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# 40 CFR Part 75 Flow 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

November 22, 2022

**Test Date: October 20, 2022**

Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Section
Work Order No. 4103501
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: 2388 Date(s) Tested October 20, 2022

Facility Name: Grayling Generating Station Limited Partnership

Facility Address: 400 West Four Mile Road, Grayling, MI 49738

Equipment Tested: EUBOILER Volumetric Flow CEMS

AETB Firm: Consumers Energy; 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:  Date: November 22, 2022

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] |
| ☐ | 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] |
| N/A | 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] |
| N/A | 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] |
| N/A | $NO_x$ 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] |
| N/A | 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] |

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# APPENDICES

# 1.0 INTRODUCTION

Consumers Energy Company (CECo), Regulatory Compliance Testing Section (RCTS) conducted a continuous emission monitoring systems (CEMS) quality assurance (QA) audit associated with emission unit EUBOILER operating at the Grayling Generating Station located in Grayling, Michigan.

The relative accuracy test audit (RATA) was conducted on October 20, 2022, to satisfy 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). The CEMS are installed in the EUBOILER exhaust to satisfy U.S. EPA Code of Federal Regulations, Chapter 40, Part 75 (40 CFR Part 75) monitoring requirements, the Cross State Air Pollution Rule (CSAPR), and 40 CFR Part 60, Subpart Db, as specified in State of Michigan Renewable Operating Permit (ROP) MI-ROP-N2388-2014a.

A test protocol describing the sampling, calibration, and QA procedures in USEPA Reference Methods (RM) 1, 2, 2H, 3, and ALT-008 was submitted September 13, 2022, to EGLE offices. The protocol was subsequently approved in a letter dated September 30, 2022, by EGLE representative Mr. Jeremy Howe.

The CEMS audits were performed by RCTS representatives Dillon King and Thomas Schmelter. Mr. Richard Laur, Environmental Health and Safety Coordinator, and Mr. Dave Luck, Instrument Controls and Electric Technician, of the Grayling Generating Station coordinated the tests with applicable plant personnel and provided CEMS data. EGLE representatives Mr. Jeremy Howe and Ms. Becky Radulski witnessed portions of the testing October 20, 2022.

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 met these requirements and assumed the on-site lead QI roles for the duration of the Flow CEMS audits.

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

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**Table 1-1**
**Contact Information**

| Program Role | Contact | Address |
|---|---|---|
| EPA Regional Contact | Mr. Michael Compher<br>312-886-5745<br>compher.michael@epa.gov | USEPA Region 5<br>77 W. Jackson Blvd. (AR-18J)<br>Chicago, IL 60604 |
| State Regulatory Administrator | Mr. Jeremy Brown<br>Acting TPU Supervisor<br>517-599-7825<br>brownj9@michigan.gov | EGLE – Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S<br>Lansing, Michigan 48933 |
| Regulatory Agency Representative | Ms. Becky Radulski<br>Environmental Engineer<br>989-217-0051<br>radulskir@michigan.gov | EGLE<br>Gaylord District Office<br>2100 West M-32<br>Gaylord, Michigan 49735-9282 |
| Regulatory Agency Representative | Mr. Jeremy Howe<br>Environmental Quality Analyst<br>231-878-6687<br>howej1@michigan.gov | EGLE<br>Cadillac District Office<br>120 West Chapin Street<br>Cadillac, Michigan 49601-2158 |
| Primary Designated Representative | Mr. Edward Going<br>Plant General Manager<br>989-348-4575<br>edward.going@cmsenergy.com | CMS Enterprises Co.<br>Grayling Generating Station Limited Partnership<br>4400 West 4 Mile Road<br>Grayling, Michigan 49738 |
| Alternate Designated Representative | Mr. Richard Laur<br>Environmental Health & Safety Coordinator<br>989-348-4575 x112<br>richard.laur@cmsenergy.com | CMS Enterprises Co.<br>Grayling Generating Station Limited Partnership<br>4400 West 4 Mile Road<br>Grayling, Michigan 49738 |
| Test Facility | Mr. David Luck<br>Lead IC/E Technician<br>989-348-4575<br>david.luck@cmsenergy.com | CMS Enterprises Co.<br>Grayling Generating Station Limited Partnership<br>4400 West 4 Mile Road<br>Grayling, Michigan 49738 |
| Field Operations Environmental Compliance | Ms. Kathryn Cunningham<br>Senior Engineer III<br>517-768-3462<br>kathryn.cunningham@cmsenergy.com | Consumers Energy Company<br>1945 Parnall Road<br>Jackson, Michigan 49201 |
| Test Team Representative | Mr. Dillon King, QSTI<br>Sr. Engineering Technical Analyst<br>989-791-5983<br>dillon.king@cmsenergy.com | Consumers Energy Company<br>Saginaw Service Center<br>2400 Weiss Street<br>Saginaw, Michigan 48602 |

# 2.0 SUMMARY AND DISCUSSION

The Grayling Generating Station volumetric airflow CEMS relative accuracy (RA) results indicate the CEMS meet the annual RA frequency standards in 40 CFR 75, Appendix A.

Results are presented in Table 2-1 and Appendix B of this report. Applicable sample calculations are presented in Appendix A.

## 2.1 WALL ADJUSTMENT FACTOR

For both the high-load and low-load testing at EUBOILER, 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 measurements 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 October 20, 2022, 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 level 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 FLOWSIC 100 V1.8 | EUBOILER SN: 22248469 | Low (normal) Load | ≤10% of mean RM | 2.17% |
| | | Bias | \|d\| ≤ \|CC\| = Pass | Pass |
| | | High Load | ≤10% of mean RM | 1.01% |
| | | Bias | \|d\| ≤ \|CC\| = Pass | Pass |

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

# 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<br>Sick Model<br>FLOWSIC 100 V1.8 | FL1 | 106 | 200,000<br>SCFM | 22248469 |

In preparation for the testing, an Operating Load Analysis was obtained for EUBOILER encompassing a period of September 1, 2021, through August 31, 2022. 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. During the Q3 Monitoring Plan and the Operating Load Analysis reviewed, Low and High are the most frequently used load levels, with both designated as the normal operating level. Therefore, 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, and ALT-008, were followed in conjunction with Part 75 Appendices A and B to conduct 12 runs and to calculate CEMS RA. 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.

### 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 3 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 for EUBOILER 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 flow RATA, Oxygen ($O_2$) and $CO_2$ concentrations were 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 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 4.

## 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.

## 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 in 40 CFR 75, Appendix B. These data indicate compliance with the CEMS monitoring and recordkeeping requirements of the facility's air permit MI-ROP-N2388-2014a and 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).

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 are presented in Appendix C. AETB certifications and signature forms are provided in Appendices D1 and D2.

## 6.1 Flow RATA Traverse Point Temperature Anomalies

When conducting a detailed review of the flow RATA traverse point data, it was observed that on two occasions, the temperatures recorded at traverse point 8 were lower than those at the remaining traverse points. After having reviewed previous flow RATA results, we believe there is no reason to suspect that there is an actual substantive temperature gradient across the tested stack diameters. Due to the degree of negative pressure at the RATA test ports, it is believed that decreased temperatures recorded at traverse point 8 were the result of air in-leakage at the test ports despite RCTS's best efforts to prevent such in-leakage.

To gain an understanding of whether the depressed temperatures at traverse points 8 would have a material effect on the outcome of the flow RATA, the temperatures at these traverse points were estimated as the average temperatures observed at traverse points 1-6 whenever the originally recorded temperature at these points varied from the average temperature across traverse points 1-6 by more than 10°F. This resulted in one temperature adjustment at high load and one such adjustment at low load.

In both instances, the substitution of more reasonable temperatures for traverse point 8 lowered the reference method (RM) standard exhaust flow rates, thereby increasing the calculated relative accuracy for high load by 0.01% and having no effect on the RA at low load. the preceding is based on no changes to which runs were excluded. Therefore, any temperature depression at traverse point 8 potentially caused by air in-leakage at the test ports does not have a material effect (pass/fail and bias adjustment factor) on the outcome of the flow RATA.

## 6.2 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

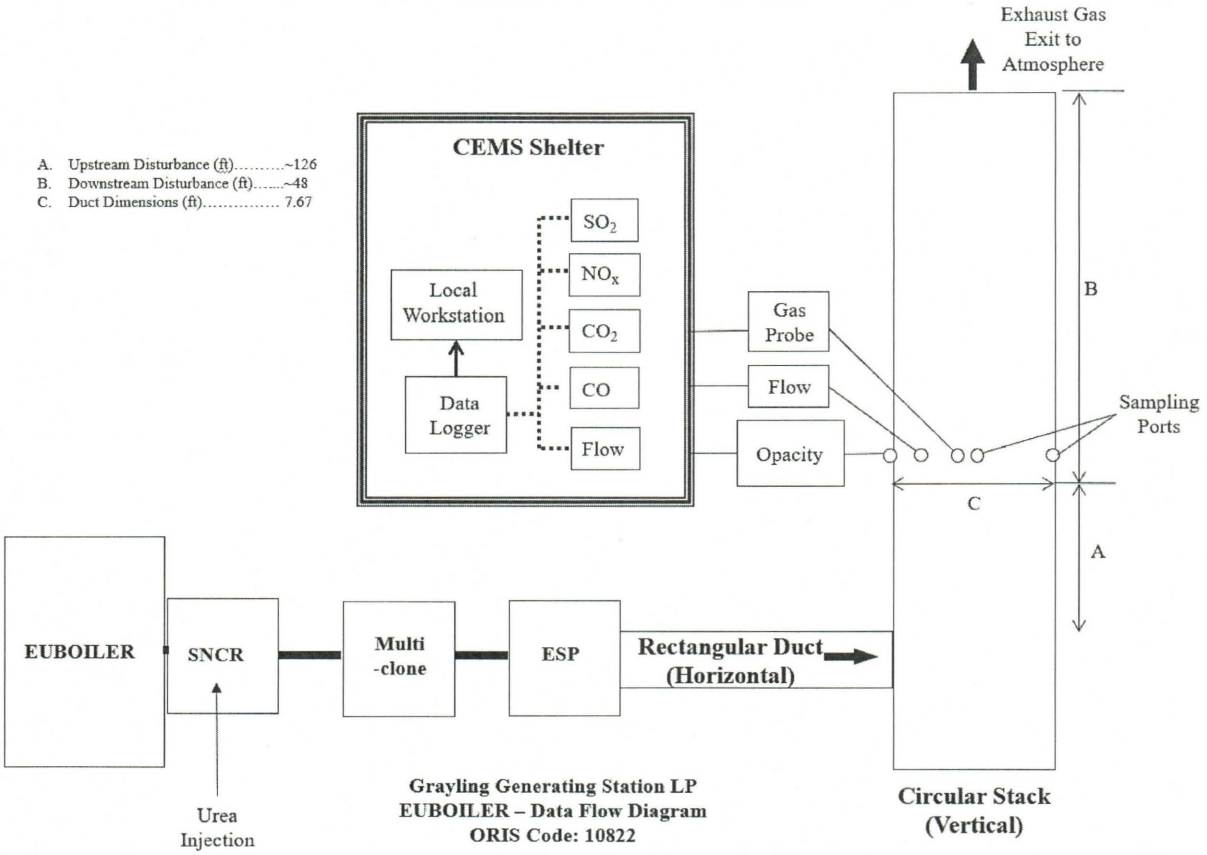

Figure 2 – EUBOILER Flow Traverse Points Dimensions and Detail

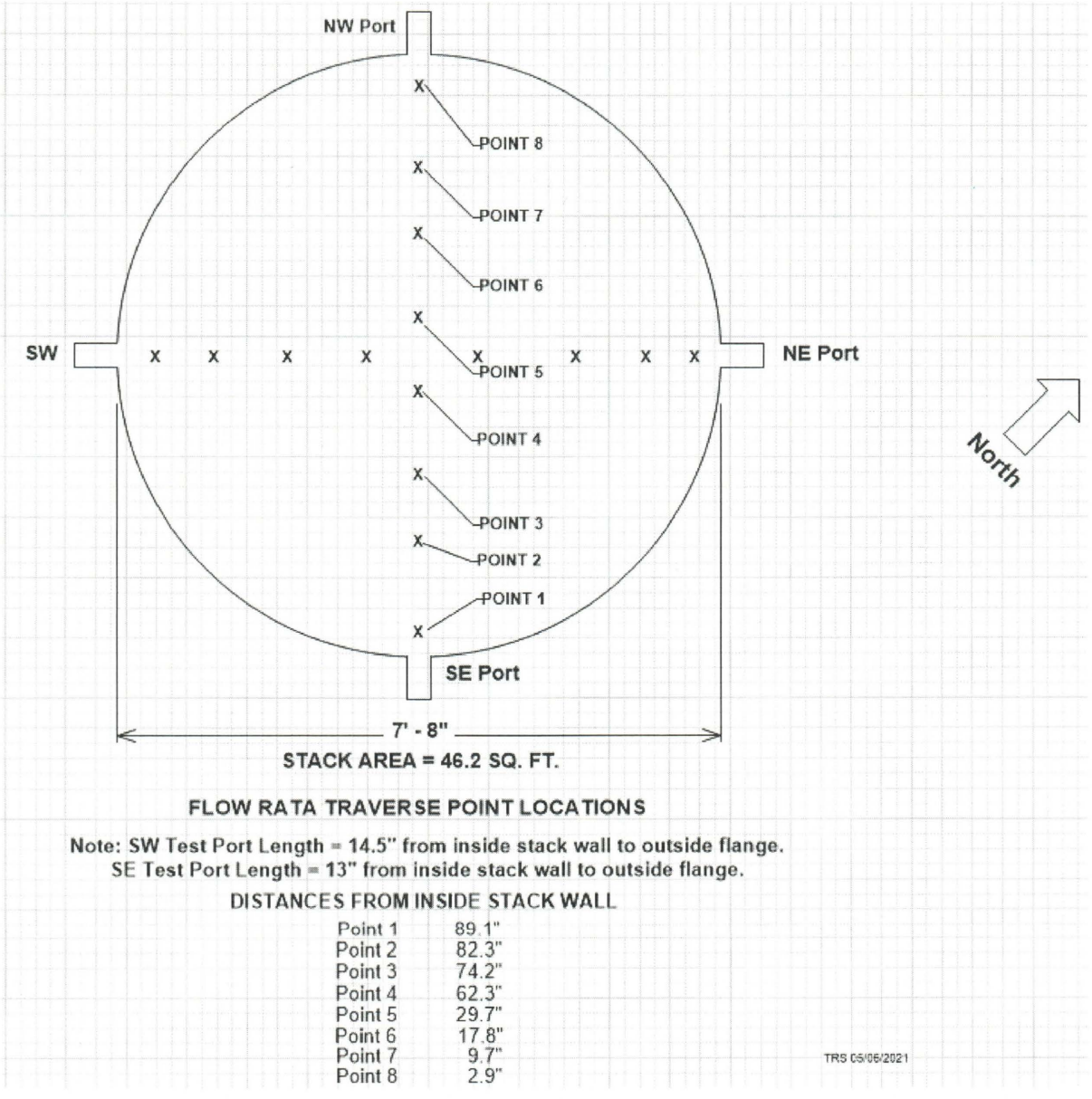

Figure 3 – Volumetric Airflow RATA Sample Apparatus

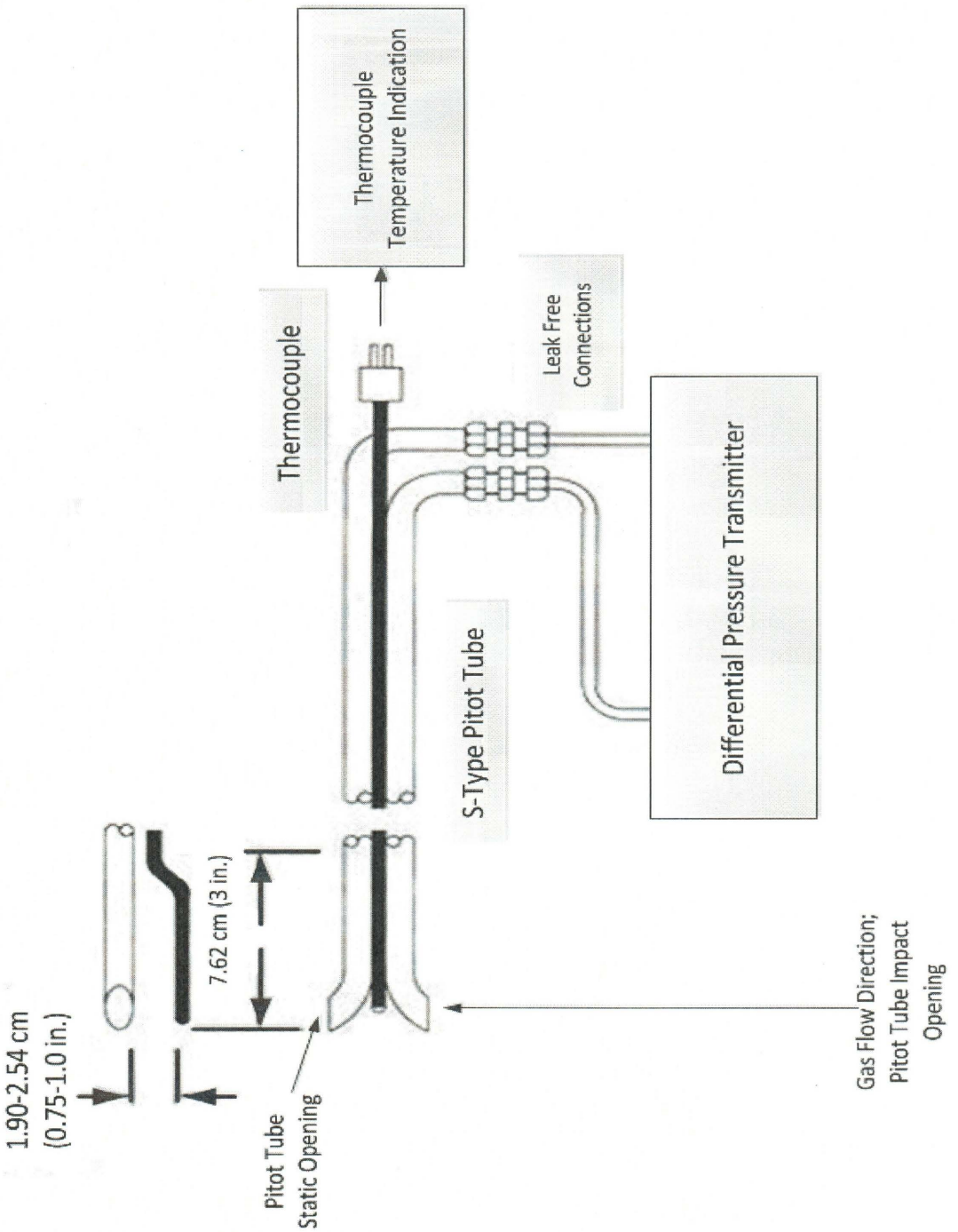


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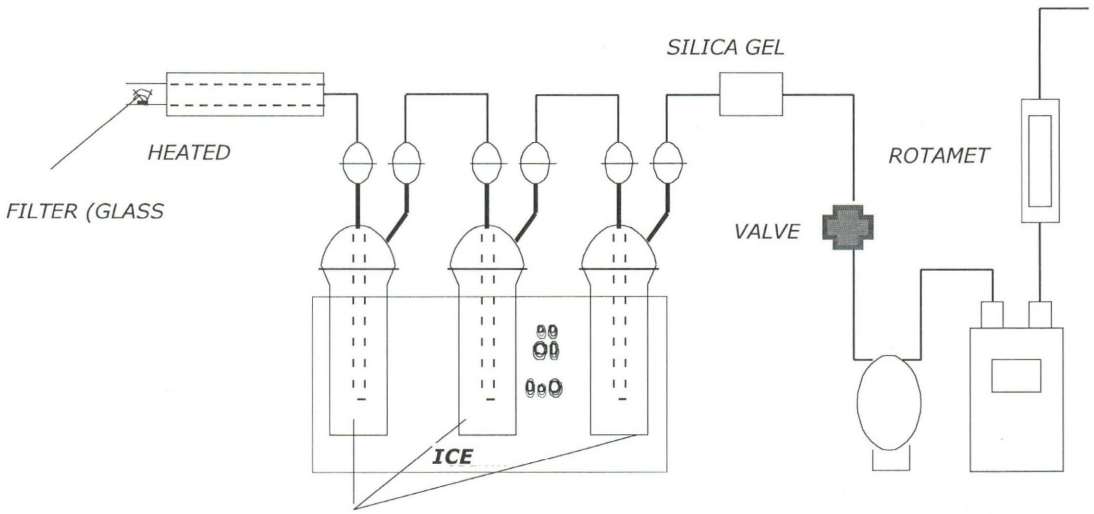
Figure 4 – ALT-008 Moisture Sample Apparatus




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