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40 CFR Part 63, Subpart HHH Compliance Test Report

EUGLYCDEHYD01 and EUGLYCDEHYD02

Consumers Energy Company
Ray Compressor Station
69333 Omo Road
Armada, MI 48005
SRN: B6636

March 9, 2020

Test Date: January 14 and 15, 2020

Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Section
Work Order No.'s 35568840 & 35568843
Version No.: 0

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EXECUTIVE SUMMARY

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted benzene, toluene, ethylbenzene, and xylenes (BTEX) testing on January 14 and 15, 2020 at the exhaust location of the thermal oxidizers serving the small glycol dehydration units installed and operating at Plant 1 and Plant 2 at the Ray Compressor Station in Armada, Michigan.

The glycol dehydration systems, equipped with thermal oxidizers for VOC emissions control, are identified as EUGLYCDEHYD01 and EUGLYCDEHYD02 within the Michigan Department of Environment, Great Lakes and Energy (EGLE) renewable operating permit (ROP) *MI-ROP-B6636-2015a*. EUGLYCDEHYD01 and EUGLYCDEHYD02 are two of three existing glycol dehydration units in ROP Flexible Group (FG) FGDEHYHHH and are subject to *National Emission Standards for Hazardous Air Pollutants* (NESHAP) *from Natural Gas Transmission and Storage Facilities*, 40 CFR Part 63, Subpart HHH.

The test was conducted to verify that the control devices for the small glycol dehydration units are achieving the §63.1281(f)(1) performance requirements and to establish new operating limits (minimum thermal oxidizer combustion zone temperature) necessary to continuously achieve compliance with the BTEX emission limit calculated pursuant to §63.1275(b)(1)(iii). Due to circumstances beyond the facility's control this periodic performance test program did not meet the NESHAP §63.1282(d)(3)(vi)(B) requirement *no later than 60 months after the initial performance test* timing specification, however extensions to the performance test deadline were requested and approved by the United States Environmental Protection Agency (USEPA) in letters dated November 22, 2019 and December 18, 2019. These letters are included in Appendix E.

Triplicate 60-minute test runs were conducted without deviation from the approved test protocol following United States Environmental Protection Agency (USEPA) 40 CFR Part 60, Appendix A Reference Methods (RM) 1, 2, 3A, 4 (ALT-008), and 18. The results summarized in Table E-1 indicate the EUGLYCDEHYD01 and EUGLYCDEHYD02 sources are operating in compliance with the applicable BTEX emission limits and established new minimum thermal oxidizer combustion zone temperatures of 1,553°F and 1,538°F, respectively.

Table E-1
Summary of Test Results

Source Name	BTEX Compound Concentration (ppmvd)[1]	BTEX Emission Rate (MG/year)	BTEX Emission Limit (MG/year)[2]	Combustion Chamber Temperature (°F)
EUGLYCDEHYD01	<0.07	<0.01	2.1	1,553
EUGLYCDEHYD02	<0.06	<0.01	1.8	1,538

[1] The BTEX sample concentrations were below the laboratory's detectable limit. For these instances, the minimum detection limit (MDL) of these compounds were used to calculate the average compound concentrations for this test event. Additional information is presented in the Laboratory Report presented in Appendix C.

[2] BTEX emission limit was calculated as required per §63.1275(b)(1)(iii), Equation 1 – Refer to Appendix A

Detailed results are presented in Appendix Table 1. Sample calculations, field data sheets, and laboratory data are presented in Appendices A, B, and C. System operating data and supporting documentation are provided in Appendices D and E.

1.0 INTRODUCTION

This report summarizes the results of compliance air emissions testing conducted January 14 and 15, 2020 at the exhaust locations of the thermal oxidizers serving the small glycol dehydration units installed and operating at Plant 1 and 2 within the Ray Compressor Station in Armada, Michigan.

This document is compiled using the Michigan Department of Environment, Great Lakes and Energy (EGLE) reference document *Format for Submittal of Source Emission Test Plans and Reports*, dated March 2018. Reproducing portions of this document may cause omissions or contextual misinformation to occur. If any portion is reproduced, please exercise due care in this regard.

1.1 IDENTIFICATION, LOCATION, AND DATES OF TESTS

The small glycol dehydration units described within the EGLE renewable operating permit (ROP) *MI-ROP-B6636-2015a* are identified as EUGLYCDEHYD01 and EUGLYCDEHYD02.

A test protocol submitted to EGLE on October 7, 2019 was subsequently approved by Mr. Tom Gasloli, EGLE Environmental Quality Analyst, in a letter dated October 10, 2019. There were no protocol deviations during the test event.

1.2 PURPOSE OF TESTING

This test was performed to verify that the control device for the small glycol dehydration unit continues to achieve the §63.1281(f)(1) performance requirements and to establish a new operating limit (minimum thermal oxidizer combustion zone temperature) necessary to continuously achieve compliance with the BTEX emission limit calculated pursuant to §63.1275(b)(1)(iii). Due to circumstances beyond the facility's control this periodic performance test program did not meet the NESHAP §63.1282(d)(3)(vi)(B) requirement *no later than 60 months after the initial performance test* timing specification, however extensions to the performance test deadline were requested and approved by the United States Environmental Protection Agency (USEPA) in letters dated November 22, 2019 and December 18, 2019. These letters are included in Appendix E. The applicable emission limits are presented in Table 1-1.

Table 1-1
Applicable Emission Limits

Source	40 CFR 63.1275(b)(1)(iii)			
	Parameter	Throughput (scm/day)	$C_{i,BTEX}$ [1] (ppmv)	EL_{BTEX} (MG/year)
EUGLYCDEHYD01	BTEX	1,021,629	18	2.1
EUGLYCDEHYD02		915,735	18	1.8

scm/day	Standard cubic meters per day
$C_{i,BTEX}$	Average annual BTEX concentration of natural gas at inlet of the glycol dehydration system (2014 annual average)
EL_{BTEX}	Unit-specific BTEX emission limit
MG/year	Megagrams per year

[1] $C_{i,BTEX}$ was determined via Extended Analysis of Natural Gas, GPA 2286, samples collected 2019

1.3 BRIEF DESCRIPTION OF SOURCE

The Ray Compressor Station maintains natural gas pipeline pressure in order to move it in and out of storage reservoirs and along the pipeline system. Excess moisture in natural gas from storage reservoirs is removed by injecting the gas into a contact tower with active counter current lean triethylene glycol (TEG). The TEG absorbs the moisture and the dry gas exits the top of the absorption column for routing to pipeline systems, while moisture rich TEG is directed to a flash vessel to remove hydrocarbon vapors and skim liquid hydrocarbons. The TEG is then heated in a reboiler and directed to a regenerator/separator column to remove excess water and restore purity. Remaining hydrocarbons in the flash vessel or regenerator are routed to the thermal oxidizer.

1.4 CONTACT INFORMATION

Table 1-2 presents the names, addresses, and telephone numbers of the contacts for information regarding the test and the test report, and names and affiliation of personnel involved in conducting the testing.

Table 1-2
Contact Information

Program Role	Contact	Address
State Regulatory Administrator	Ms. Karen Kajiya-Mills Technical Programs Unit Manager 517-335-4874 kajiya-millsk@michigan.gov	Michigan Department of Environment, Great Lakes, and Energy 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
State Technical Programs Field Inspector	Mr. Tom Gasloli Technical Programs Unit Field Operations Section 517-335-4861 gaslolit@michigan.gov	Michigan Department of Environment, Great Lakes, and Energy 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
State Regulatory Inspector	Mr. Robert Elmouchi Environmental Quality Analyst 586-753-3736 elmouchir@michigan.gov	Michigan Department of Environment, Great Lakes, and Energy Southeast District Office 27700 Donald Court Warren, Michigan 48902-2793
Responsible Official	Mr. Gregory Baustian Executive Director-Natural Gas Compression and Storage 616-638-8037 gregory.baustian@cmsenergy.com	Consumers Energy Company Zeeland Generation 425 N. Fairview Road Zeeland, Michigan 49464
Corporate Air Quality Contact	Ms. Amy Kapuga Senior Engineer 517-788-2201 amy.kapuga@cmsenergy.com	Consumers Energy Company Environmental Services Department 1945 West Parnall Road Jackson, Michigan 49201
Test Facility	Mr. Charles Kelly Gas Field Leader III 586-784-2096 charles.kelly@cmsenergy.com	Consumers Energy Company Ray Compressor Station 69333 Omo Road Armada, Michigan 48005
Test Team Representative	Mr. Dillon King, QSTI Engineering Technical Analyst 989-891-5585 dillon.king@cmsenergy.com	Consumers Energy Company D.E. Karn Generating Station 2742 North Weadock Hwy, ESD Trailer #4 Essexville, Michigan 48732

2.0 SUMMARY OF RESULTS

2.1 OPERATING DATA

Operating data collected during the test runs included thermal oxidizer combustion chamber temperature (°F), dry natural gas processing rate (MMscfd), and the glycol recirculation rate (gpm). Refer to Attachment D for detailed operating data.

2.2 APPLICABLE PERMIT INFORMATION

The Ray Compressor Station, State of Michigan Registration Number (SRN) B6636, operates in accordance with air emissions permit *MI-ROP-B6636-2015a* which collectively groups EUGLYCDEHYD01 (operating within Plant 1) EUGLYCDEHYD02 (operating within Plant 2) and EUDEHY3 (operating within Plant 3) as existing glycol dehydration units within FGDEHYHHH, which are subject to compliance evaluations specific to 40 CFR Part 63, Subpart HHH. This report documents the EUGLYCDEHYD01 and EUGLYCDEHYD02 emissions testing conducted January 14 and 15, 2020.

2.3 RESULTS

The BTEX test results indicate the glycol dehydrator systems are compliant with applicable emission limit. Refer to Table 2-1 for the summary of test results.

Table 2-1
Summary of Test Results

Source Name	BTEX Compound Concentration (ppmvd)[1]	BTEX Emission Rate (MG/year)	BTEX Emission Limit (MG/year)[2]	Combustion Chamber Temperature (°F)
EUGLYCDEHYD01	<0.07	<0.01	2.1	1,553
EUGLYCDEHYD02	<0.06	<0.01	1.8	1,538

[1] The BTEX sample concentrations were below the laboratory's detectable limit. For these instances, the minimum detection limit (MDL) of these compounds were used to calculate the average compound concentrations for this test event. Additional information is presented in the Laboratory Report presented in Appendix C.

[2] BTEX emission limit was calculated as required per §63.1275(b)(1)(iii), Equation 1 – Refer to Appendix A

Detailed results are presented in Appendix Table 1. A discussion of the results is presented in Section 5.0. Sample calculations, field data sheets, and laboratory results are presented in Appendices A, B, and C. Operating data and supporting information are provided in Appendices D and E.

3.0 SOURCE DESCRIPTION

EUGLYCDEHYD01 and EUGLYCDEHYD02 are glycol dehydration systems used to remove excess moisture from natural gas that is withdrawn from underground storage reservoirs. The dehydrators are equipped with thermal oxidizers used to control volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions.

3.1 PROCESS

The Ray Compressor Station maintains the pressure of natural gas to transport the gas in and out of storage reservoirs and along the pipeline system. The glycol dehydration unit installed at the Ray Compressor Station is used to remove water from the natural gas withdrawn from underground storage reservoirs in order to meet pipeline gas quality specifications.

3.2 PROCESS FLOW

The water removal process of the dehydrator involves flowing lean, water-free triethylene glycol (TEG) into the top of a contact tower(s). As the TEG flows downward, it contacts wet natural gas flowing upward, thereby removing water through physical absorption. The dry natural gas exits the top of the absorption column and into the pipeline distribution system. The water-rich TEG exiting the bottom of the absorption column is directed to a flash vessel for removal of any hydrocarbon vapors and the skimming of liquid hydrocarbons. After leaving the flash vessel, the water-rich glycol is heated and directed to a reboiler for thermal regeneration, which removes excess water, thereby returning the TEG to its original purity. Remaining hydrocarbon vapors in the flash vessel and reboiler/regenerator are consumed in the forced-draft natural gas-fired thermal oxidizer. Detailed operating data recorded during testing are provided in Appendix D.

3.3 MATERIALS PROCESSED

EUGLYCDEHYD01 and EUGLYCDEHYD02 process "wet" natural gas that is withdrawn from underground storage reservoirs and TEG is used to dry the gas to pipeline specifications.

3.4 RATED CAPACITY

The glycol dehydrator capacity is limited to the availability of lean TEG, which is continuously purified by the removal of excess moisture in the flash vessel, regenerator and reboiler process components. The 2019 annual average daily natural gas flow rate that the EUGLYCDEHYD01 and EUGLYCDEHYD02 systems process is 36 million standard cubic feet per day (MMscfd) and 32 MMscfd respectively. During testing the EUGLYCDEHYD01 system was processing an average of 66.9 MMscfd and the EUGLYCDEHYD02 system was processing an average of 88.9 MMscfd. Refer to Appendix D for operating data recorded during testing.

3.5 PROCESS INSTRUMENTATION

Data collected during each test run included the thermal oxidizer combustion chamber temperature (continuous parameter monitoring system), dry natural gas processing rate, and the glycol recirculation rate. Refer to Attachment D for detailed operating data. The preceding data was logged at least once every minute and then averaged to determine the per-test run values.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Consumers Energy RCTS tested for BTEX, flow, moisture, oxygen (O_2) and carbon dioxide (CO_2) concentrations at the EUGLYCDEHYD01 and EUGLYCDEHYD02 thermal oxidizer exhaust stacks using the United States Environmental Protection Agency (USEPA) test methods presented in Table 4-1. The sampling and analytical procedures associated with each parameter are described in the following sections.

Table 4-1
Test Methods

Parameter	Method	USEPA Title
Sample traverses	1	Sample and Velocity Traverses for Stationary Sources
Volumetric flow	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Oxygen, Carbon Dioxide	3A	Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)
Moisture content	ALT-008	Alternative Moisture Measurement Method Midget Impingers
BTEX	18	Measurement of Gaseous Organic Compound Emissions by Gas Chromatography

4.1 DESCRIPTION OF SAMPLING TRAIN AND FIELD PROCEDURES

The test matrix presented in Table 4-2 summarizes the sampling and analytical methods performed for the specified parameters during this test program.

Table 4-2
Test Matrix

Date (2019)	Run	Sample Type	Start Time (EDT)	Stop Time (EDT)	Test Duration (min)	EPA Test Method	Comment
EUGLYCDEHYD01							
Jan. 14	1	Flow O_2, CO_2 Moisture BTEX	10:09	11:09	60	1 2 3A ALT-008 18	BTEX sampled from single point at exhaust stack centroid
	2		11:45	12:45	60		
	3		13:10	14:10	60		
EUGLYCDEHYD02							
Jan. 15	1	Flow O_2, CO_2 Moisture BTEX	9:20	10:20	60	1 2 3A ALT-008 18	BTEX sampled from single point at exhaust stack centroid
	2		10:54	11:54	60		
	3		12:25	13:25	60		

4.2 SAMPLE LOCATION AND TRAVERSE POINTS (USEPA METHOD 1)

The number and location of traverse points was evaluated according to the requirements in 40 CFR Part 63, Subpart HHH, and USEPA Method 1, Sample and Velocity Traverses for

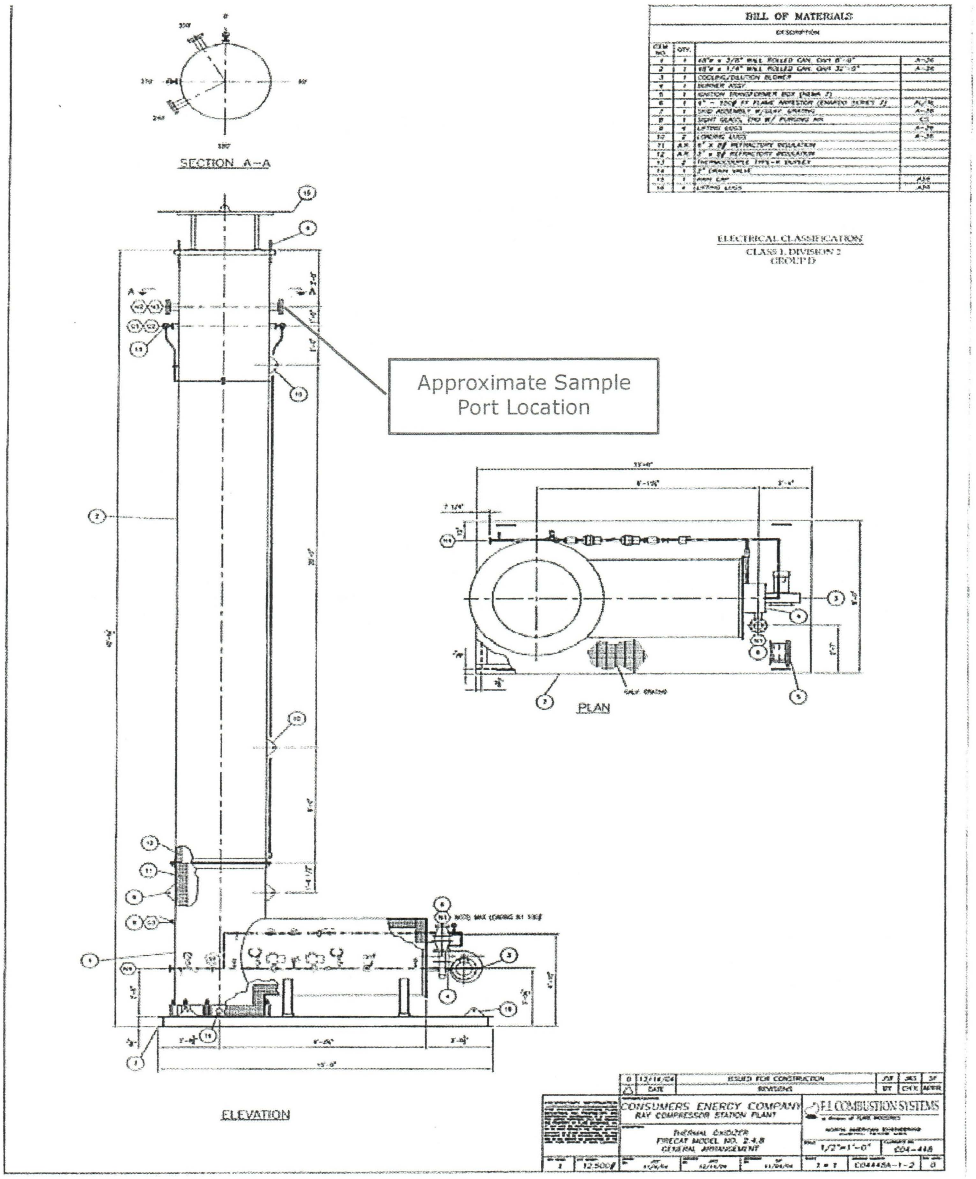
Stationary Sources. The sampling locations for EUGLYCDEHYD01 and EUGLYCDEHYD02 are identical. Information and drawings are presented in the following section:

EUGLYCDEHYD01 and EUGLYCDEHYD02 Thermal Oxidizer 39.5-inch Diameter Exhaust Stack Sample Port Locations:

- Approximately 384-inches or 9.7 duct diameters downstream of a flow disturbance, and
- Approximately 36-inches or 0.9 duct diameters upstream of the stack exit.

The sample ports are 4-inch in diameter and extend 4 inches beyond the stack wall. Because the stack is >12 inches in diameter and the sampling port location met the two and one-half diameter criterion of § 11.1.1 of Method 1 of 40 CFR Part 60, Appendix A-1, the exhaust duct was sampled at a single traverse point located in the centroid of the duct in accordance with USEPA Reference Method 18, § 8.2.4.2.2.

Figure 4-1. EUGLYCDEHYD01 and EUGLYCDEHYD02 Sampling Location

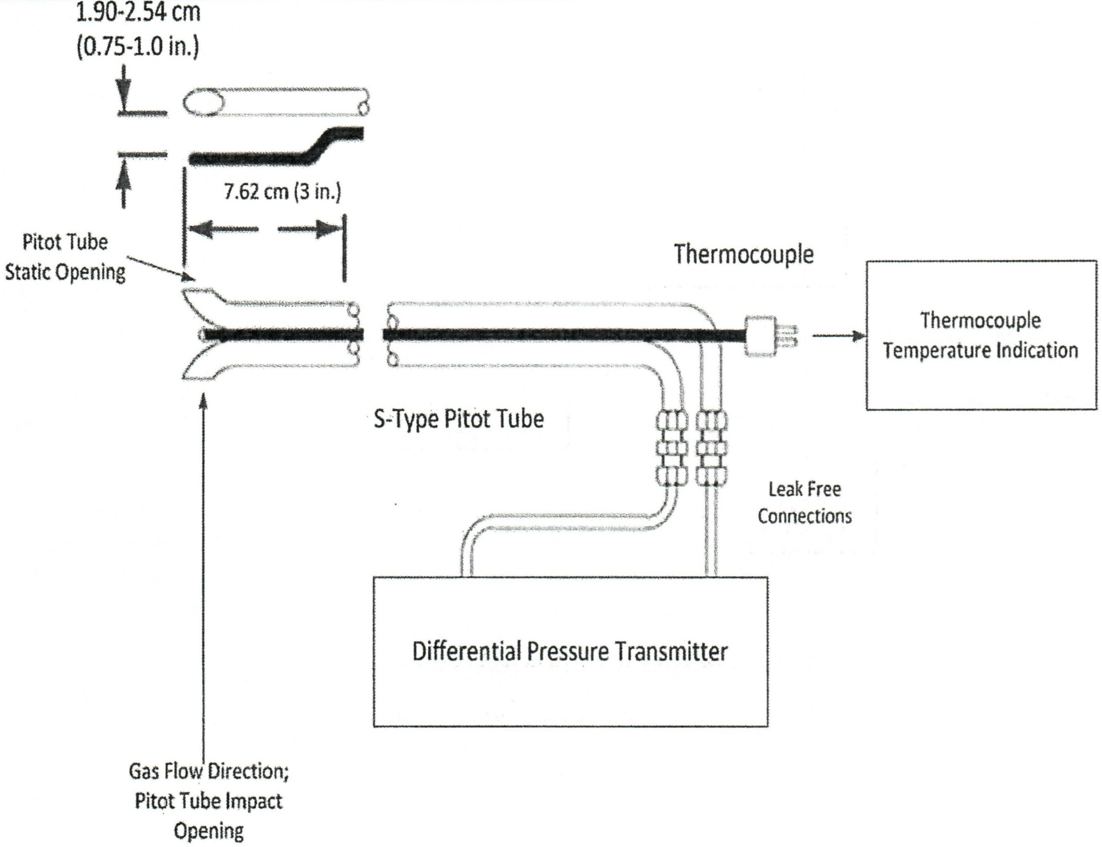


Approximate Sample Port Location

4.3 VOLUMETRIC FLOW (USEPA METHOD 2)

The exhaust gas velocity and temperature measurements were conducted in accordance with USEPA Method 2, *Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)*. The exhaust stack velocity was measured using an S-type Pitot tube connected to a pressure transducer in place of an inclined manometer as illustrated in Figure 4-2. Exhaust gas temperatures were measured using a nickel-chromium/nickel-alumel "Type K" thermocouple and a temperature indicator. A flow traverse across two stack diameters at six traverse points each was performed once during each test run to determine exhaust gas velocity and temperature for this test event.

Figure 4-2. Method 2 Sample Apparatus

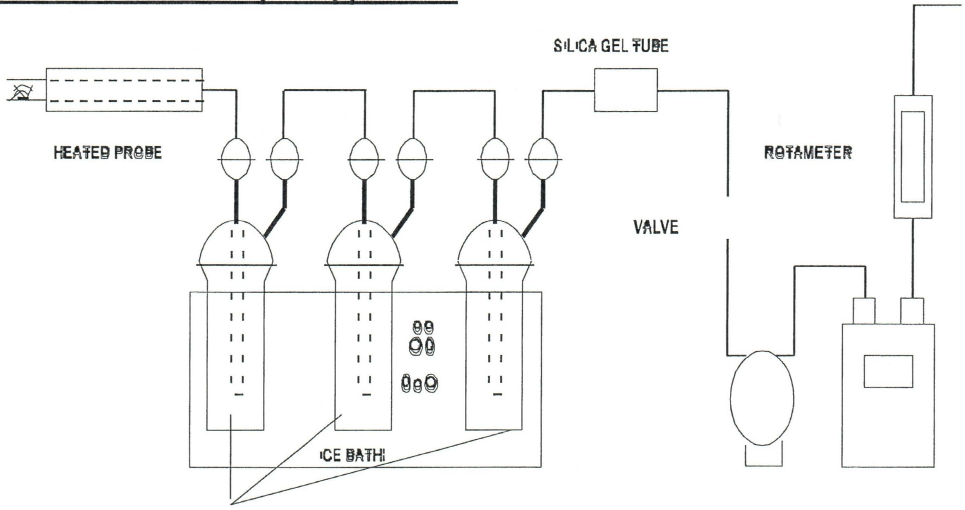


4.4 MOISTURE CONTENT (USEPA METHOD 4 / APPROVED ALTERNATIVE 008)

In lieu of USEPA Method 4 to conduct the moisture analysis of the flue gas sampled, RCTS employed the USEPA Broadly Applicable Approved Alternative ALT-008, *Alternative Moisture Measurement Method Midget Impingers*, to determine moisture content. ALT-008 is 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 U.S. EPA 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, U.S. EPA Emissions Measurement Branch). The sample apparatus configuration follows the general guidelines contained in Figure 4-2 and § 8.2 of U.S. EPA Method 4, *Determination of Moisture Content in Stack Gases,* and ALT-008 Figure 1 or 2.

The flue gas was withdrawn from the stack at a constant rate through a sample probe, umbilical, 4 midget impingers and a metering console/pump. The moisture was removed from the gas stream in the impingers and determined gravimetrically. Refer to Figure 4-3 for a figure of the Alternative Method 008 Moisture Sample Apparatus.

Figure 4-3. ALT-008 Sample Apparatus

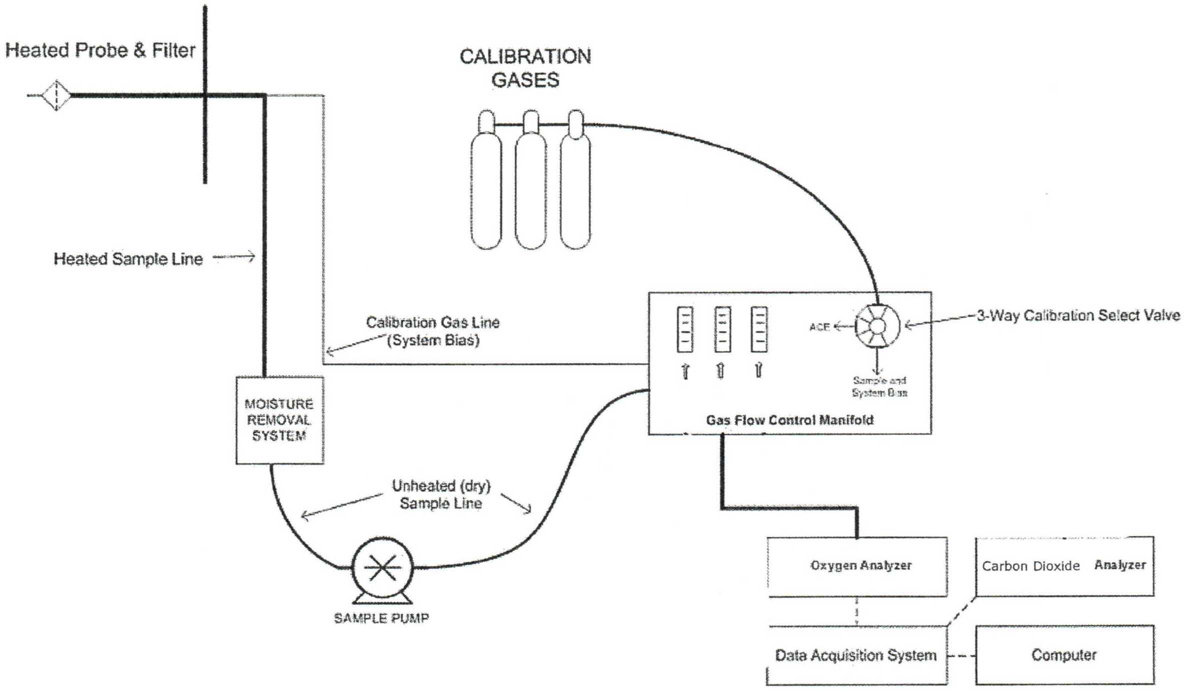


4.5 O$_2$ AND CO$_2$ (USEPA METHOD 3A)

Oxygen and carbon dioxide concentrations were measured using USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure).*

Flue gas was extracted from the stack through a stainless steel probe, heated Teflon® sample line, and through a gas conditioning system to remove water and dry the sample before entering a sample pump, flow control manifold, and gas analyzer. Figure 4-4 depicts a drawing of the Method 3A sampling system.

Figure 4-4. USEPA Method 3A Sampling System



Prior to sampling flue gas, the analyzers were calibrated by performing a calibration error test where zero-, mid-, and high-level calibration gases were introduced directly to the back of the analyzers. The calibration error check was performed to evaluate if the analyzers response was within ±2.0% of the calibration gas span or high calibration gas concentration. An initial system-bias test was performed where the zero- and mid- or high-calibration gases were introduced at the sample probe to measure the ability of the system to respond accurately to within ±5.0% of span.

Upon successful completion of the calibration error and initial system bias test, sample flow rate and component temperatures were verified and the probe was inserted into the stack at the appropriate traverse point. After confirming the source was operating at established conditions, the test run was initiated. Gas concentrations were recorded at 1-minute intervals throughout the 60-minute test period.

At the conclusion of the test run, a post-test system bias check was performed to evaluate analyzer bias and drift from the pre- and post-test system bias checks. The system-bias checks evaluated if the analyzer bias was within ±5.0% of span and drift was within ±3.0%. The analyzer response was used to correct the measured gas concentrations for analyzer drift.

4.6 BTEX (USEPA METHOD 18)

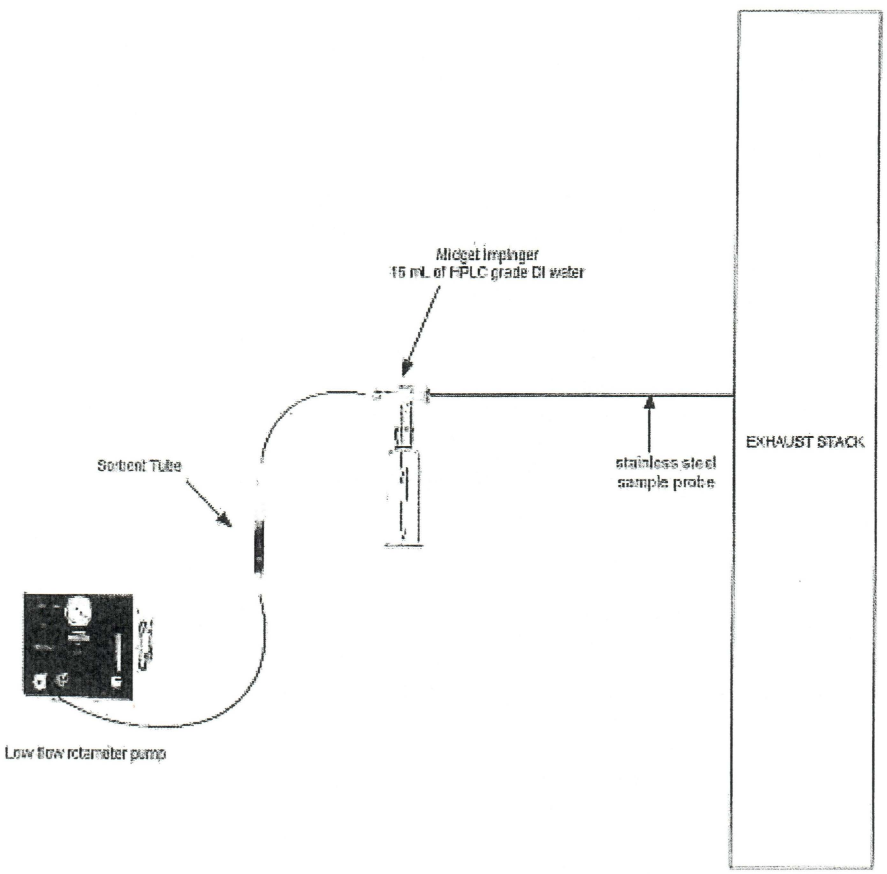
USEPA Method 18, *Measurement of Gaseous Organic Compound Emissions by Gas Chromatography*, was used to calculate BTEX emissions from the EUGLYCDEHYD01 and EUGLYCDEHYD02 thermal oxidizer stack, employing the adsorbent tube procedure identified in § 8.2.4.

Prior to the test event, spiked and un-spiked adsorption tubes from the contracted laboratory, Enthalpy Analytical, Inc. (Enthalpy), were received in a tightly sealed cold pack insulated shipping container. The pre-spiked charcoal tubes were each labeled with the following pre-spiked concentrations: 79.1 micrograms (µg) of benzene, 77.8 µg of toluene, 78.0 µg of ethyl benzene, and 77.2 µg of p-xylene, 77.3 µg of m-xylene, and 79.0 µg of o-xylene, which represented the equivalent of 40 – 60 percent of the expected BTEX mass to be collected in the un-spiked train.

For each run, two identical sample apparatus' (one spiked and one un-spiked train) were used. Each apparatus was configured with a clean stainless steel probe followed by a series of midget impingers for water condensate collection. Immediately following the impingers, two pre-labeled charcoal tubes were connected in series, each containing two charcoal adsorbent sections. The sample flow rate and volume measurement for each train was controlled by low flow pumps, mass flow controllers, and dry gas meters connected to the charcoal tubes. The primary difference between the spiked and un-spiked sample trains therefore was the spiked (or conversely un-spiked) nature of the first charcoal tube in series for each train, as the spiked apparatus was equipped with one spiked and one un-spiked tube, while the un-spiked apparatus was configured with two un-spiked tubes.

After each run, the sorbent tube openings were capped and the tubes were placed in a cooler. The recovered midget impinger water catch was placed into a labeled sample bottle, and triplicate deionized water rinses of each impinger were performed and included in the same bottle. Deionized water was added to the impinger catch to ensure zero headspace existing within the sample bottle. Upon completion of the sampling program, the sorbent tubes and water catch samples were shipped with their associated chain of custodies to Enthalpy for analysis. The BTEX sample system apparatus diagram is shown in Figure 4-5.

Figure 4-5. Method 18 Sample Apparatus



Method 18 Sorbent Tube
BTEX Sample Apparatus Schematic

5.0 TEST RESULTS AND DISCUSSION

This test was performed to satisfy performance testing requirements and evaluate compliance with 40 CFR Part 63, Subpart HHH, "National Emission Standards for Hazardous Air Pollutants (NESHAP) from Natural Gas Transmission and Storage Facilities," and MI-ROP-B6636-2015a.

5.1 TABULATION OF RESULTS

The results of the testing indicate the EUGLYCDEHYD01 and EUGLYCDEHYD02 sources are compliant with the applicable emission limits as summarized in Table 2-1. Appendix Table 1 contains detailed tabulation of results, process operating conditions, and exhaust gas conditions.

BTEX compounds were not detected in the condensate nor the sorbent tube samples. The sum of the sorbent tube minimum detection limits for the two sorbent tube fractions were used to calculate the emissions results.

5.2 SIGNIFICANCE OF RESULTS

The results of the testing indicate compliance with the applicable emission limit. During testing, the EUGLYCDEHYD01 thermal oxidizer combustion chamber operated between 1,551°F and 1,559°F with an average combustion chamber temperature of 1,553°F; the EUGLYCDEHYD02 thermal oxidizer combustion chamber operated between 1,534°F and 1,545°F with an average combustion chamber temperature of 1,538°F. The average combustion chamber temperatures will be used as the new minimum combustion chamber operating temperature.

5.3 VARIATIONS FROM SAMPLING OR OPERATING CONDITIONS

No operating condition variations were observed during the test program.

5.4 PROCESS OR CONTROL EQUIPMENT UPSET CONDITIONS

No process or control equipment upset conditions were observed during this test program.

5.5 AIR POLLUTION CONTROL DEVICE MAINTENANCE

No significant maintenance had been performed on the glycol dehydrator system in the three months prior to this test program.

5.6 RE-TEST DISCUSSION

Based on the results of this test program, a re-test is not required.

5.7 RESULTS OF AUDIT SAMPLES

USEPA Method 18 requires the successful passing of a spike recovery study for each compound of interest when using the adsorption tube procedure identified in § 8.2.4. Two sample trains are required, one sample train including a sorbent tube spiked with 40-60% of the mass of the expected compounds of interest. Sampling on the two trains is performed simultaneously and the sorbent tubes are analyzed using the same analytical procedures and instruments to determine the fraction of the recovered spike compounds (R). The average fraction of recovered compounds from three runs must fall within $0.70 \leq R \leq 1.30$ to validate the sampling procedures. The field measurements collected from the un-spiked sorbent tubes are then corrected to the calculated R value. The calculated R values ranged from 0.953 to 1.10 for this test program.

Audit samples for the reference methods utilized during this test program are not available from USEPA Stationary Source Audit Sample Program providers. The USEPA reference methods performed state reliable results are obtained by persons equipped with a thorough knowledge of the techniques associated with each method. Factors with the potential to cause measurement errors are minimized by implementing quality control (QC) and assurance (QA) programs into the applicable components of field-testing. QA/QC components were included in this test program. Table 5-1 summarizes the primary field quality assurance and quality control activities that were performed. Refer to Appendix E for supporting documentation.

Table 5-1
QA/QC Procedures

QA/QC Activity	Purpose	Procedure	Frequency	Acceptance Criteria
M1: Sampling Location	Evaluates if the sampling location is suitable for sampling	Measure distance from ports to downstream and upstream flow disturbances	Pre-test	≥2 diameters downstream; ≥0.5 diameter upstream.
M1: Duct diameter/ dimensions	Verifies area of stack is accurately measured	Review as-built drawings and field measurement	Pre-test	Field measurement agreement with as-built drawings
M2: Pitot tube calibration and standardization	Verifies construction and alignment of Pitot tube	Inspect Pitot tube, assign coefficient value	Pre-test and after each field use	Method 2 alignment and dimension requirements
M3A: Calibration Error	Evaluates operation of analyzers	Calibration gases introduced directly into analyzers	Pre-test	±2.0% of the calibration span
M3A: System Bias and Analyzer Drift	Evaluates analyzer and sample system integrity and accuracy over test duration	Calibration gases introduced at sample probe tip, heated sample line, and into analyzers	Pre-test and Post-test	±5.0% of the analyzer calibration span for bias and ±3.0% of analyzer calibration span for drift
M4 (ALT-008): Field balance calibration	Verify moisture measurement accuracy	Use Class 6 weight to check balance accuracy	Daily before use	The field balance must measure the weight within ±0.5 gram of the certified mass
M18: Spike Recovery Study	Demonstrate proper sampling/analysis procedures were selected	Compare compound mass collected on spiked sorbent traps against un-spiked sorbent traps	Once per test for all compounds analyzed	Average of 3 runs spike recovery must be within 70≤R≤130% of the spike mass

5.8 CALIBRATION SHEETS

Calibration sheets, including gas protocol sheets and analyzer quality control and assurance checks are presented in Appendix E.

5.9 SAMPLE CALCULATIONS

Sample calculations and formulas used to compute emissions data are presented in Appendix A.

5.10 FIELD DATA SHEETS

Field data sheets are presented in Appendix B.

5.11 LABORATORY QUALITY ASSURANCE / QUALITY CONTROL PROCEDURES

The method specific quality assurance and quality control procedures in each method employed during this test program were followed, without deviation. Refer to Appendix C for the laboratory data sheets.

5.12 QA/QC BLANKS

Other than Method 18 QA/QC and calibration gases used for zero calibrations, no other reagent or media blanks were used. The analysis of laboratory blanks and those submitted with the samples (blank sorbent tube and deionized water) did not show any of the analytes of interest at concentrations greater than the detection limit.

Laboratory QA/QC data is contained in Appendix C.

Appendix Table