Compliance Test Report
Utility Flare Performance Test

Autumn Hills Recycling and Disposal Facility

Zeeland, Michigan

December 2023

Prepared for:
Westside Recycling and Disposal Facility
14094 West M-60
Three Rivers, Michigan 49093

Prepared by:
Environmental Information Logistics, LLC

CONTENTS

EXECUTIVE SUMMARY

Westside Recycling & Disposal Facility (Westside) retained Environmental Information Logistics, LLC (EIL) to conduct a performance evaluation of (2) two utility (open) flares located at Westside in Three Rivers, Michigan. The utility flares are control devices to control landfill gas emissions from Westside Recycling & Disposal Facility.

The purpose of the test program was to demonstrate that both utility flares owned and operated by Westside meet the performance requirements of the site's renewable operating permit (ROP) conditions FGOPENFLARE-AAAA-1 V.3, FGOPENFLARE-OOO-1 V.3. Additionally, it demonstrates that the flares are also in compliance 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 conducted the fieldwork on October 18, 2023, and in accordance with the approved Test Plan, dated September 8, 2023. Mr. Ben Kotrba and Mr. Tyler Smith conducted the tests. Mr. James Mohney with Waste Management provided on-site coordination of the test. Mr. Chance Collins with Michigan Department of Environment, Great Lakes, and Energy (EGLE) reviewed and approved the test plan.

The results of the performance evaluations were:

Parameter	Applicable Requirement	Average Test Result (EUOPENFLARE)	Applicable Requirement	Average Test Result (EUOPENFLARE2)
Flare Exhaust Smoke Emissions (Visual Emissions in a 2-hour Period)	<5 minutes over 2 hours [1]	0 minutes, 2 seconds	<5 minutes over 2 hours [1]	0 minutes, 2 seconds
Flare Inlet Gas Net Heating Value (MJ/scm)	>7.45 [2]	18.99	>7.45 [2]	12.07
Flare Exhaust Gas Exit Velocity (Feet per second)	<60 [3]	50.80	<60 [3]	11.05
Maximum Permitted Velocity (V_{max}, feet per second)	<75.37[4]	50.80	<33.03[4]	11.05

MJ: megajoules
scm: standard cubic meter

[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

Westside Recycling & Disposal Facility (Westside) retained Environmental Information Logistics, LLC (EIL) to conduct a performance evaluation of (2) two utility (open) flares located at Westside in Three Rivers, Michigan. The utility flares are control devices to control landfill gas emissions from Westside Recycling & Disposal Facility.

The purpose of the test program was to demonstrate that both utility flares owned and operated by Westside meet the performance requirements of the site's renewable operating permit (ROP) conditions FGOPENFLARE-AAAA-1 V.3, FGOPENFLARE-OOO-1 V.3. Additionally, it demonstrates that the flares are also in compliance 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 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).

EIL conducted the fieldwork on October 18, 2023, and in accordance with the approved Test Plan, dated September 8, 2023. Mr. Ben Kotrba and Mr. Tyler Smith conducted the tests. Mr. James Mohney with Waste Management provided on-site coordination of the test. Mr. Chance Collins with Michigan Department of Environment, Great Lakes, and Energy (EGLE) reviewed and approved the test plan.

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**
Tyler Smith Environmental Scientist	Environmental Information Logistics, LLC 130 East Main Street SE Caledonia, MI 49339	(616) 558-3978

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**
Robert Pliska Environmental Manager	Waste Management of Michigan, Inc. 700 56th Avenue Zeeland, Michigan 49464	(906) 250-8717

2.0 SUMMARY OF RESULTS

On October 18, 2023, EUOPENFLARE operated at an average inlet volumetric flow rate of approximately 1,064 standard cubic feet per minute (scfm) as measured and calculated by USEPA Methods 1A and 2C, or 1,079 scfm as averaged from the manually recorded process flow meter data (1,077 scfm as averaged from the data recorder data). EUOPENFLARE2 operated at an average inlet volumetric flow rate of approximately 130 standard cubic feet per minute (scfm) as measured and calculated by USEPA Methods 1A and 2C, or 128 scfm as averaged from the manually recorded process flow meter data (128 scfm as averaged from the data recorder data).

The average test results were:

EUOPENFLARE
1) visible emissions: 0 minutes, 2 seconds (accumulated, total),
2) average net heating value of the gas being combusted: 18.99 megajoules per standard cubic meter (MJ/scm), and
3) average exhaust gas exit velocity: 50.80 feet per second (fps).

EUOPENFLARE2
1) visible emissions: 0 minutes, 2 seconds (accumulated, total),
2) average net heating value of the gas being combusted: 12.07 megajoules per standard cubic meter (MJ/scm), and
3) average exhaust gas exit velocity: 11.05 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 75.37 fps for EUOPENFLARE and 33.03 fps for EUOPENFLARE2).

The test results demonstrate that that both utility flares meet the performance requirements of §63.11(b), §60.18 at the test flow rates.

3.0 SOURCE DESCRIPTION

Westside 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), with the remainder balance gases nitrogen, oxygen, and trace amounts of non-methane organic compounds.

Westside employs a gas collection and control system to meet the requirements of the Landfill NESHAP and the Federal Plan. Gas collection wells are installed in a grid pattern about the landfill. The wells are connected to a common header system. A blower produces a vacuum on the well field. Collected gas is routed to treatment systems for beneficial use. The utility flares serve as auxiliary controls for the landfill gas collection system. Used primarily when the treatment systems are non-operational or cannot use all of the gas from the landfill.

The utility flares are 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 for EUOPENFLARE and 1,000 scfm for EUOPENFLARE2.

EUOPENFLARE was tested at a flow rate of approximately 1,079 scfm as measured by the installed process flow meter, or 1,064 scfm as measured and calculated by USEPA Methods 1A and 2C. EUOPENFLARE2 was tested at a flow rate of approximately 128 scfm as measured by the installed process flow meter, or 130 scfm as measured and calculated by USEPA Methods 1A and 2C.

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 October 18, 2023, may be considered 'typical' for the gas quality directed to each flare. Gas composition for each flare is listed below.

EUOPENFLARE: methane, 57.07%; carbon dioxide, 38.17%; oxygen, 0.56%; and nitrogen, 2.62%. The landfill gas temperature at the utility flare inlet averaged 110°F.

EUOPENFLARE2: methane, 36.70%; carbon dioxide, 27.10%; oxygen, 0.78%; and nitrogen, 32.33%. The landfill gas temperature at the utility flare inlet averaged 115°F.

The utility flares are equipped with a thermocouple to monitor 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 63 and 62, Appendix A. The sample collection and analytical methods used in the test program are listed in the table below. Figure 1 depicts the sample site.

Sample Method	**Parameter**	**Analysis**
USEPA Methods 1A & 2C	Stack Gas Velocity and Volumetric Flow Rate	Field Data
USEPA Method 3C	Carbon Dioxide, Methane, Nitrogen, Oxygen, and moisture fraction	Gas Chromatography / Thermal Conductivity Detector (GC/TCD)
USEPA Method 22	Visible Emissions	Field Observation

4.1 Stack Gas Velocity and Volumetric Flow Rate (USEPA Methods 1A and 2C)

EIL used Method 1A to determine the appropriate number and location of traverse points on the utility flare inlet duct. EIL selected traverse points based on division of the stack cross-section into equal areas, and the number of upstream and downstream stack diameters from the sample ports to the nearest flow disturbance. Figure 2 depicts a representative flare inlet cross-section and traverse point locations.

EIL used Method 2C to measure stack gas velocity pressure and temperature at each traverse point. EIL positioned a standard pitot tube, with a baseline coefficient of 0.99, at each traverse point. The velocity pressure and temperature were measured and recorded. Velocity pressure measurements were read from a digital manometer with increments of 0.01 inches of water column.

The raw field data, and computer-generated velocity and volumetric flow rate spreadsheets are presented in Appendix A.

The average stack gas velocity is a function of the average velocity pressure, absolute stack gas pressure, average stack gas temperature, stack gas wet molecular weight, and pitot tube coefficient. EIL derived the average stack gas velocity from equations presented in USEPA Method 2.

EIL calculated the stack gas flow rate by multiplication of the stack gas velocity and the cross-sectional area of the stack.

EIL used the measured inlet flow rate from each individual test to calculate the corresponding exhaust exit velocity for that test.

4.2 Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources (Method 3C)

EIL used Method 3C to determine the composition of the landfill gas. EIL collected three, 30-minute (minimum), integrated tank samples of landfill gas from the utility flare inlet (downstream of the blower).

EIL submitted the samples to Enthalpy Analytical (EA), Richmond, Virginia for analysis. EA analyzed each tank for carbon dioxide (CO_2), methane (CH_4), nitrogen (N_2), and oxygen (O_2) concentration via Method 3C. Figure 3 depicts the Method 3C sample train.

EA followed the analytical procedures of Method 3C by using a gas chromatograph (GC), with appropriate separation column for the expected parameters, equipped with a thermal conductivity detector (TCD). The EA laboratory analytical report is presented in Appendix B.

EIL used the Method 3C analytical results to calculate stack gas molecular weight (for use in stack gas velocity calculation), and to calculate the maximum permitted velocity, V_{max}, per §63.11(b)(7)(i), 60.18(c)(4)(i). The reported net heating value is the arithmetic average of three valid test runs.

EIL calculated the dry molecular weight of the stack gas based on the primary constituents of methane, carbon dioxide, nitrogen, oxygen, and hydrogen (other compounds present have a negligible relative concentration). The stack gas dry molecular weight is equal to the sum of stack gas constituent concentrations (%) multiplied by the corresponding molecular weight of that constituent.

4.3 Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares (Method 22)

EIL conducted a single, 120-minute, non-continuous observation of the utility flare exhaust for smoke emissions. EIL observed continuously for 15 to 20 minutes, then took a break for at least 5 – but no more than 10 minutes, and then resumed observation in this pattern until a full 120-minute period of observation time had accrued. A copy of the Method 22 observation data is presented in Appendix A.

5.0 RESULTS AND DISCUSSION

On October 18, 2023, EIL observed an accumulated total of 0 minutes, 2 seconds of visible emissions from the EUOPENFLARE exhaust. Additionally, EIL observed an accumulated total of 0 minutes, 2 seconds of visible emissions from the EUOPENFLARE2 exhaust. The limit for visible emissions is less than 5 minutes per 2-hour time period [63.11(b)(4), 60.18(c)(1)].

On October 18, 2023, the average net heating value of the gas being combusted for EUOPENFLARE was 18.99 MJ/scm. For EUOPENFLARE2 the average net heating value was 12.07 MJ/scm. The requirement for net heating value is >7.45 MJ/scm [63.11(b)(6)(the, 60.18(c)(3)(ii)].

On October 18, 2023, the average stack gas exit velocity, calculated from field data, for EUOPENFLARE was 50.80 fps. For EUOPENFLARE2 the calculated exit velocity was 11.05 fps. 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 75.37 fps for EUOPENFLARE and 33.03 fps for EUOPENFLARE2 [63.11(b)(7)(iii), 60.18(c)(4)(iii)].

The October 18, 2023 testing results demonstrate that both utility flares meet the performance requirements of the site's renewable operating permit (ROP) conditions FGOPENFLARE-AAAA V.3, FGOPENFLARE-OOO V.3, and is thus in compliance 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.

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

This report prepared by: ______________________
Tyler Smith
Environmental Scientist

November 21, 2023

TABLES

Table 1

EUOPENFLARE Inlet Volumetric Flow Rate and Flare Exit Velocity
Westside Recycle and Disposal Facility
Three, Michigan
October 18, 2023

Parameter	Test 1	Test 2	Test 3	Average
Inlet Volumetric Flow Rate (scfm) – Measured Field Data	1,055	1,070	1,068	1,064
Exit Tip Diameter (inches)	8	8	8	
Exit Tip Cross-Sectional Area (ft^2)	0.34907	0.34907	0.34907	
Allowable Exit Velocity (fps)[1]	**60**	**60**	**60**	**60**
Maximum Permitted Velocity, V_{max} (fps) [2]	**75.26**	**74.93**	**75.92**	**75.37**
Calculated Exit Velocity (fps)	**50.36**	**51.07**	**50.97**	**50.80**

[1] 40 CFR 63.11(b)(6)(i), 60.18(c)(3)(i)
[2] 40 CFR 63.11(b)(6)(i), 60.18(c)(3)(i)
scfm: standard cubic feet per minute
ft^2: square feet
fps: feet per second

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Table 1A

EUOPENFLARE2 Inlet Volumetric Flow Rate and Flare Exit Velocity
Westside Recycle and Disposal Facility
Three, Michigan
October 18, 2023

Parameter	Test 1	Test 2	Test 3	Average
Inlet Volumetric Flow Rate (scfm) – Measured Field Data	130	136	124	130
Exit Tip Diameter (inches)	6	6	6	
Exit Tip Cross-Sectional Area (ft^2)	0.19635	0.19635	0.19635	
Allowable Exit Velocity (fps)[1]	**60**	**60**	**60**	**60**
Maximum Permitted Velocity, V_{max} (fps) [2]	**33.11**	**32.68**	**33.30**	**33.03**
Calculated Exit Velocity (fps)	**11.05**	**11.54**	**10.54**	**11.05**

[1] 40 CFR 63.11(b)(6)(i), 60.18(c)(3)(i)
[2] 40 CFR 63.11(b)(6)(i), 60.18(c)(3)(i)
scfm: standard cubic feet per minute
ft^2: square feet
fps: feet per second

ENVIRONMENTAL INFORMATION LOGISTICS, LLC

Table 2

EUOPENFLARE Inlet Volumetric Flow Rate and Flare Exit Velocity
Westside Recycle and Disposal Facility
Three, Michigan
October 18, 2023

Parameter	Test 1	Test 2	Test 3	Average
Flare Inlet Gas Methane Content (%)	57.0	56.8	57.4	57.07
Methane, Molecular Weight (lb/lb mole)	16	16	16	
Methane, Heating Value (kcal/g)[1]	11.9533	11.9533	11.9533	
Methane, Heating Value (kcal/g mole)	191.25	191.25	191.25	
Minimum Net Heating Value (MJ/scm)[2]	**7.45**	**7.45**	**7.45**	**7.45**
Flare Inlet Gas Net Heating Value (MJ/scm)	**18.97**	**18.90**	**19.10**	**18.99**

1 USEPA Office of Air Quality Planning and Standards' Control Cost Manual
2 40 CFR 63.11(b)(6)(ii), 60.18(c)(3)(ii)
ppm: parts per million
%: percent
lb/lb mole: pounds per pound-mole
kcal/g: kilocalories per gram
kcal/g mole: kilocalories per gram-mole
MJ/scm: megajoules per standard cubic meter

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Table 2A

EUOPENFLARE2 Inlet Volumetric Flow Rate and Flare Exit Velocity
Westside Recycle and Disposal Facility
Three, Michigan
October 18, 2023

Parameter	Test 1	Test 2	Test 3	Average
Flare Inlet Gas Methane Content (%)	36.4	35.7	36.7	36.3
Methane, Molecular Weight (lb/lb mole)	16	16	16	
Methane, Heating Value (kcal/g)[1]	11.9533	11.9533	11.9533	
Methane, Heating Value (kcal/g mole)	191.25	191.25	191.25	
Minimum Net Heating Value (MJ/scm)[2]	**7.45**	**7.45**	**7.45**	**7.45**
Flare Inlet Gas Net Heating Value (MJ/scm)	**12.11**	**11.88**	**12.21**	**12.07**

[1] USEPA Office of Air Quality Planning and Standards' Control Cost Manual
[2] 40 CFR 63.11(b)(6)(ii), 60.18(c)(3)(ii)
ppm: parts per million
%: percent
lb/lb mole: pounds per pound-mole
kcal/g: kilocalories per gram
kcal/g mole: kilocalories per gram-mole
MJ/scm: megajoules per standard cubic meter

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FIGURES

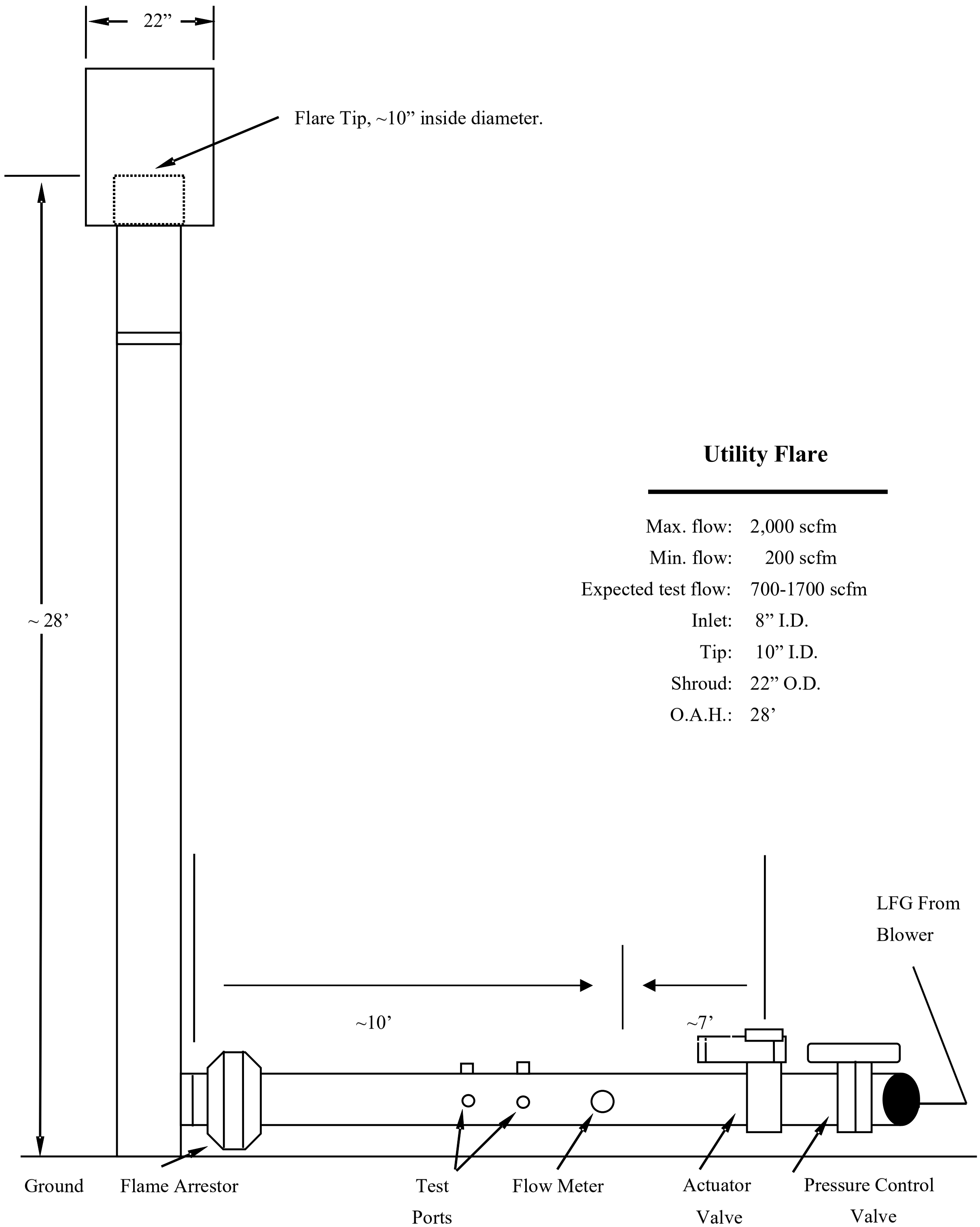


Figure 1 (a) EUOPENFLARE
Utility flare duct and stack arrangement, approximate dimensions, and test locations, Westside Recycling & Disposal Facility in Three Rivers, Michigan

EIL LLC
October 18, 2023

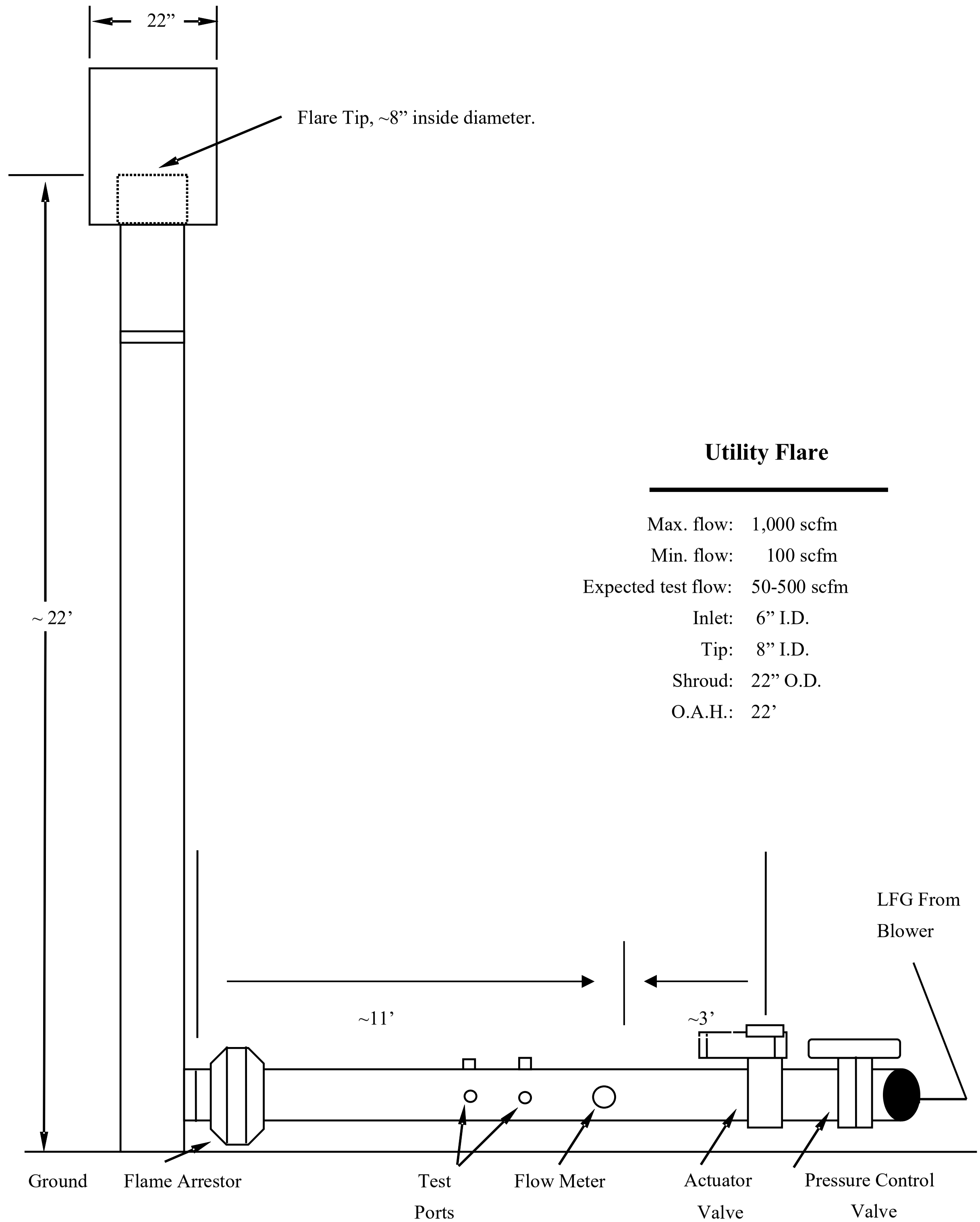
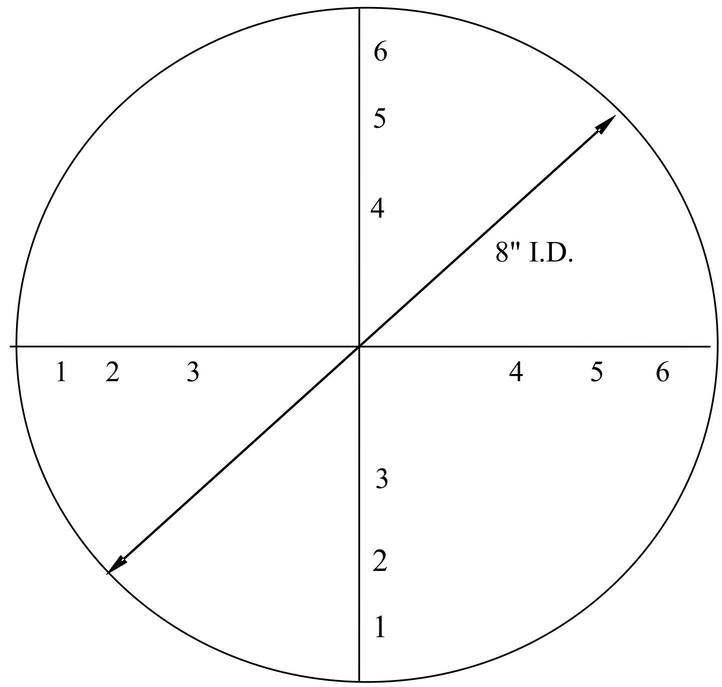


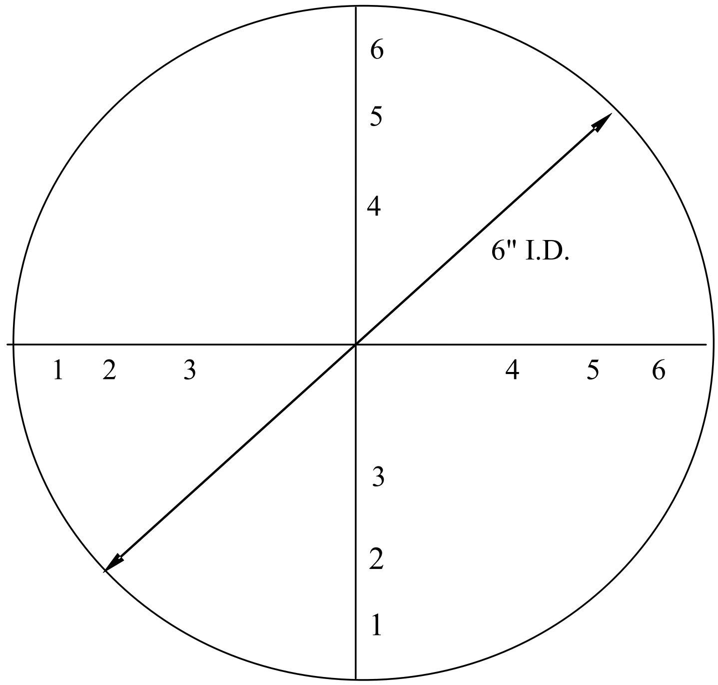
Figure 1 (b) EUOPENFLARE2 Utility flare duct and stack arrangement, approximate dimensions, and test locations, Westside Recycling & Disposal Facility in Three Rivers, Michigan.	EIL LLC October 18, 2023



Traverse Point Number	Distance From Wall (inches)
1	0.50
2	1.17
3	2.37
4	5.63
5	6.83
6	7.50

Figure 2 (a) EUOPENFLARE
Traverse point numbers and locations on the utility flare inlets
at Westside Recycling & Disposal Facility in Three Rivers, Michigan.

EIL LLC
October 18, 2023



Traverse Point Number	Distance From Wall (inches)
1	0.50
2	0.88
3	1.78
4	4.22
5	5.12
6	5.50

Figure 2 (b) EUOPENFLARE2

Traverse point numbers and locations on the utility flare inlets
at Westside Recycling & Disposal Facility in Three Rivers, Michigan

EIL LLC
October 18, 2023

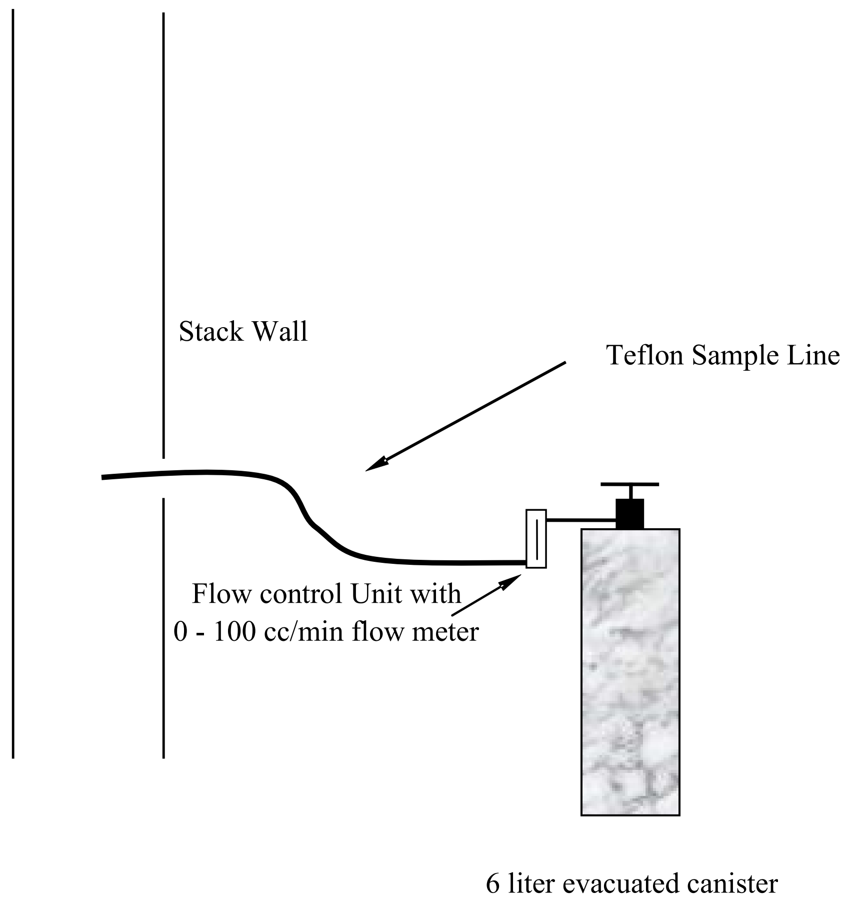


Figure 1
USEPA Method 3C sample train for the utility flare inlet duct at Westside Recycling & Disposal Facility in Three Rivers, Michigan.

EIL LLC
October 18, 2023