

Compliance Test Report  
Utility Flare Performance Test

**Autumn Hills Recycling and Disposal Facility**  
Zeeland, Michigan



December 2023

*Prepared for:*  
**Autumn Hills Recycling and Disposal Facility**  
700 56<sup>th</sup> Avenue  
Zeeland, Michigan 49464

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## CONTENTS

<u>Section</u>	<u>Page</u>
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
4.1 Stack Gas Velocity and Volumetric Flow Rate (USEPA Methods 1A and 2C).....	3
4.2 Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources (USEPA Method 3C) .....	4
4.3 Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares (USEPA Method 22).....	5
5.0 RESULTS AND DISCUSSION .....	5

### Tables

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

### Figures

- 1 Utility Flare Schematic
- 2 Utility Flare Traverse Point Locations
- 3 USEPA Method 3C Sample Train

### Appendices

- A FIELD AND CALCULATED DATA SHEETS
- B LABORATORY ANALYTICAL REPORT
- C SAMPLE CALCULATIONS

## EXECUTIVE SUMMARY

Autumn Hills Recycling & Disposal Facility, (Autumn) retained Environmental Information Logistics, LLC (EIL) to conduct a performance evaluation of the utility (open) flare located at Autumn Hills Landfill in Zeeland, Michigan. The utility flare is an auxiliary control device to control landfill gas emissions from Autumn Hills Recycling & Disposal Facility.

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.3, FGOPENFLARE-XXX V.3, and is thus in compliance with §63.11(b) of the Landfill NESHAP and 40 CFR §60.18 as referenced in §60.762(b)(2)(iii) of the NSPS.

EIL conducted the fieldwork on October 12, 2023, and in accordance with the Test Plan, dated September 8, 2023. Mr. Ben Kotrba and Mr. Tyler Smith conducted the tests. Mr. James Mohny and Mr. Robert Pliska with Waste Management provided on-site coordination of the test. Mr. Chris Robinson with Michigan Department of Environment, Great Lakes, and Energy (EGLE) reviewed and approved the test plan. Mr. Robinson with EGLE also witnessed a portion of the field test program on October 12, 2023.

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 <sup>1</sup>	0 minutes, 2 seconds
Flare Inlet Gas Net Heating Value (MJ/scm)	>7.45 <sup>2</sup>	16.97
Flare Exhaust Gas Exit Velocity (Feet per second)	<60 <sup>3</sup>	44.32
Maximum Permitted Velocity (V <sub>max</sub> , feet per second)	<118.67 <sup>4</sup>	44.32

MJ: megajoules

scm: standard cubic meter

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<sup>1</sup> 40 CFR 63.11(b)(4), 60.18(c)(1)

<sup>2</sup> 40 CFR 63.11(b)(6)(ii), 60.18(c)(3)(ii)

<sup>3</sup> 40 CFR 63.11(b)(7)(i), 60.18(c)(4)(i)

<sup>4</sup> 40 CFR 63.11(b)(7)(iii), 60.18(c)(4)(iii)

## 1.0 INTRODUCTION

Autumn Hills Recycling & Disposal Facility, (Autumn) retained Environmental Information Logistics, LLC (EIL) to conduct a performance evaluation of the utility (open) flare located at Autumn Hills Landfill in Zeeland, Michigan. The utility flare is an auxiliary control device to control landfill gas emissions from Autumn Hills Recycling & Disposal Facility.

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.3, FGOPENFLARE-XXX V.3, and is thus in compliance with §63.11(b) of the Landfill NESHAP and 40 CFR §60.18 as referenced in §60.762(b)(2)(iii) of the NSPS.

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 §60.764(d).

EIL conducted the fieldwork on October 12, 2023, and in accordance with the Test Plan, dated September 8, 2023. Mr. Ben Kotrba and Mr. Tyler Smith conducted the tests. Mr. James Mohny and Mr. Robert Pliska with Waste Management of Michigan, Inc. provided on-site coordination of the test. Mr. Chris Robinson with Michigan Department of Environment, Great Lakes, and Energy (EGLE) reviewed and approved the test plan. Mr. Robinson with EGLE also witnessed a portion of the field test program on October 12, 2023.

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

Name and Title	Company	Telephone
Robert Pliska Environmental Manager	Waste Management of Michigan, Inc. 700 56 <sup>th</sup> Avenue Zeeland, Michigan 49464	(906) 250-8717



## 2.0 SUMMARY OF RESULTS

On October 12, 2023, the utility flare operated at an average inlet volumetric flow rate of approximately 2,089 standard cubic feet per minute (scfm) as measured and calculated by USEPA Methods 1A and 2C, or 2,071 scfm as averaged from the manually recorded process flow meter data (2,096 scfm as averaged from the raw yokogawa data recorder data).

The average test results were:

- 1) visible emissions: 0 minutes, 2 seconds (accumulated, total),
- 2) average net heating value of the gas being combusted: 16.97 megajoules per standard cubic meter (MJ/scm), and
- 3) average exhaust gas exit velocity: 44.32 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 118.67 fps).

The test results demonstrate that that utility flare meets the performance requirements of §63.11(b), §60.18, at the tested flow rate.

## 3.0 SOURCE DESCRIPTION

Autumn 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.

Autumn employs a gas collection and control system to meet the requirements of the Landfill NESHAP and the NSPS. 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 flare serves as an auxiliary control for the landfill gas collection system. Used primarily when the treatment systems are non-operational or cannot take all the gas directed from the landfill.

The utility flare is designed to meet the requirements of 40 CFR 60.762(b)(2)(iii) and 63.1959(b)(2)(iii) at a flow rate of up to 3,000 scfm. The utility flare was tested at a flow rate of approximately 2,071 scfm as measured by the installed process flow meter, or 2,089 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 12, 2023, may be considered 'typical' for the gas quality directed to the flare:



Methane, 51.0%; Carbon Dioxide, 35.8%; Oxygen, 0.7%; and Nitrogen, 11.9%. The landfill gas temperature at the utility flare inlet averaged 131.3°F.

The utility flare is 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.

<u>Sample Method</u>	<u>Parameter</u>	<u>Analysis</u>
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<sub>2</sub>), methane (CH<sub>4</sub>), nitrogen (N<sub>2</sub>), and oxygen (O<sub>2</sub>) 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 12, 2023, EIL observed an accumulated total of 0 minutes, 2 seconds of visible emissions from the utility flare 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 12, 2023, the average net heating value of the gas being combusted was 16.97 MJ/scm. The requirement for net heating value is >7.45 MJ/scm [63.11(b)(6)(ii), 60.18(c)(3)(ii)].

On October 12, 2023, the average stack gas exit velocity, calculated from field data, was 44.32 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 118.67 fps [63.11(b)(7)(iii), 60.18(c)(4)(iii)].

The October 12, 2023 results demonstrate that the utility flare meets the performance requirements of the site's renewable operating permit (ROP) conditions FGOPENFLARE-AAAA V.3, FGOPENFLARE-XXX V.3, and is thus in compliance with §63.11(b) of the Landfill NESHAP and 40 CFR §60.18 as referenced in §60.762(b)(2)(iii) of the NSPS.

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:



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December 7, 2023



## TABLES

**Table 1**

**Utility Flare Inlet Volumetric Flow Rate and Flare Exit Velocity  
Autumn Hills Recycle and Disposal Facility  
Zeeland, Michigan  
October 12, 2023**

<b>Parameter</b>	<b>Test 1</b>	<b>Test 2</b>	<b>Test 3</b>	<b>Average</b>
Inlet Volumetric Flow Rate (scfm) – Measured Field Data	2,072	2,073	2,069	2,071
Flare Inlet Diameter (inches)	12	12	12	
Flare Inlet Cross-Sectional Area (ft <sup>2</sup> )	0.78540	0.78540	0.78540	
Allowable Exit Velocity (fps) <sup>1</sup>	<b>60</b>	<b>60</b>	<b>60</b>	<b>60</b>
Maximum Permitted Velocity, V <sub>max</sub> (fps) <sup>2</sup>	<b>121.06</b>	<b>111.65</b>	<b>123.29</b>	<b>118.67</b>
Calculated Exit Velocity (fps)	<b>44.04</b>	<b>45.04</b>	<b>43.89</b>	<b>44.32</b>

<sup>1</sup> 40 CFR 63.11(b)(6)(i), 60.18(c)(3)(i)

<sup>2</sup> 40 CFR 63.11(b)(6)(i), 60.18(c)(3)(i)

scfm: standard cubic feet per minute

ft<sup>2</sup>: square feet

fps: feet per second



**Table 2**

**Utility Flare Inlet Gas Net Heating Value  
Autumn Hills Recycle and Disposal Facility  
Zeeland, Michigan  
October 12, 2023**

<b>Parameter</b>	<b>Test 1</b>	<b>Test 2</b>	<b>Test 3</b>	<b>Average</b>
Flare Inlet Gas Methane Content (%)	51.8	48.7	52.5	51.0
Methane, Molecular Weight (lb/lb mole)	16	16	16	
Methane, Heating Value (kcal/g) <sup>1</sup>	11.9533	11.9533	11.9533	
Methane, Heating Value (kcal/g mole)	191.25	191.25	191.25	
Minimum Net Heating Value (MJ/scm) <sup>2</sup>	7.45	7.45	7.45	7.45
Flare Inlet Gas Net Heating Value (MJ/scm)	17.24	16.21	17.47	16.97

<sup>1</sup> USEPA Office of Air Quality Planning and Standards' Control Cost Manual

<sup>2</sup> 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

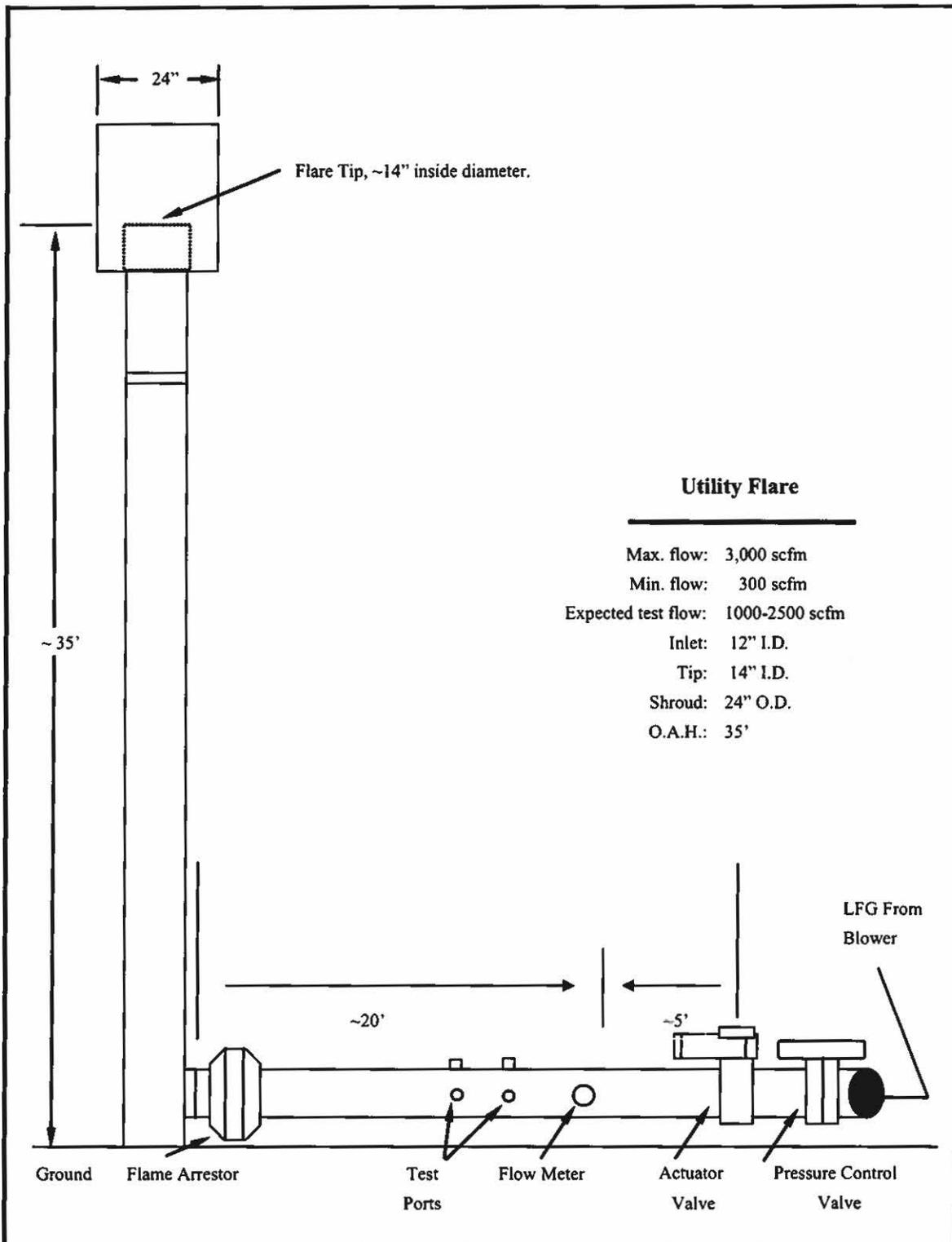
kcal/g mole: kilocalories per gram-mole

MJ/scm: megajoules per standard cubic meter



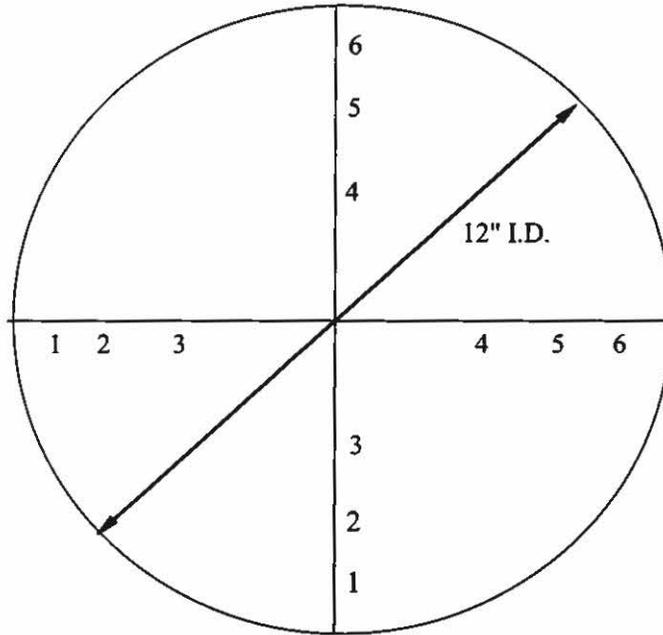
## FIGURES





**Figure 2**  
Utility flare duct and stack arrangement, approximate dimensions, and test locations, Autumn Hills Recycling & Disposal Facility in Zeeland, Michigan.

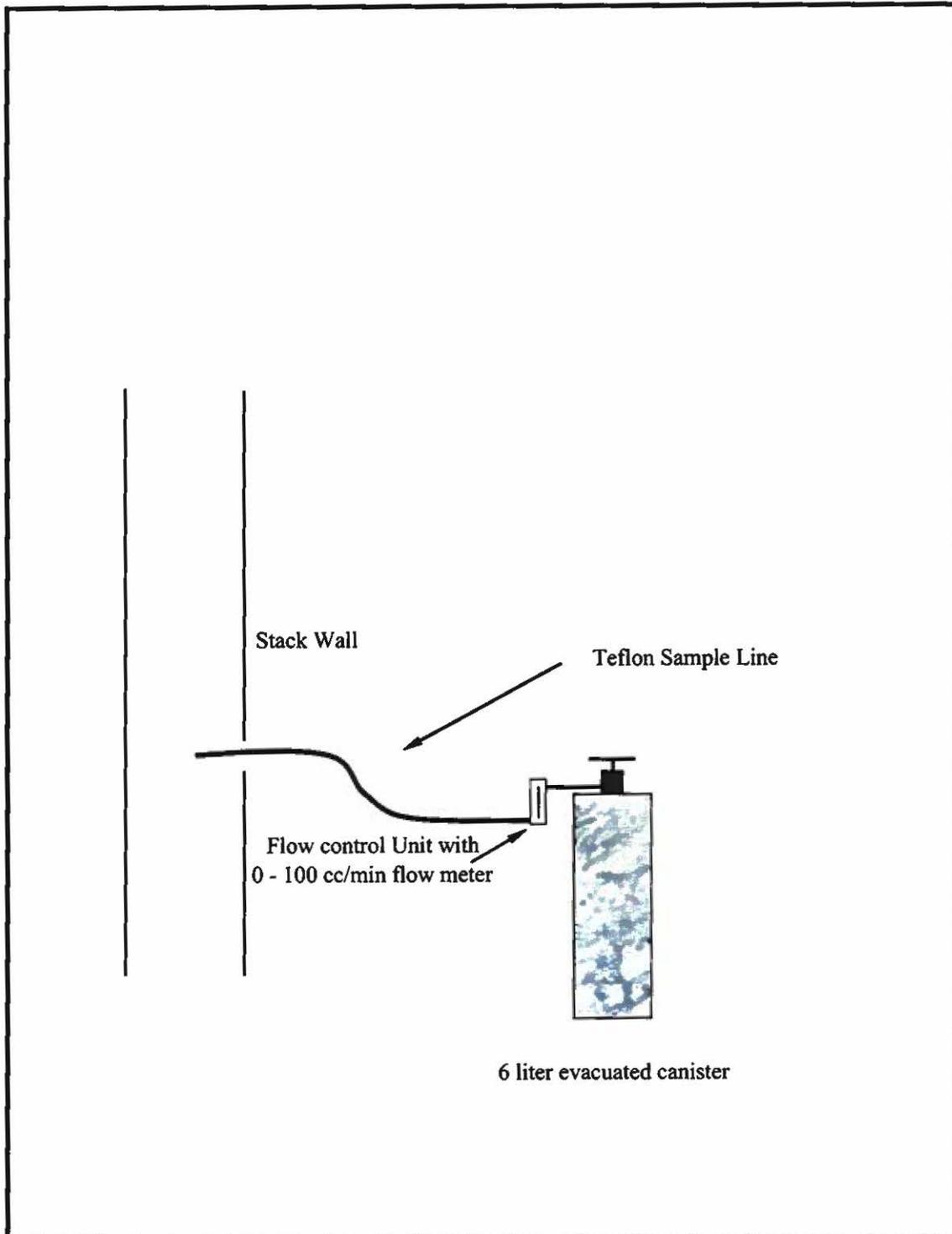
EIL LLC  
October 12, 2023



Traverse Point Number	Distance From Wall (inches)
1	0.50
2	1.75
3	3.55
4	8.45
5	10.25
6	11.47

**Figure 3**  
 Traverse point numbers and locations on the utility flare inlets  
 at Autumn Hills Recycling and Disposal Facility in Zeeland, Michigan.

EIL LLC  
 October 12, 2023



**Figure 1**  
USEPA Method 3C sample train for the utility flare inlet duct at  
Autumn Hills Recycling & Disposal Facility in Zeeland, Michigan.

EIL LLC  
October 12, 2023