Consumers Energy
Count on Us®

RATA Test Report

EUBOILER01
EUBOILER02

CMS Energy
TES Filer City Station
700 Mee Street
Filer City, Michigan 49634
SRN: N1685
ORIS: 50835

September 19, 2019

Test Dates: August 12 through 14, 2019

Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Section
Work Order No. 4102183
Initial Revision No.: 1.0

CERTIFICATION FOR 40 CFR PART 75 TEST REPORT

(To be completed by authorized AETB firm representative and included in source test report)

Facility ID: ORIS 50835; SRN N1685 Date(s) Tested: August 12-14, 2019

Facility Name: TES Filer City Station

Facility Address: 700 Mee Street, Filer City, Michigan 49634

Equipment Tested: EUBOILER01 & EUBOILER02 CEMS Audits

AETB Firm: CECo/RCTS AETB

Business Address: 2742 N Weadock Hwy, ESD Trailer #4, Essexville, MI 48732

Phone: (989) 891-3492 Email: brian.pape@cmsenergy.com

As the legally authorized representative of the RCTS AETB, I certify that I have reviewed this test report in conjunction with the relevant Quality Manual Appendix D checklist. Having checked each item, I believe the information provided in this test report is true, accurate, and complete.

Signature: [signature] Date: September 23, 2019

Name: Brian C Pape Title: AETB Technical Director

Phone: (989) 891-3492 Email: brian.pape@cmsenergy.com

RELATIVE ACCURACY TEST REPORT CHECKLIST

	Description (Typical location(s) in report) [ASTM D 7036-04 Section Reference]
✓	Title (Title Page) [15.3.1]
✓	AETB name & address (QM App. D pg. D-2) [15.3.2]
✓	Unique identification number on each page and a clear identification of the end of the report (Headers & Footers; "End of Report" page) [15.3.3]
✓	Name and address of the customer (Title Page; QM App. D pg. D-2) [15.3.4]
✓	Date(s) the testing was performed (Title page; Introduction; QM App. D pg. D-2) [15.3.10]
✓	Identification of the units tested (Title page; Introduction) [15.3.9]
✓	Identification of regulatory personnel that observed testing (Introduction; Appendix D1) [Note 13]
✓	Clear identification of the pollutants/parameters tested (Summary & Discussion) [15.3.5]
✓	Identification of the test methods used (Sampling and Analytical Procedures) [15.3.8]
✓	Identification of the sampling location, including diagrams, sketches or photographs (Figures) [15.3.6]
✓	Detailed process description and process operations for each test run (Source and Monitor Description; Appendix B CEMS data sheets) [15.3.7]
✓	Reference to the test protocol and procedures used by the AETB (Introduction) [15.3.11] [15.3.11]
✓	Test results and units of measure (Summary and Discussion) [15.3.12]
✓	Information on specific test conditions, including text description of process operations for each test run and description of any operational issues with the unit or the control device (Discussion of Test Results) [15.3.14]
✓	Discussion of the test results including the uncertainty associated with the test and discussion of possible errors or limiting conditions (Quality Assurance Procedures) [15.3.15]
✓	Reference Method analyzer calibrations for each RM gas RATA run. (Appendix B) [15.3.16]
✓	Raw plant CEMS data for each RATA run and each CEMS component (i.e. all gas analyzers, flow monitors). (Appendix B) [15.3.17]
✓	Raw Reference Method DAS data for each RM gas RATA run. (Appendix B) [15.3.17]
✓	CEMS "Operating Load Analysis" report. (Appendix C) [15.3.11]
✓	Meter box pre- and post-test calibration results (Appendix C) [15.3.16]
✓	NO_x converter check results (Appendix C) [15.3.16]
✓	Pitot calibrations and inspections (Appendix C) [15.3.16]
✓	FRRS/manometer/Magnehelic gage calibration results (Appendix C) [15.3.16]
✓	Reference Method calibration gas certificates of analysis (Appendix C) [15.3.16]
✓	RATA field data sheets verified against spreadsheet data (Field data sheets in project file) [15.3.17]
✓	RCTS AETB Letter of Certification (Appendix D1) [15.3.19]
✓	Completed QM Appendix F – "AETB Field Test Signature Form" (Appendix D1) [3.1.3; 3.1.9; 3.1.14; 8.3; Note 14; 12.2; 12.3; 12.4; 14.1.1]
N/A	Deviations from, additions to, or exclusions from the test protocol, test methods, or AETB Quality Manual entered on QM App. F pg. F-2 (Appendix D2) [15.3.13]
✓	Names, titles and signatures of persons authorizing the test report – "QM App. D pg. D-2" (After Title Page) [15.3.18]
✓	QSTI certificates for Qualified Individuals overseeing/performing the test (Appendix D2) [3.1.12]
✓	Table of Contents is correct (Report Body) [Neatness & professionalism]
✓	Report Headers & Footers are correct (Report Body) [Neatness & professionalism]
✓	RM and CEMS run data in correct order (Appendix B) [Neatness & professionalism]

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Consumers Energy Company (CECo), Regulatory Compliance Testing Section (RCTS) performed Relative Accuracy Test Audits (RATA) on continuous emission monitoring systems (CEMS) associated with emission units EUBOILER01 (Unit 1) and EUBOILER02 (Unit 2) operating at the TES Filer City Station located in Filer City, Michigan. The CEMS are installed to satisfy United States Environmental Protection Agency (USEPA) Title 40, Code of Federal Regulations (CFR), Part 75 acid rain reporting requirements, Part 97 Cross State Air Pollution Rule (CSAPR), and Part 60, Subpart Da Electric Utility Steam Generating Units, which are incorporated in Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI-ROP-N1685-2015b. Note that as of April 22, 2019, the MDEQ was re-organized and re-named the Michigan Department of Environment, Great Lakes, and Energy (EGLE). The RATA tests were performed to satisfy requirements of the ROP, which incorporates 40 CFR 75, Appendices A and B and 40 CFR 60, Appendices B and F.

A test notification/sampling protocol describing the sampling, calibration and quality assurance procedures in USEPA Reference Methods (RM) 1, 2, 2H, 3, 3A, 4, Alt-008, 6C, 7E, 10, and 19, in conjunction with Part 75 Appendices A and B was submitted July 9, 2019 to the USEPA Region 5 and EGLE offices. EGLE representative Mr. Jeremy Howe approved the protocol in a letter dated August 1, 2019 and witnessed portions of the testing on August 14, 2019.

RCTS representatives Brian Pape, Dillon King, Thomas Schmelter, and Joe Mason conducted the RATAs on August 12, 13, and 14, 2019; Mr. Schmelter was the RCTS Lead Qualified Individual (QI) directing the gas RATA, while Mr. King was the lead QI for the flow RATA. Mr. Austin Swiatlowski, Instrument Controls and Electrical Technician, coordinated the tests with applicable plant personnel and provided CEMS data.

Table 1-1 presents the test program organization, major lines of communication, and names of responsible individuals.

Table 1-1 Test Program Contact List

Program Role	Contact	Address
EPA Regional Contact	Mr. Michael Compher Air Monitoring 312-886-5745 compher.michael@epa.gov	USEPA Region 5 Air and Radiation Division 77 W. Jackson Blvd. (AR-18J) Chicago, Illinois 60604
State Regulatory Administrator	Ms. Karen Kajiya-Mills Technical Programs Unit Manager 517-256-0880 kajiya-millsk@michigan.gov	Michigan Department of Environment, Great Lakes, and Energy Air Quality Division - Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
State Technical Programs Field Inspector	Mr. Jeremy Howe Environmental Quality Analyst 231-878-6687 howej1@michigan.gov	Michigan Department of Environment, Great Lakes, and Energy Cadillac District – Air Quality Division 120 West Chapin Street Cadillac, Michigan 49601
Responsible Official	Mr. Henry Hoffman General Manager 231-723-6573 henry.hoffman@cmsenergy.com	CMS Energy TES Filer City Generating Station 700 Mee Street Filer City, Michigan 49634
Test Facility	Mr. Austin Swiatlowski IC&E Technician 231-723-6573, ext. 108 austin.swiatlowski@cmsenergy.com	CMS Energy TES Filer City Generating Station 700 Mee Street Filer City, Michigan 49634

Program Role	Contact	Address
Test Team Representative	Mr. Dillon King, QSTI Engineering Technical Analyst 989-891-5585 dillon.king@cmsenergy.com	Consumers Energy Company D.E. Karn Power Plant 2742 North Weadock Highway, ESD Trailer #4 Essexville, Michigan 48732
	Mr. Thomas Schmelter, QSTI Engineering Technical Analyst 616-738-3234 thomas.schmelter@cmsenergy.com	Consumers Energy Company L&D Training Center 17010 Croswell Street West Olive, Michigan 49460

RCTS operates as a self-accredited Air Emission Testing Body (AETB) as described in the AETB Letter of Certification contained in Appendix D of this report and is therefore qualified to conduct test programs required in 40 CFR Part 75. RCTS' AETB program has been developed in accordance with the American Society for Testing and Materials (ASTM) D 7036-04, Standard Practice for Competence of Air Emissions Testing Bodies.

Reproducing portions of this report may omit critical substantiating documentation or cause information to be taken out of context. If any portion of this report is reproduced, please exercise due care in this regard.

2.0 SUMMARY AND DISCUSSION

The RATA results presented in Appendix B of this report indicate that Flow, NO_x, CO_2, SO_2, and CO CEMS operating at the inlet of the dry scrubber control device and/or at the stack exhaust meet the semi-annual relative accuracy (RA) frequency standards in 40 CFR 75 Appendix A and the annual reduced test frequency incentives in 40 CFR 75, Appendix B at the evaluated operating levels. Further, where applicable, the CEMS meet the applicable RATA requirements of 40 CFR Part 60, Appendices B and F.

The RATA results are summarized in Tables 2-1 through 2-5. RA equations and other applicable sample calculations are presented in Appendix A. Comprehensive test results are presented in Appendix B.

2.1 Wall Adjustment Factor

Without taking wall effect measurements in the stack, the applicable default WAF of 0.9950 (dimensionless) was used to adjust the flue gas velocity and calculate volumetric flow rate for both Units 1 and 2. Accordingly, when reviewing the volumetric flow RATA results, note the volumetric flowrate corrected for WAF is used in relative accuracy calculations.

2.2 Volumetric Flowrate

The flow monitoring system on each exhaust duct consists of in-situ S-type Pitot tubes located near the centroid of the ducts. The resultant differential pressure is transmitted via open tubes to an instrument enclosure located within the CEMS shelter. After conditioning by a signal-conditioning module, the gas flow signal is channeled to the signal transducer module. The signal transducer produces a DC output, which is routed to an electronic conditioner and interface.

These stack gas volumetric flow rate monitoring systems are referred to as the Unit 1 Flow Monitor (monitoring plan system identification FL1, component identification 104), and Unit 2 Flow Monitor (FL2, 204). The flow monitors are used to calculate heat input rate and pollutant emission rates.

As part of RATA test program, trial flow RATA runs were performed on Unit 1 and Unit 2 on August 12, 2019. The trial flow RATA runs were performed at the high operating load for the purpose of evaluating and optimizing the flow CEMS if necessary, as allowed in 40 CFR 75, Appendix B §2.3.2(b)(2). Using the trial flow run data, the Unit 1 and Unit 2 flow monitors met the ≤7.5% annual RATA test frequency criterion in 40 CFR 75, Appendix A §3.3.4(a) and this data was included in the 12-run flow RATA results. The results indicate the monitors meet the ≤10.0% criterion in 40 CFR 75, Appendix A §3.3.4(a) and the annual reduced test frequency incentive standard of ≤7.5% in 40 CFR 75, Appendix B §2.3.1.2(c). Table 2-1 summarizes the volumetric air flow RATA results.

Table 2-1 Summary of Volumetric Air Flow RATA Results

CEMS Make/ Model	CEMS Duct Location & Serial Number	RATA Criteria	Required RATA Performance	Actual RATA Performance
Air Monitor/ MasstronII/CEM	Unit 1 Stack SN: 59413A	High Load	≤10% of mean RM	4.79%
		Bias	|d| ≤ |CC| = Pass	Fail, 1.041
Air Monitor/ MasstronII/CEM	Unit 2 Stack SN: 59413B	High Load	≤10% of mean RM	5.81%
		Bias	|d| ≤ |CC| = Pass	Pass

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient

2.3 SO_2 Gas RATA

The facility operates SO_2 dilution out-of-stack pulsed fluorescence CEMS at each unit upstream of the dry lime flue gas desulfurization (FGD) scrubber systems and at the exhaust stacks. The SO_2 CEMS at the inlet to the scrubber are used to calculate inlet SO_2 lb/mmBtu emissions to evaluate the SO_2 removal efficiency of the dry lime FGD.

The exhaust stack SO_2 CEMS are used to report continuous emissions. The SO_2 concentrations (ppm) are used in 40 CFR Part 75 acid rain program reporting. The lb/mmBtu emission rates are used to evaluate compliance with rolling SO_2 lb/mmBtu and SO_2 reduction limits. Because the reference method measured less than 50% of the 0.5 lb SO_2/mmBtu 30-day rolling average emission limit, this emission limit was used as the denominator in calculation of CEMS relative accuracy.

The SO_2 ppm RATA results met the ±15 ppm specification in 40 CFR 75, Appendix A §3.3.1(b) as well as the reduced RATA test frequency incentive standard of ±12 ppm in 40 CFR 75, Appendix B §2.3.1.2(e). The SO_2 lb/mmBtu RATA results met the ≤20% RA when the mean RM value is used in the RA calculation and ≤10% RA when the emission limit is used as the denominator in the RA calculation as required by 40 CFR 60, Appendices B and F. Table 2-2 summarizes the SO_2 RATA results.

Table 2-2 Summary of SO_2 RATA Results

<table>
<tr><th>CEMS Make and Model</th><th>CEMS Location & Serial Number</th><th>RATA Performance Criteria</th><th>Required RATA Performance</th><th>Actual RATA Performance</th></tr>
<tr><td rowspan="6">Thermo SO_2 Model 43i</td><td>Unit 1 Scrubber Inlet SN 0622717879</td><td>lb/mmBtu[1,2]</td><td>≤20% of mean RM</td><td>6.03%</td></tr>
<tr><td rowspan="5">Unit 1 Exhaust SN 0622717877</td><td rowspan="2">ppm</td><td rowspan="2">≤10% of mean RM or ±15.0 ppm RM-CEMS difference</td><td>11.37</td></tr>
<tr><td>-5.278 ppm</td></tr>
<tr><td>bias (ppm)</td><td>|d|≤|CC|=Pass</td><td>Pass</td></tr>
<tr><td rowspan="2">lb/mmBtu[1,2]</td><td rowspan="2">≤10% of emission limit</td><td rowspan="2">2.32%</td></tr>
<tr></tr>
<tr><td rowspan="5">Thermo SO_2 Model 43i</td><td>Unit 2 Scrubber Inlet SN 0622717883</td><td>lb/mmBtu[1]</td><td>≤20% of mean RM</td><td>0.81%</td></tr>
<tr><td rowspan="4">Unit 2 Exhaust SN 0622717880</td><td rowspan="2">ppm</td><td rowspan="2">≤10% of mean RM or ±15.0 ppm RM/CEMS difference</td><td>13.71%</td></tr>
<tr><td>-5.256 ppm</td></tr>
<tr><td>bias (ppm)</td><td>|d|≤|CC|=Pass</td><td>Pass</td></tr>
<tr><td>lb/mmBtu[1,2]</td><td>≤10% of emission limit</td><td>2.37%</td></tr>
</table>

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient
[1] SO_2 pound per million British thermal unit (lb/mmBtu) RA is reported to comply with the EGLE Air Pollution Control (APC) Rules, Part 4, R336.1401, Emissions of Sulfur Dioxide from Power Plants and 40 CFR Part 60, Subpart Da, §60.49Da(b).
[2] In cases where the average emissions for the test are less than 50 percent of the applicable standard, substitute the emission standard value in the denominator of the relative accuracy equation in place of the mean reference method value.

2.4 NO_x GAS RATA

The facility operates NO_x dilution out-of-stack chemiluminescence CEMS at the exhaust stacks of each boiler to report continuous emissions. The NO_x concentrations (ppm) are used in 40 CFR Part 75 acid rain program reporting. The NO_x lb/mmBtu emission rates are used to evaluate compliance with rolling NO_x limits.

The NO_x ppm RATA results met the ≤10% RA specification in 40 CFR 75, Appendix A §3.3.1(a) as well as the reduced RATA test frequency incentive standard of ≤7.5% RA in 40 CFR 75, Appendix B §2.3.1.2(a). The NO_x lb/mmBtu RATA results met the ≤20% RA in 40 CFR 60, Appendices B and F. Table 2-3 summarizes the NO_x RATA results.

Table 2-3 Summary of NO_x RATA Results

CEMS Make and Model	CEMS Location & Serial Number	RATA Performance Criteria	Required RATA Performance	Actual RATA Performance
Thermo NO_x Model 42i	Unit 1 Exhaust SN 0623017966	ppm	10% of mean RM or ±15.0 ppm RM-CEMS difference	7.21%
				-12.911 ppm
		bias (ppm)	|d|≤|CC|=Pass	Pass
		lb/mmBtu[1]	≤20% of mean RM	3.68%
Thermo NO_x Model 42i	Unit 2 Exhaust SN 0623017967	ppm	10% of mean RM or ±15.0 ppm RM/CEMS difference	6.14%
				-9.867 ppm
		bias (ppm)	|d|≤|CC|=Pass	Pass
		lb/mmBtu[1]	≤20% of mean RM	1.76%

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient
[1] In cases where the average emissions for the test are less than 50 percent of the applicable standard, substitute the emission standard value in the denominator of the relative accuracy equation in place of the mean reference method value.

2.5 CO_2 GAS RATA

The facility operates CO_2 dilution out-of-stack non-dispersive infrared CEMS at the exhaust stacks that were evaluated during this test program. The CO_2 concentrations are used to calculate lb/mmBtu emission rates. The CO_2 RATA results met the ≤10% RA and the mean difference of no greater than ±1.0% CO_2 specifications in 40 CFR 75, Appendix A §3.3.3 and the reduced RATA test frequency incentive standard in 40 CFR 75, Appendix B §2.3.1.2(a) and (h) where the RA is ≤7.5% or the mean difference does not exceed ±0.7% CO_2, respectively. Table 2-4 summarizes the CO_2 RATA results.

Table 2-4 Summary of CO_2 RATA Results

CEMS Make and Model	CEMS Location & Serial Number	Required Performance Criteria	Actual RATA Performance
Thermo CO_2 410i	Unit 1 Exhaust SN 0622717869	≤10% of mean RM or ±1.0% RM-CEMS difference	3.71%
			-0.344%
Thermo CO_2 410i	Unit 2 Exhaust SN 0622717874	≤10% of mean RM or ±1.0% RM-CEMS difference	4.37%
			-0.378%

2.6 CO Gas RATA

CO dilution out-of-stack non-dispersive infrared gas filter correlation CEMS are installed at the boiler exhaust flues to report continuous emissions and evaluate compliance with CO emission limits. Because the CO lb/mmBtu reference method results were less than 50% of the applicable emission standard of 0.3 lb/mmBtu, this emission standard was used as the denominator in the RA calculation. The CO lb/mmBtu RATA results met the ≤5% RA specification in 40 CFR 60, Appendix B, Performance Specification 4A, §13.2.

The CO ppm RATA results met the ≤5% RA or ±5 ppmv difference specifications in 40 CFR 60, Appendix B, Performance Specification 4A (PS4A), §13.2 for Unit 2. However, at Unit 1 the PS4A criteria was not met. Because the facility uses the CO ppm concentration and volumetric flowrate to calculate and report CO lb/hr emissions, and at the request of Mr. Jeremy Howe, the CO RATA was evaluated on a lb/hr basis against 40 CFR Part 60, Appendix B, Performance Specification 6 criteria. For purposes of RM CO lbs/hr calculations, the RM CO concentrations and CEMS flowrate data were utilized. Since the reference method CO mass emission rates were less than 50% of the 115.2 lbs CO/hr 24-hour rolling average emission limit, this emission limit was used in calculation of relative accuracy. The CO lb/hr RATA results met the ≤10% RA in 40 CFR 60, Appendix B and F, when the applicable emission standard is used in the RA calculation. Table 2-5 summarizes the CO RATA results.

Table 2-5 Summary of CO RATA Results

CEMS Make and Model	CEMS Location & Serial Number	RATA Performance Criteria	Required RATA Performance	Actual RATA Performance
Thermo CO Model 48i	Unit 1 Exhaust SN 0622717887	ppm	5% of mean RM or ±5.0 ppm RM-CEMS difference + CC	15.74%
				10.577 ppm
		lb/mmBtu	≤5% of emission standard[1]	3.11
		lb/hr	≤10% of emission standard[1]	4.05
Thermo CO Model 48i	Unit 2 Exhaust SN 0622717888	ppm	5% of mean RM or ±5.0 ppm RM-CEMS difference + CC	6.95%
				2.277 ppm
		lb/mmBtu	≤5% of emission standard[1]	0.45

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient
[1] In cases where the average emissions for the test are less than 50 percent of the applicable standard, substitute the emission standard value in the denominator of the relative accuracy equation in place of the mean reference method value.

3.0 SOURCE AND MONITOR DESCRIPTION

TESFC operates a cogeneration power plant with a rated output of 60-megawatts (MW), and 50,000 pounds of steam per hour. The electricity and steam are sold under contract to private companies. Unit 1 and Unit 2 each have a nominal heat input rating of 384 lb/mmBtu and are capable of firing mixtures of coal, construction/demolition (C/D) material, wood and wood waste (not including C/D material), petroleum coke, tire-derived-fuel (TDF) and natural gas. Following issuance of Permit to Install No. 110-14B, TESFC does not anticipate firing petroleum coke in the future, and natural gas is generally used for startup, shutdown, flame stabilization, and/or other purposes. Designated lime slurry dry scrubbers and baghouses control boiler exhaust gas pollutants prior to discharge through separate flues situated within a common stack.

Prior to the RATA, in accordance with 40 CFR Part 75, Appendix A, Section 6.5.2.1(c), Operating Load Analyses were obtained for Units 1 and 2 for the July 1, 2018 through June 30, 2019 time span. Based on these four quarters of representative historical operating data, the first (i.e., normal) and second most frequently (i.e., an optional 2^{nd} normal load) used load levels were evaluated to ensure the appropriate load levels were tested during the RATA. Currently, the monitoring plan lists High Load as the normal operating level and Mid Load as the 2^{nd} most frequent operating level. The load analysis indicated EUBOILER01 and EUBOILER02 operated at the High Load level ≥85% of the time, and the flow RATAs were therefore conducted at High Load only as allowed in 40 CFR Part 75, Appendix B, Section 2.3.1.3(c)(3). The RATAs were conducted with each boiler operating at its respective normal High Load. Refer to Appendix C for the operating load analysis for Units 1 and 2.

Thermo Scientific (Thermo) dilution-extractive CO_2, SO_2, NO_x and CO CEMS and Air Monitor Masstron II differential pressure airflow CEMS are installed at the exhaust stack locations, while similar CO_2 and SO_2 CEMS are installed at the inlet duct to the dry scrubber control devices. The CEMS interface with a data acquisition handling system (DAHS) manufactured by VIM Technologies, Inc. (VIM). The DAHS records various data including exhaust gas flow rates, concentrations and emissions, as well as operating unit parameters. Figure 1 illustrates the Unit 1 Data Flow Diagram, which is representative of Unit 2.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Ten, 21-minute gas and twelve minimum 5-minute flow test runs were conducted on Units 1 and 2 to calculate the CEMS RA. Specific test procedures as detailed in 40 CFR Part 60, Appendix A, Reference Methods 1, 2, 2H, 3, 3A, 4 and Alt-008, 6C, 7E, 10, and 19 were followed, in conjunction with Part 75 Appendices A and B. Conformance with quality system documents of the AETB program, and where applicable, the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III, Stationary Source Specific Methods, was used as a reference. The following sections describe the sampling and analytical procedures.

4.1 Traverse Points (USEPA Method 1)

The number and location of traverse points for determining exhaust gas velocity and flow RA was determined in accordance with USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources*. The area of the exhaust duct was calculated and the cross-section divided into a number of equal areas based on the location of existing air flow disturbances.

At the Unit 1 and 2 Dry Scrubber Inlet sampling locations, gas concentrations were measured while traversing the duct approximately every 7-minutes at 16.7, 50.0, and 83.3 percent of the duct diameter. Because the sampling locations at the exhaust stacks are at least 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance, gas concentrations were measured for approximately 7-minutes at each of three traverse points located at 12.7, 38.0 and 63.3 inches from the stack wall (the long reference method measurement line). During the flow RATA, 12 traverse points (6 traverse points in each of two test ports) were selected and traversed to measure flue gas velocity and temperature to calculate volumetric flowrate. Refer to Figures 2, 3, and 4 for illustrations of the dry scrubber inlet sampling locations, exhaust stack configuration, and stack sampling locations.

4.2 Velocity and Volumetric Flow (USEPA Methods 2 and 2H)

The exhaust gas velocity and temperature measurements were conducted in accordance with USEPA Method 2*, Determination of Stack Gas Velocity and Volumetric Flow Rate*. The pressure differential across the positive and negative openings of an S-type Pitot tube connected to a pressure transducer was used to measure exhaust gas velocity, as illustrated in Figure 5.

Please note that the RM flow data incorporates the applicable default WAF of 0.9950 for Unit 1 and Unit 2 as obtained from USEPA Method 2H, *Determination of Stack Gas Velocity Taking into Account Velocity Decay Near the Stack Wall*.

4.3 Diluent/Molecular Weight (USEPA Method 3 and 3A)

CO_2 diluent concentrations were measured using a non-dispersive infrared (NDIR) analyzer following guidelines in USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from a Stationary Source (Instrumental Analyzer Procedure)*. Refer to Section 4.6 for a description of the Method 3A sampling apparatus.

Oxygen (O_2) and CO_2 concentrations were also obtained via USEPA Method 3, *Gas Analysis for the Determination of Dry Molecular Weight* to determine flue gas composition during the air flow RATA using calibrated Fyrite gas analyzers. Triplicate grab samples were captured in absorbing fluid resulting in a proportional rise in the fluid to the gas concentration absorbed. Each sample concentration was read on the instrument scale, and the calculated dry molecular weight was verified to not differ from the triplicate sample mean by more than 0.3 g/g-mole (0.3 lb/lb-mole), and the average result was reported to the nearest 0.1 g/g-mole (0.1 lb/lb-mole).

4.4 Moisture Content (USEPA Method 4 and ALT-008)

The gas RATA moisture content was determined in accordance with USEPA Method 4, *Determination of Moisture Content in Stack Gases*. Flue gas is extracted from the stack at a constant rate through a stainless steel probe, flexible line, four impingers assembled in an ice bath container, and a metering console/pump. Moisture in the gas stream sampled condensed in the impingers and was quantified gravimetrically. The amount of moisture collected and the volume of gas sampled was used to calculate moisture content. Refer to Figure 6 for an illustration of the Reference Method 4 Moisture Sample Apparatus.

During the flow RATA, exhaust gas moisture content was determined in accordance with USEPA ALT-008, *Alternative Moisture Measurement Method Midget Impingers*, an alternative method for correcting pollutant concentration data to appropriate moisture conditions (e.g. pollutant and/or air flow data on a dry or wet basis) validated May 19, 1993 by the USEPA Emission Measurement Branch. The procedure is incorporated into Method 6A of 40 CFR Part 60 and is based on field validation tests described in *An Alternative Method for Stack*

Gas Moisture Determination (Jon Stanley, Peter Westlin, 1978, USEPA Emissions Measurement Branch). The sample apparatus configuration follows the general guidelines contained in Figure 4-2 and § 8.2 of USEPA Method 4, *Determination of Moisture Content in Stack Gases,* and ALT-008 Figure 1 or 2. The flue gas is withdrawn from the stack at a constant rate through a heated sample probe, umbilical, four midget impingers, and a metering console with pump. The moisture is removed from the gas stream in the ice-bath chilled impingers and determined gravimetrically. Refer to Figure 7 for an illustration of the Alternative Method 008 Moisture Sample Apparatus.

4.5 Sulfur Dioxide (USEPA Method 6C)

SO_2 concentrations were measured using a non-dispersive infrared analyzer following the guidelines of USEPA Reference Method 6C, *Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)*. Refer to Section 4.6 for a description of the sample apparatus.

4.6 Oxides of Nitrogen (USEPA Method 7E)

A chemiluminescence analyzer was used to measure concentrations of NO_x following the guidelines of USEPA Method 7E, *Determination of Nitrogen Oxides from Stationary Sources (Instrumental Analyzer Procedure)*. Diluent, sulfur dioxide, and carbon monoxide concentrations were measured following USEPA Methods 3A, 6C, and 10, which refer to USEPA Method 7E. The sample system is the same for these parameters with the exception of the analytical technique.

All components of the extractive gaseous RM system in contact with flue gas were constructed of Type 316 stainless steel and Teflon. Flue gas was drawn from the stack via a heated sample probe and line, and routed through an electronic chilled gas conditioning system to remove moisture prior to passing through a distribution manifold for delivery to the analyzers. The output signal from each analyzer was connected to a computerized data acquisition system (DAS). The RM analyzers were calibrated with USEPA Protocol calibration gases and operated to ensure that zero drift, calibration gas drift, bias and calibration error met the specified method requirements. Refer to Figure 8 for a drawing of the reference method gaseous RATA sample apparatus.

Data collected from the RM analyzers were averaged for each run with SO_2, CO, and NO_x concentrations measured in parts per million by volume, dry basis (ppmvd) and CO_2 concentrations as percent, dry (%, dry). At the exhaust stacks, since the extractive RM analyzers and dilution CEMS operate on different principles (dry vs. wet measurement), flue gas moisture content was measured concurrently with each gas RATA run to convert RM concentrations from a dry to a wet basis. Conversely, one set of auxiliary measurements (i.e. diluent and moisture content for gas composition) was performed at least once per every clock hour of the air flow RATA consistent with 40 CFR Part 75, Appendix A, Section 6.5.7(a). As the inlet SO_2 RATAs were performed on a lb/mmBtu basis only and both the RM pollutant and diluent concentration were measured on the same moisture basis (i.e., dry), no moisture determinations were need or conducted for the inlet RATAs.

4.7 Carbon Monoxide (USEPA Method 10)

CO concentrations were measured using a gas filter correlation infrared analyzer following the guidelines of USEPA Reference Method 10, *Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)*. Refer to Section 4.6 for a description of the sample apparatus.

4.8 Emission Rates (USEPA Method 19)

USEPA Method 19, *Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates*, was used to calculate emission rates in units of lb/mmBtu. Measured carbon dioxide concentrations and site-specific F factors (ratios of combustion gas volumes to heat inputs) were used to calculate emission rates using equation 19-6 from the method.

USEPA Method 19 Equation 19-6

$$E=C_d F_c \frac{100}{\%CO_{2d}}$$

Where:

E	=	Pollutant emission rate (lb/mmBtu)
C_d	=	Pollutant concentration, dry basis (lb/dscf)
F_c	=	Volumes of combustion components per unit of heat content, (scf CO_2/mmBtu)
$\%CO_{2d}$	=	Concentration of carbon dioxide on a dry basis (%, dry)

The average Fc factor reported by the facility during each 10-run gas RATA was used to calculate RM lb/mmBtu emissions and calculate CEMS relative accuracy. Specifically, the following Fc values were used: Unit 1 Inlet Gas RATA = 1,755.96 scf CO_2/mmBtu; Unit 1 Outlet Gas RATA = 1,756.28 scf CO_2/mmBtu; Unit 2 Inlet Gas RATA = 1,762.14 scf CO_2/mmBtu; Unit 2 Outlet Gas RATA = 1,761.87 scf CO_2/mmBtu. Refer to Appendix A for RATA calculation summary presenting the calculations used in this report and Appendix B for the CEMS data that include the per run Fc values.

5.0 QUALITY ASSURANCE PROCEDURES

The objective of a Quality Assurance (QA) program is to produce data that are complete, representative, and of known precision and accuracy. Within the RATA test program, completeness can be defined as the percentage of the required field measurements and associated documentation achieved. Representativeness, defined as the "when," "how," and "how many" measurements taken, is typically specified within the regulations governing the source to be tested as well as the Test Protocol submitted to the regulatory agency prior to the test event. Precision and accuracy are measures of data quality and exist by design within each of the USEPA reference test methods and procedures incorporated during the RATA.

RCTS addresses these QA goals by operating within a Quality System in compliance with ASTM D 7036-04, Standard Practice for Competence of Air Emissions Testing Bodies; a practice specifying the general competence requirements applicable to all AETB staff engaged in air emission testing at stationary sources, regardless of testing scope. By employing these requirements in conjunction with the precision and accuracy standards in each reference method, RCTS is better able to ensure consistently accurate data quality from an individual and AETB perspective. RCTS' AETB Letter of Accreditation and individual QSTI Certificates are contained in Appendix D.

5.1 Pitot Tube and Thermocouples

The Pitot tubes and thermocouples used to measure the exhaust gas volumetric flow were inspected and/or calibrated according to procedures outlined in the *Quality Assurance Handbook for Air Pollution Measurement Systems:* Volume III, Stationary Source-Specific Methods, Method 2, Type S Pitot Tube Inspection, and the *Alternative Method 2 Thermocouple Calibration Procedure* (ALT-011). ALT-011 describes the inherent accuracy and precision of the thermocouple within ±1.3°F in the range of -32°F and 2,500°F and states that a system that performs accurately at one temperature is expected to behave similarly at other temperatures. Therefore, the calibration procedure described in Method 2 may be replaced with a single point calibration procedure that verifies a thermocouple system is operating within ±1.0 percent of the absolute measured temperature, while taking into account the presence of disconnected wire junctions, other loose connections or a potential miscalibrated temperature display.

The differential pressure transmitters used in conjunction with Method 2 were calibrated in accordance with §6.2.1 of the method. Refer to Appendix C for Pitot tube and thermocouple inspection and calibration sheets.

5.2 Dry Gas Metering Console

The dry gas metering consoles and associated pumps used for measuring exhaust gas moisture content following the procedures of Methods 4 and ALT-008 were calibrated against a dry gas meter calibration standard as described in Method 5, §16.1, using the procedures in Method 5, §10.3.2. Refer to Appendix C for dry gas metering console calibration data.

5.3 USEPA Protocol Gas Standards

USEPA Protocol gas standards used by RCTS were purchased from an outside vendor participating in the USEPA Protocol Gas Verification Program (PGVP) calibration gas audit program described 40 CFR Part 75 § 75.21(g). The standards are certified to have a total relative uncertainty of no greater than ±2.0 percent according to the *USEPA Traceability Protocol for Assay & Certification of Gaseous Calibration Standards; EPA – 600/R-97/121; September, 1997* or the current version of the traceability protocol (*EPA – 600/R-12/531; May, 2012*). Refer to Appendix C for a summary of the PGVP calibration gas standards used during this test program.

5.4 Analyzer Calibrations

The RM instruments measuring gaseous concentrations were calibrated on-site and operated following manufacturer's specifications and the applicable reference method based in part on the quality assurance and quality control requirements contained in USEPA Method 7E.

A nitrogen dioxide (NO_2) to nitric oxide (NO) conversion efficiency (CE) test was conducted on the NO_x analyzer prior to the test program. The NO_2-NO conversion efficiency test verified the analyzer's ability to convert NO_2 to NO in order to accurately measure NO_x by chemiluminescence. Refer to Appendix C for the NO_2-NO conversion efficiency documentation.

Before beginning the gas RATA, a three-point analyzer calibration error (ACE) check was conducted on each RM analyzer by injecting zero-, mid-, and high-level calibration gases directly into the instruments and measuring the responses. The instrument response must be within ±2.0% of the respective analyzer span or within ±0.5 ppmv or ±0.5% for O_2 and/or CO_2 absolute difference to be acceptable. An initial system bias check was then performed by measuring the instrument response while introducing zero- and mid- or high-level (upscale) calibration gases at the probe, upstream of all sample conditioning components, and drawing it through the various sample components in the same manner as flue gas. The initial system bias check is acceptable if the instrument response at the zero and upscale calibration is within ±5.0% of the calibration span or ±0.5 ppmv or ±0.5% for O_2 and/or CO_2 absolute difference.

After each gaseous RATA run, post-test zero and upscale system bias checks were performed to quantify and compensate for RM analyzer drift and bias. The RM system bias is acceptable if those values remain within ±5.0% of the calibration span or 0.5 ppmv or ±0.5% for O_2 and CO_2 absolute difference. The RM drift is acceptable if the zero and upscale values are within ±3.0% of the calibration span. Measurement system response times were documented during the initial system bias tests and calibration gas flow rates thereafter were maintained at the target sample rate, with each subsequent run started after twice the system response time had elapsed. Analyzer calibration error data is presented in Appendix C, while bias and drift data is presented in Appendices B5 through B8.

6.0 DISCUSSION OF TEST RESULTS

The CEMS RATA results presented in Appendix B indicate the CEMS operating at TES Filer City Station meet the performance specifications in 40 CFR 75, Appendix A, and the annual reduced RATA test frequency incentive standards in 40 CFR 75, Appendix B. Further, where applicable, the CEMS meet the applicable RATA requirements of 40 CFR Part 60, Appendices B and F. These data indicate compliance with the CEMS monitoring and recordkeeping requirements of the facility's air permit MI-ROP-N1685-2015b.

During the test event, no deviations were observed by the QI's in attendance. The criteria specified in the applicable Reference Methods and the agency-approved Test Protocol were followed. Hard copy and/or electronic field data were completed in the field and upon return to the home office, verified for data precision and accuracy, further ensuring the appropriate AETB and Reference Method quality measures were met.

The Quality Assurance data include the protocol gas certificates of analysis, analyzer calibration error and system response time, NO_2 to NO converter efficiency check, instrument interference checks, flow instrument calibration, moisture, thermocouple and Pitot tube calibration sheets, all of which are contained in Appendix C. Gas RATA instrument calibration and system bias/drift data are contained in Appendices B5 through B8. AETB certification and field test signature forms are provided in Appendix D.

6.1 Clock Time Synchronization

The flow traverse and gaseous RM data is presented in time synchronized to the CEMS DAHS, which is in Eastern Standard Time (EST). However, the time reported on the moisture analyses associated with the flow RATA runs were reported in Eastern Daylight Time (EDT), 60 minutes later than EST. To align the flow RATA moisture run start and stop times to CEMS time, subtract 60 minutes from the times reported on the appropriate flow RATA moisture field datasheets presented in Appendix B.

Figures

Figure 1 – Unit 1 Data Flow Diagram

A: Location of sample probe (ft) .... 95' 11"
B: Location of flow monitor probe (ft) .... 95' 2"
C: Location of opacity ports (ft)........................ 96' 9"
D: Inside cross-sectional area at test port (ft^2)....... 31.5032
E: Stack exit height above grade (ft)................... 249'
F: Upstream distance to disturbance (ft)............. 71' 2"
G: Downstream distance to disturbance (ft).......... 153' 1"

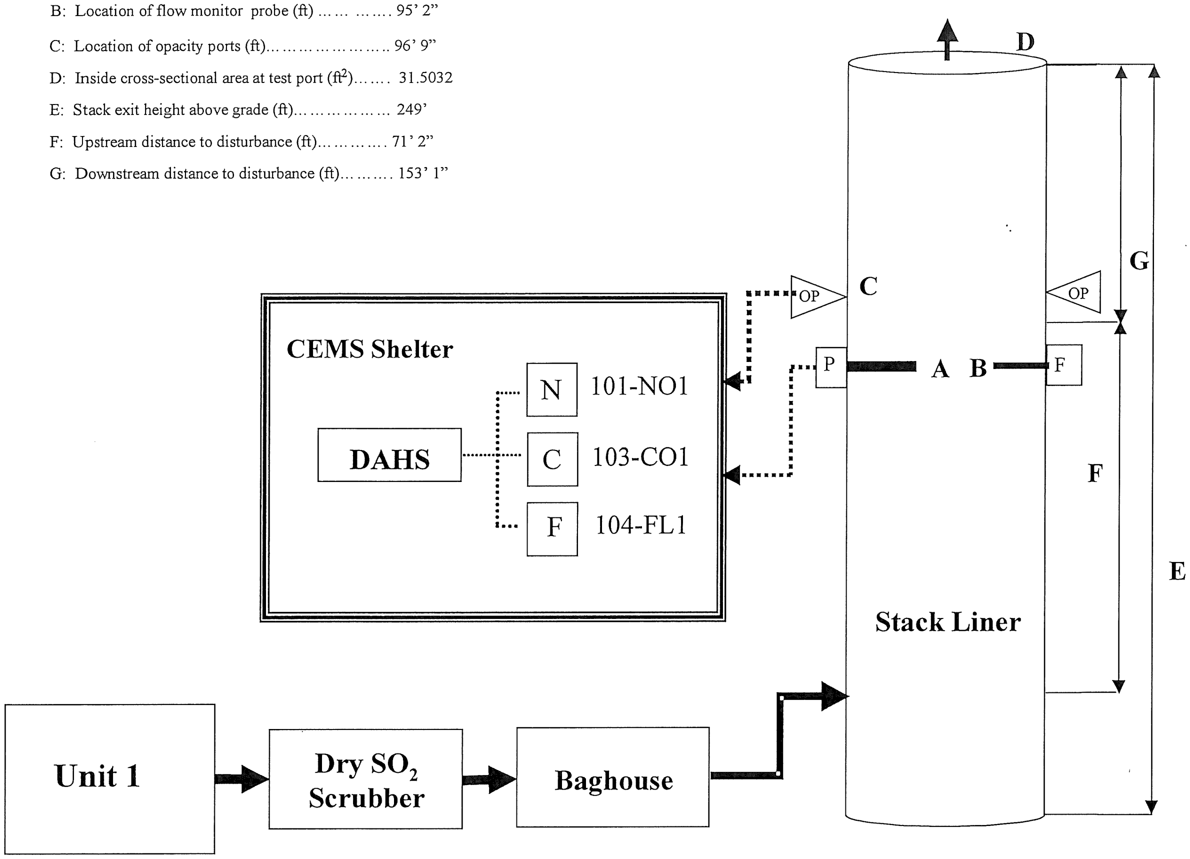


Figure 2 – Unit 1 and 2 Dry Scrubber Inlet Dimensions and Traverse Point Detail

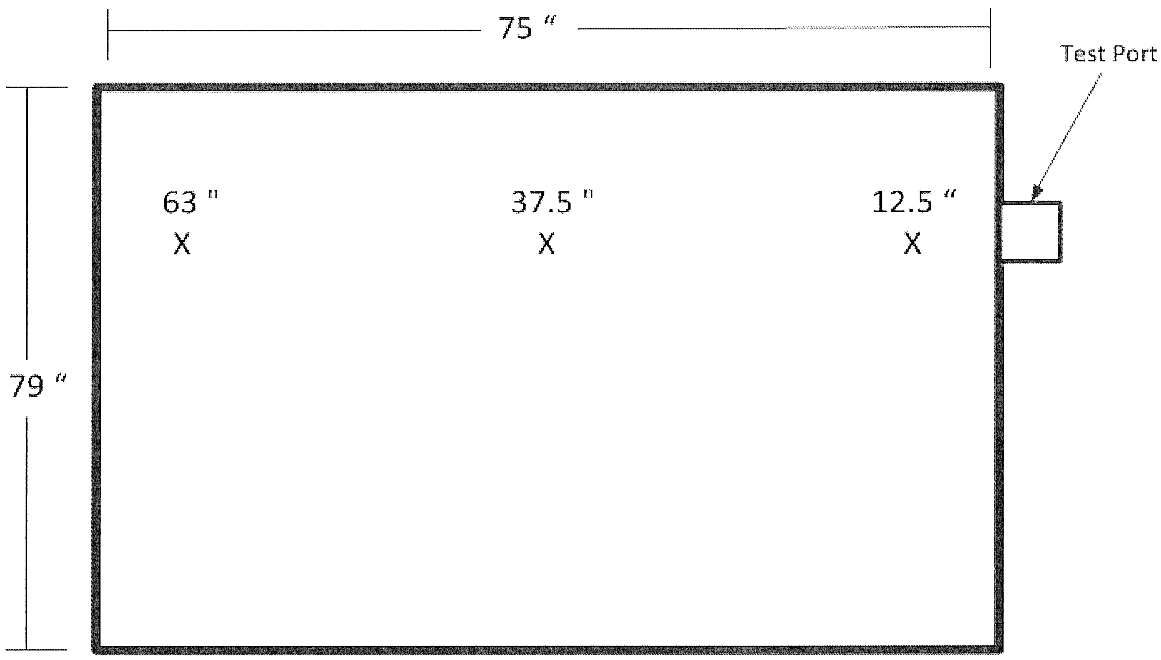


Figure 3 – Unit 1 and 2 Sample Locations

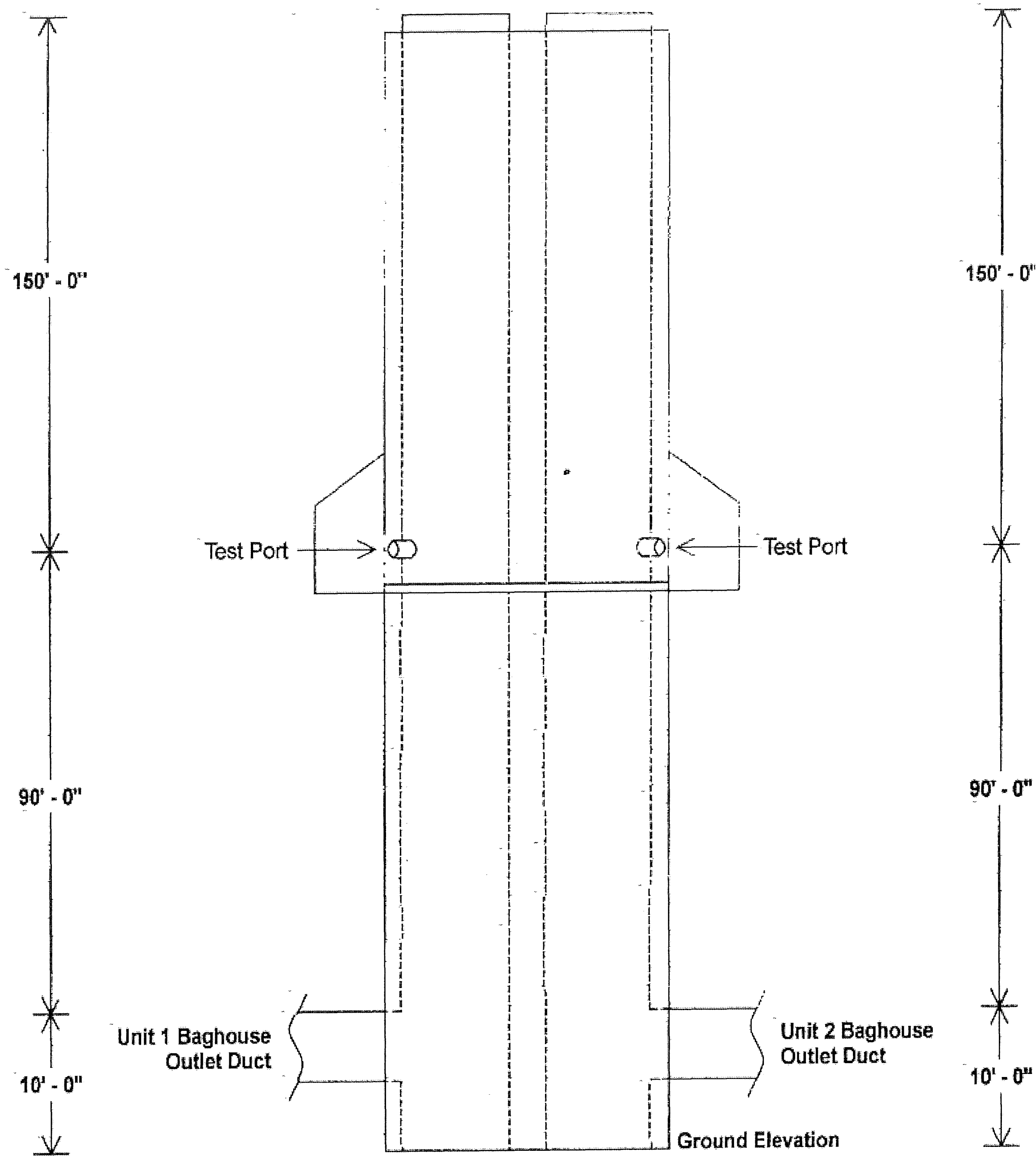
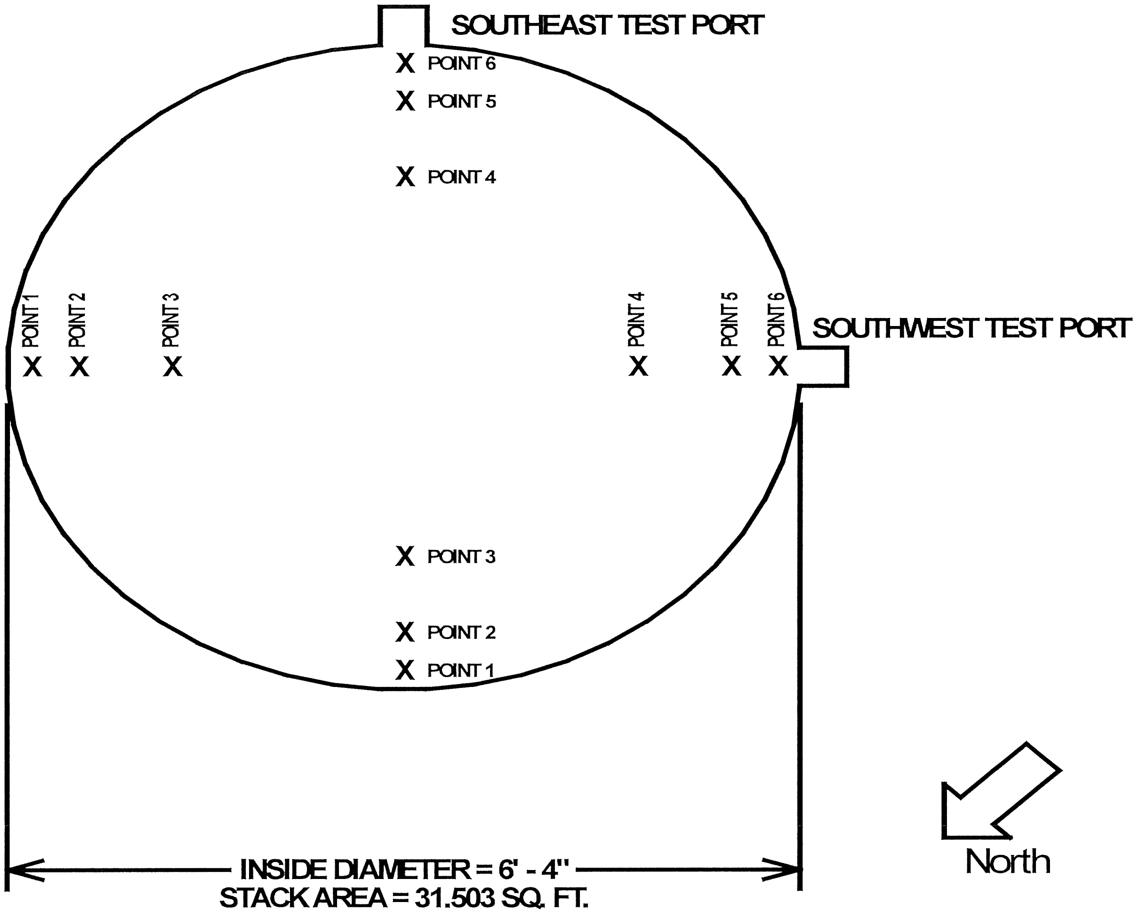


Figure 4 – Unit 1 Duct Cross Section and Traverse Point Detail



Gas RATA Probe Depths From Inside Stack Wall

Gas Port Length = 20"

Point 1 = 63.3"
Point 2 = 38.0"
Point 3 = 12.7"

Flow RATA Probe Depths From Inside Stack Wall

Flow Port Length = 20"

Point 1 = 72.656"
Point 2 = 64.904"
Point 3 = 53.504"
Point 4 = 22.496"
Point 5 = 11.096"
Point 6 = 3.344"

Figure 5 – Volumetric Airflow RATA Sample Apparatus

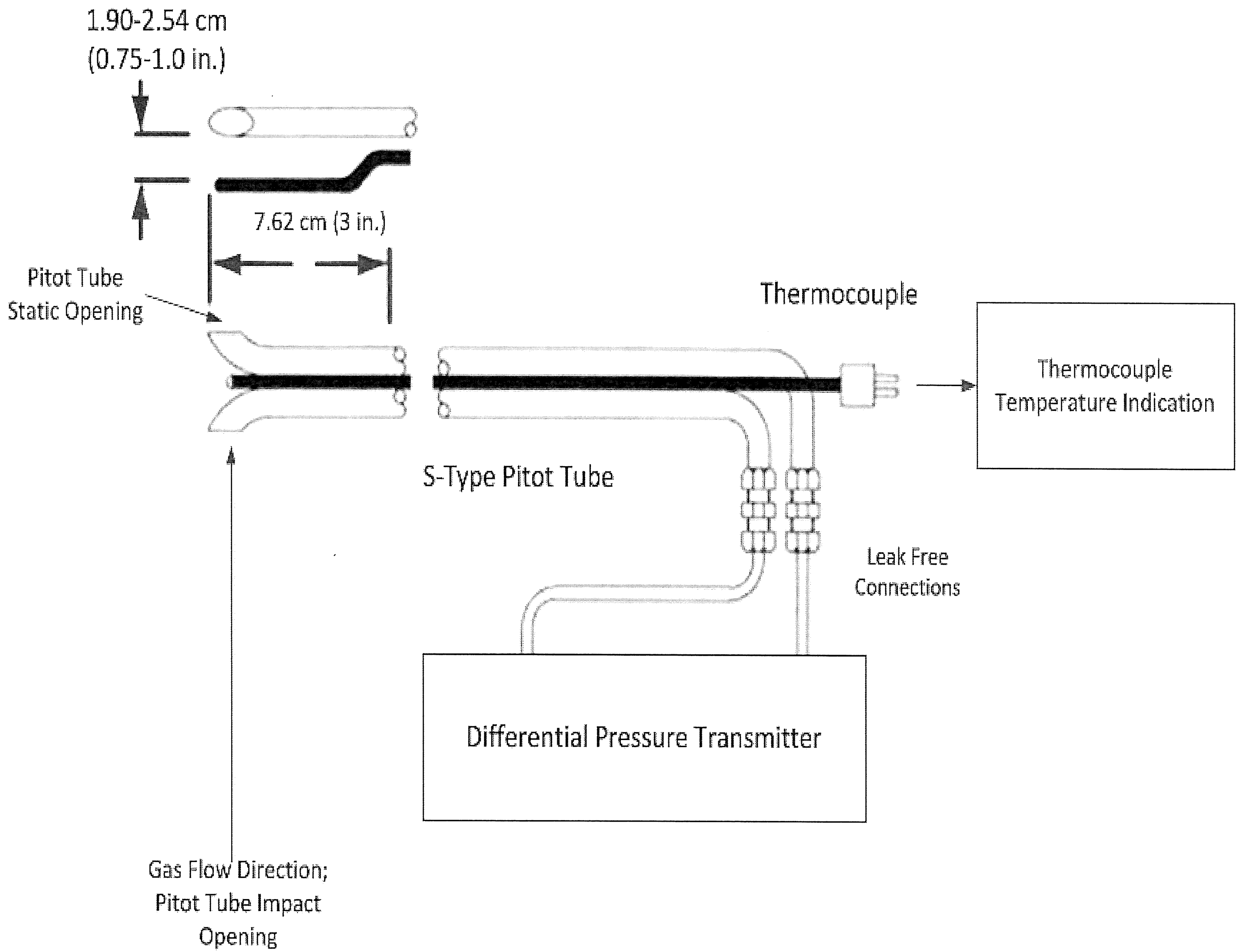


Figure 6 – USEPA Reference Method 4 Sample Apparatus

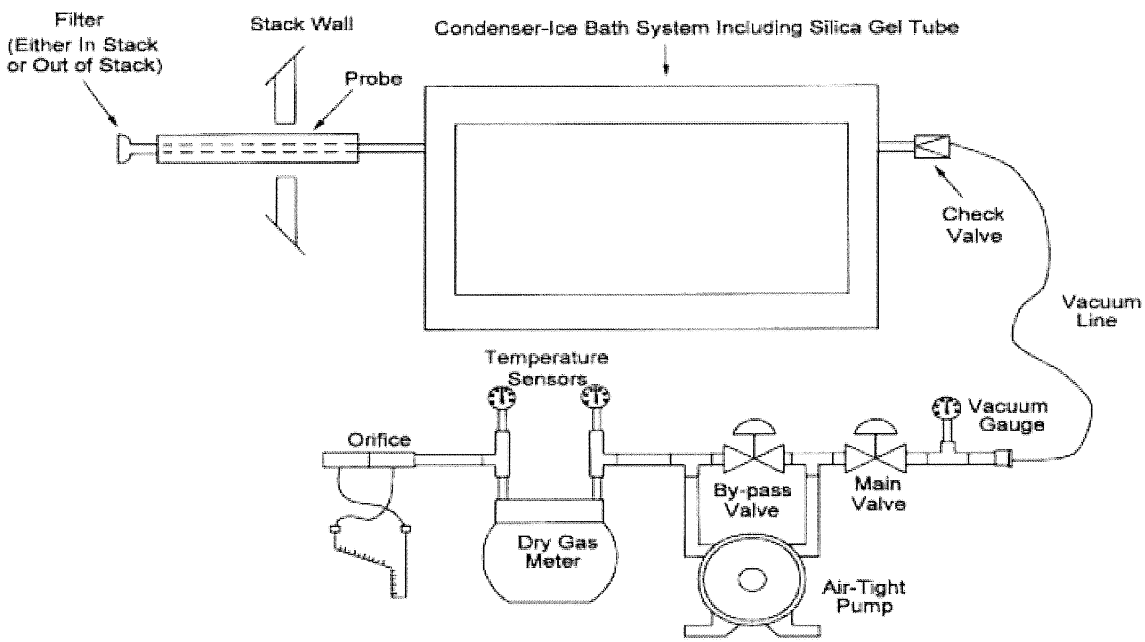
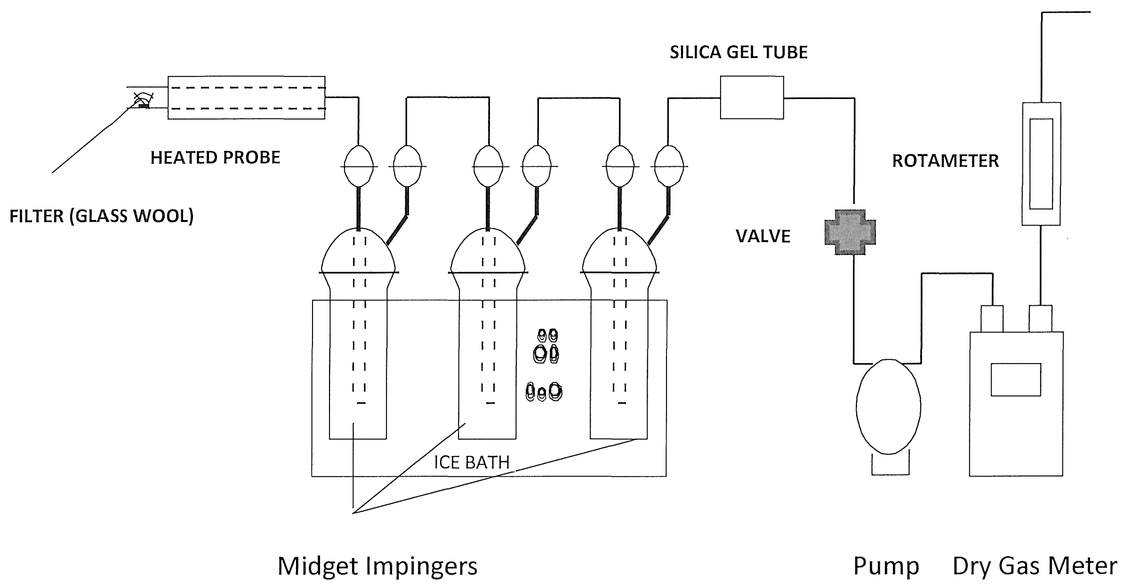


Figure 7 – Alternative Method 008 Moisture Sample Apparatus



The silica gel tube depicted in this figure was replaced with a midget impinger (bubbler) with a straight tube insert, as allowed in ALT-008, §1

Figure 8 – Reference Method Gaseous RATA Sample Apparatus