



**Consumers Energy**

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# 40 CFR Part 63, Subpart HHH Compliance Test Report

## EUGLYCDEHY

Consumers Energy Company  
Muskegon River Compressor Station  
8613 Pine Road  
Marion, MI 49665  
SRN: N2901

January 21, 2020

**Test Date: December 3, 2019**

Test Performed by the Consumers Energy Company  
Regulatory Compliance Testing Section  
Air Emissions Testing Body  
Laboratory Services Section  
Work Order No. 35787256  
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## EXECUTIVE SUMMARY

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted benzene, toluene, ethylbenzene, and xylene (BTEX) testing on December 3, 2019 at the exhaust location of the thermal oxidizer serving the small glycol dehydration unit installed and operating at the Muskegon River Compressor Station in Marion, Michigan.

The glycol dehydrator, equipped with a thermal oxidizer for VOC emissions control, is identified as EUGLYCDEHY within the Michigan Department of Environment, Great Lakes and Energy (EGLE) renewable operating permit (ROP) *MI-ROP-N2901-2014* and is 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 device for the small glycol dehydration unit is achieving 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). This subsequent periodic performance test program met the NESHAP §63.1282(d)(3)(vi)(B) requirement of *no later than 60 months after the initial performance test* timing specification as the previous performance test was conducted on March 25, 2015.

Triplicate 60-minute test runs were conducted with one 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 EUGLYCDEHY source is operating in compliance with the applicable BTEX emission limit and established a new minimum thermal oxidizer combustion zone temperature of 1,115°F.

**Table E-1**  
**Summary of Test Results**

Source Name	BTEX Compound Concentration (ppmvd)	BTEX Emission Rate (Mg/year)	BTEX Emission Limit (Mg/year) <sup>1</sup>	Combustion Chamber Temperature (°F)
<b>EUGLYCDEHY</b>	5.52	0.13	3.2	1,115

<sup>1</sup> 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 December 3, 2019 at the exhaust location of the thermal oxidizer serving the small glycol dehydration unit installed and operating at the Muskegon River Compressor Station in Marion, 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 unit described within EGLE renewable operating permit (ROP) *MI-ROP-N2901-2014* is identified as EUGLYCDEHY.

A test protocol submitted to EGLE on October 1, 2019 was subsequently approved by Mr. Tom Gasloli, EGLE Environmental Quality Analyst, in a letter dated October 14, 2019. There was one deviation from the approved test protocol during the test event, which is explained in further detail in sections 4.3 and 5.3 of this report.

### 1.2 PURPOSE OF TESTING

The test was conducted 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). Furthermore, this periodic performance test program met the NESHAP §63.1282(d)(3)(vi)(B) requirement of *no later than 60 months after the previous performance test* timing specification as the initial performance test was conducted on March 25, 2015. The applicable emission limit is presented in Table 1-1.

**Table 1-1**  
**Applicable Emission Limit**

Parameter	40 CFR 63.1275(b)(1)(iii)		
	Throughput (scm/day)	C <sub>i,BTEX</sub> <sup>1</sup> (ppmv)	EL <sub>BTEX</sub> (Mg/year)
BTEX	1,897,209	15.0	3.2
scm/day	Standard cubic meters per day		
C <sub>i,BTEX</sub>	Average annual BTEX concentration of natural gas at inlet of the glycol dehydration system		
EL <sub>BTEX</sub>	Unit-specific BTEX emission limit		
Mg/year	Megagrams per year		
<sup>1</sup> C <sub>i,BTEX</sub> was determined via Extended Analysis of Natural Gas, GPA 2286, samples collected 2019			

### 1.3 BRIEF DESCRIPTION OF SOURCE

The Muskegon River 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 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 fed 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. Any remaining hydrocarbons in the flash vessel or regenerator are routed to the thermal oxidizer for pollution control.

## 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 <a href="mailto:kajiya-millsk@michigan.gov">kajiya-millsk@michigan.gov</a>	Michigan Department of Environment, Great Lakes, and Energy Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
State Technical Programs Field Inspector	Mr. Thomas Gasloli Technical Programs Unit Field Operations Section 517-335-4861 <a href="mailto:gaslolit@michigan.gov">gaslolit@michigan.gov</a>	Michigan Department of Environment, Great Lakes, and Energy Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
State Regulatory Inspector	Ms. Meg Sheehan Environmental Quality Analyst 989-439-5001 <a href="mailto:sheehanm@michigan.gov">sheehanm@michigan.gov</a>	Michigan Department of Environment, Great Lakes, and Energy Bay City District 401 Ketchum Street, Suite B Bay City, Michigan 48708
Responsible Official	Mr. Gregory Baustian Executive Director-Natural Gas Compression and Storage 616-638-8037 <a href="mailto:gregory.baustian@cmsenergy.com">gregory.baustian@cmsenergy.com</a>	Consumers Energy Company Traverse City Service Center 821 Hastings Street Traverse City, Michigan 49686
Corporate Air Quality Contact	Ms. Amy Kapuga Senior Engineer 517-788-2201 <a href="mailto:amy.kapuga@cmsenergy.com">amy.kapuga@cmsenergy.com</a>	Consumers Energy Company Environmental Services Department 1945 West Parnall Road Jackson, Michigan 49201
Test Facility	Mr. Parish Geers Gas Field Leader 231-743-4101 <a href="mailto:parish.geers@cmsenergy.com">parish.geers@cmsenergy.com</a>	Consumers Energy Company Muskegon River Compressor Station 8613 Pine Road Marion, Michigan 49665
Test Team Representative	Mr. Gregg Koteskey, QSTI Engineering Technical Analyst 616-738-3712 <a href="mailto:gregg.koteskey@cmsenergy.com">gregg.koteskey@cmsenergy.com</a>	Consumers Energy Company L&D Training Center 17010 Croswell Street West Olive, Michigan 49460

## 2.0 SUMMARY OF RESULTS

### 2.1 OPERATING DATA

Operating data collected during the test runs included thermal oxidizer combustion chamber temperature, gas flow rate, water content, and glycol flow rate. Refer to Attachment D for detailed operating data.



## 2.2 APPLICABLE PERMIT INFORMATION

The Muskegon River Compressor Station, State of Michigan Registration Number (SRN) N2901, operates in accordance with air emissions permit *MI-ROP-N2901-2014* which identifies EUGLYCDEHY as an existing glycol dehydration unit, which is subject to compliance evaluations specific to 40 CFR Part 63, Subpart HHH §63.1275(b)(1)(iii).

## 2.3 RESULTS

The BTEX test results indicate the glycol dehydrator system is compliant with applicable emission limits. Refer to Table 2-1 for the summary of test results.

**Table 2-1**  
**Summary of Test Results**

Source Name	BTEX Compound Concentrations (ppmvd)	BTEX Emission Rate (Mg/year)	BTEX Emission Limit (Mg/year) <sup>1</sup>	Average Combustion Chamber Temperature (°F)
EUGLYCDEHY	5.52	0.13	3.2	1,115

<sup>1</sup> 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

EUGLYCDEHY is a glycol dehydration system used to remove excess moisture from natural gas that is withdrawn from underground storage reservoirs. The dehydrator is equipped with a thermal oxidizer used to control VOC and HAP emissions from the dehydration process.

### 3.1 PROCESS

The Muskegon River 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 Muskegon River 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. 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 via the bottom of the 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

EUGLYCDEHY processes "wet" natural gas withdrawn from underground storage reservoirs and TEG used to dry the gas to pipeline gas 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 annual average daily natural gas flow rate that the EUGLYCDEHY system processes is 68 million standard cubic feet per day (MMscfd). During testing the system was processing an average of 269 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), gas flow rate, water content, and glycol flow rate. The preceding data was logged at least once every 5 minutes and then averaged to determine the per-test run values. Refer to Appendix D for operating data.

## 4.0 SAMPLING AND ANALYTICAL PROCEDURES

Consumers Energy RCTS tested for BTEX, flow, moisture, and oxygen (O<sub>2</sub>) concentrations 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	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
December 3	1	Flow O <sub>2</sub> BTEX	11:35	12:35	60	1 2 3A ALT-008 18	BTEX sampled from single point at exhaust stack centroid
	2		13:05	14:05	60		
	3		14:30	15:30	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 location for EUGLYCDEHY is presented in the following section:

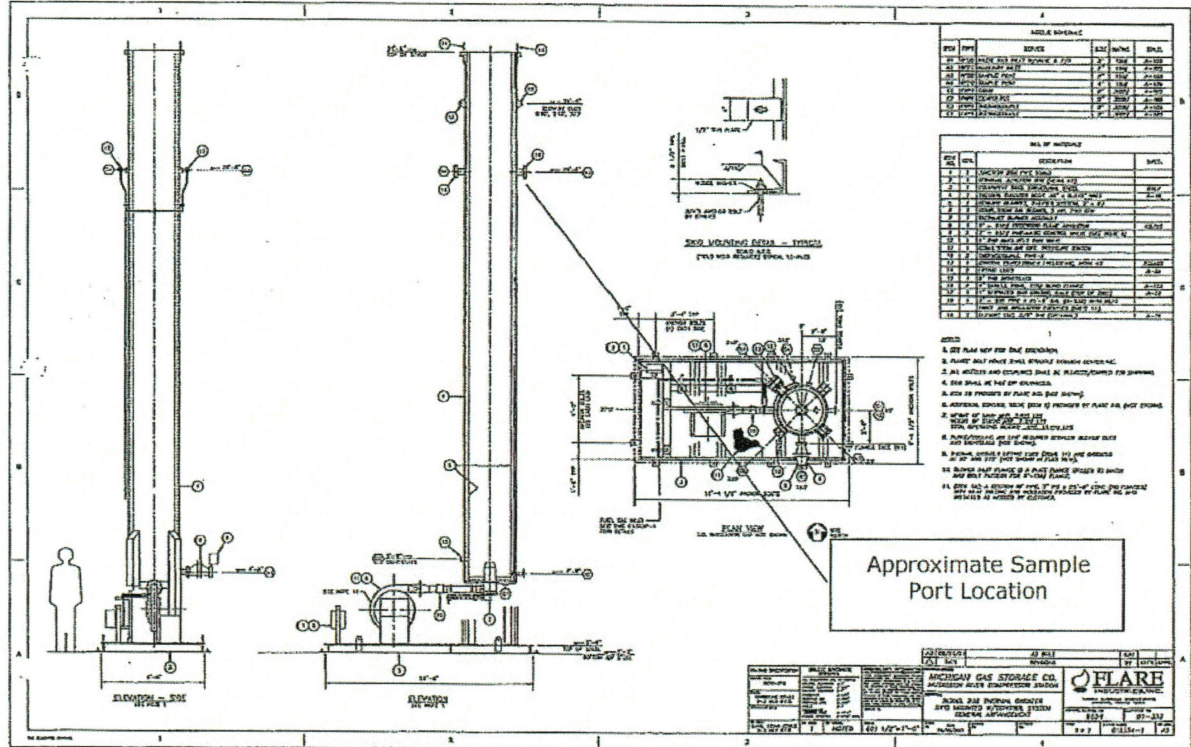
### Reboiler Process Vent Sample Port Location:

- Approximately 260-inches or 7.8 duct diameters downstream of an open flame, and
- Approximately 72-inches or 2.0 duct diameters upstream of the stack exit.

The sample ports are 2-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 ducts were sampled for BTEX at a single point located in the centroid of the duct in accordance with USEPA Reference Method 18, § 8.2.4.2.2.



**Figure 4-1. EUGLYCDEHY Sampling Location**

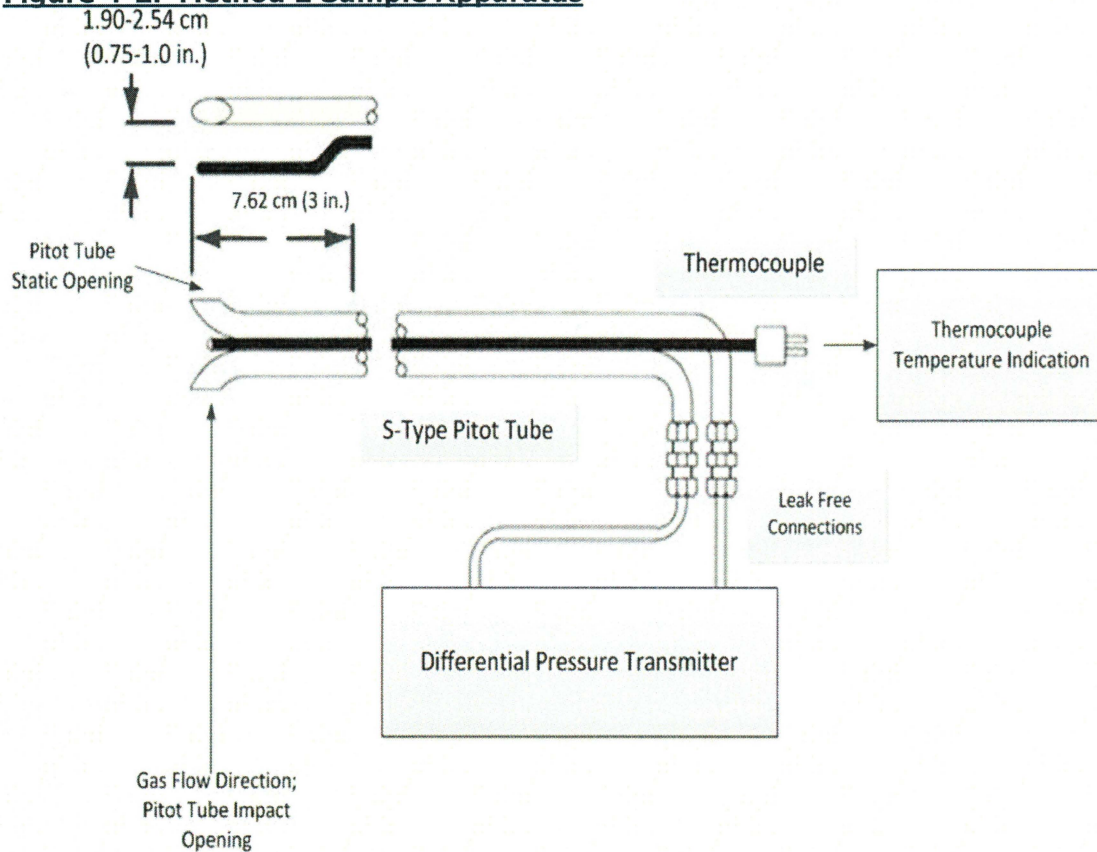


**4.3 VOLUMETRIC FLOW (USEPA METHOD 2)**

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. The test ports on the thermal oxidizer stack were installed 180 degrees apart (along the same diameter), precluding sampling from two separate diameters 90 degrees apart. As a result, the flow data was collected on only one stack diameter at twelve traverse points, performed once during each test run to determine exhaust gas velocity and temperature for this test event.



**Figure 4-2. Method 2 Sample Apparatus**



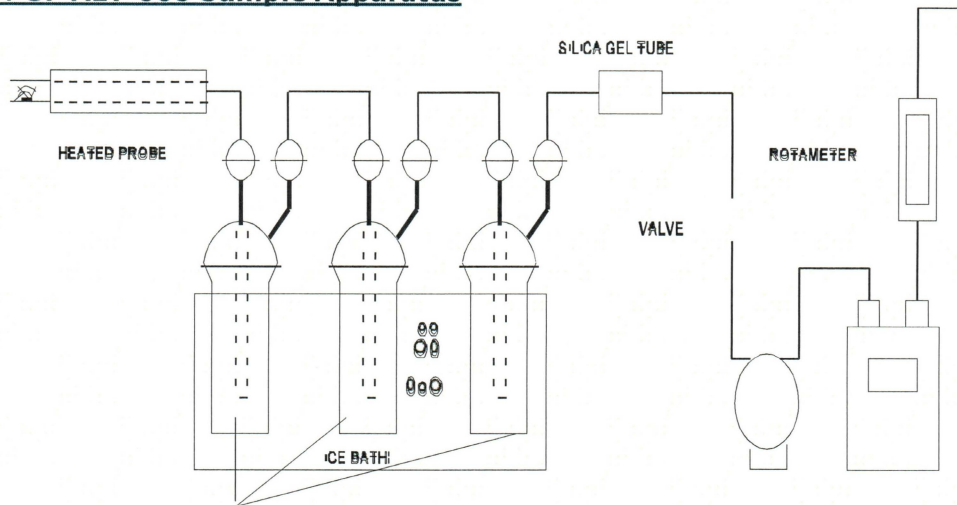
#### 4.4 MOISTURE CONTENT (USEPA METHOD 4 / APPROVED ALTERNATIVE 008)

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**

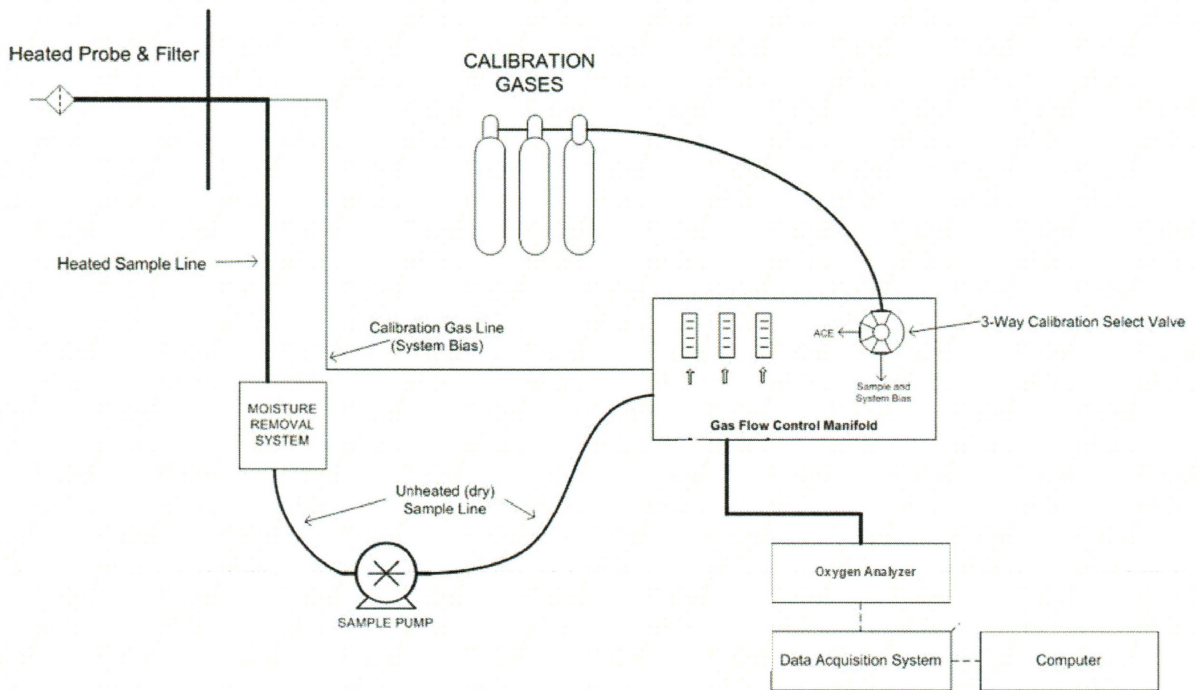


**4.5 O<sub>2</sub> (USEPA METHOD 3A)**

Oxygen 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 analyzer was 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  $\pm 2.0\%$  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  $\pm 5.0\%$  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  $\pm 5.0\%$  of span and drift was within  $\pm 3.0\%$ . The analyzer response was used to correct the measured gas concentrations for analyzer drift.

#### **4.6 BTEX (USEPA METHOD 18)**

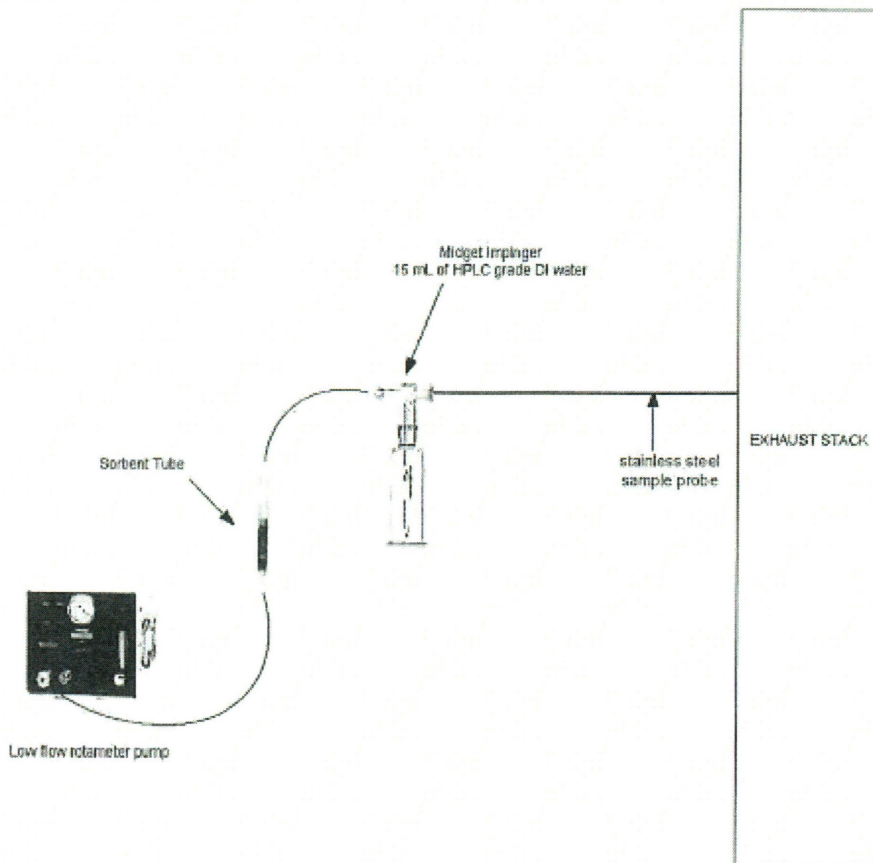
USEPA Method 18, *Measurement of Gaseous Organic Compound Emissions by Gas Chromatography*, was used to calculate BTEX emissions from the EUGLYCDEHY process vent stack, employing the adsorbent tube procedure identified in § 8.2.4.

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 ( $\mu\text{g}$ ) of benzene, 77.8  $\mu\text{g}$  of toluene, 78.0  $\mu\text{g}$  of ethylbenzene, and 77.2  $\mu\text{g}$  of p-xylene, 77.3  $\mu\text{g}$  of m-xylene, and 79.0  $\mu\text{g}$  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, calibrated flow sensors 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. For this test event, the spiked sorbent tubes were associated with the "A DGM" sample train, and the un-spiked sorbent tubes were sampled using the "B DGM" sample train, as identified in the field data sheets presented in Appendix B.

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

The test program was conducted on December 3, 2019 to satisfy performance testing requirements and evaluate compliance with 40 CFR 63, Subpart HHH, "National Emissions Standards for Hazardous Air Pollutants (NESHAP) from Natural Gas Transmission and Storage Facilities," and MI-ROP-N2901-2014.

### 5.1 TABULATION OF RESULTS

The results of the testing indicate the EUGLYCDEHY source is compliant with applicable emissions limits as summarized in Table 2-1. Appendix Table 1 contains detailed tabulation of results, process operating conditions, and exhaust gas conditions.

### 5.2 SIGNIFICANCE OF RESULTS

The results of the testing indicate compliance with the applicable emission limit. During testing, the EUGLYCDEHY thermal oxidizer combustion chamber operated between 1,090°F



and 1,150°F with an average combustion chamber temperature of 1,115°F, which 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. There was a deviation from the approved test protocol in which a pressure transducer was used in place of an inclined oil manometer for the purposes of determining flow within the thermal oxidizer stack. A 0 to 2 in. H<sub>2</sub>O oil manometer was initially attached to the Pitot tube to measure differential pressure, but the extremely low pressures observed could not be accurately quantified by the manometer, so a 0 to 1 in. H<sub>2</sub>O pressure transducer was used in place of the oil manometer, in accordance with USEPA Method 2.

### **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.

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 unspiked sorbent traps	Once per test for all compounds analyzed	Average of 3 runs spike recovery must be within $70 \leq R \leq 130\%$ 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. Laboratory QA/QC data is contained in Appendix C.

# Appendix Table

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**Regulatory Compliance Testing Services  
Test Data Summary Table**

Facility and Source Information				
Customer:	Muskegon River Compressor Station			
Source:	EUGLYCDEHY			
Work Order:	35787256			
Test Date:	12/3/2019	12/3/2019	12/3/2019	
Run Number:	Run 1	Run 2	Run 3	
Stack or Duct Diameter, (in):	36	36	36	
Stack or Duct Area, (ft <sup>2</sup> ):	7.07	7.07	7.07	
Barometric Pressure, (in Hg):	28.55	28.49	28.45	
<b>Source Pollutant Test Data</b>	Run 1	Run 2	Run 3	Average
Run Start Time:	11:35	13:05	14:30	
Run Stop Time:	12:35	14:05	15:30	
Duration of Pollutant Sample, minutes:	60.0	60.0	60.0	
<b>Source Moisture Analysis Data</b>	Run 1	Run 2	Run 3	Average
Moisture Meter Calibration Factor (Y):	1.000	1.000	1.000	
Run Start Time:	10:10	11:40	13:05	
Run Stop Time:	11:10	12:40	14:05	
Duration of Moisture Sample, minutes:	60	60	60	
Moisture Meter Start Volume, ft <sup>3</sup> :	0	0	0	
Moisture Meter Final Volume, ft <sup>3</sup> :	4.214	4.109	3.788	
Moisture Meter Leak Rate, cfm:	0.000	0.000	0.000	
Average Meter Pressure, (in H <sub>2</sub> O):	0.60	0.60	0.60	0.60
Average Meter Temperature (°F):	62.9	63.9	64.2	63.7
Liquid Mass Collected, grams:	4.50	6.00	5.80	5.43
Water Vapor Volume at STP, scf:	0.212	0.283	0.273	0.256
Sample Volume, Actual Cubic Feet:	4.214	4.109	3.788	4.037
Sample Volume at STP, dscf:	4.065	3.947	3.632	3.881
Sample Volume at STP, dscm:	0.115	0.112	0.103	0.110
Total Gas Sampled, scf:	4.28	4.23	3.90	4.14
Source Gas Moisture (%):	5.0	6.7	7.0	6.22
<b>Source Gas Analysis Data</b>	Run 1	Run 2	Run 3	Average
Carbon Dioxide, (%) dry:	2.0	2.2	2.1	2.07
Oxygen, (%) dry:	17.7	17.3	17.4	17.50
Nitrogen (%):	80.30	80.53	80.48	80.43
Dry Molecular Weight, lb/lb-Mole:	29.022	29.040	29.030	29.031
Molecular Weight, at Source Condition, lb/lb-Mole:	28.476	28.302	28.258	28.345
Calculated Fuel Factor, F <sub>o</sub> :	1.614	1.656	1.663	1.644
Fuel F-Factor, F <sub>d</sub> :	8710	8710	8710	
Excess Air (%):	514.13	436.84	458.48	469.82
<b>Source Gas Velocity &amp; Volumetric Flow Rate</b>	Run 1	Run 2	Run 3	Average
Pitot Tube Calibration Factor (C <sub>p</sub> ):	0.827	0.827	0.827	
Average Square Root Pitot Pressure, (in H <sub>2</sub> O):	0.032	0.032	0.032	0.032
Static Pressure, (in H <sub>2</sub> O):	0.0001	0.0001	0.0001	0.0001
Gas Temperature, degrees F:	1209.3	1205.9	1216.7	1210.6
Average Source Gas Velocity, ft/s:	3.20	3.21	3.23	3.21
Source Gas Flow Rate, acfm:	1,357	1,361	1,370	1,363
Source Gas Flow Rate, scfm:	410	411	410	410
Source Gas Flow Rate, dscfm:	389	383	381	385
Source Gas Flow Rate, dscm:	11.0	10.8	10.8	10.9



## Regulatory Compliance Testing Services Test Data Summary Table

Facility and Source Information				
Customer:	Muskegon River Compressor Station			
Source:	EUGLYCDEHY			
Work Order:	35787256			
Source Gas Concentrations and Emission Rates	Run 1	Run 2	Run 3	Average
<b>Benzene</b>				
Compound Molecular Weight:	78.11	78.11	78.11	
Compound / Adjusted Catch Weight (µg):	147.00	184.00	217.00	182.67
Concentration, mg/cubic meter:	5.47	6.87	8.11	6.82
Volume of air/gram mole @ 68 °F, liters:	24.05	24.05	24.05	
Concentration, ppmvw:	1.685	2.115	2.498	2.099
Emission Rate, lbs/hr:	0.0080	0.0099	0.0116	0.0098
Concentration, ppmvd:	1.773	2.266	2.686	2.242
<b>Ethylbenzene</b>				
Compound Molecular Weight:	106.17	106.17	106.17	
Compound / Adjusted Catch Weight (µg):	27.10	41.30	81.50	49.97
Concentration, mg/cubic meter:	1.01	1.54	3.05	1.87
Concentration, ppmvw:	0.229	0.349	0.690	0.423
Emission Rate, lbs/hr:	0.0015	0.0022	0.0044	0.0027
Concentration, ppmvd:	0.241	0.374	0.742	0.452
<b>Toluene</b>				
Compound Molecular Weight:	92.14	92.14	92.14	
Compound / Adjusted Catch Weight (µg):	179.00	216.00	290.00	228.33
Concentration, mg/cubic meter:	6.66	8.06	10.84	8.52
Concentration, ppmvw:	1.740	2.105	2.830	2.225
Emission Rate, lbs/hr:	0.0097	0.0116	0.0155	0.0123
Concentration, ppmvd:	1.830	2.256	3.043	2.376
<b>m + p + o-Xylenes</b>				
Compound Molecular Weight:	318.50	318.50	318.50	
Compound / Adjusted Catch Weight (µg):	112.60	131.10	201.90	148.53
Concentration, mg/cubic meter:	4.19	4.89	7.55	5.54
Concentration, ppmvw:	0.317	0.370	0.570	0.419
Emission Rate, lbs/hr:	0.0061	0.0070	0.0108	0.0080
Concentration, ppmvd:	0.333	0.396	0.613	0.447
<b>BTEX Emission Rate</b>				
EUGLYCDEHY Annual Operating Hours	8760	8760	8760	8760
Sum of BTEX Emission Rates, lbs/hr:	0.0253	0.0307	0.0422	0.0327
Sum of BTEX Components, ppmvw:	3.97	4.94	6.59	5.17
Sum of BTEX Components, ppmvd:	4.18	5.29	7.08	5.52
BTEX Emission Rate, Kg/Hr, dry basis:	1.21E-02	1.39E-02	1.91E-02	1.50E-02
BTEX Emission Rate, Megagrams/hr, dry basis:	1.21E-05	1.39E-05	1.91E-05	1.50E-05
BTEX Emission Rate, Megagrams/Yr, dry basis:	0.11	0.12	0.17	0.13