Source Test Report for 2024 Compliance Testing
EUENGINE07
Michigan Gas Utilities (MGU)
Partello Gas Storage
Olivet, Michigan

Prepared For:

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CERT #3925.01

Review and Certification

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project.

Signature:	Brandon Check	**Date:**	11 / 01 / 2024
Name:	Brandon Check	**Title:**	Client Project Manager

I have reviewed, technically and editorially, details, calculations, results, conclusions, and other appropriate written materials contained herein. I hereby certify that, to the best of my knowledge, the presented material is authentic, accurate, and conforms to the requirements of the Montrose Quality Management System and ASTM D7036-04.

Signature:		**Date:**	11 / 01 / 2024
Name:	Scott Brown, QSTI	**Title:**	Reporting Hub Manager - Midwest

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1.0 Introduction

1.1 Summary of Test Program

WEC Energy Group, Inc (WEC) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance emissions test program on the EUENGINE07 natural gas fired compressor engine at the Michigan Gas Utilities (MGU) Partello Gas Storage facility located in Olivet, Michigan.

The tests were conducted to satisfy the requirements of Permit to Install (PTI) 527-97F and the United States Environmental Protection Agency (U.S. EPA), 40 CFR 60, Subpart JJJJ, as applicable.

The specific objectives were to:

- Determine the nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), methane (CH_4), ethane (C_2H_6), and formaldehyde (HCHO) concentrations and emissions from the exhaust of EUENGINE07
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

Table 1-1
Summary of Test Program

Test Date	Unit ID/ Source Name	Activity/Parameters	Test Methods	No. of Runs	Duration (Minutes)
9/12/2024	EUENGINE07	O_2, CO_2	EPA 3A	3	60
		NO_x	EPA 7E	3	60
		CO	EPA 10	3	60
		Emission Rate Calculation	EPA 19	3	60
		VOC	EPA 25A	3	60
		H_2O, CH_4, C_2H_6, HCHO	EPA 320	3	60

To simplify this report, a list of Units and Abbreviations is included in Appendix C.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized and compared to their respective permit limits in Table 1-2. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-3. The tests were conducted according to the test plan (protocol) dated July 7, 2024 that was submitted to EGLE.

Table 1-2
Summary of Average Compliance Results – EUENGINE07

September 12, 2024

Parameter/Units	Average Results	Emission Limits
Nitrogen Oxides (NO_x)		
ppmvd	111	--
ppmvd @ 15% O_2	53.3	82
g/hp-hr	0.377	1.0
Carbon Monoxide (CO)[1]		
ppmvd	<1.89	--
ppmvd @ 15% O_2	<0.91	270
g/hp-hr	<0.004	2.0
Total Non-Methane/Non-Ethane Hydrocarbons, as Carbon (VOC)[2]		
ppmvd	77.8	--
ppmvd @ 15% O_2	37.3	60
g/hp-hr	0.069	0.7

[1]Measured CO concentrations were below the detectable limit. Reported values were calculated using the MDL
[2]Formaldehyde was also subtracted as it is an exempt compound

1.2 Key Personnel

A list of project participants is included below:

Facility Information

Source Location:	WEC Energy Group MGU Partello Gas Storage 21663 24 Mile Road Olivet, MI 49076
Project Contact:	James Jensen
Telephone:	414-221-2530
Email:	james.jensen@wecenergygroup.com

Agency Information

Regulatory Agency:	Michigan Department of Environment, Great Lakes and Energy
Agency Contact:	Jeremy Howe
Telephone:	231-878-6687
Email:	Howej@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC
Contact:	Brandon Check
Title:	Client Project Manager
Telephone:	630-860-4740
Email:	bcheck@montrose-env.com

Test personnel and observers are summarized in Table 1-3.

Table 1-3
Test Personnel and Observers

Name	Affiliation	Role/Responsibility
Brandon Check	Montrose	Project Manager/Field Team Leader/Qualified Individual (QI)/Trailer operator
Scott Dater	Montrose	Qualified Individual (QI)/FTIR operator
John Ziber	Montrose	Field Support
Sean Dyra	Montrose	Calculations and report preparation
James Jensen	WEC Energy Group	Observer/Client Liaison/Test Coordinator

2.0 Plant and Sampling Location Descriptions

2.1 Process Description, Operation, and Control Equipment

Partello Gas Storage provides seasonal natural gas storage for local natural gas customers within the Michigan Gas Utilities Corporation (MGU) service territory. Partello Gas Storage is permitted under Permit-To-Install (PTI) No. 527-97F. Compressor #7 is a Caterpillar Model G3516J Engine. It is rated at 1380 brake horsepower. It is a four stroke lean burn spark ignition engine. The engine has an oxidation catalyst for control.

2.2 Flue Gas Sampling Location

Information regarding the sampling location is presented in Table 2-1.

Table 2-1
Sampling Location

Sampling Location	Number of Traverse Points
EUENGINE07	Gaseous: 3

2.3 Operating Conditions and Process Data

Emission tests were performed while the source/units and air pollution control devices were operating at the conditions required by the permit. The unit was tested when operating as close to full load as possible.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B. Data collected includes the following parameters:

- Ambient temperature, °F
- Barometric pressure, in. Hg
- Humidity, %
- Load, %
- Catalyst Dp, in. H_2O
- Catalyst temperature, °F
- Fuel flow, MSCFH
- Heating value, BTU
- Heat input, MMBtu/hr
- Engine power, hp

3.0 Sampling and Analytical Procedures

3.1 Test Methods

The test methods for this test program have been presented in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Methods 3A, 7E, and 10, Determination of Oxygen, Nitrogen Oxides, and Carbon Monoxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

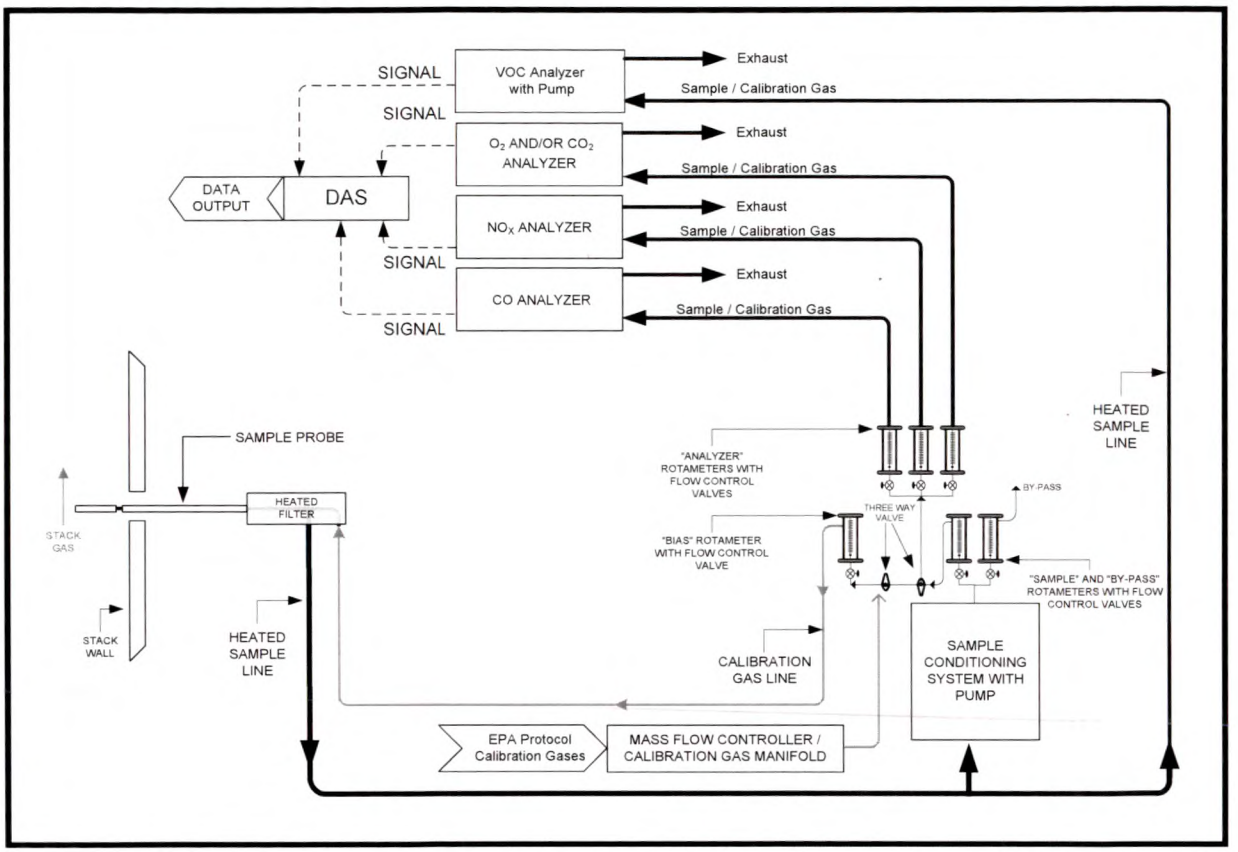
Concentrations of O_2, NO_X, and CO are measured simultaneously using EPA Methods 3A, 7E, and 10, which are instrumental test methods. Conditioned gas is sent to a series of analyzers to measure the gaseous emission concentrations. The performance requirements of the method must be met to validate the data.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
  - A dry extractive sampling system is used to report emissions on a dry basis
  - A paramagnetic analyzer is used to measure O_2
  - A chemiluminescent analyzer is used to measure NO_X
  - A gas filter correlation nondispersive infrared analyzer is used to measure CO
  - Calibration span values are 21.02% O_2, 435.2 ppmvd NO_X, and 94.51 ppmvd CO
  - Three-point sample traverses were conducted for all runs
- Method Exceptions:
  - For gaseous emissions sampling, MDL are calculated for each analyzer. The ISDL is equal to the sensitivity of the instrumentation, which is 2% of the span value.
- Target and/or Minimum Required Sample Duration: 60 minutes
- Target Analytes: O_2, NO_X, and CO

The typical sampling system is detailed in Figure 3-1.

Figure 3-1
EPA Method 3A, 7E, 10, and 25A Sampling Train



3.1.2 EPA Method 19, Measurement of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

EPA Method 19 is used to calculate mass emission rates in units of lb/MMBtu. EPA Method 19 is also used to calculate the stack gas volumetric flow rate from the measurement of the heat input rate, stack concentration of O_2 or CO_2, and an F factor determined from fuel analysis. Volumetric flow rates are used to calculate mass emission rates in units of lb/hr.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
  - F factor is the oxygen-based F factor, dry basis (F_d)
- Method Exceptions:
  - None

3.1.3 EPA Method 25A, Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer

EPA Method 25A is an instrumental test method used for the determination of total gaseous organic concentration of vapors in stack gas. A gas sample is extracted from the source through a heated sample line and glass fiber filter to an FIA. Results are reported as THC as volume concentration equivalents of the calibration gas, typically propane, or as carbon equivalents.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
  - Results are reported in terms of carbon
  - THC emissions on a carbon basis are calculated by multiplying the concentrations as C_3H_8 by a factor of 3
- Method Exceptions:
  - For gaseous emissions sampling, MDL are calculated for each analyzer. The ISDL is equal to the sensitivity of the instrumentation, which is 2% of the span value.
- Target and/or Minimum Required Sample Duration: 60 minutes

The typical sampling system is detailed in Figure 3-1.

3.1.4 EPA Method 320, Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive FTIR Spectroscopy

EPA Method 320 is an instrumental test method used to measure specific analyte concentrations for which EPA reference spectra have been developed or prepared. Extractive emission measurements are performed using FTIR spectroscopy. The FTIR analyzer is composed of a spectrometer and detector, a high optical throughput sampling cell, analysis software, and a quantitative spectral library. The analyzer collects high resolution spectra in the mid infrared spectral region (400 to 4,000 cm^{-1}), which are analyzed using the quantitative spectral library. This provides an accurate, highly sensitive measurement of gases and vapors.

Pertinent information regarding the performance of the method is presented below:

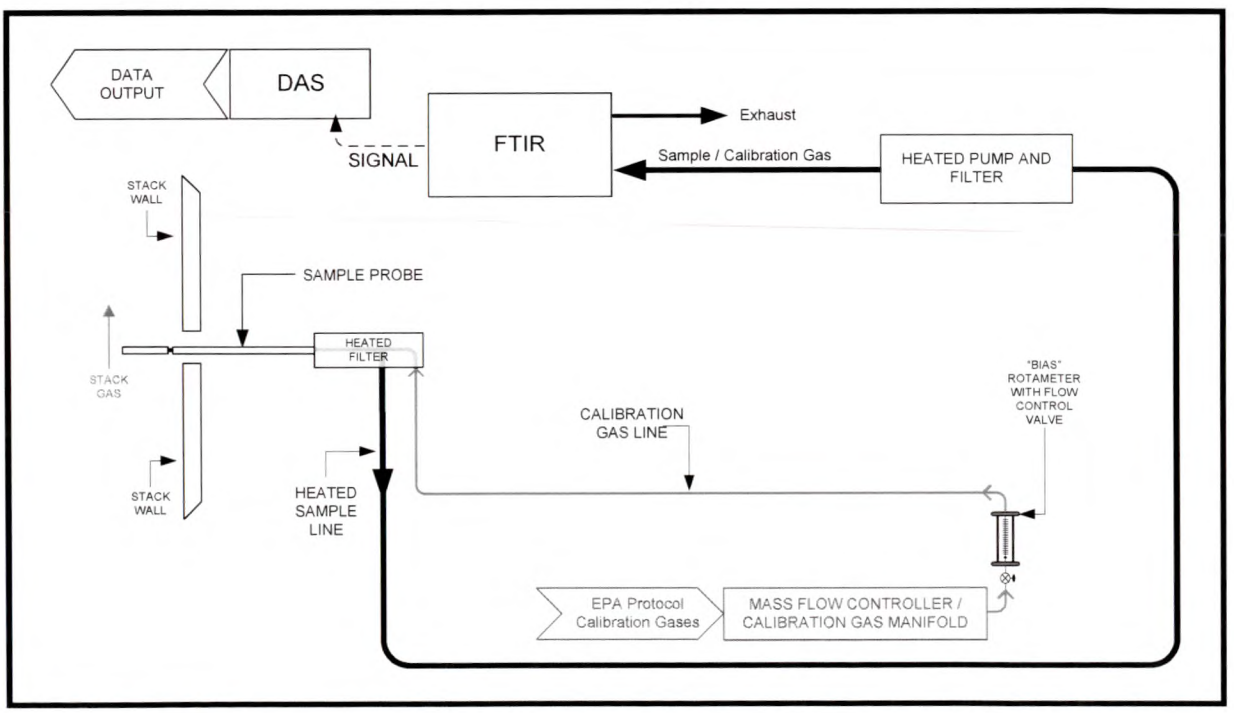
- Method Options:
  - The specific analyte concentrations include H_2O, methane, ethane, and formaldehyde
  - Continuous static sampling is performed at a flow rate of approximately 6 liters per minute
  - Previous spiking studies validate the use of FTIR spectroscopy to accurately measure the concentrations of the specific analytes from similar sources

- A dynamic matrix spike is performed using acetaldehyde as a surrogate analyte gas standard and SF_6 as a tracer gas

- Method Exceptions:
  - To calculate the MDL for the target analytes, the guidelines in Appendix B of 40 CFR 136 are followed using the Student t-test to calculate the MDL for each analyte at a 99% confidence level. This follows EPA guidelines for reporting of zeroes or non-detects and also meets the NELAC requirements for determination of MDL values.
  - Independent calculations of optical path length are not performed because the instrument has a fixed path of 5.11 meters
- Target and/or Minimum Required Sample Duration: 60 minutes

The typical sampling system is detailed in Figure 3-2.

Figure 3-2
EPA Method 320 Sampling Train



3.2 Process Test Methods

The test plan did not require that process samples be collected during this test program; therefore, no process sample data are presented in this test report.

4.0 Test Discussion and Results

4.1 Field Test Deviations and Exceptions

No field deviations or exceptions from the test plan or test methods occurred during this test program.

4.2 Presentation of Results

The average results are compared to the permit limits in Table 1-2. The results of individual compliance test runs performed are presented in Table 4-1. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

Table 4-1
NO_x, CO, and VOC Emissions Results -
EUENGINE07

Parameter/Units	Run 1	Run 2	Run 3	Average
Date	9/12/2024	9/12/2024	9/12/2024	--
Time	9:10-10:10	10:34-11:34	12:00-13:00	--
Process Data				
Load, %	89.0	88.0	88.0	88.3
Heat Input, MMBtu/hr	5.19	5.16	5.12	5.16
Engine Power, hp	1228.2	1214.4	1214.4	1219.0
Sampling & Flue Gas Parameters				
O_2, % volume dry	8.6	8.6	8.6	8.6
moisture content, % volume	13.3	13.3	13.1	13.2
Nitrogen Oxides (NO_x)				
ppmvd	112	111	111	111
ppmvd @ 15% O_2	53.4	53.4	53.3	53.3
lb/MMBtu	0.197	0.197	0.196	0.197
lb/hr	1.02	1.01	1.00	1.01
g/hp-hr	0.377	0.379	0.375	0.377
Carbon Monoxide (CO)[1]				
ppmvd	<1.89	<1.89	<1.89	<1.89
ppmvd @ 15% O_2	<0.90	<0.91	<0.91	<0.91
lb/MMBtu	<0.002	<0.002	<0.002	<0.002
lb/hr	<0.01	<0.01	<0.01	<0.01
g/hp-hr	<0.004	<0.004	<0.004	<0.004
Total Hydrocarbons, as Carbon (VOC)				
ppmvd	1,330	1,287	1,292	1,303
Methane (CH_4), as Carbon				
ppmvd	1,113	1,105	1,103	1,107
Ethane (CO), as Carbon				
ppmvd	119.3	118.2	115.4	117.6
Formaldehyde (HCHO), as Carbon				
ppmvd	0.94	0.95	0.94	0.94

[1]Measured CO concentrations were below the detectable limit

Table 4-1
NO_x, CO, and VOC Emissions Results –
EUENGINE07 (continued)

Parameter/Units	Run 1	Run 2	Run 3	Average
Total Non-Methane/Non-Ethane Hydrocarbons, as Carbon (VOC)[2]				
ppmvd	97.0	63.5	73.0	77.8
ppmvd @ 15% O_2	46.4	30.4	35.1	37.3
lb/MMBtu	0.0446	0.0293	0.0337	0.0359
lb/hr	0.23	0.15	0.17	0.19
g/hp-hr	0.086	0.056	0.064	0.069

[2]Formaldehyde was also subtracted as it is an exempt compound

5.0 Internal QA/QC Activities

5.1 QA/QC Audits

EPA Method 3A, 7E, and 10 calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks.

EPA Method 25A FIA calibration audits were within the measurement system performance specifications for the calibration drift checks and calibration error checks.

The NO_2 to NO converter efficiency check of the analyzer was conducted per the procedures in EPA Method 7E, Section 8.2.4. The conversion efficiency met the criteria.

The EPA Method 320 performance parameters measured included signal to noise tests, noise equivalent absorbance (NEA), detector linearity, background spectra, potential interferents, and cell and system leakage. Quality assurance procedures included baseline measurement with ultra-high purity nitrogen, measurement of a calibration transfer standard (~100 ppm ethylene), direct analyte calibration measurements, and measurements to determine baseline shift. SF_6 was also used as a tracer gas in the calibration gases to evaluate dilution ratios and verify the sample delivery system integrity. A dynamic matrix spike was performed using SF_6 as a tracer gas. The method QA/QC criteria were met.

5.2 QA/QC Discussion

All QA/QC criteria were met during this test program.

5.3 Quality Statement

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).