Consumers Energy
Count on Us®

40 CFR Part 60 and 75 CEMS Relative Accuracy Test Audit Report

EUBOILER

Grayling Generating Station Limited Partnership
4400 West Four Mile Road
Grayling, Michigan 49738
SRN: N2388
FRS: 110028027917
ORIS: 10822

June 2, 2023

Test Dates: April 17 - 19, 2023

Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Section
Work Order No. 4103641
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: 10822, SRN: N2388 Date(s) Tested April 17-19. 2023

Facility Name: Grayling Generating Station Limited Partnership

Facility Address: 4400 West Four Mile Road, Grayling, MI 49738

Equipment Tested: EUBOILER SO2, NOX, CO2, CO and Volumetric Flow CEMS

AETB Firm: CECo/RCTS AETB

Business Address: 135 W. Trail St., Jackson MI 49201

Phone: (616) 738-3234 Email: thomas.schmelter@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: Thomas Schmelter Digitally signed by Thomas Schmelter Date: 2023.06.02 12:31:25 -04'00' Date: 6/2/2023

Name: Thomas R. Schmelter Title: AETB Technical Director

Phone: (616) 738-3234 Email: thomas.schmelter@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]
☑	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 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]
☑	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)
☑	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) conducted continuous emission monitoring systems (CEMS) quality assurance (QA) audits associated with emission unit EUBOILER operating at the Grayling Generating Station located in Grayling, Michigan.

The relative accuracy test audits (RATA) were conducted on April 17 through 19, 2023. The purpose of the CEMS audits is to comply with the periodic QA required in 40 CFR Part 75, Appendices A and B, and 40 CFR Part 60, Appendix F, as incorporated in the ROP and comply with the periodic QA required in the consent order entered into by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division (AQD) and Grayling Generating Station Limited Partnership on July 28, 2022 (EGLE AQD ACO 2022-14).

A test protocol describing the sampling, calibration and QA procedures in USEPA Reference Methods (RM) 1, 2, 2H, 3, 3A, ALT-008, 6C, 7E, 10, and 19, in conjunction with Performance Specifications (PS) 2 (for the SO_2 lb/mmBtu RATA), 4A (for the CO ppmv RATA), and 40 CFR 75, Appendices A and B was submitted March 17, 2023 to the USEPA Region 5 and EGLE offices. The protocol was subsequently approved in a letter dated April 7, 2023 by EGLE representative Mr. Jeremy Howe.

The CEMS audits were performed by RCTS representatives Dillon King, Thomas Schmelter, and Joe Gallagher. Mr. Liam Campbell, Instrument Controls and Electric Technician, of the Grayling Generating Station coordinated the tests with applicable plant personnel and provided CEMS data. EGLE representatives Mr. Daniel Droste and Ms. Becky Radulski witnessed portions of the testing April 18, 2023.

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 accordingly qualified to conduct 40 CFR Part 75 test programs. RCTS' AETB program is developed in accordance with the American Society for Testing and Materials (ASTM) D 7036-04, *Standard Practice for Competence of Air Emissions Testing Bodies*, in which the AETB is required during test projects to provide at least one qualified individual (QI), qualified in the specific methods for that project, to be on-site at all times. RCTS representatives Mr. King and Mr. Schmelter met these requirements and assumed the on-site lead QI roles for the duration of the Flow and Gas CEMS audits, respectively.

Reproducing only a portion 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.

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

Table 1-1
Contact Information

Program Role	Contact	Address
EPA Regional Contact	Michael Compher 312-886-5745 compher.michael@epa.gov	USEPA Region 5 77 W. Jackson Blvd. (AR-18J) Chicago, IL 60604
Regulatory Agency Representative	Mr. Jeremy Howe Supervisor -Technical Programs Unit 231-878-6687 howej1@michigan.gov	EGLE Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933-1502
Regulatory Agency Representative	Ms. Becky Radulski Environmental Engineer 989-217-0051 radulskir@michigan.gov	EGLE Gaylord District Office 2100 West M-32 Gaylord, Michigan 49735-9282
Regulatory Agency Representative	Mr. Daniel Droste Environmental Quality Analyst 989-225-6052 drosted3@michigan.gov	EGLE Bay City District Office 401 Ketchum Street, Suite B Bay City, Michigan 48708-5430
Primary Designated Representative	Mr. Edward Going Plant General Manager 989-348-4575 edward.going@cmsenergy.com	Northstar Clean Energy Grayling Generating Station Limited Partnership 4400 West 4 Mile Road Grayling, Michigan 49738
Alternate Designated Representative	Mr. Richard Laur Environmental Health & Safety Coordinator 989-348-4575 x112 richard.laur@cmsenergy.com	Northstar Clean Energy Grayling Generating Station Limited Partnership 4400 West 4 Mile Road Grayling, Michigan 49738
Field Operations Environmental Compliance	Ms. Kathryn Cunningham Principal Environmental Engineer 517-768-3462 kathryn.cunningham@cmsenergy.com	Consumers Energy Company 1945 Parnall Road Jackson, Michigan 49201
Test Team Representative	Mr. Dillon King, QSTI Sr. Engineering Technical Analyst 989-791-5983 dillon.king@cmsenergy.com	Consumers Energy Company Saginaw Service Center 2400 Weiss Street Saginaw, Michigan 48602
Test Team Representative	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

2.0 SUMMARY AND DISCUSSION

The Grayling Generating Station carbon dioxide (CO_2), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and volumetric airflow CEMS relative accuracy (RA) results indicate the CEMS meet the annual RA frequency standards in 40 CFR 75, Appendix A. Further, where applicable, the CEMS meet the applicable RATA requirements of 40 CFR Part 60, Appendices B and F.

Results are presented in Tables 2-1 through 2-5 and Appendix B of this report. RA equations and other applicable sample calculations are presented in Appendix A.

2.1 WALL ADJUSTMENT FACTOR

The applicable default wall adjustment factor (WAF) of 0.9950 (dimensionless) was used to adjust the flue gas velocity and calculate volumetric flow rate. 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 consists of a Sick Model FLSE100-PR ultrasonic air flow probe installed in the EUBOILER exhaust stack. Two high frequency ultrasonic sender/receiver transducer units are installed opposite one another on a probe situated at a 45° angle within the exhaust stack. Pulses of sound are emitted between the sender/receiver units and the transit time is used to calculate the gas flow rate. The signal transducer produces an electronic signal to the control unit and output is captured in a VIM Technologies CEMLink6 data acquisition system. The flow monitor is used in conjuction with diluent measurments to calculate heat input rate, as well as to calculate pollutant mass emission rates.

As part of the RATA test program, trial flow RATA runs were performed on April 17, 2023, at low and high operating loads 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). This trial flow data was included in the 12-run flow RATA results at both loads, as the individual trial run results from the EUBOILER flow monitor were within the ±10% difference specification in 40 CFR 75, § 75.20(b)(3)(vii)(E).

The 12-run flow RATA results at low and high load levels met 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 airflow RATA results.

Table 2-1
Summary of Volumetric Airflow RATA Results

CEMS Make/ Model	CEMS Duct Location & Serial Number	RATA Criteria	Required RATA Performance	Actual RATA Performance
Sick Model FLSE100-PR	EUBOILER SN: 22248469	Low (normal) Load	≤10% of mean RM	4.30%
		Bias	|d| ≤ |CC| = Pass	Pass
Sick Model FLSE100-PR	EUBOILER SN: 22248469	High Load	≤10% of mean RM	1.45%
		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 the exhaust stack to report continuous emissions. The SO_2 concentrations (ppm) are used in conjunction with flow data to support 40 CFR Part 75 mass emissions reporting and assess compliance with a 24-hour rolling SO_2 mass emission limit. The lb/mmBtu emission rates are used to evaluate compliance with a related rolling SO_2 emission limit. Because the SO_2 emission standard is less than 0.20 lb/mmBtu, and the measured emissions were less than 50% of the 0.07 lb SO_2/mmBtu 24-hour rolling average emission limit, the 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 criterion when the emission limit was 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

CEMS Make and Model	CEMS Location & Serial Number	RATA Performance Criteria	Required RATA Performance	Actual RATA Performance
Thermo Model 43iQ	EUBOILER SN: 1192744555	ppm	≤10% of mean RM or ±15.0 ppm RM/CEMS difference	262.83%
				-1.40 ppm
		bias (ppm)	|d|≤|CC|=Pass	Pass
		lb/mmBtu[1]	≤20% of emission limit	7.22%

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

[1] As the SO_2 lb/mmBtu emission limit is less than 0.20 lb/mmBtu and the measured emissions were less than 50% of the emission limit, the SO_2 emission limit of 0.07 lb/mmBtu was used in the denominator of the percent RA calculation in lieu of the average RM value per §13.2 of 40 CFR Part 60, Appendix B, Performance Specification 2.

2.4 NO_x Gas RATA

The facility operates NO_x dilution out-of-stack chemiluminescence CEMS at the exhaust stack to report continuous emissions. The NO_x emission rates (lb/mmBtu) are used in 40 CFR Part 75 Acid Rain Program reporting and to evaluate compliance with rolling NO_x emission limits.

The NO_x lb/mmBtu 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). 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 42iQ-D	EUBOILER SN: 1192744557	lb/mmBtu	≤10% of mean RM	3.71%
		Bias	|d|≤|CC|=Pass	Fail Bias: 1.028

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

2.5 CO_2 Gas RATA

The facility operates a CO_2 dilution out-of-stack non-dispersive infrared CEMS at the exhaust stack that was evaluated during this test program. The CO_2 concentrations are used to calculate heat input and pollutant lb/mmBtu emission rates. The CO_2 RATA results met the ≤10% RA requirement as well as the mean difference of no greater than ±1.0% CO_2 specification 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	RATA Performance Criteria	Required Performance Criteria	Actual RATA Performance
Thermo Model 410iQ	EUBOILER SN: 1192674378	%	≤10% of mean RM or ±1.0% CO_2 RM-CEMS difference	6.22% RA
		%		-0.544%

2.6 CO Gas RATA

A CO dilution out-of-stack non-dispersive infrared gas filter correlation CEMS is installed at the boiler exhaust 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 0.40 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 did not meet the PS4A criteria. Because the facility uses the CO ppm concentration and volumetric flowrate to calculate and report CO lb/hr emissions, with the approval of EGLE representatives Mr. Daniel Droste and 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 209.2 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 Model 48iQ	EUBOILER SN: 1192744556	ppm	10% of mean RM or ±5.0 ppm RM-CEMS difference + CC	17.64%
				25.747 ppm
		lb/mmBtu	≤5% of emission standard[1]	5.02%
		lb/hr	≤20% of emission standard[1]	6.22%

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient
[1] As the average RM CO lb/mmBtu and CO lb/hr emission rates was less than 50% of the CO emission limits, the emission limits were used in the denominator of the percent RA calculation in lieu of the average RM value per §13.2 of 40 CFR Part 60, Appendix B, Performance Specification 4/4A.

3.0 SOURCE AND MONITOR DESCRIPTION

The Grayling Generation Station Limited Partnership is an electric utility facility located southeast of Grayling, Michigan. The facility commenced operation on May 9, 1992 and includes one 635 mmBtu/hr wood and tire-derived fuel (TDF) fired boiler equipped with natural gas auxiliary burners. The boiler is of a spreader-stoker design with a source classification code (SCC) of 10100911. The facility receives both chipped wood and TDF by truck and uses these fuels in the boiler to produce steam. The steam is used to turn a turbine and generator to produce approximately 38 MW of electricity at full capacity. The electricity is sold to Consumers Energy (the utility subsidiary of CMS Energy) and routed through transmission and distribution systems to consumers. Emissions from the boiler are controlled by multiple air pollution control systems and monitored by the CEMS systems.

Sick ultrasonic air flow CEMS, and a Thermo Scientific dilution-extractive SO_2, NO_x CO_2, and CO CEMS are installed in the EUBOILER exhaust stack. The CEMS interface with a data acquisition and handling system (DAHS) manufactured by VIM Technologies, responsible for recording data that includes exhaust gas flow rate, pollutant and diluent concentrations, emission rates, and operating parameters. Figure 1 illustrates the EUBOILER Data Flow Diagram and Sampling Location.

The CEMS systems quality assured during this test program are summarized in Table 3-1.

Table 3-1
CEMS Information

Make and Model	System ID	Component ID	Span	Serial Number
Flow Sick Model FLSE100-PR	FL1	106	200,000 SCFM	22248469

Make and Model	System ID	Component ID	Span	Serial Number
SO_2 Thermo Model 43iQ	SO1	109	50 ppm	1192744555
NO_x Thermo Model 42iQ-D	NO1	108	200 ppm	1192744557
CO_2 Thermo Model 410iQ	CO1	107	20%	1192674378
CO Thermo Model 48iQ	NA	NA	1,000 ppm	1192744556

In preparation for the testing, an Operating Load Analysis was obtained for EUBOILER encompassing a period of March 2, 2022 through March 1, 2023. Based on these four or more quarters of representative historical operating data, the first (i.e., normal) and second most frequently used load levels were determined to ensure the appropriate load levels were selected during the RATAs. Based upon planned revisions to the Part 75 Monitoring Plan and the Operating Load Analysis reviewed, Low and High are the most frequently used load levels, with High designated as the normal operating level. Therefore, the gas RATAs were conducted at high load, while the flow RATAs were performed at high and low loads.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Specific test procedures detailed in 40 CFR Part 60, Appendix A, Reference Methods 1, 2, 2H, 3, 3A, ALT-008, 6C, 7E, 10, and 19 were followed in conjunction with Part 75 Appendices A and B to conduct 12 runs and to calculate CEMS RA. CO_2, NO_x, CO, and SO_2 concentrations were measured for 21-minutes during each gas RATA run. Flue gas velocity and temperature were measured for a minimum of 5-minutes during each flow RATA test run. The following sections provide the sampling and analytical procedures employed.

4.1 Traverse Points (USEPA Method 1)

The number and location of traverse points used for determining exhaust gas velocity and flow RA was determined in accordance with USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources*. The exhaust stack area was calculated and the cross-section divided into traverse points of equal area based on the location of existing airflow disturbances. Sixteen traverse points, 8 traverse points in each of 2 test ports, were used to measure flue gas volumetric flowrate. Refer to Figure 2 for the EUBOILER flow traverse points dimensions and detail.

Because the sampling location at the exhaust stack is at least 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance, gas concentrations were measured while traversing the duct approximately every 7-minutes at 16.7, 50.0, and 83.3 percent of the duct dimension parallel to the port (15.4, 46, and 76.6 inches from the stack wall). Refer to Figure 3 for the EUBOILER Gas Traverse Points Dimensions and Detail.

4.2 Velocity and Volumetric Flow (USEPA Method 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 were used to calculate exhaust gas velocity and volumetric flowrate. Refer to Figure 4 for an illustration of the volumetric flow RM apparatus.

As described in Section 2.1 above, the RM flow data incorporates the applicable default WAF of 0.9950 as referenced in USEPA Method 2H, *Determination of Stack Gas Velocity Taking into Account Velocity Decay near the Stack Wall.*

It should be noted that the most recent calibration for the pitot employed during sampling (2331) showed an A-side C_p of 0.820 and a B side C_p of 0.826. Rather than use the average of the A and B-side C_p values, the A-side C_p of 0.820 was used in accordance with Section 10.1.5.1.1 of Method 2, as the A-side of the pitot consistently faced the flow direction throughout testing.

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

During the gas RATAs, 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)*. Section 4.5 describes the sample apparatus configuration.

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

4.4 Moisture Content (USEPA Method ALT-008)

Flow and gas RATA moisture content was determined using USEPA ALT-008, *Alternative Moisture Measurement Method Midget Impingers*. The sample apparatus follows the general guidelines contained in USEPA Method ALT-008 *Alternative Moisture Measurement Method Midget Impingers* Figure 1 or 2. Exhaust gas was drawn at a constant rate through a series of midget impingers immersed in an ice bath to remove moisture, which was subsequently measured gravimetrically to calculate moisture content. The ALT-008 Moisture Sample Apparatus is shown in Figure 5.

4.5 CO_2, SO_2, NO_x, and CO Concentrations (USEPA Methods 3A, 6C, 7E and 10)

Carbon dioxide, sulfur dioxide, nitrogen oxide, and carbon monoxide concentrations were measured using the following sampling and analytical procedures:

- USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure),*
- USEPA Method 6C, *Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure), and*

- USEPA Method 7E, *Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)*
- USEPA Method 10, *Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)*

The sampling procedures of the methods are similar with the exception of the analyzers and analytical technique used to quantify the parameters of interest. Components of the extractive gaseous RM system in contact with flue gas are constructed of Type 316 stainless steel and Teflon. Exhaust gas was extracted from the stack through a steel tube probe, heated Teflon® tubing, and a gas conditioning system to remove water and dry the sample before entering a pump, manifold, and the gas analyzers. The output signal from each analyzer was connected to a 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 6 for a drawing of the reference method gaseous RATA sample apparatus.

Data collected from the RM analyzers were averaged for each run with CO, NO_x, and SO_2 concentrations measured in ppmvd. CO_2 concentrations were measured as percent by volume on a dry basis. Equation 19-6 from 40 CFR Part 60, Appendix A, Method 19 was used to calculate CO, NO_x and SO_2 lb/mmBtu emission rates.

4.6 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 lb/mmBtu emission rates. Measured CO_2 and pollutant concentrations and F factors (ratios of combustion gas volume to heat input) 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 F_c factor reported by the facility during each gas RATA was used to calculate RM lb/mmBtu emissions and calculate CEMS relative accuracy. Refer to Appendix A for RATA calculation summary presenting the calculations used in this report.

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, Thermocouple, and Pressure Equipment

The Pitot tube-thermocouple assembly for measuring exhaust gas volumetric flow was inspected and/or calibrated according to procedures in RCTS' AETB Standard Operating Procedure 3-5 and Appendix O, USEPA RM 2, and Approved Alternative Method (ALT-011).

A Pitot tube inspection occurred before the field test to confirm there is no gross damage or excess misalignment of the Pitot openings. A post-test Pitot tube inspection and certification is performed to evaluate if the Pitot face openings are still aligned within acceptable tolerances.

ALT-011 describes the inherent accuracy and precision of a thermocouple within ±1.3°F in the range of -32°F and 2,500°F and states that a system performing accurately at one temperature is expected to behave similarly at other temperatures. Therefore, a single point thermocouple calibration procedure to verify accuracy within ±1.0 percent of absolute temperature, taking into account the presence of disconnected wire junctions or a potential miscalibrated temperature display, was performed. After the test event, the accuracy of the thermocouple system was checked at ambient temperature, or other temperature, within the range specified by the manufacturer, using a reference thermometer. The temperatures of the thermocouple and reference thermometer(s) shall agree within ±2°F.

The differential pressure transmitters used with Method 2 were calibrated in accordance with §6.2.1 of the method and RCTS AETB Standard Operating Procedure Appendix J-4. Refer to Appendix C for Pitot tube, thermocouple, differential pressure and barometer calibration or inspection records.

5.2 Dry Gas Metering Console

The ALT-008 dry gas metering (DGM) console and pump for measuring exhaust gas moisture content was calibrated against a DGM calibration standard as described in Method 5, §16.1, using the procedures in Method 5, §10.3.2 and RCTS AETB Standard Operating Procedure 3-4. Refer to Appendix C for DGM 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) following RCTS AETB Standard Operating Procedure 2-10. 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*). Appendix C contains a summary of the PGVP calibration gas standards used during this test program.

5.4 Analyzer Calibrations

The gaseous RM instruments 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 Methods 3A, 6C, 7E, and 10.

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 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 CO_2 absolute difference.

A NO_x analyzer nitrogen dioxide (NO_2) to nitric oxide (NO) conversion efficiency (CE) test was conducted to verify the analyzer's ability to convert NO_2 to NO and accurately measure NO_x by chemiluminescence. Refer to Appendix C for this CE documentation.

After each gas 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 CO_2 absolute difference. The RM drift is acceptable if the zero and upscale values are within ±3.0% of the calibration span. System response times were documented during the initial system bias tests. Calibration gas flow rates were maintained at the target sample rate, with each subsequent run started after twice the system response time elapsed. Analyzer bias and drift data is presented in Appendix B, while calibration data is in Appendix C.

6.0 DISCUSSION OF TEST RESULTS

The CEMS RATA results presented in Table 2-1 through 2-5 and Appendix B indicate the CEMS operating at Grayling Station EUBOILER exhaust meet the performance specifications in 40 CFR 75, Appendix A, and the annual reduced RATA test frequency incentive standards (except for the flow CEMS, which met the semi-annual RATA criterion) 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-N2388-2014a.

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.

Quality Assurance data, such as protocol gas certificates of analysis, analyzer calibration error and system response time, NO_2 to NO CE check and instrument interference information are presented in Appendix C. Gas RATA instrument system bias/drift data is presented in Appendix B5. AETB certifications and signature forms are provided in Appendices D1 and D2.

6.1 Clock Time Synchronization

The electronic timestamps recorded for RM RATA runs are on military time basis and synchronized to the CEMS DAHS, which is in Eastern Standard Time (EST).

Figures

Figure 1 – EUBOILER Data Flow Diagram and Sampling Location

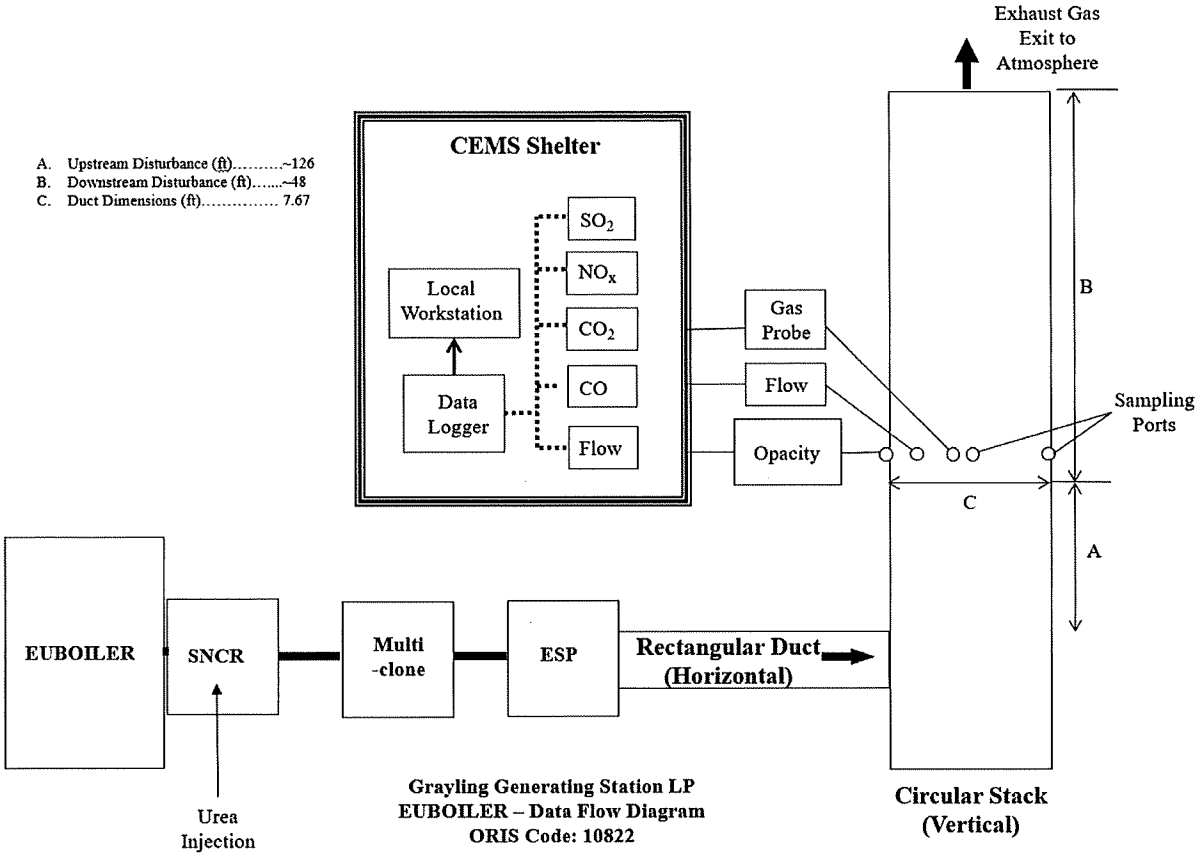


Figure 2 – EUBOILER Flow Traverse Points Dimensions and Detail

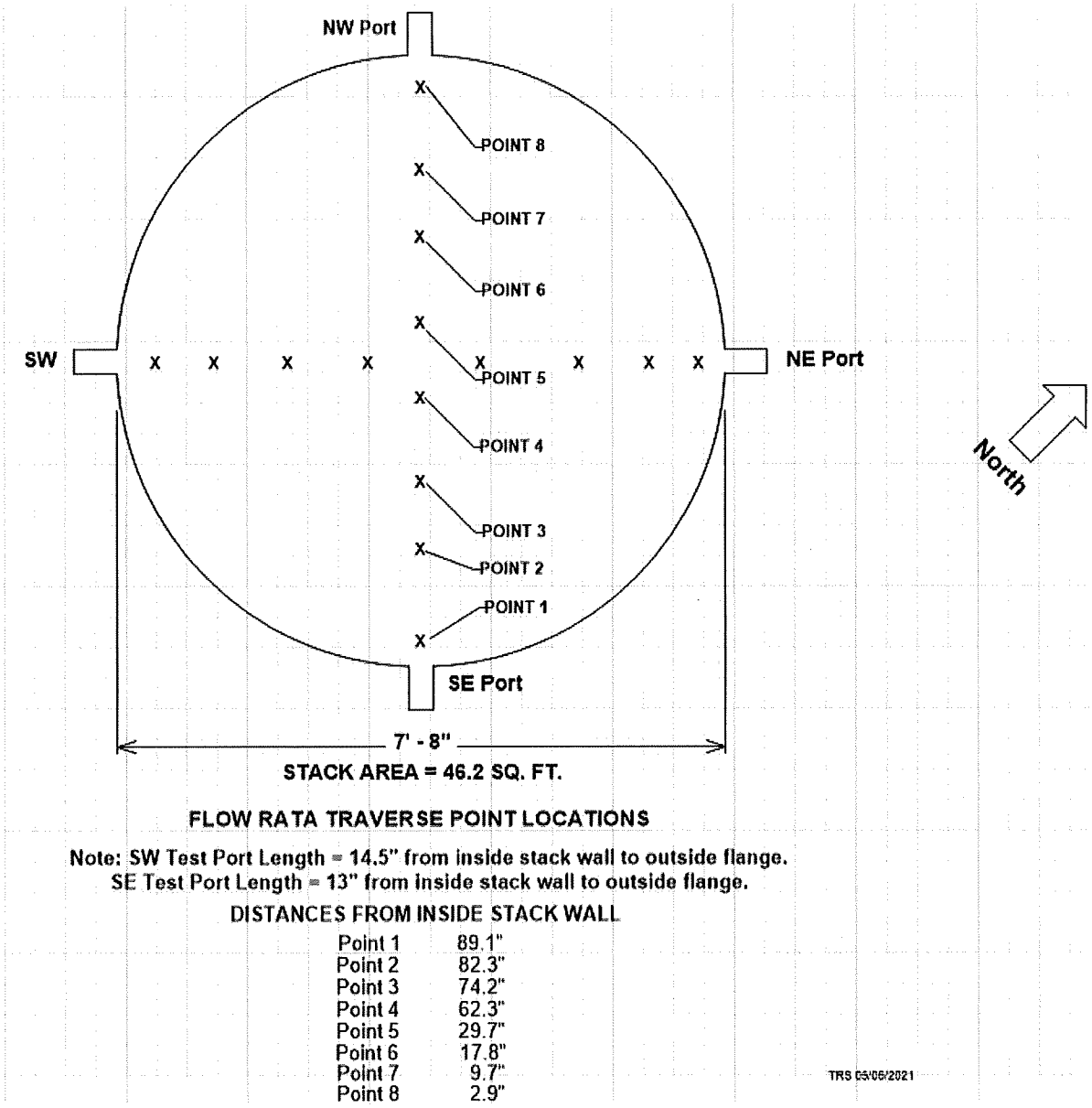
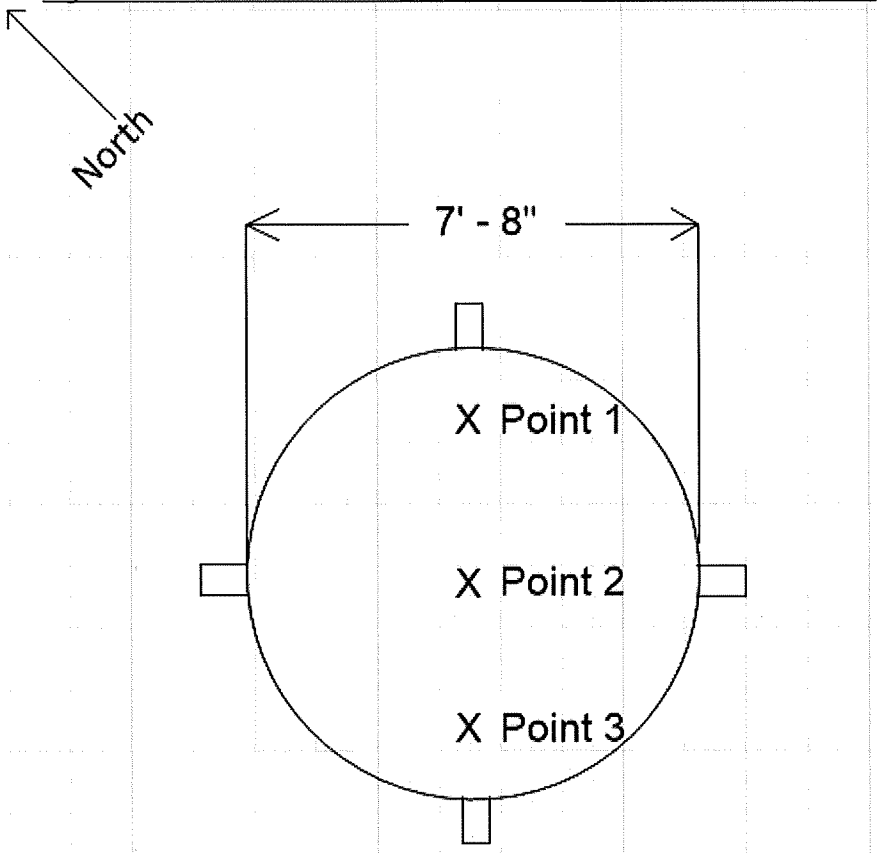


Figure 3 – EUBOILER Gas Traverse Points Dimensions and Detail



In-Stack Sample Point Locations

Distances from inside stack wall:

Point 1 = 76.6"
Point 2 = 46"
Point 3 = 15.4"

Figure 4 – Volumetric Airflow RATA Sample Apparatus

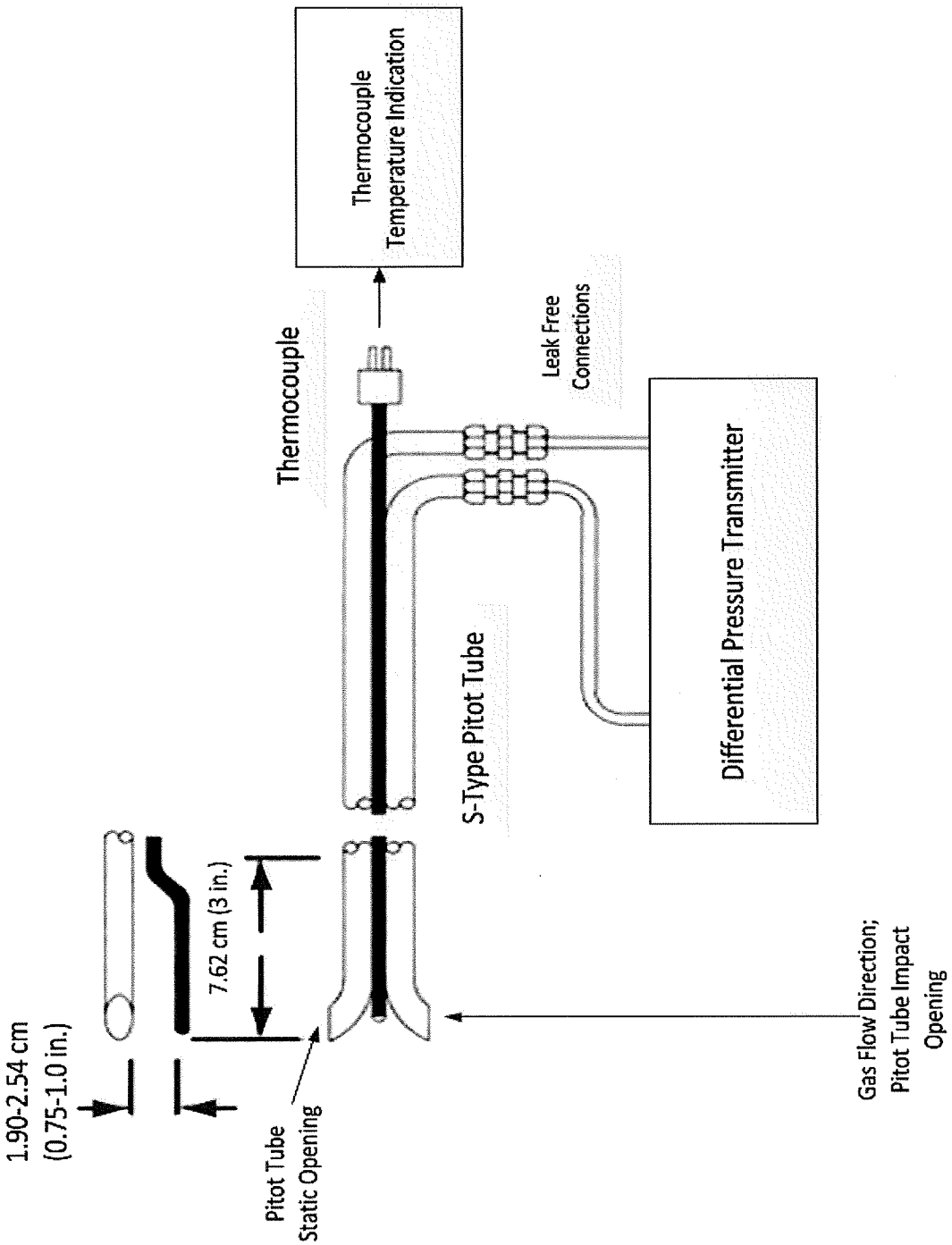
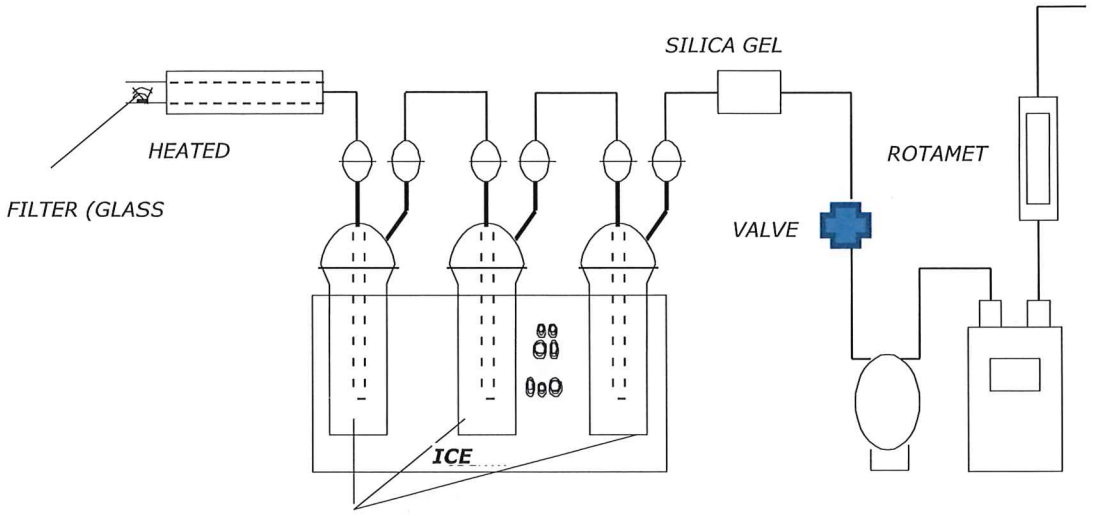


Figure 5 – ALT-008 Moisture Sample Apparatus



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 6 – Reference Method Gaseous RATA Sample Apparatus