Compliance Test Report
Utility Flare Performance Test

City of Midland Utilities Division
Midland, Michigan

June 28, 2024

Prepared for:
City of Midland Utilities Division
4311 East Ashman Street
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CONTENTS

Section		Page
Executive Summary		iii
1.0	INTRODUCTION	1
2.0	SUMMARY OF RESULTS	2
3.0	SOURCE DESCRIPTION	2
4.0	SAMPLE AND ANALYTICAL PROCEDURES	3
5.0	RESULTS AND DISCUSSION	5

Tables

1 Utility Flare Inlet Net Heating Value
2 Utility Flare Inlet Volumetric Flow Rate and Flare Exit Velocity

Figures

1 Utility Flare Schematic
2 USEPA Method 3C Sample Train

Appendices

A FIELD AND CALCULATED DATA SHEETS
B FLARE FLOW DATA
C LABORATORY ANALYTICAL REPORT
D SAMPLE CALCULATIONS
E FLOW METER CALIBRATION

EXECUTIVE SUMMARY

The City of Midland Utilities Division (Midland) retained Environmental Information Logistics, LLC (EIL) to conduct a performance evaluation of the utility (open) flare located at the City of Midland Landfill in Midland, Michigan. The utility flare is an auxiliary control device to control landfill gas generated by the City of Midland Landfill.

The purpose of the test program was to demonstrate that the utility flare meets the performance requirements of the site's renewable operating permit (ROP) conditions FGOPENFLARE-AAAA V.1 and FGOPENFLARE-OOO V.1. These conditions cite §63.11(b) of the Landfill NESHAP and 40 CFR §60.18 as referenced in §62.16714(c)(1) of the Federal Plan.

EIL conducted the testing on June 4, 2024 in accordance with the Test Plan submitted to EGLE, dated April 24, 2024. Ms. Gina McCann with Michigan Department of Environment, Great Lakes, and Energy (EGLE) reviewed and approved the test plan. Mr. Ben Kotrba conducted the tests. Mr. Scott O'Laughlin with Midland provided on-site coordination of the tests with landfill operations.

The results of the performance evaluations were:

Parameter	Applicable Requirement	Average Test Result
Flare Exhaust Smoke Emissions (Visual Emissions in a 2-hour Period)	<5 minutes over 2 hours [1]	0 minutes, 2 seconds
Flare Inlet Gas Net Heating Value (MJ/scm)	>7.45 [2]	17.56
Flare Exhaust Gas Exit Velocity (Feet per second)	<60 [3]	10.39
Maximum Permitted Velocity (V_{max}, feet per second)	<124.15[4]	10.39

MJ: megajoules
scm: standard cubic meter

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[1] 40 CFR 63.11(b)(4), 60.18(c)(1)
[2] 40 CFR 63.11(b)(6)(ii), 60.18(c)(3)(ii)
[3] 40 CFR 63.11(b)(7)(i), 60.18(c)(4)(i)
[4] 40 CFR 63.11(b)(7)(iii), 60.18(c)(4)(iii)

1.0 INTRODUCTION

The latest Renewable Operating Permit (ROP) for the The City of Midland Utilities Division (Midland) was issued on December 20, 2023. Conditions FGOPENFLARE-OOO V.3 & FGOPENFLARE-AAAA V.3 now require that landfills with open flares conduct a new performance test within 180 days of permit issuance to demonstrate compliance with 40 CFR §60.18 and §63.11(b). Midland therefore retained Environmental Information Logistics, LLC (EIL) to conduct a performance evaluation of the utility (open) flare located at the City of Midland Landfill (the Landfill) in Midland, Michigan.

The utility flare is an auxiliary control device to control landfill gas emissions from the Landfill. The main control devices are two landfill gas engines at the City-owned landfill gas to energy plant. These engines were shut down during the testing in order to provide maximum gas flow to the flare.

EIL conducted the test program with methodologies outlined in 40 CFR 63.11(b) and 60.18, except that United States Environmental Protection Agency (USEPA) Method 3C, *"Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources,"* was employed for net heating value determination in lieu of Method 18 and ASTM D1946. Method 3C is the applicable method for utility flares at landfills, in accordance with 40 CFR §63.1959(e) and 40 CFR §62.16718(d).

Flare performance testing was conducted on June 4, 2024 per the approved Test Plan dated April 24, 2024. Mr. Ben Kotrba of EIL conducted the tests. Mr. Scott O'Laughlin with the City of Midland Landfill provided on-site coordination of the tests with landfill operations.

The name, address, and telephone number of the primary contact for further information about the tests and this test report is:

Name and Title	**Company**	**Telephone**
Mr. Ben Kotrba Environmental Scientist	Environmental Information Logistics, LLC 707 South Chilson Street Bay City, MI 48706	(989) 415-3741

The name, address, and telephone number of the primary contact for further information about the flare and associated operations is:

Name and Title	**Company**	**Telephone**
Mr. Scott O'Laughlin Landfill Superintendent	The City of Midland Utilities Division 4311 East Ashman Street Midland, Michigan 48415	(989) 837-6989

2.0 SUMMARY OF RESULTS

On June 4, 2024, the utility flare operated at an inlet volumetric flow rate of approximately 490 scfm as averaged from the manually recorded process flow meter data and 490 scfm as averaged from the data recorder data.

The test results were:

1) Visible emissions: 0 minutes, 2 seconds (accumulated, total),
2) Average net heating value of the gas being combusted: 17.56 megajoules per standard cubic meter (MJ/scm), and
3) Average exhaust gas exit velocity: 10.39 feet per second (fps).

The performance criteria are less than 5 minutes visible emissions in a 2-hour period, a net heating value of greater than 7.45 MJ/scm, and an exit velocity less than 60 fps (or less than the maximum permitted velocity (V_{max}), calculated to be 88.21 fps).

The test results demonstrate that that utility flare meets the performance requirements of §63.11(b), §60.18, and thus also satisfies the requirements of 63.1959(b)(2)(iii)(B) and 62.16714(c)(2), at the test flow rate.

3.0 SOURCE DESCRIPTION

Midland is an active municipal solid waste (MSW) landfill. Anaerobic bacteria decompose the emplaced waste. The primary by-products of decomposition are methane (~40-50%, typical) and carbon dioxide (~35-45%, typical). Landfill gas also contains nitrogen, oxygen, sulfur compounds and trace amounts of non-methane organic compounds. The landfill gas flow rate is variable and depends on gas production in the landfill. The composition of the landfill gas varies, but the average Method 3C values obtained on June 11, 2024, may be considered 'typical' for the gas quality directed to the flare: methane, 52.77%; carbon dioxide, 36.57%; oxygen, 0.79%; and nitrogen, 16.70%.

Midland employs a gas collection and control system to meet the requirements of the Landfill NESHAP and the Federal Plan. Gas collection wells and horizontal trenches are installed within the landfilled waste. The extraction locations are connected to a common header system. A blower or the compressor from the landfill gas to energy plant produces a vacuum on the well field. Collected gas is routed to treatment systems for beneficial use. The utility flare serves as an auxiliary control for the landfill gas collection system and is used primarily when the treatment systems are non-operational.

The utility flare is designed to meet the requirements of 63.1959(b)(2)(iii)(B) and 62.16714(c)(2) at a flow rate up to 2,000 scfm. The utility flare was tested at a flow rate of approximately 490 scfm as measured by the installed process flow meter.

The utility flare is also equipped with a thermocouple to monitor for the presence of a flame, and an automatic shutdown software routine that activates if the presence of flame cannot be verified by the sensor.

4.0 SAMPLE AND ANALYTICAL PROCEDURES

EIL conducted measurements in accordance with USEPA Reference Test Methods, as presented in 40 CFR 60 and 63, Appendix A. The sample collection and analytical methods used in the test program are detailed in the paragraphs below. Figure 1 depicts the sample site.

Visible Emissions from the Flare Stack

A single 2-hour observation for visible emissions at the flare exhaust was performed in accordance with USEPA Method 22. EIL observed a total of 0 minutes, 2 seconds of visible emissions from the utility flare exhaust. Per 40 CFR 60.18(c)(1) and 40 CFR 63.11(b)(4), the limit for visible emissions is less than 5 minutes per 2-hour period. Results from the visible emissions observation are included in Attachment A.

Flame Presence

Flame presence was confirmed by reviewing combustion temperature monitoring data while the flare was operating. Flare operational data (including temperature) is provided in Appendix B.

Net Heating Value of the Landfill Gas

Samples of landfill gas were collected and sent to Enthalpy Analytical Laboratory (Enthalpy) in Richmond, Virginia. The gas was collected from the discharge side of the blower between the blower and flare. The gas was collected through stainless steel tubing into pre-evacuated summa canisters partially filled with helium gas. Mr. Kotrba used a flow controller to regulate the flow rate into each summa canister for each 30-minute sample run. Three primary samples and one spare were collected. The primary sample canisters arrived to the laboratory in good condition and contained adequate volume; therefore, gas from the spare was not analyzed. Enthalpy analyzed the samples by US EPA Method 3C, as allowed by 40 CFR 60.754(e), for methane content. The analyses met laboratory quality control standards.

Enthalpy calculated the net heating value based on the Method 3C methane results not corrected for water vapor, per ASTM Method D3588-98. The results are summarized below. The Enthalpy analytical report is provided as Appendix C.

Table 1
Methane and Net Heating Results

Parameter	Test 1	Test 2	Test 3	Average
Methane (%)	52.8	52.4	53.1	52.8
Net Heating Value (Btu/scf)	444	443	442	443
Minimum Net Heating Value (MJ/scm)	7.45	7.45	7.45	7.45
Net Heating Value (MJ/scm) [2]	16.54	16.51	16.47	16.51

Notes:
[2] Enthalpy reported net heating value in units of Btu/scf. 1 BTU/scf is equal to 0.03726 MJ/scm. Results were multiplied by 0.03726 to determine net heating value in MJ/scm.

As shown in the table above, the calculated average net heating value of the three test runs at the City of Midland Landfill flare was 16.51 MJ/scm, which is greater than the lower limit of 7.45 MJ/scm for non-assisted flares listed in 40 CFR 60.18(c)(3)(ii) and 40 CFR 63.11(b)(6)(ii). Therefore, the subject flare meets the requirement for minimum net heating value for non-assisted flares.

Landfill Gas Exit Velocity from the Flare Stack

The exit velocity from the flare's stack was determined based on landfill gas flow rates measured by the calibrated mass flow meter. This alternative method of determining the flow described in 40 CFR 60.18(f)(4) received a blanket approval from the US EPA Office of Air Quality Planning and Standards in a letter to SCS Engineers in 2009. A copy of the letter was provided with the Test Protocol submitted on April 24, 2024.

Flow rate data were recorded by the flare's digital data logger and downloaded for the evaluation. Flow meter calibration documentation is included as Appendix E and the flare operational data are included in Appendix B.

The flow rate to the flare was also recorded before and after each Method 3C gas sample run. Those measurements are shown in field data logs included as Appendix A. However, these values were not used in the subsequent calculations because the flow meter data from the data logger were deemed valid.

The average flow rates measured during each sample run by the calibrated flow meter, in standard units of temperature and pressure (see Appendix B), were converted to cubic feet per second, and then divided by the unobstructed cross-sectional area of the flare tip (0.785 ft^2) to determine the exit velocity. The flare tip diameter is twelve inches (see Figure 1).

Table 2
Average Exit Velocity Calculation

Parameter	Test 1	Test 2	Test 3	Average
Flow Rate (ft^3/min)	493	489	487	490
Flow Rate (ft^3/sec)	8.22	8.15	8.12	8.16
Exit Tip Diameter (inches)	12	12	12	
Exit Tip Cross-Sectional Area (ft^2)	0.7854	0.7854	0.7854	
Allowable Exit Velocity (fps)	**60**	**60**	**60**	**60**
Maximum Permitted Velocity, V_{max} (fps)	**114.36**	**114.36**	**114.36**	**114.36**
Calculated Exit Velocity (fps)	**10.46**	**10.38**	**10.33**	**10.39**

Maximum Allowable Flare Exit Velocity

The maximum allowable flare exit velocity was calculated using the equation for non-assisted flares specified in 40 CFR 60.18(f)(5). A calculation page to determine the allowable flare exit velocity is provided in Appendix A. As shown on the calculation page, the maximum allowable flare exit velocity (V_{max}) is 114.36 ft/sec. The actual exit velocity of 10.39 ft/sec, calculated above, is less than the maximum allowable flare exit velocity. Therefore, the City of Midland Landfill utility flare meets the requirement for exit velocity.

5.0 RESULTS AND DISCUSSION

EIL observed an accumulated total of 0 minutes, 2 seconds of visible emissions from the utility flare exhaust during the performance test. The limit for visible emissions is less than 5 minutes per 2-hour time period [63.11(b)(4), 60.18(c)(1)].

The average net heating value of the gas being combusted was 16.51 MJ/scm per gas samples collected during the testing. The requirement for net heating value is >7.45 MJ/scm [63.11(b)(6)(ii), 60.18(c)(3)(ii)].

The average stack gas exit velocity, calculated from field data, was 10.39 fps based on flow data from the calibrated flow meter. The limit is <60 fps [63.11(b)(7)(i), 60.18(c)(4)(i)], or less than the Maximum Permitted Velocity, V_{max}, calculated to be 114.36 fps [63.11(b)(7)(iii), 60.18(c)(4)(iii)].

The June 4, 2024 test results demonstrate that the utility flare meets the performance requirements of the site's renewable operating permit (ROP) conditions FGOPENFLARE-AAAA V.1, FGOPENFLARE-OOO V.1, and therefore complies with §63.11(b) of the Landfill NESHAP and 40 CFR §60.18 as referenced in §62.16714(c)(1) of the Federal Plan.

EIL quality assurance (QA) procedures included:

1) Leak-check of the velocity measurement system (pitot tube through manometer), prior to each test,
2) Leak-check of the Method 3C train, prior to each test, and,
3) Verification of sufficient evacuation of each Method 3C canister prior to initiation of each sample collection.

Appendix A contains the field and computer-calculated data used in the determination of the utility flare average exit velocities and net heating values. It also includes the visible emissions observation data Recorded process flow meter data is presented in Appendix B. The Method 3C laboratory analytical results and chain-of-custody forms are presented in Appendix C. Sample calculations are presented in Appendix D.

This report was prepared by:

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FIGURES

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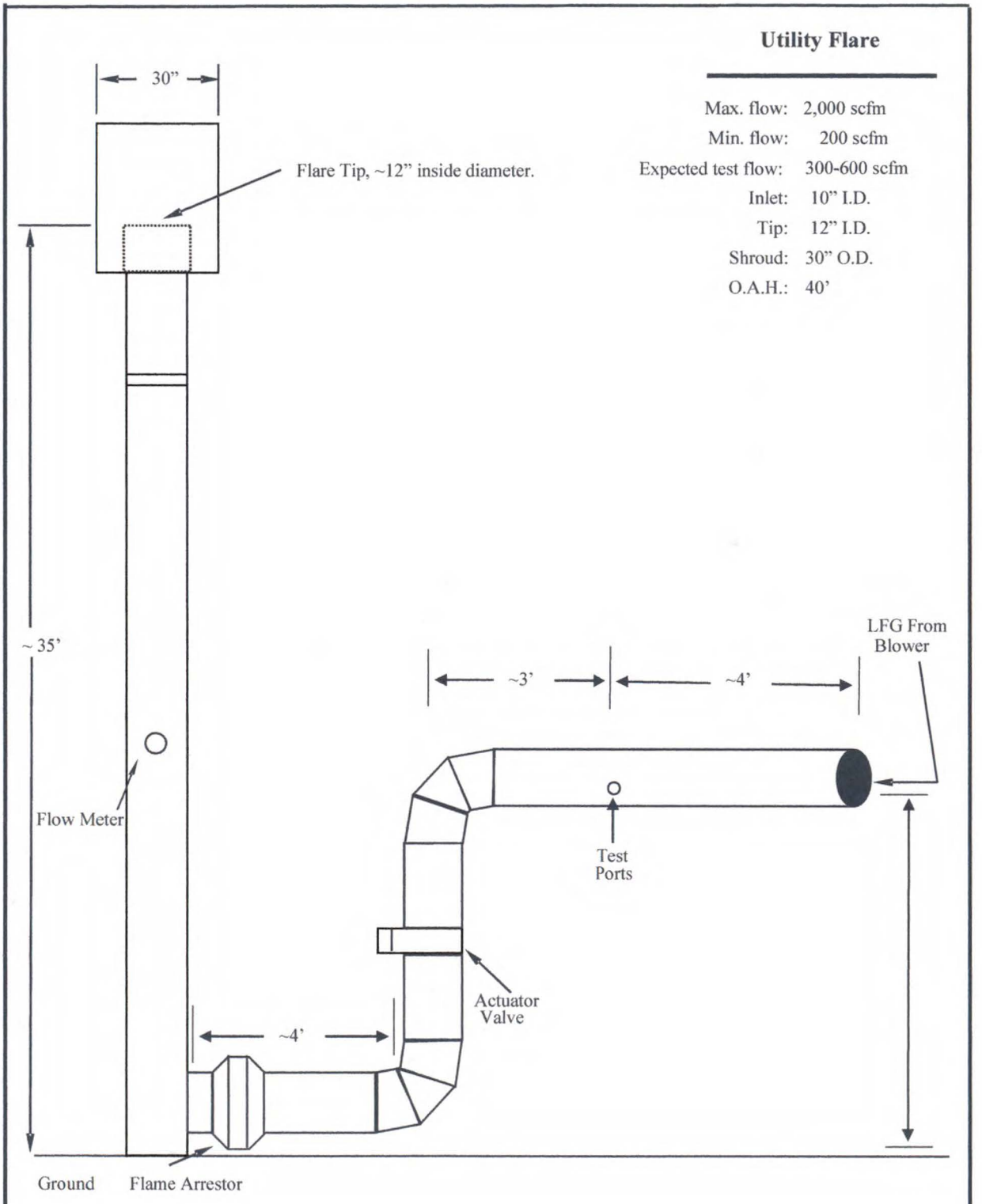

Figure 2
Utility flare duct and stack arrangement, approximate dimensions, and test locations, City of Midland Landfill in Midland, Michigan.

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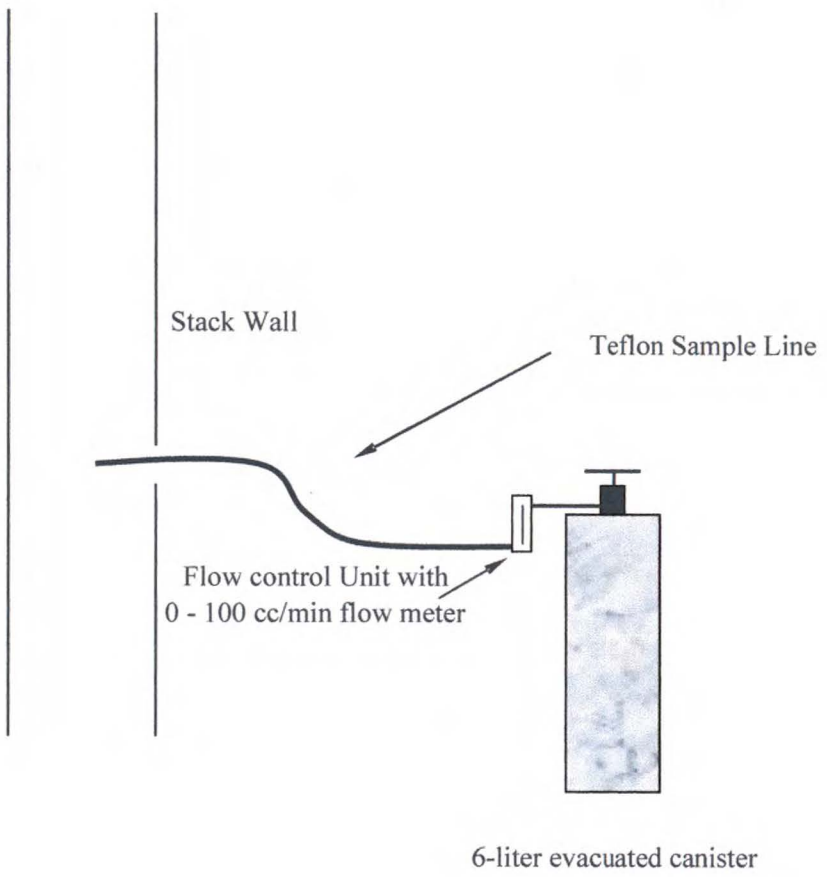

Figure 1
USEPA Method 3C sample train for the utility flare inlet duct at Midland Landfill in Midland, Michigan.

EIL LLC

APPENDIX A

FIELD AND CALCULATED DATA SHEETS