RECEIVED

AUG 29 2023

AIR QUALITY DIVISION

BOILER NUMBER ONE
CONTINUOUS EMISSION MONITORING SYSTEM
RELATIVE ACCURACY TEST AUDIT REPORT

L'ANSE WARDEN ELECTRIC COMPANY, LLC

TEST DATE: 20 JUNE 2023

Prepared for:

L.W.E.C.

BRINGING GREEN TO MICHIGAN

L'ANSE WARDEN ELECTRIC COMPANY, LLC
157 South Main Street
L'Anse, Michigan 49946

Prepared by:

WESTON SOLUTIONS

WESTON SOLUTIONS, INC.
1400 Weston Way
P.O. Box 2653
West Chester, Pennsylvania 19380-1499

August 2023

W. O. No. 14464.008.006

TABLE OF CONTENTS

LIST OF FIGURES

Title **Page**

LIST OF TABLES

Title **Page**

1. INTRODUCTION

Weston Solutions, Inc. (WESTON®) was retained by L'Anse Warden Electric Company, LLC (LWEC) to conduct a Relative Accuracy Test Audit (RATA) on the continuous emissions monitoring system (CEMS) serving the Boiler No. 1 exhaust duct at the LWEC facility located in L'Anse, Baraga County, Michigan. Boiler No. 1 was previously a coal, oil and gas-fired steam generating unit and has been converted to burn biomass. Boiler No. 1 is identified as EUBOILER #1, and the facility currently operates under the State of Michigan Renewable Operating Permit (ROP) MI-ROP-B4260-2021 and the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Air Quality Division (AQD) Permit to Install (PTI) MI-PTI-B4260-2021.

LWEC contracted Monitoring Solutions, Inc. (MSI) to design and install the CEMS on the Boiler No. 1 exhaust duct. Specifically, the CEMS includes carbon monoxide (CO) and Oxygen (O_2) monitors. The CEMS uses a straight extractive approach and an O_2 F_d factor, derived from EPA Method 19, to calculate CO emissions (in terms of lb/MMBtu). A summary of each CEMS analyzer and measurement range is provided below.

Location	Parameter	Analyzer Make	Model No.	Measurement Ranges
Boiler No. 1	CO	California Analytical	701 NDIR	0-200, 0-1000
	O_2	Brand Gaus	4705	0-25%

The LWEC contact for the program is:

L'Anse Warden Electric Company, LLC
157 South Main Street
L'Anse, Michigan 49946
Mr. Chad Cichosz, Plant Manager
Phone: 906-885-7187

WESTON contact for this program is:

Weston Solutions, Inc.
1400 Weston Way
West Chester, PA 19380
Mr. Ken Hill
Phone: 610-701-3043

WESTON performed the RATA on 20 June 2023 with the following project team:

Name	Project Role
Ken Hill	Project Manager
Tyson Belknap	CEMS Operator

Mr. Chad Cichosz of LWEC coordinated the testing with operations and served as WESTON's technical contact throughout the effort.

2. RESULTS AND DISCUSSION

All CO and O_2 testing was performed pursuant to requirements specified by 40 CFR Part 60, Appendix B, Performance Specification Nos. 2, 3, and 4A. CO and O_2 concentrations were measured during the RATA using EPA Reference Method 10 and 3A, respectively. Twelve test runs, 21 minutes (each) in duration, were conducted to complete the RATA.

Table 2-1 compares the test results to the relative accuracy performance requirements. Any differences between the calculated results shown in the appendices and the reported results in the summary table are due to rounding the results for presentation.

Table 2-1
Summary of Relative Accuracy Test Results

Analyzer	Reference Method	Performance Required (%)	Performance Demonstrated (%)
CO (ppm)	EPA 10	≤ 10 (% of the Reference Method)	RA_{RM} 5.8
CO (lb/MMBtu)	EPA 10/19	≤ 10 (% of the Reference Method)	RA_{RM} 6.8
O_2	EPA 3A	NA(1)	RA_{RM} 3.1

(1) Since the O_2 analyzer is an integrated component of the CEMS, a separate RATA is not required but was performed as an additional quality assurance measure.

The reference method CO emission rates (in terms of lb/MMBtu) were derived using a facility provided F_d-factor and EPA Reference Method 19. The RATA was conducted while the boiler was operated at normal (50% or greater) load conditions. No unusual boiler or CEMS problems occurred during the RATA program.

Appendix A provides detailed summaries of the relative accuracy test results. Test methodology, reference method CEMS data, facility CEMS and process data, example calculations and quality control data are presented in Appendices B through F, respectively.

3. DESCRIPTION OF PROCESS AND SAMPLING LOCATIONS

3.1. PROCESS OVERVIEW

LWEC is a cogeneration facility, consisting of a single boiler generating process steam and electric power to the grid, firing primarily biomass materials. The Boiler typically produces steam at 180,000 lb/hr and gross generation from 14 to 17.7 megawatts per hour (MW/hr).

3.1.1. Basic Operating Parameters

The fuel feed to the boiler is regulated to meet process steam and electrical generation requirements. The fuel blend and excess air may be modified to improve combustion characteristics. Adjustments to air, fuel blend, or load are made as necessary to conform to emissions monitoring limits.

3.1.2. Boiler Operations

The hourly boiler operating limit is 324 million British thermal units (MMBtu). The maximum annual heat input is 2,656,800 MMBtu, based on 8,200 hours of operation per year. During the RATA, the boiler was operated at a load condition of 50% or greater.

3.1.3. Test Program Fuel Mix and Firing Rates

The fuel mix during testing consisted of wood, creosote treated wood derived fuel (CDF), and tire derived fuel (TDF). The firing rates for each of the fuels were within the range consistent for safe normal operation.

3.2. AIR POLLUTION CONTROL EQUIPMENT

Particulate emissions are controlled with a single chamber, three-field electrostatic precipitator (ESP).

3.2.1. ESP Operating Parameters

The precipitator electrical controls and rapping sequence, intensity and frequency are set for optimum performance and are not generally modified after this optimization exercise unless emissions issues are observed.

3.3. CEMS AND REFERENCE METHOD TEST LOCATION

The CEMS and reference method sample ports (two sets) are located on a section of rectangular ductwork that runs horizontally from the exit of the ESP prior to the exhaust stack. The rectangular ductwork is six feet by six feet six inches (6 feet x 6.5 feet) and has a straight run of 57 feet. All dimensions and port locations were verified prior to testing.

Additionally, a third set of sample ports are located on top of the ESP outlet ductwork. Figure 3-1 presents a diagram of the CEMS and reference method test location.

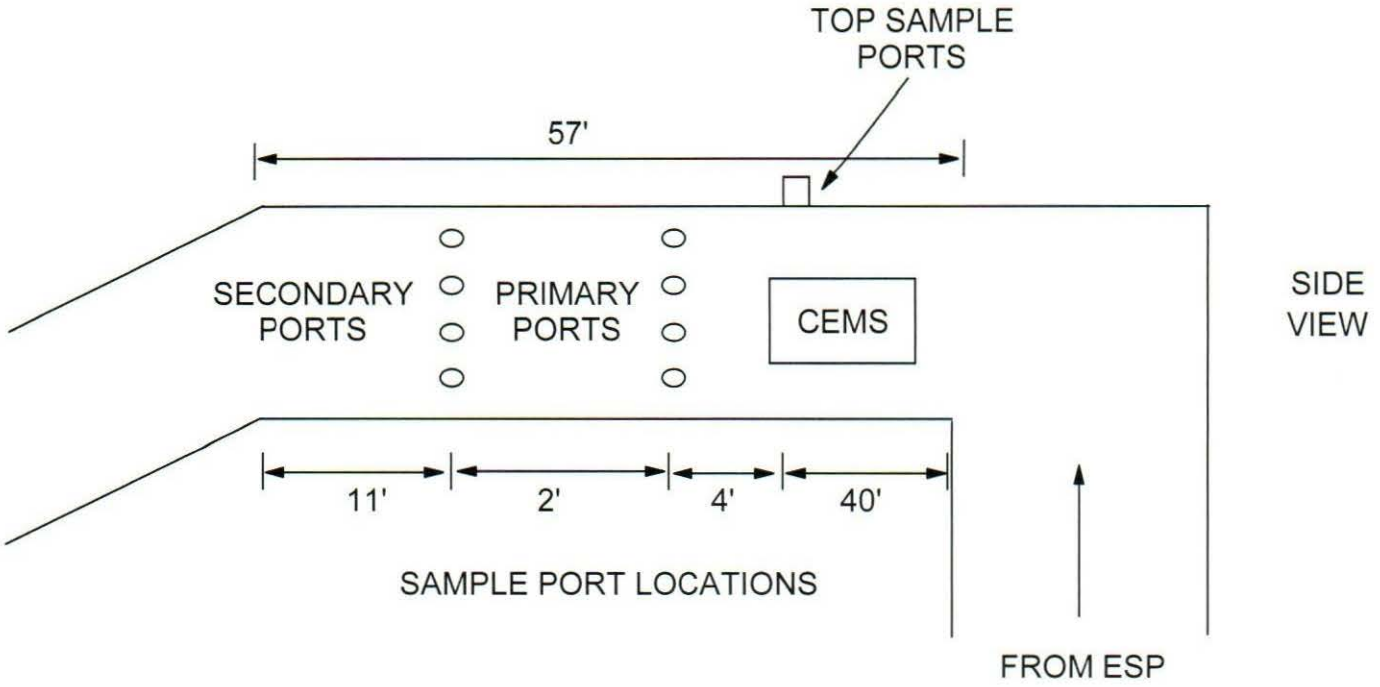
3.3.1. Flue Gas Parameters

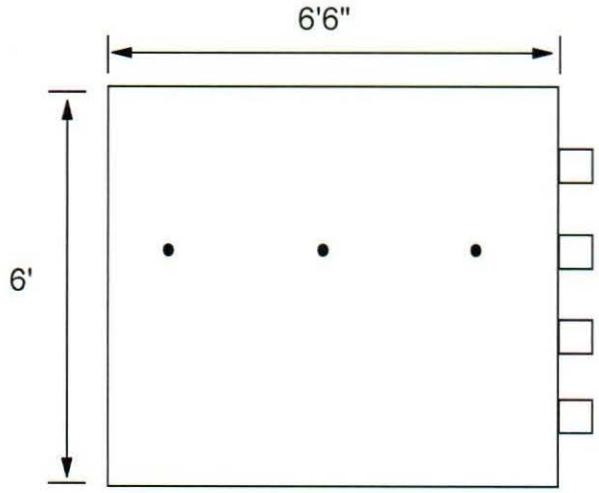
The flue gas parameters at this location are as follows:

Temperature: approximately 370 – 450 °F, load dependent

Moisture: approximately 15% v/v, fuel moisture dependent

Volumetric Flow Rate: Up to about 150,000 ACFM, load dependent





Reference Method Traverse Point Number	Distance From Inside Near Wall
1	13"
2	39"
3	65"

DRAWING NOT TO SCALE

FIGURE 3-1
CEMS AND REFERENCE METHOD TEST LOCATION

4. SOURCE TESTING METHODOLOGY

A mobile sampling system equipped with instrumental analyzers was used to measure CO and O_2. A summary of the U.S. EPA Reference Methods used throughout the test program and sampling system specifications is provided below. Method descriptions and quality assurance data are provided in the referenced appendices.

Parameter Measured	Analyzer Manufacturer	Analyzer Span	EPA Reference Method	Unit of Measure	Appendix Reference	
					Method Description	Quality Control Data
O_2	Servomex 4900 (or equivalent)	0-21%	3A	%	B.1	F
CO	Servomex 4900 (or equivalent)	0-454 ppm	10/19	ppm, lb/MMBtu	B.2	F

4.1. CEMS RATA SAMPLING PROCEDURES

The RATA was conducted while traversing three points at 16.7%, 50%, and 83.3% along a measurement line using a single test port, as described in 40 CFR Part 60, Appendix B, Performance Specification 2, Section 8.1.3.2. Each traverse point was sampled for seven minutes during all RATA test runs.

Twelve CO and O_2 sample runs, 21 minutes (each) in duration, were performed on the Boiler No. 1 exhaust duct for comparison to the facility CEMS. A reference method bias check was repeated at the end of each set of three (maximum) test runs to determine sampling system bias and instrument drift for each analyzer.

The output from the instrumental analyzers was directed to a computer data acquisition system equipped with data reduction software. The software averaged the measured concentrations to form one-minute values, which were used to compute an average concentration for the test run.

The gas stream O_2 concentration and facility provided F-factor were used to calculate CO emission rates in terms of lb/MMBtu pursuant to EPA Reference Method 19. These values were compared with the output of the CEMS data acquisition system to evaluate the performance of the CO CEMS using the equation shown below.

$$Relative\ Accuracy = \frac{\left| \bar{d} \right| + \left| \frac{2.306}{\sqrt{9}} \times Sd \right|}{Reference\ method\ mean\ or\ applicable\ standard} \times 100$$

The CO CEMS passes the relative accuracy test if the results are within 10% of the mean reference method value or 5% of the standard.

The RATA was performed while the boiler operated above 50% of the maximum operating load, as required under 40 CFR Part 60. Boiler operating data was collected by LWEC representatives during each test period.

APPENDIX A
RELATIVE ACCURACY TEST RESULTS

L'ANSE WARDEN ELECTRIC COMPANY
BOILER No. 1
CO RELATIVE ACCURACY CALCULATIONS

RUN NO.		DATE	TIME	LWEC CO Emissions (ppmvd)	WESTON CO Emissions (ppmvd)	DIFFERENCE
1	*	20-Jun-23	1550-1610	236.7	217.0	19.7
2		20-Jun-23	1611-1631	160.0	166.0	-6.0
3	*	20-Jun-23	1632-1652	132.2	146.0	-13.8
4		20-Jun-23	1716-1736	205.1	209.0	-3.9
5		20-Jun-23	1737-1757	156.0	160.0	-4.0
6		20-Jun-23	1758-1818	136.7	132.0	4.7
7		20-Jun-23	1823-1843	241.8	229.0	12.8
8		20-Jun-23	1844-1904	129.8	118.0	11.8
9		20-Jun-23	1905-1925	142.9	133.0	9.9
10		20-Jun-23	1930-1950	144.4	140.0	4.4
11		20-Jun-23	1951-2011	139.4	136.0	3.4
12	*	20-Jun-23	2012-2032	132.2	123.00	-9.2
			SUM	1456.1	1423.0	33.1
			MEAN	161.8	158.1	3.7

*** Run data not used in Relative Accuracy calculations.**

n	**9**
t	**2.306**
Std. Dev.	**7.067**
$C.I._{95}$	**5.432**
RA_{RM}	**5.76%**

L'ANSE WARDEN ELECTRIC COMPANY
BOILER No. 1
CO RELATIVE ACCURACY CALCULATIONS

RUN NO.		DATE	TIME	LWEC CO Emissions (lb/MMBTU)	WESTON CO Emissions (lb/MMBTU)	DIFFERENCE
1	*	20-Jun-23	1550-1610	0.298	0.265	0.033
2		20-Jun-23	1611-1631	0.190	0.193	-0.003
3		20-Jun-23	1632-1652	0.155	0.169	-0.014
4		20-Jun-23	1716-1736	0.228	0.232	-0.004
5		20-Jun-23	1737-1757	0.192	0.191	0.001
6		20-Jun-23	1758-1818	0.168	0.159	0.009
7	*	20-Jun-23	1823-1843	0.371	0.303	0.068
8	*	20-Jun-23	1844-1904	0.177	0.147	0.030
9		20-Jun-23	1905-1925	0.173	0.157	0.016
10		20-Jun-23	1930-1950	0.177	0.168	0.009
11		20-Jun-23	1951-2011	0.170	0.161	0.009
12		20-Jun-23	2012-2032	0.160	0.145	0.015
			SUM	1.613	1.575	0.038
			MEAN	0.179	0.175	0.004

*** Run data not used in Relative Accuracy calculations.**

n	**9**
t	**2.306**
Std. Dev.	**0.0099**
$C.I._{95}$	**0.0076**
RA_{RM}	**6.77%**

L'ANSE WARDEN ELECTRIC COMPANY
BOILER No. 1
O_2 RELATIVE ACCURACY CALCULATIONS

RUN NO.		DATE	TIME	LWEC O_2 Concentrations (%)	WESTON O_2 Concentrations (%)	DIFFERENCE
1		20-Jun-23	1550-1610	9.2	9.0	0.2
2		20-Jun-23	1611-1631	8.6	8.4	0.2
3		20-Jun-23	1632-1652	8.4	8.3	0.1
4		20-Jun-23	1716-1736	8.1	7.8	0.3
5		20-Jun-23	1737-1757	9.0	8.7	0.3
6		20-Jun-23	1758-1818	9.1	8.8	0.3
7		20-Jun-23	1823-1843	10.1	9.9	0.2
8	*	20-Jun-23	1844-1904	9.6	9.2	0.4
9		20-Jun-23	1905-1925	8.8	8.6	0.2
10		20-Jun-23	1930-1950	9.0	8.8	0.2
11	*	20-Jun-23	1951-2011	9.0	8.6	0.4
12	*	20-Jun-23	2012-2032	8.9	8.6	0.3
			SUM	80.3	78.3	2.0
			MEAN	8.9	8.7	0.2

*** Run data not used in Relative Accuracy calculations.**

n	**9**
t	**2.306**
Std. Dev.	**0.067**
$C.I._{95}$	**0.051**
RA_{RM}	**3.14%**

APPENDIX B
TEST METHODOLOGY

B.1 OXYGEN

B.2 CARBON MONOXIDE

B.1 Oxygen (Instrumental)

Oxygen (O_2) testing is conducted in accordance with EPA Reference Method 3A.

Sampling Equipment and Procedures

Figure B-1 illustrates the sampling system. The sample is withdrawn continuously from the source through a heated probe, filter, and sample line to a sample conditioner which removes moisture from the gas stream. The sample is then transported to a Servomex Model 4900 paramagnetic O_2 analyzer.

Sample Analysis

The O_2 analyzer uses a paramagnetic detector to produce an electrical signal which is linearly proportional to the O_2 concentration.

Data Acquisition and Reduction

Data is acquired electronically using computer software designed by WESTON for EPA Reference Method 3A analysis. This system converts electronic signals into concentrations and provides one-minute averages during the sample run and an average concentration over the duration of the sample run.

Quality Control

At the time of analysis, O_2 in nitrogen calibration gases (certified according to EPA Protocol), are used to calibrate the analyzer and to determine a bias correction factor for the entire system bias in accordance with EPA Reference Method 7E.

The calibration gases are introduced directly to the analyzer to generate a calibration curve. A zero gas and an upscale calibration gas is introduced at the probe and recovered through the sampling and analytical system. A bias correction factor is calculated using the ratio of the measured concentration of the bias gas and concentration certified by the vendor. Sample run averages are corrected for system bias results.

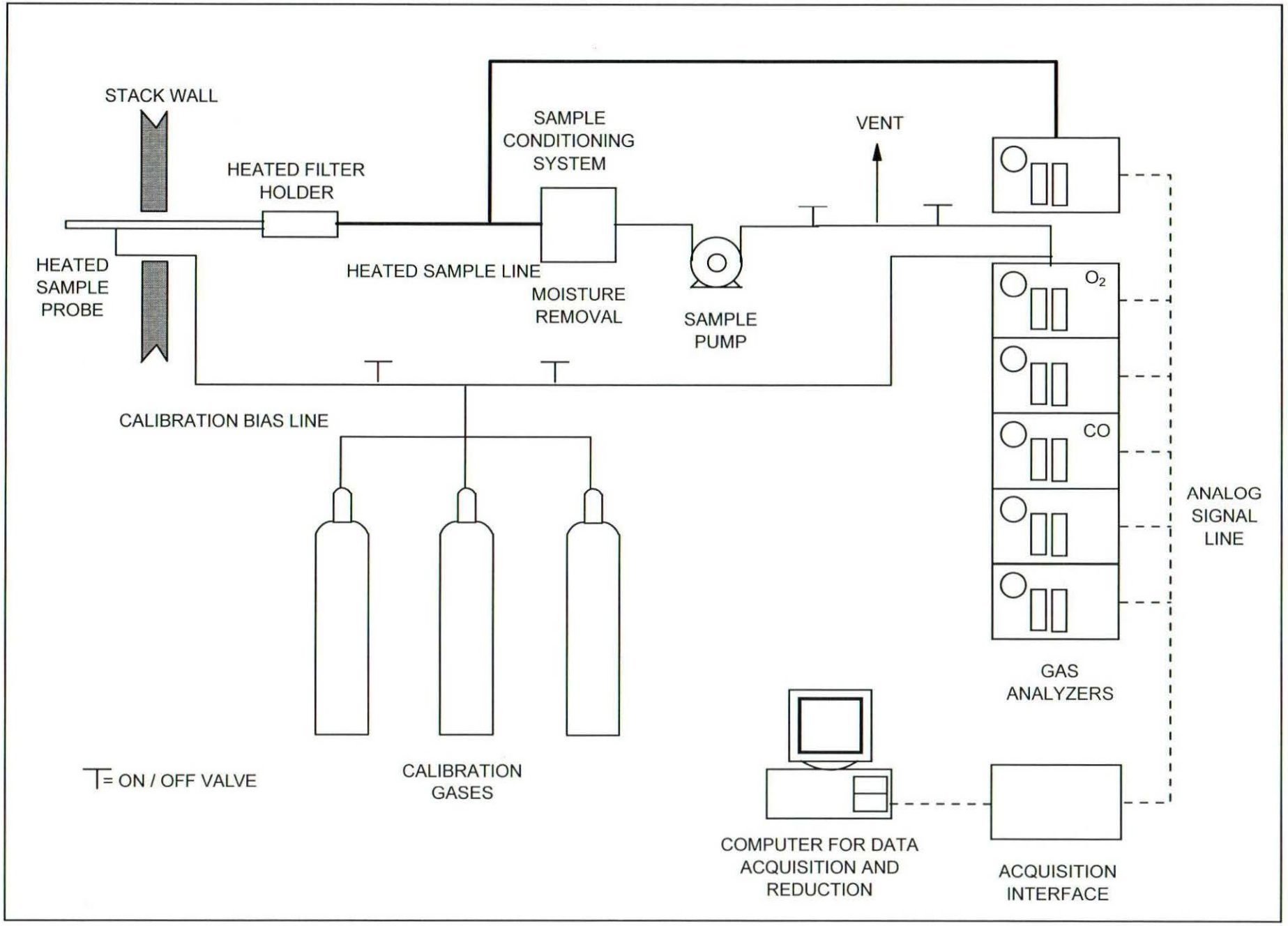


FIGURE B-1
REFERENCE METHOD SAMPLING SYSTEM

IASDATA\LWEC\14464.008.006\FIGURE 5-1 REFERENCE METHOD SAMPLING SYSTEM

Pursuant to EPA Reference Method 7E, an interference response study is required. As per Section 8.2.7 of EPA Reference Method 7E, the interference checks on WESTON's O_2 analyzers were previously performed (December 2014) and were not repeated for this test program.

B.2 CARBON MONOXIDE (Instrumental)

Carbon monoxide (CO) testing is conducted in accordance with EPA Reference Method 10.

Sampling Equipment and Procedures

Figure B-1 illustrates the sampling system. The sample is withdrawn from the source gas stream through a heated probe, filter, and sample line to a sample conditioner that removes moisture from the gas stream. The dry gas sample is then transported through sample lines to a Servomex Model 4900 CO analyzer for continuous on-line monitoring.

Sample Analysis

The CO non-dispersive infrared (NDIR) analyzer uses gas filter correlation spectroscopy to measure the amount of CO present in the sample. Infrared radiation is chopped and passed through an alternating CO and N_2 correlation filter wheel and the sample stream. Carbon monoxide in the sample absorbs the infrared radiation, leaving the remaining radiation to be measured by a detector producing a linear output signal proportional to the CO concentration.

Data Acquisition and Reduction

Data is acquired electronically using computer software designed by WESTON for EPA Reference Method 10 analysis. The system converts electronic signals into concentrations and provides one-minute averages during the sample run and an average concentration over the duration of the sample run.

Quality Control

At the time of analysis, certified CO in nitrogen calibration gases (certified according to EPA Protocol) are used to calibrate the analyzer. The calibration gases are introduced directly to the analyzer to generate a calibration curve. A zero gas and an upscale calibration gas is introduced at the probe and recovered through the sampling and analytical system.

Pursuant to EPA Reference Method 7E, an interference response study is required. As per Section 8.2.7 of EPA Reference Method 7E, the interference checks on WESTON's CO analyzers were previously performed (December 2014) and were not repeated for this test program.