1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Packaging Corporation of America (PCA) (State Registation No.: B3692), located in Filer City, Michigan, contracted Montrose Air Quality Services, LLC (Montrose) of Detroit, Michigan, to conduct compliance stack emission testing for their Boiler 4A (EUBOILER4A). Testing was performed to satisfy the emissions testing requirements pursuant to Michigan Department of Environmental Quality, Air Quality Division, (MDEQ-AQD) Renewable Operating Permit No. MI-ROP-B3692-2015b. The testing was performed on April 2, 2019.

Sampling was performed at the EUBOILER4A Exhaust Stack to determine the emissions of carbon monoxide (CO). Testing was conducted during normal operations while the boiler was fired with natural gas. During this test, emissions from Boiler 4A were controlled by low-NO_x burners.

The test methods that were conducted during this test were US EPA Methods 1, 2, 3A, 4, and 10.

1.2 KEY PERSONNEL

The key personnel who coordinated this test program (and their phone numbers) were:

- Dyllan Walker, Environmental Engineer, Packaging Corp. of America, 231-723-9951 ext. 434
- Jeremy Howe, EQA 11, MDEQ, 231-878-6687
- Steven Smith, Field Project Manager, Montrose, 248-548-8070
- Mike Nummer, Field Technician, Montrose, 248-548-8070

2.0 SUMMARY AND DISCUSSION OF TEST RESULTS

2.1 OBJECTIVES AND TEST MATRIX

The purpose of this test was to determine the emissions of CO at the EUBOILER4A Exhaust Stack during normal operations while the boiler was fired with natural gas. Testing was performed to satisfy the emissions testing requirements pursuant to MDEQ-AQD Renewable Operating Permit No. MI-ROP-B3692-2015b.

The specific test objectives for this test are as follows:

- Measure the concentrations of oxygen (O_2), carbon dioxide (CO_2), and CO at the EUBOILER4A Exhaust Stack.
- Measure the actual and dry standard volumetric flow rate of the stack gas at the EUBOILER4A Exhaust Stack.
- Utilize the above variables to determine the emissions of CO at the EUBOILER4A Exhaust Stack during normal operations while the boiler was fired with natural gas.

Table 2-1 presents the sampling matrix log for this test.

2.2 FIELD TEST CHANGES AND PROBLEMS

Run 1 was voided due to biogas being fired in the boiler with natural gas. Runs 2-4 were performed running only natural gas.

2.3 PRESENTATION OF RESULTS

Two sampling trains were utilized during each run at the EUBOILER4A Exhaust Stack to determine the emissions of CO. One sampling train measured the stack gas volumetric moisture content while the second sampling train measured the stack gas concentrations of O_2, CO_2, and CO. Stack gas flow rate was measured during each concentration run.

Table 2-2 displays the emissions of CO measured at the EUBOILER4A Exhaust Stack during normal operations while the boiler was fired with natural gas.

The graphs that present the raw, uncorrected concentration data measured in the field by the US EPA Method 3A and 10 sampling systems at the EUBOILER4A are located in the Field Data section of the Appendix.

TABLE 2-1
SAMPLING MATRIX OF TEST METHODS UTILIZED

Date	Run No.	Sampling Location	US EPA METHODS 1/2 (Flow) Sampling Time / Duration (min)	US EPA METHOD 3A (O_2/CO_2) Sampling Time / Duration (min)	US EPA METHOD 4 ($\%H_2O$) Sampling Time / Duration (min)	US EPA METHOD 10 (CO) Sampling Time / Duration (min)
4/2/2019	2	EUBOILER4A Exhaust Stack	9:30 - 9:35 / 5	9:10 - 10:15 / 60	9:10 - 9:40 / 30	9:10 - 10:15 / 60
4/2/2019	3	EUBOILER4A Exhaust Stack	10:30 - 10:35 / 5	10:22 - 11:27 / 60	10:22 - 10:52 / 30	10:22 - 11:27 / 60
4/2/2019	4	EUBOILER4A Exhaust Stack	11:45 - 11:50 / 5	11:36 - 12:41 / 60	11:37 - 12:07 / 30	11:36 - 12:41 / 60

All times are Eastern Daylight Time.

TABLE 2-2
EMISSION RESULTS

Parameter	EUBOILER4A Exhaust Stack			
	Run 2	Run 3	Run 4	Average
Carbon Monoxide Emissions (lb/hr)	6.1	4.4	4.7	5.1
Carbon Monoxide Concentration (ppmvd)	39.6	29.7	31.4	33.5
Stack Gas Average Flow Rate (acfm)	72,848	70,738	72,602	72,063
Stack Gas Average Flow Rate (scfm)	42,314	40,865	42,094	41,758
Stack Gas Average Flow Rate (dscfm)	35,318	33,717	34,596	34,544
Stack Gas Average Velocity (fpm)	2,805	2,724	2,796	2,775
Stack Gas Average Static Pressure (in-H_2O)	-0.61	-0.61	-0.61	-0.61
Stack Gas Average Temperature (°F)	425	429	426	427
Stack Gas Percent by Volume Moisture (%H_2O)	16.53	17.49	17.81	17.28
Measured Stack Inner Diameter (in)			63.0	
Percent by Volume Carbon Dioxide in Stack Gas (%-dry)	9.64	9.58	9.62	9.61
Percent by Volume Oxygen in Stack Gas (%-dry)	4.21	4.33	4.30	4.28
Percent by Volume Nitrogen in Stack Gas (%-dry)	86.14	86.09	86.09	86.11

3.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

3.1 PROCESS DESCRIPTION AND OPERATION

PCA operates a Babcock & Wilcox boiler unit (EUBOILER4A) utilized to provide steam for various mill processes and for electrical generation. The boiler can be fired with natural gas or biogas. EUBOILER4A is rated at 227 MMBtu/hr, and the maximum steam load is 150,000 pounds of steam. EUBOILER4A was in operation for this test event and fired with natural gas.

Figure 3-1 depicts the process and sampling location schematic.

3.2 CONTROL EQUIPMENT DESCRIPTION

During this test, emissions from Boiler 4A were controlled by low-NO_x burners.

3.3 SAMPLING LOCATION(S)

The EUBOILER4A Exhaust Stack had a measured inner diameter of 69.0-inches and was oriented in the vertical plane. Two sampling ports were located 90° apart from one another at a location that met US EPA Method 1, Section 11.1.1 criteria. Prior to emissions sampling, the stack was traversed to verify the absence of cyclonic flow. An average yaw angle of 0.0° was measured. Therefore, the sampling location also met US EPA Method 1, Section 11.4.2 criteria. During emissions sampling, the stack was traversed for stack gas volumetric flow rate, O_2, CO_2, and CO concentration determinations. A second point was used for determination of stack gas moisture content.

Figures 3-2 and 3-3 schematically illustrate the traverse point and sample port locations utilized.

3.4 PROCESS SAMPLING LOCATION(S)

The US EPA Reference Test Methods performed did not specifically require that process samples were to be taken during the performance of this testing event. It is in the best knowledge of Montrose that no process samples were obtained and therefore no process sampling location was identified in this report.

FIGURE 3-1
EUBOILER4A PROCESS AND SAMPLING LOCATION SCHEMATIC

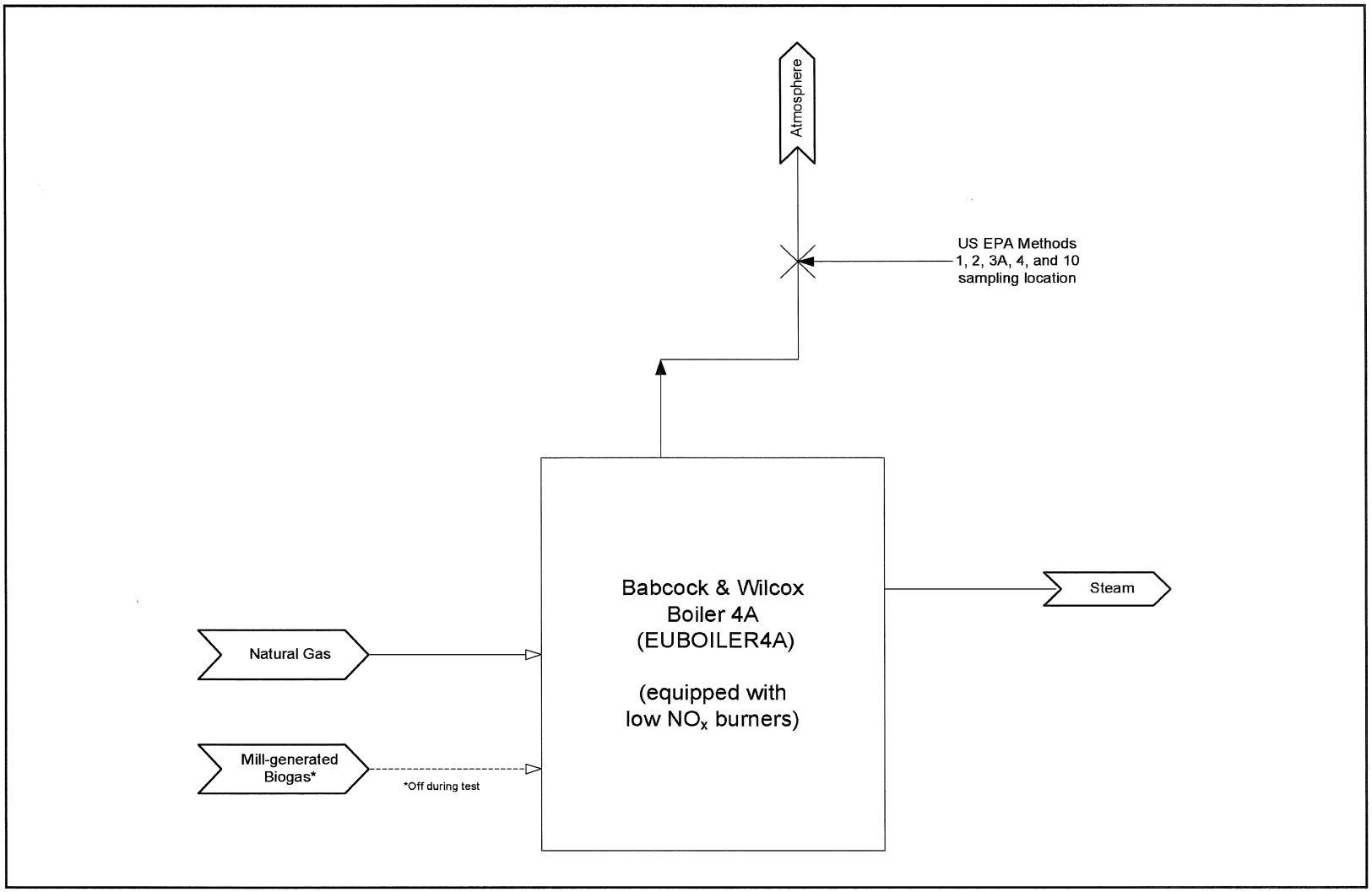
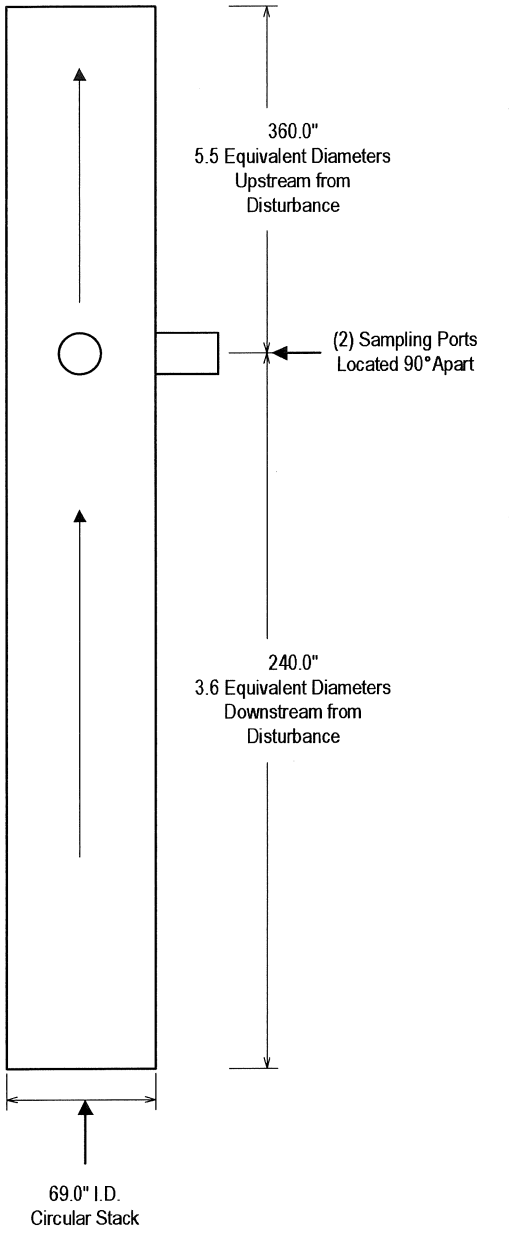
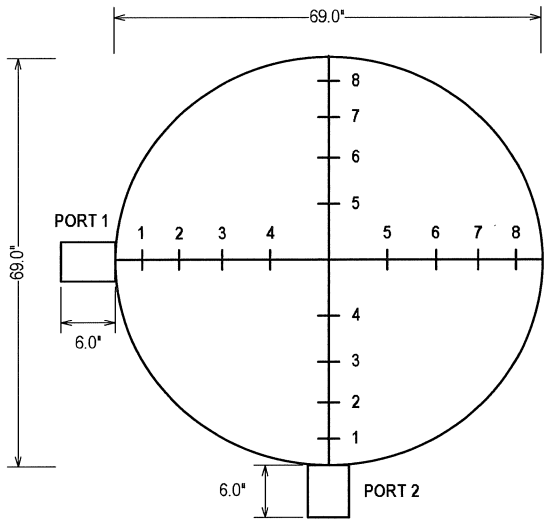


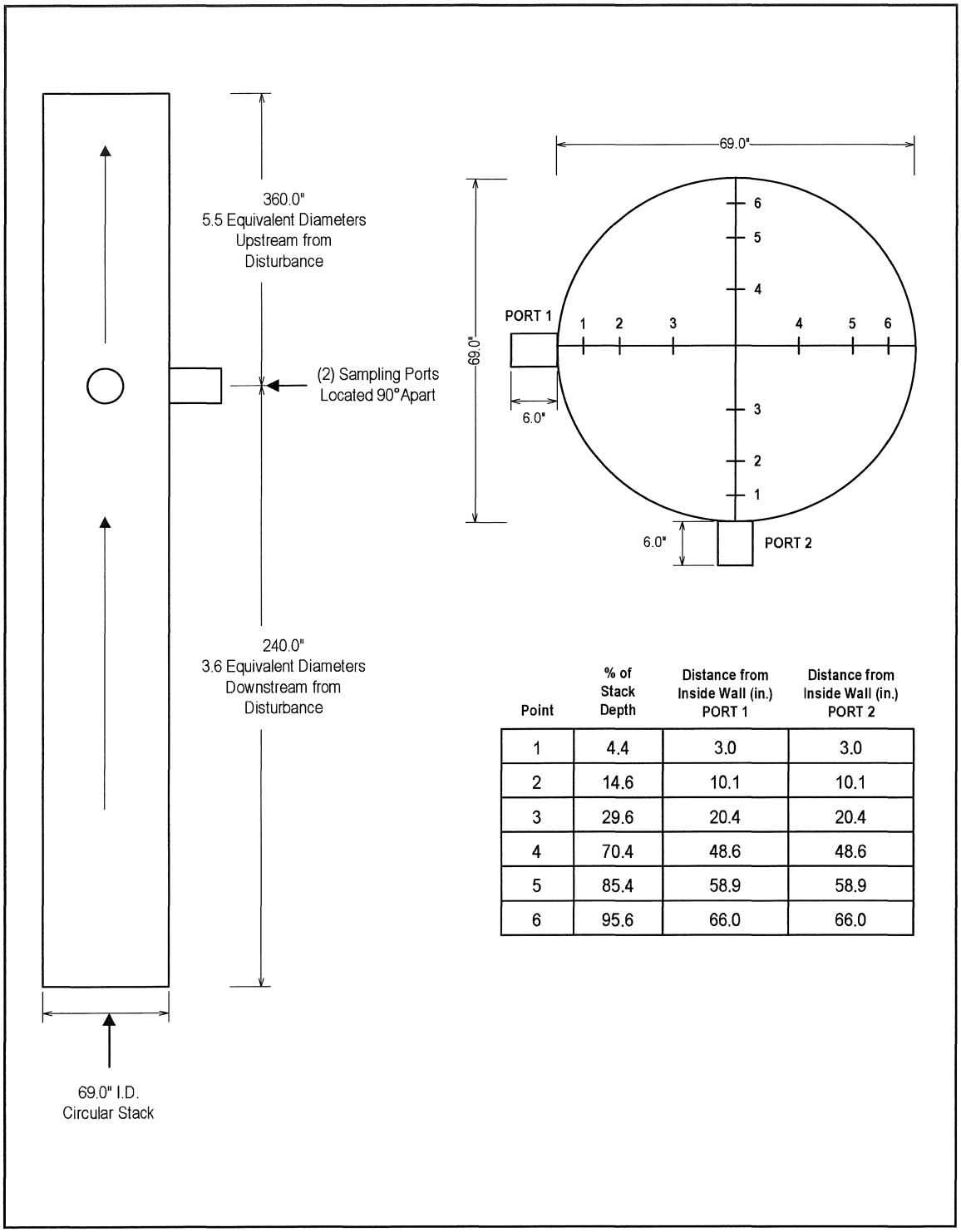
FIGURE 3-2
EUBOILER4A EXHAUST FLOW TRAVERSE POINT LOCATION DRAWING





Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	3.2	2.2	2.2
2	10.5	7.2	7.2
3	19.4	13.4	13.4
4	32.3	22.3	22.3
5	67.7	46.7	46.7
6	80.6	55.6	55.6
7	89.5	61.8	61.8
8	96.8	66.8	66.8

FIGURE 3-3
EUBOILER4A EXHAUST CEMS TRAVERSE POINT LOCATION DRAWING



Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	4.4	3.0	3.0
2	14.6	10.1	10.1
3	29.6	20.4	20.4
4	70.4	48.6	48.6
5	85.4	58.9	58.9
6	95.6	66.0	66.0

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 TEST METHODS

4.1.1 US EPA Method 1: "Sample and Velocity Traverses for Stationary Sources"

Principle: To aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

4.1.2 US EPA Method 2: "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"

Principle: The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

4.1.3 US EPA Method 3A: "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"

Principle: A gas sample is continuously extracted from the effluent stream. A portion of the sample stream is conveyed to an instrumental analyzer(s) for determination of O_2 and CO_2 concentration(s). Performance specifications and test procedures are provided to ensure reliable data. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

4.1.4 US EPA Method 4: "Determination of Moisture Content in Stack Gases"

Principle: A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined either volumetrically or gravimetrically. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

4.1.5 US EPA Method 10: "Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)"

Principle: A gas sample is continuously extracted from the effluent stream. A portion of the sample stream is conveyed to an instrumental analyzer for determination of CO concentration. Performance specifications and test procedures are provided to ensure reliable data. This method was utilized in its entirety as per the procedures outlined in 40 CFR Part 60, Appendix A.

The sampling trains utilized during this testing project are depicted in Figures 4-1 and 4-2.

4.2 PROCEDURES FOR OBTAINING PROCESS DATA

Process data was recorded by Packaging Corporation of America personnel utilizing their typical record keeping procedures. Recorded process data was provided to Montrose personnel at the conclusion of this test event. The process data is located in the Appendix.

FIGURE 4-1
US EPA METHOD 4 SAMPLING TRAIN SCHEMATIC

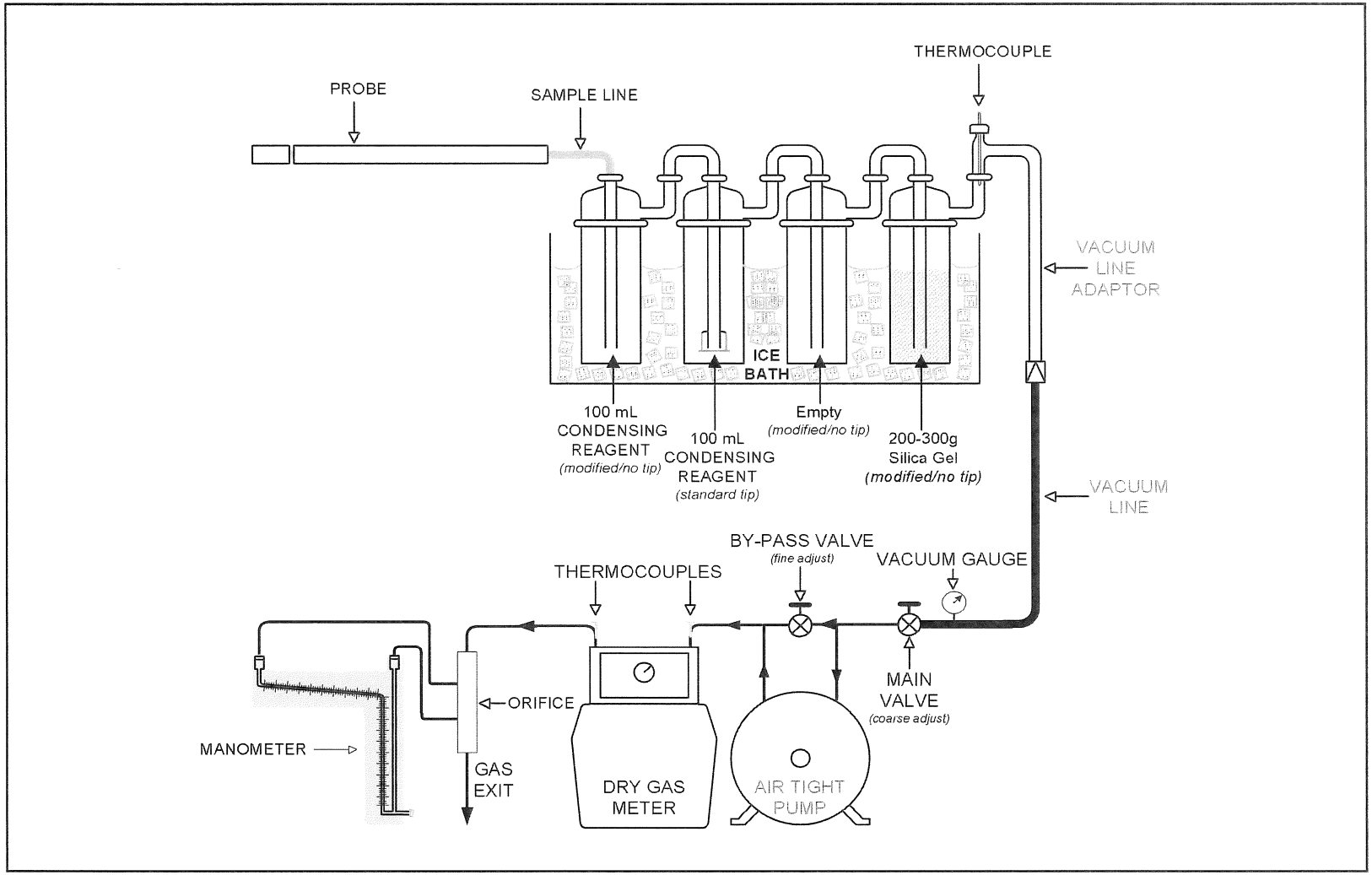
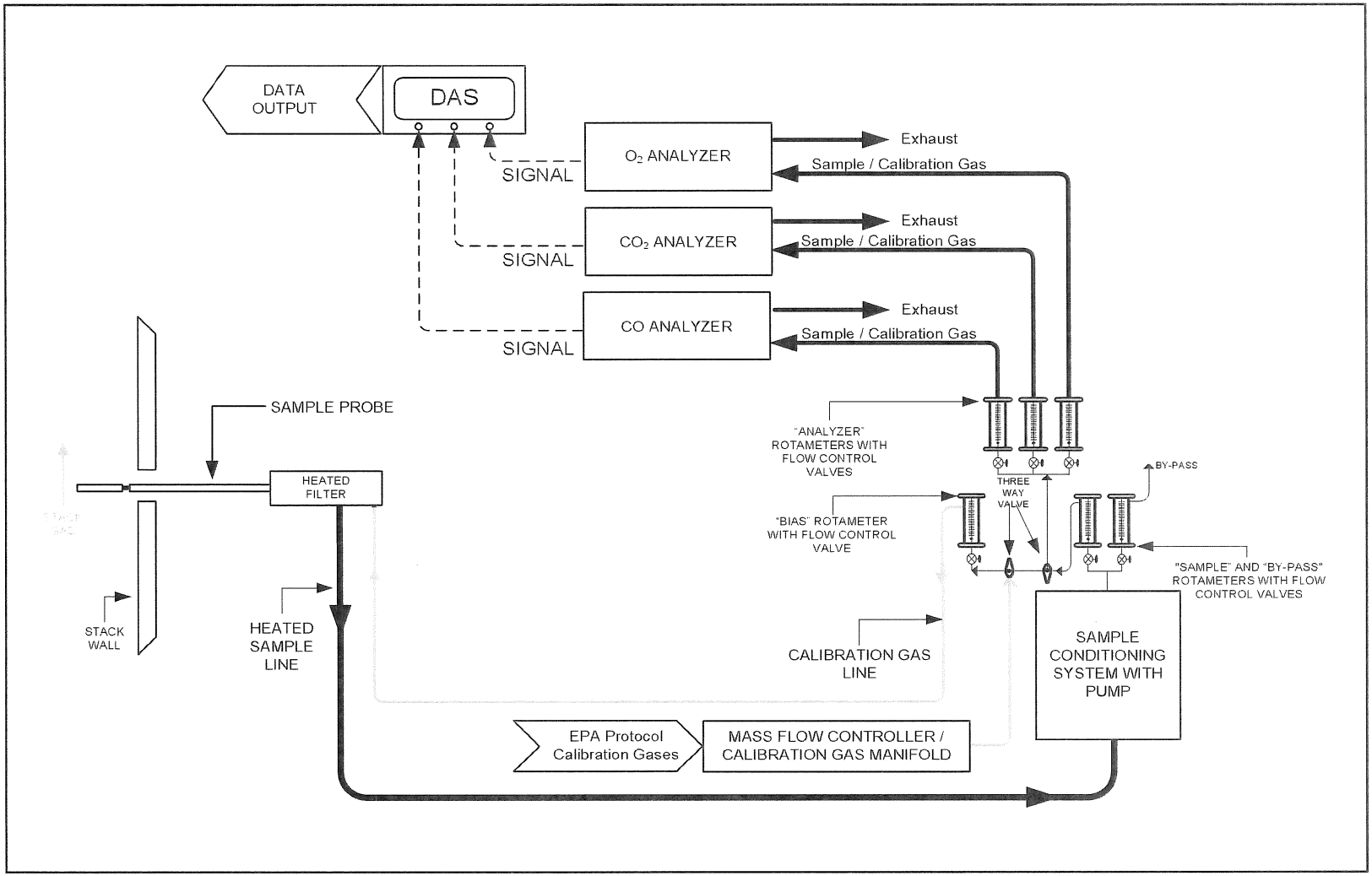


FIGURE 4-2
US EPA METHOD 3A and 10 SAMPLING TRAIN SCHEMATIC



5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA AUDITS

Tables 5-1 to 5-6 illustrate the QA audits that were performed during this test.

All meter boxes and sampling trains used during sampling performed within the requirements of their respective methods as is shown in Tables 5-1 and 5-2. All post-test leak checks were well below the applicable limit. Minimum metered volumes were also met where applicable.

Tables 5-3 to 5-5 illustrate the O_2, CO_2, and CO calibration audits which were performed during this test (and integral to performing US EPA Method 3A and 10 correctly) were all within the Measurement System Performance Specifications of ±3% of span for the Zero and Calibration Drift Checks, ±5% of span for the System Calibration Bias Checks, and ±2% of span for the Calibration Error Checks.

Table 5-6 displays the US EPA Method 205 field evaluation of the calibration gas dilution system utilized during this test event. As shown, the average concentration output at each dilution level was within ±2% of the predicted value. The average concentration output of the mid-level gas was also within ±2% of the certified concentration.

5.2 QA/QC PROBLEMS

No QA/QC problems occurred during this test event.

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 D7036-04 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 presented in the report appendices.

TABLE 5-1
US EPA METHOD 4 SAMPLING TRAIN AUDIT RESULTS

Parameter	Run 2	Run 3	Run 4
Sampling Location	**EUBOILER4A Exhaust Stack**		
Post-Test Leak Rate Observed (cfm)	0.000	0.000	0.000
Applicable Method Allowable Leak Rate (cfm)	0.020	0.020	0.020
Acceptable	Yes	Yes	Yes
Volume of Dry Gas Collected (dscf)	23.089	23.128	23.063
Recommended Volume of Dry Gas Collected (dscf)	21.000	21.000	21.000
Acceptable	Yes	Yes	Yes

TABLE 5-2
US EPA METHOD 4 DRY GAS METER AUDIT RESULTS

Sampling Location	Pre-Test Dry Gas Meter Calibration Factor (Y)	Average Post-Test Dry Gas Meter Calibration Check Value (Yqa)	Post Test Dry Gas Meter Calibration Check Value Difference From Pre-Test Calibration Factor (%)	Applicable Method Allowable Difference (%)	Acceptable
EUBOILER4A Exhaust Stack	1.0020	1.0092	-0.72%	5.00%	Yes

TABLE 5-3
US EPA METHOD 3A (O_2) ANALYZER CALIBRATION AND QA

	EUBOILER4A Exhaust Stack					
OXYGEN ANALYZER	**RUN 2**	**Acceptable**	**RUN 3**	**Acceptable**	**RUN 4**	**Acceptable**
Analyzer Span During Test Run (%)	20.3	YES	20.3	YES	20.3	YES
Initial System Calibration Response for Zero Gas (%)	0.13	N/A	0.13	N/A	0.11	N/A
Final System Calibration Response for Zero Gas (%)	0.13	N/A	0.11	N/A	0.15	N/A
Actual Concentration of the Upscale Calibration Gas (%)	10.08	N/A	10.08	N/A	10.08	N/A
Initial System Calibration Response for Upscale Gas (%)	10.04	N/A	10.03	N/A	10.02	N/A
Final System Calibration Response for Upscale Gas (%)	10.03	N/A	10.02	N/A	10.00	N/A
Initial System Calibration Bias for Zero Gas (% of Span)	0.39	YES	0.39	YES	0.30	YES
Final System Calibration Bias for Zero Gas (% of Span)	0.39	YES	0.30	YES	0.49	YES
Initial System Calibration Bias for Upscale Gas (% of Span)	0.54	YES	0.49	YES	0.44	YES
Final System Calibration Bias for Upscale Gas (% of Span)	0.49	YES	0.44	YES	0.35	YES
System Drift for Zero Gas (% of Span)	0.00	YES	-0.10	YES	0.20	YES
System Drift for Upscale Gas (% of Span)	-0.05	YES	-0.05	YES	-0.10	YES
Analyzer Calibration Error for Zero Gas (% of Span)	0.25	YES	0.25	YES	0.25	YES
Analyzer Calibration Error for Mid-Level Gas (% of Span)	-0.74	YES	-0.74	YES	-0.74	YES
Analyzer Calibration Error for High-Level Gas (% of Span)	0.15	YES	0.15	YES	0.15	YES

TABLE 5-4
US EPA METHOD 3A (CO_2) ANALYZER CALIBRATION AND QA

	EUBOILER4A Exhaust Stack					
CARBON DIOXIDE ANALYZER	**RUN 2**	**Acceptable**	**RUN 3**	**Acceptable**	**RUN 4**	**Acceptable**
Analyzer Span During Test Run (%)	20	YES	20	YES	20	YES
Initial System Calibration Response for Zero Gas (%)	0.28	N/A	0.25	N/A	0.22	N/A
Final System Calibration Response for Zero Gas (%)	0.25	N/A	0.22	N/A	0.23	N/A
Actual Concentration of the Upscale Calibration Gas (%)	10.07	N/A	10.07	N/A	10.07	N/A
Initial System Calibration Response for Upscale Gas (%)	10.05	N/A	10.10	N/A	10.00	N/A
Final System Calibration Response for Upscale Gas (%)	10.10	N/A	10.00	N/A	10.09	N/A
Initial System Calibration Bias for Zero Gas (% of Span)	1.16	YES	1.01	YES	0.86	YES
Final System Calibration Bias for Zero Gas (% of Span)	1.01	YES	0.86	YES	0.91	YES
Initial System Calibration Bias for Upscale Gas (% of Span)	0.71	YES	0.96	YES	0.45	YES
Final System Calibration Bias for Upscale Gas (% of Span)	0.96	YES	0.45	YES	0.91	YES
System Drift for Zero Gas (% of Span)	-0.15	YES	-0.15	YES	0.05	YES
System Drift for Upscale Gas (% of Span)	0.25	YES	-0.51	YES	0.45	YES
Analyzer Calibration Error for Zero Gas (% of Span)	0.25	YES	0.25	YES	0.25	YES
Analyzer Calibration Error for Mid-Level Gas (% of Span)	-0.81	YES	-0.81	YES	-0.81	YES
Analyzer Calibration Error for High-Level Gas (% of Span)	0.25	YES	0.25	YES	0.25	YES

TABLE 5-5
US EPA METHOD 10 ANALYZER CALIBRATION AND QA

	EUBOILER4A Exhaust Stack					
CARBON MONOXIDE ANALYZER	**RUN 2**	**Acceptable**	**RUN 3**	**Acceptable**	**RUN 4**	**Acceptable**
Analyzer Span During Test Run (ppm)	90	YES	90	YES	90	YES
Initial System Calibration Response for Zero Gas (ppm)	0.46	N/A	0.10	N/A	0.06	N/A
Final System Calibration Response for Zero Gas (ppm)	0.10	N/A	0.06	N/A	0.04	N/A
Actual Concentration of the Upscale Calibration Gas (ppm)	50	N/A	50	N/A	50	N/A
Initial System Calibration Response for Upscale Gas (ppm)	50	N/A	49	N/A	49	N/A
Final System Calibration Response for Upscale Gas (ppm)	49	N/A	49	N/A	49	N/A
Initial System Calibration Bias for Zero Gas (% of Span)	0.16	YES	-0.24	YES	-0.29	YES
Final System Calibration Bias for Zero Gas (% of Span)	-0.24	YES	-0.29	YES	-0.31	YES
Initial System Calibration Bias for Upscale Gas (% of Span)	0.37	YES	0.04	YES	0.16	YES
Final System Calibration Bias for Upscale Gas (% of Span)	0.04	YES	0.16	YES	-0.03	YES
System Drift for Zero Gas (% of Span)	-0.40	YES	-0.04	YES	-0.02	YES
System Drift for Upscale Gas (% of Span)	-0.32	YES	0.11	YES	-0.19	YES
Analyzer Calibration Error for Zero Gas (% of Span)	0.36	YES	0.36	YES	0.36	YES
Analyzer Calibration Error for Mid-Level Gas (% of Span)	-0.67	YES	-0.67	YES	-0.67	YES
Analyzer Calibration Error for High-Level Gas (% of Span)	0.16	YES	0.16	YES	0.16	YES

TABLE 5-6
US EPA METHOD 205 GAS DILUTION SYSTEM QA

Analyzer Serial Number: 97
Dilution System Serial Number: 6014

	Dilution Level 1	Dilution Level 2	Mid-Level Gas
Calibration Tag Value (ppm):	792.3	792.3	480.1
Dilution Ratio:	1.650625	3.30125	-
Predicted Diluted Value (ppm):	480	240	-
Injection 1 Response (ppm):	481.33	243.79	478.26
Injection 2 Response (ppm):	473.78	243.86	474.47
Injection 3 Response (ppm):	476.56	242.20	473.85
Average Response (ppm):	477.22	243.28	475.53
Difference From Predicted (%):	0.58	-1.37	0.95
Acceptable (YES/NO):	yes	yes	yes