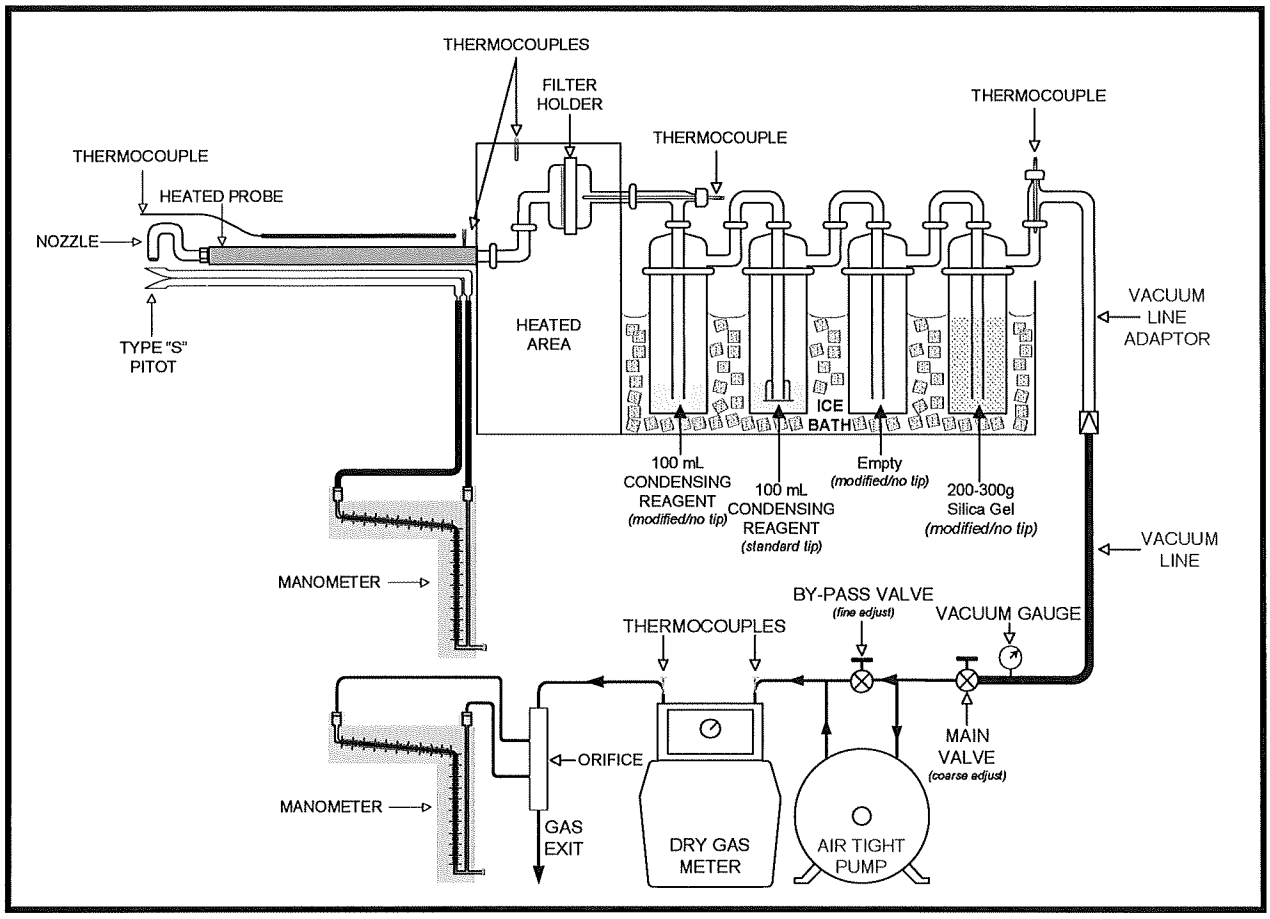
EPA Method 4 is a manual, non-isokinetic method used to measure the moisture content of gas streams. Gas is sampled at a constant sampling rate through a probe and impinger train. Moisture is removed using a series of pre-weighed impingers containing methodology-specific liquids and silica gel immersed in an ice water bath. The impingers are weighed after each run to determine the percent moisture.

3.1.5 EPA Method 5, Determination of Particulate Matter from Stationary Sources

EPA Method 5 is a manual, isokinetic method used to measure FPM emissions. The samples are analyzed gravimetrically. This method is performed in conjunction with EPA Methods 1 through 4. The stack gas is sampled through a nozzle, probe, filter, and impinger train. FPM results are reported in emission concentration and emission rate units.

The typical sampling system is detailed in Figure 3-2.

FIGURE 3-2
EPA METHOD 5 SAMPLING TRAIN



3.1.6 EPA Method 19, Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

EPA Method 19 is used to calculate mass emission rates in units of lb/MMBtu. EPA Method 19, Table 19-2 contains a list of assigned fuel factors for different types of fuels, which can be used for these calculations.

During this test event PCA elected to use site specific fuel.

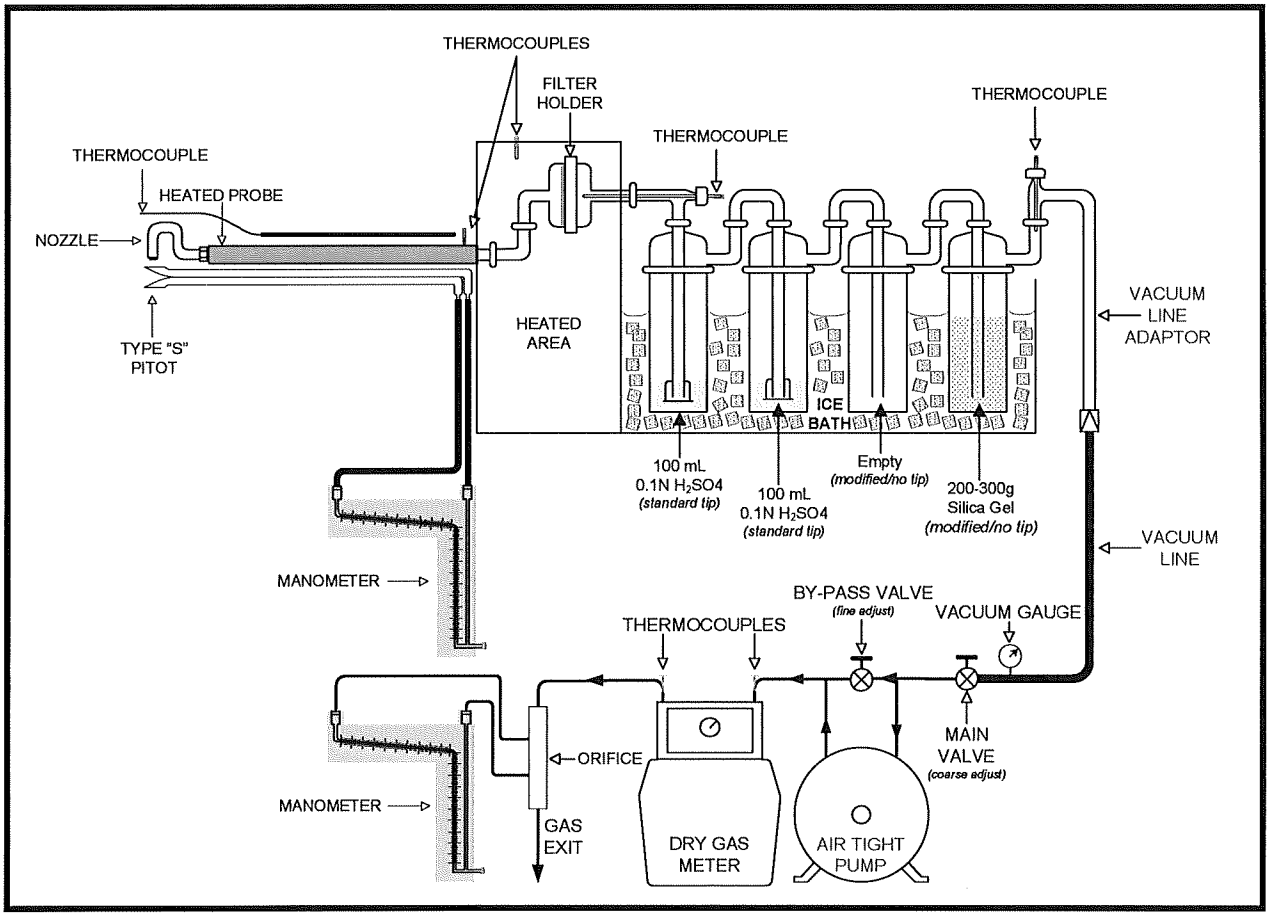
3.1.7 EPA Method 26A, Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Isokinetic Method

EPA Method 26A is a manual, isokinetic method used to measure hydrogen chloride emissions from stationary sources. Gaseous and particulate pollutants are withdrawn isokinetically from the source and collected in an optional cyclone, on a filter, and in absorbing solutions. The cyclone collects any liquid droplets and is not necessary if the source emissions do not contain them; however, it is preferable to include the cyclone in the sampling train to protect the filter from any liquid present. The filter collects particulate matter including halide salts but is not routinely recovered or analyzed. Acidic and alkaline absorbing solutions collect the gaseous

hydrogen halides and halogens, respectively. Following sampling of emissions containing liquid droplets, any halides/halogens dissolved in the liquid in the cyclone and on the filter are vaporized to gas and collected in the impingers by pulling conditioned ambient air through the sampling train. The hydrogen halides are solubilized in the acidic solution and form chloride (Cl^-), bromide (Br^-), and fluoride (F^-) ions. The halogens have a very low solubility in the acidic solution and pass through to the alkaline solution where they are hydrolyzed to form a proton (H^+), the halide ion, and the hypohalous acid (HClO or HBrO). Sodium thiosulfate is added to the alkaline solution to assure reaction with the hypohalous acid to form a second halide ion such that two halide ions are formed for each molecule of halogen gas. The halide ions in the separate solutions are measured by ion chromatography (IC). If desired, the particulate matter recovered from the filter and the probe is analyzed following the procedures in Method 5.

The typical sampling system is detailed in Figure 3-3.

FIGURE 3-3
EPA METHOD 5/26A (HALIDES) SAMPLING TRAIN

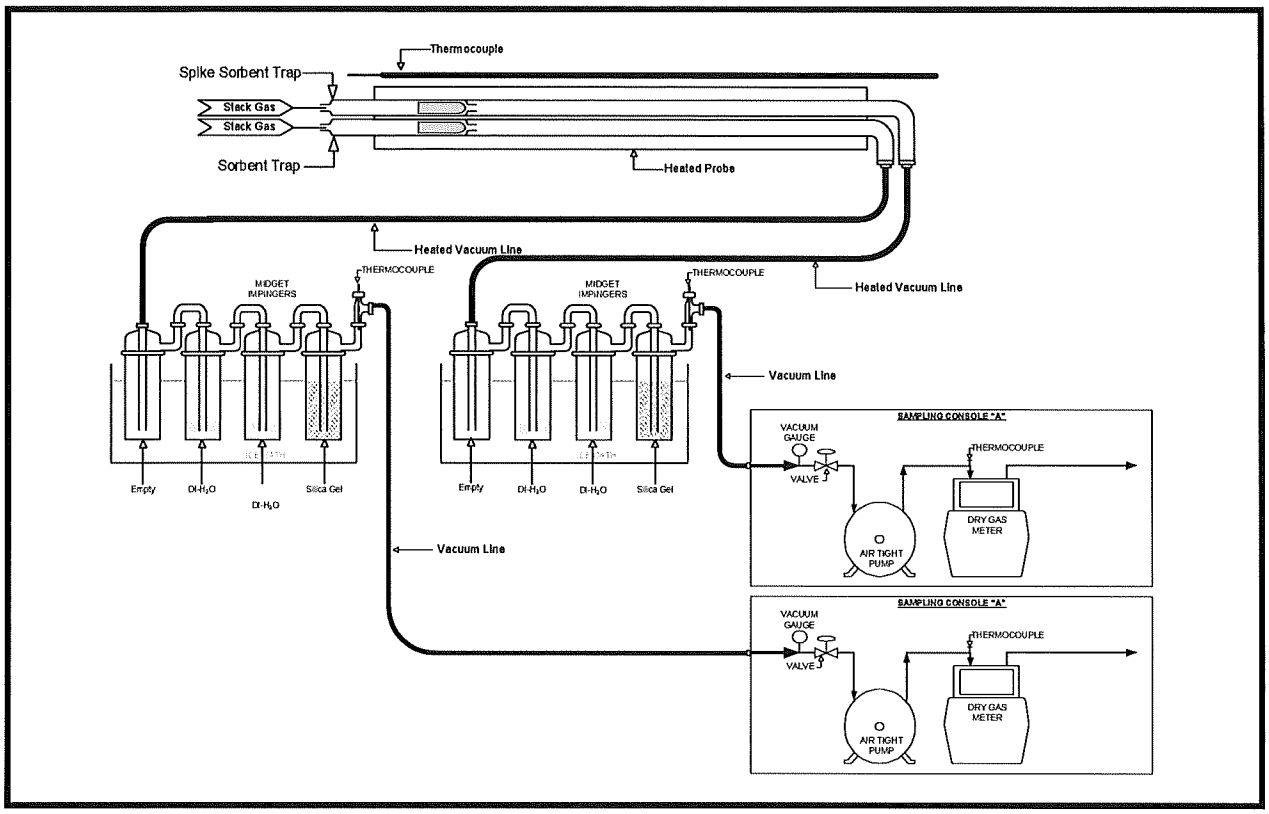


3.1.8 EPA Method 30B, Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Traps

EPA Method 30B is a manual test method for measuring total vapor phase mercury (Hg) emissions from coal-fired combustion sources using sorbent trap sampling and an extractive or thermal analytical technique. The method includes sampling into duplicate sorbent traps, which are analyzed using a sorbent trap mercury analyzer. This type of analyzer uses thermal desorption with ultraviolet atomic absorption (UV AA) or ultraviolet atomic fluorescent (UV AF) cold vapor analysis. Each trap consists of two equal-mass sections of iodinated activated charcoal (Section 1 and 2). The results for Section 1 and Section 2 of each tube are reported in nanograms (ng) of Hg per section, and then they are summed. The charcoal sorbent is pre-checked to certify that mercury background levels are below the detection limit of the laboratory instrument. Each trap is uniquely numbered, and the sorbent batch number is printed on the outside of the glass tubes. One trap per run is pre-spiked in the first sorbent section with a known quantity of elemental mercury, using a proprietary gas-phase bulk spiking procedure. Each run includes two samples (A and B) collected concurrently from a single representative sampling point in the exhaust stack using a dual probe. Samples are drawn through the sorbent traps into a moisture knockout loaded with desiccant, and then through a sampling orifice.

The typical sampling system is detailed in Figure 3-4.

FIGURE 3-4
EPA METHOD 30B SAMPLING TRAIN



3.2 PROCESS TEST METHODS

PCA facility personnel collected fuel samples for F-Factor determination. Results of the fuel samples analyzed are included in Appendix B.

4.0 TEST DISCUSSION AND RESULTS

4.1 FIELD TEST DEVIATIONS AND EXCEPTIONS

No field deviations or exceptions from the test plan or test methods occurred during this test program.

4.2 PRESENTATION OF RESULTS

The average results are displayed in Table 1-2. The results of individual test runs performed are presented in Tables 4-1 and 4-2. Additional information is included in the appendices as presented in the Table of Contents.

Concentration values in Tables 1-2 and 4-1 denoted with a '<' were measured to be below the minimum detection limit (MDL) of the applicable analytical method. Emissions denoted with a '<' in Tables 1-2 and 4-1 were calculated utilizing the applicable MDL concentration value instead of the "as measured" concentration value.

TABLE 4-1
FPM, HCl AND Hg EMISSIONS RESULTS -
EUBOILER5

Run Number	1	2	3	Average
Date	7/28/2021	7/28/2021	7/28/2021	
Time	7:55-9:22	9:52-11:12	12:00-13:22	
Process Data*				
Heat Input Rate, MMBtu/hr	248.8	224.1	213.4	228.8
F-Factor, dscf/MMBtu	9258.9	9256.1	9256.8	9257.3
Heat Input of Wood/Total, %	70	67	66	68
Flue Gas Parameters				
O_2, % volume dry	6.37	6.38	6.33	6.36
CO_2, % volume dry	13.95	13.75	13.73	13.81
flue gas temperature, °F	326.3	328.4	330.5	328.4
moisture content, % volume	20.35	19.57	19.85	19.92
volumetric flow rate, dscfm	70,338	71,200	68,776	70,105
Filterable Particulate Matter (PM)				
gr/dscf**	0.00139	<0.00038	<0.00039	<0.00072
lb/MMBtu**	0.00265	<0.00073	<0.00075	<0.00138
Hydrogen Chloride (HCl)				
ppmvd	0.335	0.337	0.342	0.338
lb/MMBtu	0.00042	0.00043	0.00043	0.00043
Mercury (Hg)				
ug/dscm	0.238	0.204	0.150	0.197
lb/MMBtu	1.98E-07	1.70E-07	1.24E-07	1.64E-07

* Process Data provided by PCA facility personnel.

** The "<" symbol indicates that compound was below the Minimum Detection Limit (MDL) of the analytical method for Runs 2 and 3. See Section 4.2 for details.

TABLE 4-2
FPM EMISSIONS RESULTS -
EUBOILER5

Run Number	1	2	3	Average
Date	7/29/2021	7/29/2021	7/29/2021	
Time	7:26-8:46	9:20-10:41	11:13-12:35	
Process Data*				
Heat Input Rate, MMBtu/hr	187.0	186.5	182.8	185.4
F-Factor, dscf/MMBtu	9183.9	9184.3	9182.9	9183.7
Heat Input of Wood/Total, %	76	76	76	76
Flue Gas Parameters				
O_2, % volume dry	6.41	6.28	6.37	6.35
CO_2, % volume dry	13.53	13.67	13.65	13.62
flue gas temperature, °F	308.6	309.1	312.1	309.9
moisture content, % volume	18.20	19.98	19.29	19.16
volumetric flow rate, dscfm	61,670	58,481	57,587	59,246
Filterable Particulate Matter (FPM)				
gr/dscf	0.00050	0.00051	0.00114	0.00072
lb/MMBtu	0.00094	0.00096	0.00215	0.00135

* Process Data provided by PCA personnel.

5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA/QC AUDITS

The meter boxes and sampling trains used during sampling performed within the requirements of their respective methods. All post-test leak checks, minimum metered volumes, minimum sample durations, and percent isokinetics met the applicable QA/QC criteria.

EPA Method 3A calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks

EPA Method 5 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met, except if noted in Section 5.2. An EPA Method 5 reagent blank was analyzed. The maximum allowable amount that can be subtracted is 0.001% of the weight of the acetone blank. The blank did not exceed the maximum residue allowed.

EPA Method 26A analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met

EPA Method 30B QA/QC acceptance and performance criteria for breakthrough, paired sorbent trap agreement, relative deviation, and spike recovery results for all runs met the requirements outlined in Table 9-1 of the method.

5.2 QA/QC DISCUSSION

All QA/QC criteria were met during this test program.

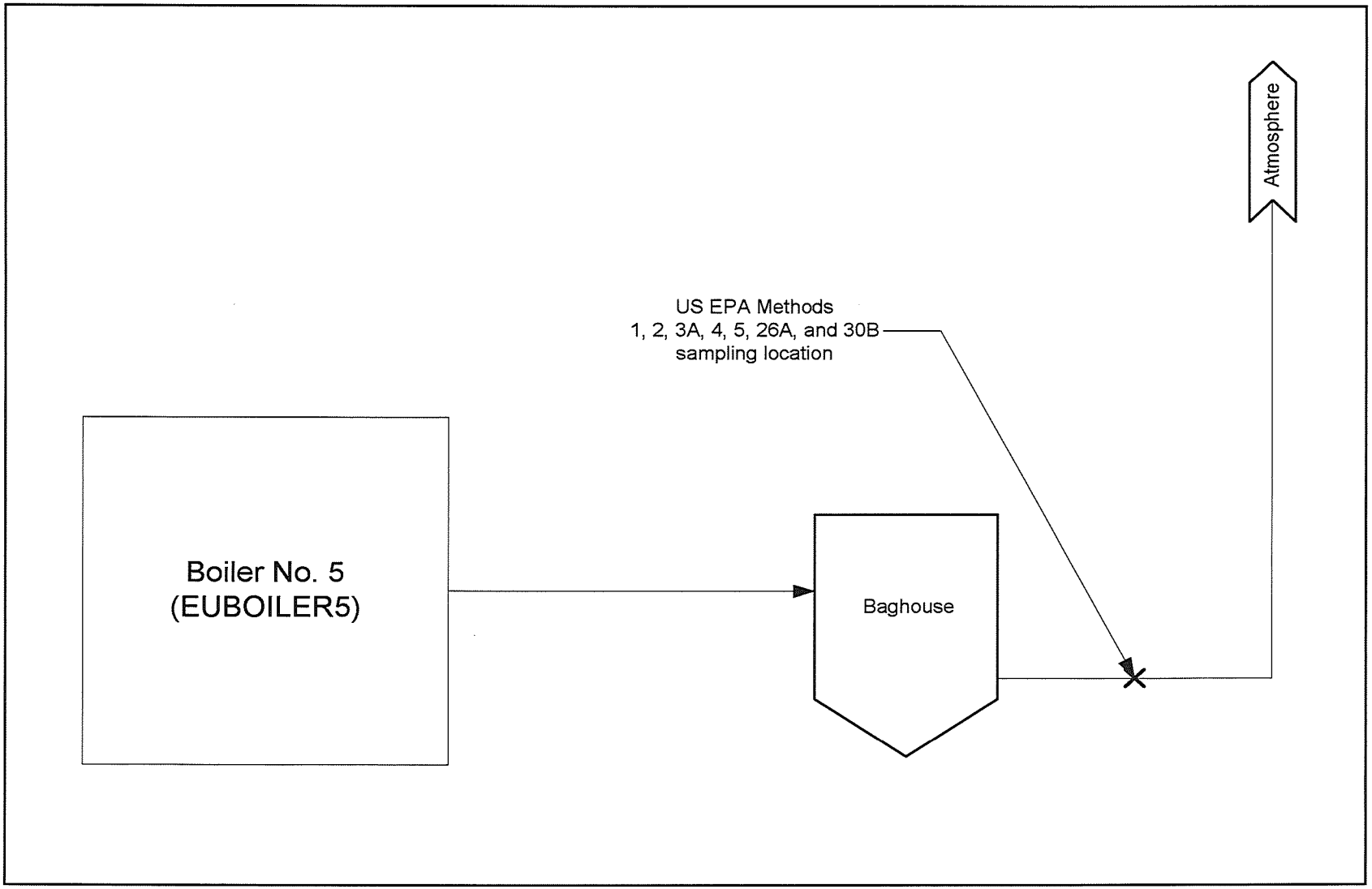
5.3 QUALITY STATEMENT

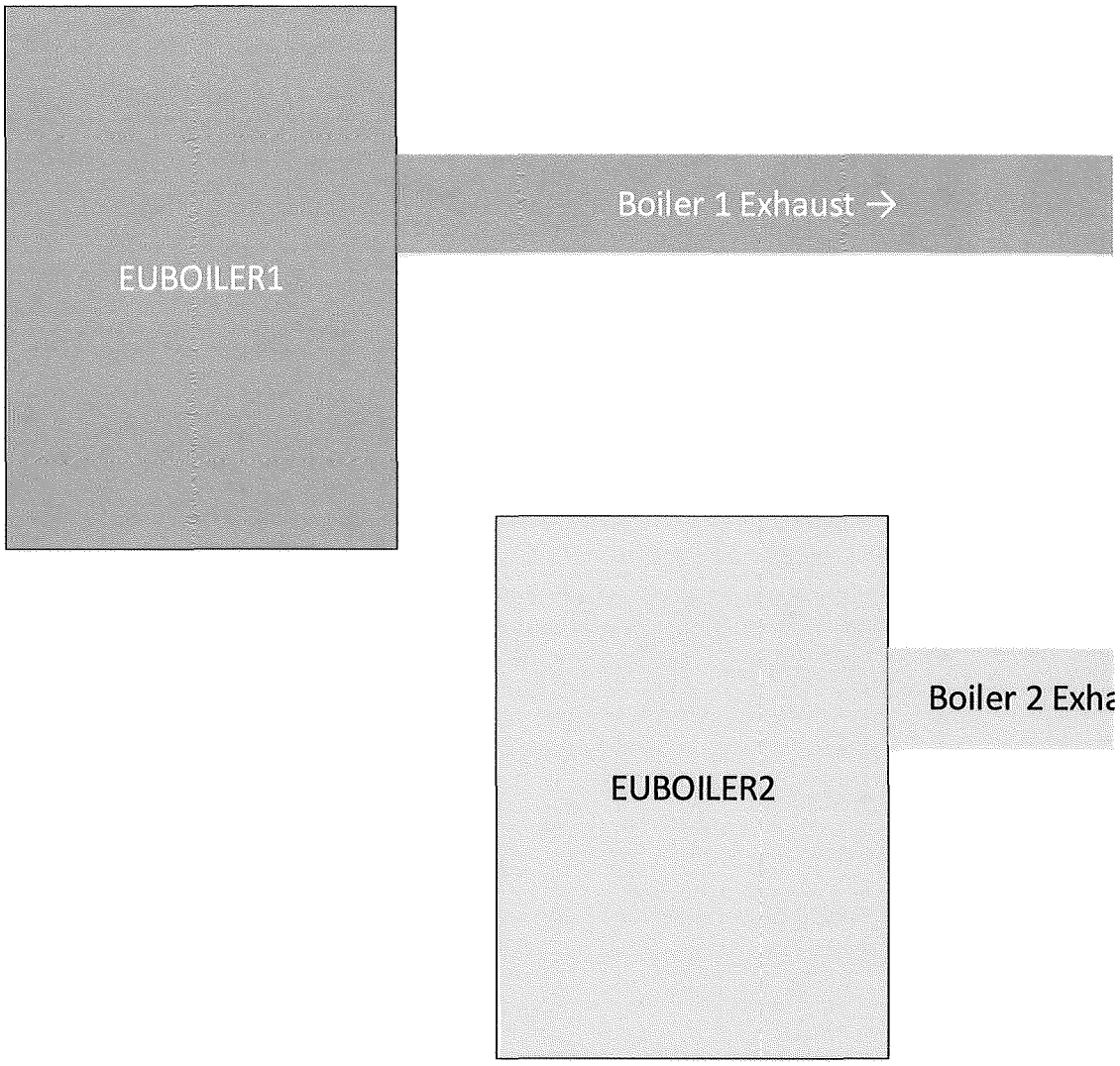
Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D 7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).

APPENDIX A
FIELD DATA AND CALCULATIONS

Appendix A.1
EUBOILER5 Sampling Locations

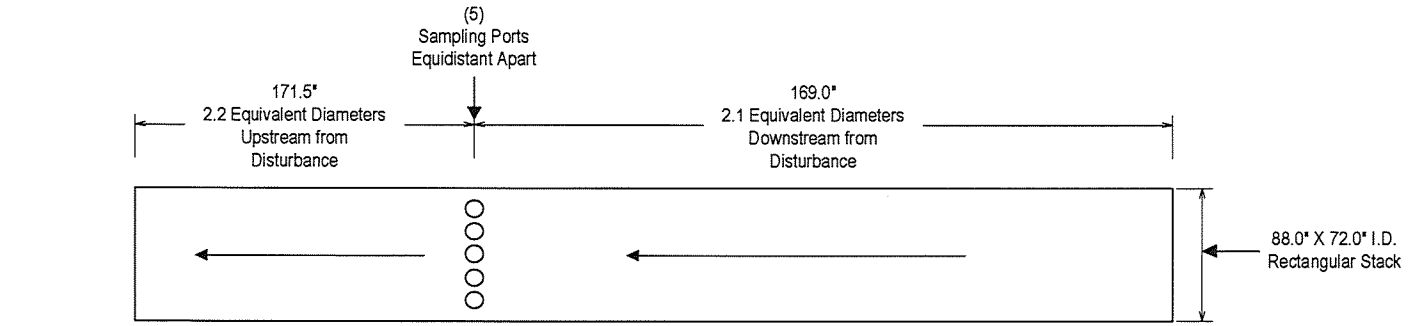
EUBOILER SAMPLING LOCATION SCHEMATIC

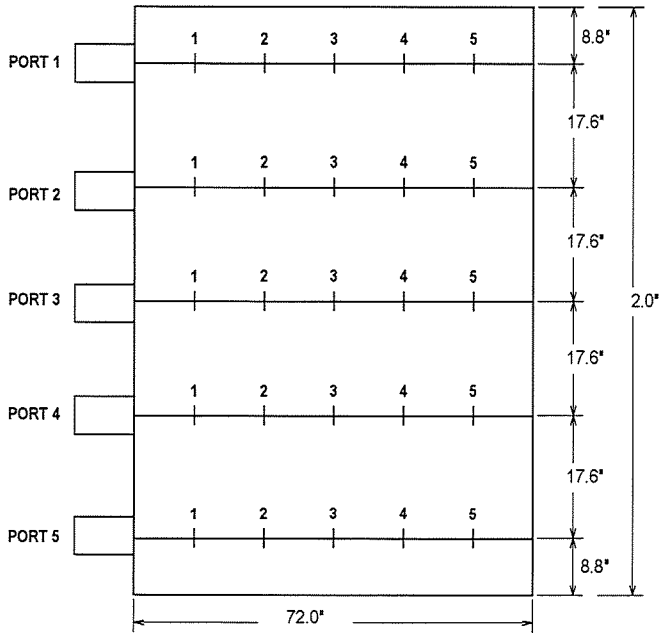




Exhaust Block Flow

EUBOILER5-EPA METHOD 5/26A AND 5 TRAVERSE POINT LOCATION DRAWING





Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2	Distance from Inside Wall (in.) PORT 3
1	10.0	8.8	8.8	8.8
2	30.0	26.4	26.4	26.4
3	50.0	44.0	44.0	44.0
4	70.0	61.6	61.6	61.6
5	90.0	79.2	79.2	79.2

Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 4	Distance from Inside Wall (in.) PORT 5
1	10.0	8.8	8.8
2	30.0	26.4	26.4
3	50.0	44.0	44.0
4	70.0	61.6	61.6
5	90.0	79.2	79.2