

AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF AIR POLLUTANT EMISSIONS
FROM AN ENCLOSED FLARE

Prepared for:
Ottawa County Farms Landfill
SRN N3294

Test Date: August 21, 2024

ICT Project No.: 2400144
September 25, 2024



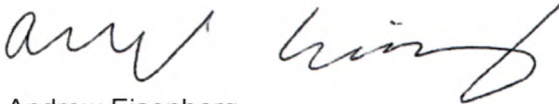
Report Certification

AIR EMISSION TEST REPORT FOR THE VERIFICATION OF AIR POLLUTANT EMISSIONS FROM AN ENCLOSED FLARE

**Ottawa County Farms Landfill
Coopersville, MI**

This document was prepared by Impact Compliance & Testing, Inc. and reviewed by Ottawa County Farms Landfill (OCFL) representatives and approved for submittal to the State of Michigan Department of Environment, Great Lakes, and Energy – Air Quality Division (EGLE-AQD) as part of air emission test event that took place on August 21, 2024.

IMPACT COMPLIANCE & TESTING, INC.



Andrew Eisenberg
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1 Introduction

OCFL operates a landfill gas (LFG) fueled enclosed flare at its facility in Coopersville, Ottawa County, Michigan.

EGLE-AQD has issued to OCFL Renewable Operating Permit (ROP) No. MI-ROP-N3294-2024, which consists of:

- One (1) enclosed flare identified as emission unit EUENCLOSEDFLARE (EUEF).

Air emission compliance testing was performed pursuant to conditions of MI-ROP-N3294-2024 and the federal Standards of Performance for Municipal Solid Waste Landfills (40 CFR 60, Subpart XXX, and 40 CFR 63, Subpart AAAA).

The compliance testing presented in this report was performed by Impact Compliance & Testing, Inc. (ICT), a Michigan-based environmental consulting and testing company. ICT representative Andrew Eisenberg and Clay Gaffey performed the field sampling and measurements on August 21, 2024.

The enclosed flare performance tests consisted of triplicate, one-hour sampling periods for carbon Monoxide (CO) and non-methane organic compounds (NMOC, as non-methane hydrocarbons (NMHC)). Exhaust gas velocity, moisture, oxygen (O₂) content, and carbon dioxide (CO₂) content were determined for each test period to calculate pollutant mass emission rates and NMOC concentrations, corrected to parts per million by volume, dry basis (ppmvd) as hexane @ 3% O₂, for comparison to the permit limit.

The exhaust gas sampling and analysis was performed using procedures specified in the Stack Test Protocol submitted June 6, 2024, that was reviewed and approved by EGLE-AQD. Mr. Chris Robinson of EGLE-AQD observed portions of the compliance testing.

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2 Summary of Test Results and Operating Conditions

2.1 Purpose and Objective of the Tests

Conditions of MI-ROP-3294-2024 and the federal Standards of Performance for Municipal Solid Waste Landfills (40 CFR 60, Subpart XXX, and 40 CFR 63, Subpart AAAA) require OCFL to test an enclosed flare (EUENCLOSEDFLARE) for air pollutant emissions. EUENCLOSEDFLARE was tested during this compliance test event.

2.2 Operating Conditions During the Compliance Tests

The flare testing was performed while EUENCLOSEDFLARE was operated at maximum achievable operating capacity based on the amount of fuel gas that was available at the time of testing. OCFL representatives monitored and recorded the combustion zone temperature (°F), fuel use (scfm), and fuel methane content (%) at 15-minute intervals for each test period.

Attachment 2 provides operating records provided by OCFL representatives for the test periods.

Average process operating data for the emission unit is presented in Tables 2.1 and 6.1.

2.3 Summary of Air Pollutant Sampling Results

The gases exhausted from the sampled enclosed flare were sampled for three (3) one-hour test periods during the compliance testing performed August 21, 2024.

Table 2.2 presents the average measured required air pollutant data for the enclosed flare (Average of the three test periods)

Test results for each one-hour sampling period and comparison to the permitted emission rates are presented in Section 6.0 of this report

Table 2.1: Average operating conditions during enclosed flare the test periods

Emission Unit	Combustion Temperature (°F)	LFG Fuel Use (SCFM)	LFG CH ₄ Content (%)
EUENCLOSEDFLARE	1,640	1,795	50.9

Table 2.2: Average measured air pollutant data for the enclosed flare

Emission Unit	CO	NMOC
	(lb/MMBtu)	(ppmvd as hexane @ 3% O ₂)
EUENCLOSEDFLARE	0.056	0.0052
<i>Permit Limit</i>	<i>0.20</i>	<i>20</i>

3 Source and Sampling Location Description

3.1 General Process Description

OCFL is permitted to operate one (enclosed flare at its facility. The unit is fired exclusively with LFG that is recovered from the OCFL facility and treated prior to use.

3.2 Rated Capacities and Air Emission Controls

The enclosed flare has a rated LFG use rate of 3,700 scfm.

The enclosed flare serves as a backup control device for LFG generated at the OCF landfill. The enclosed flare is not equipped with add-on emission control equipment.

3.3 Sampling Locations

The enclosed flare exhaust gas is released to the atmosphere through a dedicated vertical exhaust stack with a vertical release point.

The enclosed flare sampling ports are located in the vertical exhaust stack with an inner diameter of 132 inches. The stack is equipped with four (4) sampling ports, each opposed by 90°, that provide a sampling location at least 0.5 duct diameters upstream and at least 2.0 duct diameters downstream from any flow disturbance and satisfies the USEPA Method 1 criteria for a representative sample location.

All sample port locations satisfy the USEPA Method 1 criteria for a representative sample location. Individual travers points were determined in accordance with USEPA Method 1.

Attachment 1 provides a diagram of the mission test sampling locations with actual stack dimension measurements.

4 Sampling and Analytical Procedures

A Stack Test Protocol for the air emission testing was reviewed and approved by EGLE-AQD. This section provides a summary of the sampling and analytical procedures that were used during the testing periods.

4.1 Summary of Sampling Methods

USEPA Method 1	Exhaust gas velocity measurement locations were determined based on the physical stack arrangement and requirements in USEPA Method 1.
USEPA Method 2	Exhaust gas velocity pressure was determined using a Type-S Pitot tube connected to a red oil incline manometer; temperature was measured using a K-type thermocouple connected to the Pitot tube.
USEPA Method 3A	Exhaust gas O ₂ and CO ₂ content was determined using paramagnetic and infrared instrumental analyzers, respectively.
USEPA Method 4	Exhaust gas moisture was determined based on the water weight gain in chilled impingers.
USEPA Method 10	Exhaust gas CO concentration was measured using an infrared instrumental analyzer.
USEPA Method 25A / ALT-097	Exhaust gas NMOC (as NMHC) concentration was determined using a flame ionization analyzer equipped with a methane separation column.

4.2 Exhaust Gas Velocity Determination (USEPA Method 2)

Exhaust stack gas velocities and volumetric flow rates were determined using USEPA Method 2 once during each test period. An S-type Pitot tube connected to a red-oil manometer was used to determine velocity pressure at each travers point across the stack cross section. Gas temperature was measured using a K-type thermocouple mounted to the pitot tube. The Pitot tube and connective tubing were leak-checked periodically throughout the test periods to verify the integrity of the measurement system.

The absence of significant cyclonic flow at each sampling location was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each velocity traverse point with the planes of the face openings of the Pitot tube perpendicular to the stack cross-sectional plane. The Pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

Attachment 3 provides exhaust gas flowrate calculations and field data sheets.

4.3 Exhaust Gas Molecular Weight Determination (USEPA Method 3A)

CO₂ and O₂ content in the enclosed flare exhaust gas stream were measured continuously throughout each test period in accordance with USEPA Method 3A. The CO₂ content of the exhaust was monitored using a M&C GenTWO infrared gas analyzer. The O₂ content of the exhaust was monitored using a M&C GenTWO gas analyzer that uses a paramagnetic sensor.

During each sampling period, a continuous sample of the exhaust gas stream was extracted from the stack using an Inconel probe connected to a Teflon® heated sample line. The sampled gas was conditioned by removing moisture prior to being introduced to the analyzers; therefore, measurement of O₂ and CO₂ concentrations correspond to standard dry gas conditions. Instrument response data were recorded using an ESC Model 8864 data acquisition system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages.

Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document). Sampling times were recorded on field data sheets.

Attachment 4 provides O₂ and CO₂ calculation sheets. Raw instrument response data are provided in Attachment 5.

4.4 Exhaust Gas Moisture Content (USEPA Method 4)

Moisture content of the enclosed flare exhaust gas stream was determined in accordance with USEPA Method 4 using a chilled impinger sampling train. Exhaust gas moisture content measurements were performed concurrently with the instrumental analyzer sampling periods. At the conclusion of each sampling period the moisture gain in the impingers was determined gravimetrically by weighing each impinger to determine net weight gain.

4.5 CO Concentration Measurements (USEPA Method 10)

CO pollutant concentration in the enclosed flare exhaust gas stream was determined using a M&C GenTWO infrared CO analyzer.

Throughout each test period, a continuous sample of the engine exhaust gas was extracted from the stack using the Teflon® heated sample line and gas conditioning system and delivered to the instrumental analyzers. Instrument response for each analyzer was recorded on an ESC Model 8864 data acquisition system that logged data as one-minute averages. Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias.

Attachment 4 provides CO calculation sheets. Raw instrument response data are provided in Attachment 5.

4.6 NMOC Concentration Measurements (USEPA Method 25A/ALT-097)

The NMOC concentration in the enclosed flare exhaust gas stream was measured continuously throughout each test period in accordance with USEPA Method 25A / ALT-097. NMOC pollutant concentration was determined using a Thermo Environmental Instruments, Inc. (TEI) Model 55i Methane / non-methane hydrocarbon (non-methane organic compound) analyzer. The TEI 55i analyzer contains an internal gas chromatograph column that separates methane from non-methane components. The concentration of NMOC in the sampled gas stream, after separation from methane, is determined relative to a propane standard using a flame ionization detector in accordance with USEPA Method 25A.

The USEPA Office of Air Quality Planning and Standards (OAQPS) has issued an alternative test method approving the use of the TEI 55i-series analyzer as an effective instrument for measuring NMOC from LFG fueled sources (ALT-097).

Samples of the exhaust gas were delivered directly to the instrumental analyzer using the Teflon® heated sample line to prevent condensation. The sample to the NMHC analyzer was not conditioned to remove moisture. Therefore, NMOC measurements correspond to standard conditions with no moisture correction (wet basis).

Prior to, and at the conclusion of each test, the instrument was calibrated using mid-range calibration (propane) and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document).

Appendix 3 provides NMOC calculation sheets. Raw instrument response data for the NMHC analyzer is provided in Appendix 4.

5 QA/QC Activities

A Stack Test Protocol for the air emission testing was reviewed and approved by EGLE-AQD. This section provides a summary of the sampling and analytical procedures that were used during the testing periods.

5.1 Flow Measurement Equipment

Prior to arriving onsite, the instruments used during the source test to measure exhaust gas properties and velocity (pyrometer, Pitot tube, and scale) were calibrated to specifications in the sampling methods.

5.2 Gas Divider Certification (USEPA Method 205)

A STEC Model SGD-710C 10-step gas divider was used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified (within the last 12 months) with a primary flow standard in accordance with Method 205. When cut with an appropriate zero gas, the ten-step STEC gas divider delivered calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas that was introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 were followed prior to use of gas divider. The field evaluation yielded no errors greater than 2% of the triplicate measured average and no errors greater than 2% from the expected values.

5.3 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure CO, O₂, and CO₂ have had an interference response test performed prior to their use in the field, pursuant to the interference response test procedures specified in USEPA Method 7E. The appropriate interference test gases (i.e., gases that would be encountered in the exhaust gas stream) were introduced into each analyzer, separately and as a mixture with the analyte that each analyzer is designed to measure. All of the analyzers exhibited a composite deviation of less than 2.5% of the span for all measured interferent gases. No major analytical components of the analyzers have been replaced since performing the original interference tests.

5.4 Instrument Calibration and System Bias Checks

At the beginning of each day of the testing program, initial three-point instrument calibrations were performed for the CO, CO₂, and O₂ analyzers by injecting calibration gas directly into the inlet sample port for each instrument. System bias checks were performed prior to and at the conclusion of each sampling period by introducing the upscale calibration gas and zero gas into the sampling system (at the base of the Inconel sampling probe prior to the particulate filter and Teflon® heated sample line) and determining the instrument response against the initial instrument calibration readings.

At the beginning of the test day, appropriate high-range, mid-range, and low-range span gases followed by a zero gas were introduced to the NMHC analyzer, in series at a tee connection, which is installed between the sample probe and the particulate filter, through a poppet check valve. After each one-hour test period, mid-range and zero gases were re-introduced in series at

the tee connection in the sampling system to check against the method's performance specifications for calibration drift and zero drift error.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO₂, O₂, and CO in nitrogen and zeroed using hydrocarbon free nitrogen. The NMHC (NMOC) instrument was calibrated with USEPA Protocol 1 certified concentrations of propane in air and zeroed using hydrocarbon-free air. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

5.5 Determination of Exhaust Gas Stratification

A stratification test was performed for each port on the exhaust stack. The stainless-steel sample probe was positioned at multiple sample points across each plane of the stack diameter. Pollutant concentration data were recorded at each sample point for a minimum of twice the maximum system response time.

The recorded concentration data for the enclosed flare exhaust stack indicated that the measured O₂ concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the enclosed flare exhaust gas was considered to be unstratified and the compliance test sampling was performed at a single sampling location within the enclosed flare exhaust stack.

5.6 System Response Time

The response time of the sampling system was determined prior to the compliance test program by introducing upscale gas and zero gas, in series, into the sampling system using a tee connection at the base of the sample probe. The elapsed time for the analyzer to display a reading of 95% of the expected concentration was determined using a stopwatch.

Sampling periods did not commence until the sampling probe had been in place for at least twice the greatest system response time.

5.7 Meter Box Calibrations

The dry gas meter sampling console used for moisture testing was calibrated prior to and after the testing program. This calibration uses the critical orifice calibration technique presented in USEPA Method 5. The metering console calibration exhibited no data outside the acceptable ranges presented in USEPA Method 5.

The digital pyrometer in the metering console was calibrated using a NIST traceable Omega® Model CL 23A (or equivalent) temperature calibrator.

6 Source and Sampling Location Description

6.1 Test Results and Allowable Limits

Enclosed flare operating data and air pollutant concentration measurement results for each one-hour test period are presented in Table 6.1.

The enclosed flare has the following allowable limit specified in MI-ROP-N3294-2024:

- 20 ppmvd as hexane @ 3% O₂ for NMOC
- 0.20 lb/MMBtu for CO

The measured NMOC and CO concentration for EUENCLOSEDFLARE is less than the allowable limit specified in MI-ROP-N3294-2024.

6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with USEPA methods and the approved Stack Test Protocol.

The testing was performed while the flare operated at maximum achievable operating capacity based on the amount of fuel that was available at the time of testing. No variations from normal operating conditions occurred during the test periods.

Table 6.1: Measured exhaust gas conditions and air pollutant emission rates for EUENCLOSEDFLARE

Test No.	1	2	3	
Test date	8/21/2024	8/21/2024	8/21/2024	Three Test
Test period (24-hr clock)	0845-0945	1010-1110	1135-1235	Average
Combustion temperature (°F)	1,646	1,629	1,645	1,640
Fuel flowrate (scfm)	1,801	1,799	1,785	1,795
LFG methane content (%)	50.9	50.4	51.4	50.9
Calculated MMBtu content	50.0	49.5	50.1	49.8
<u>Exhaust Gas Composition</u>				
CO ₂ content (% vol)	7.12	7.08	7.05	7.08
O ₂ content (% vol)	13.1	13.1	13.2	13.1
Moisture (% vol)	10.2	8.6	7.9	8.9
Exhaust gas temperature (°F)	1,442	1,394	1,403	1,413
Exhaust gas flowrate (dscfm)	25,697	29,139	28,703	27,846
Exhaust gas flowrate (scfm)	28,611	31,897	31,157	30,555
<u>Carbon Monoxide</u>				
CO conc. (ppmvd)	21.6	28.8	17.7	22.7
CO emissions (lb/hr)	2.42	3.66	2.21	2.77
CO emissions (lb/MMBtu)	0.05	0.07	0.04	0.06
CO permit limit (lb/MMBTU)	-	-	-	0.20
<u>Non-Methane Organic Compounds</u>				
NMOC conc. (ppmv) ¹	0.00	0.01	0.05	0.00
NMOC emissions (ppmvd as C ₆) ²	0.00	0.01	0.07	0.01
NMOC permit limit (ppmvd as C₆)²	-	-	-	20

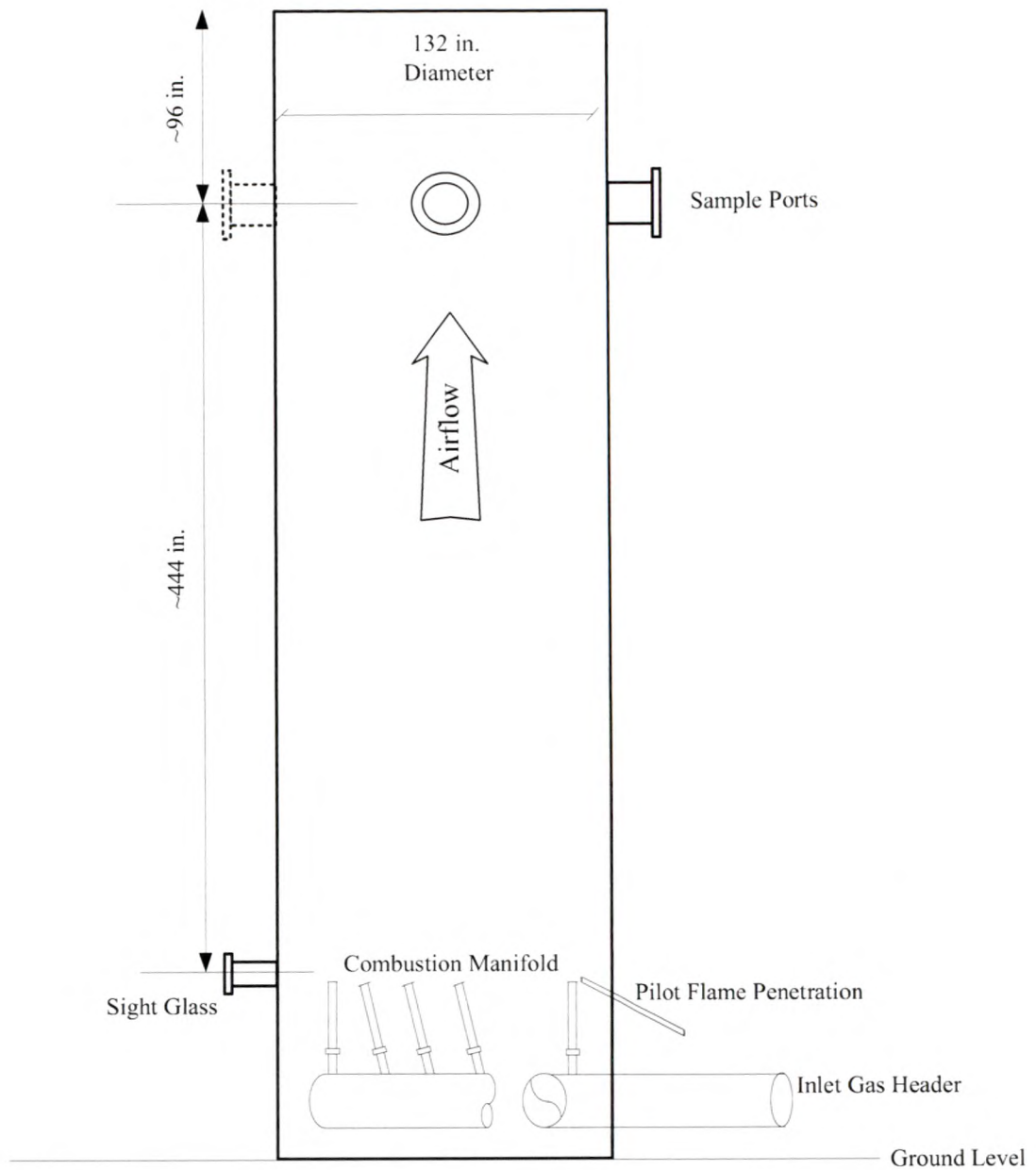
1. Measured as non-methane hydrocarbons, as propane.

2. Parts per million by volume, dry basis (ppmvd) as hexane (C₆) @ 3% oxygen.

Attachment 1

Sample Port Diagram

EUENCLOSEDFLARE



Enclosed Flare Sampling and Measurement Locations

5/5/2022	Ottawa County Farms Landfill		
	EUENCLOSEDFLARE Exhaust Sample Location		
	Scale	Sheet	
	None	1 of 1	