Compliance Test Report
Utility Flare Initial Performance Test

Harland's Sanitary Landfill, Inc. / Manistee County Landfill
Manistee, Michigan

November 16, 2020

Prepared for:
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EXECUTIVE SUMMARY

Harland's Sanitary Landfill, Inc. / Manistee County Landfill (Manistee County Landfill) retained Environmental Information Logistics, LLC (EIL) to conduct the initial performance evaluation of the utility (open) flare located at MCL in Manistee, Michigan. The utility flare is the primary control device to control landfill gas emissions from Manistee County Landfill.

The purpose of the test program was to demonstrate that the utility flare meets the performance requirements of 40 Code of Federal Regulations (CFR), §60.18, and thus is also in compliance with 40 CFR 60, Subpart WWW, 60.752(b)(2)(iii).

AQSI conducted the fieldwork on October 12, 2020, and in accordance with the Test Plan, dated September 3, 2020. Mr. Andrew Secord and Mr. Tyler Smith conducted the tests. Mr. Alto Goodspeed with Manistee County Landfill provided on-site coordination of the tests with landfill operations. Mr. Rob Dickman with Michigan Department of Environment, Great Lakes, and Energy (EGLE) reviewed and approved the test plan. Mr. Dickman with EGLE also witnessed a portion of the field test program on October 12, 2020.

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, 5 seconds
Flare Inlet Gas Net Heating Value (MJ/scm)	>7.45 [2]	14.61
Flare Exhaust Gas Exit Velocity (feet per second)	<60 [3]	46.1
Maximum Permitted Velocity (V_{max}, feet per second)	<76.7 [4]	46.1

MJ: megajoules
scm: standard cubic meter

[1] 40 CFR 60.18(c)(1)
[2] 40 CFR 60.18(c)(3)(ii)
[3] 40 CFR 60.18(c)(4)(i)
[4] 40 CFR 60.18(c)(4)(iii)

1.0 INTRODUCTION

Harland's Sanitary Landfill, Inc. / Manistee County Landfill (Manistee County Landfill) retained Environmental Information Logistics, LLC (EIL) to conduct the initial performance evaluation of the utility (open) flare located at Manistee County Landfill in Manistee, Michigan. The utility flare is the primary control device to control landfill gas emissions from Manistee County Landfill.

The purpose of the test program was to demonstrate that the utility flare meets the performance requirements of 40 Code of Federal Regulations (CFR), §60.18, and thus is also in compliance with 40 CFR 60, Subpart WWW, 60.752(b)(2)(iii).

EIL conducted the test program with methodologies outlined in 40 CFR 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 Subpart WWW, 60.754(e).

AQSI conducted the fieldwork on October 12, 2020, and in accordance with the Test Plan, dated September 3, 2020. Mr. Andrew Secord and Mr. Tyler Smith conducted the tests. Mr. Alto Goodspeed with Manistee County Landfill provided on-site coordination of the tests with landfill operations. Mr. Rob Dickman with Michigan Department of Environment, Great Lakes, and Energy (EGLE) reviewed and approved the test plan. Mr. Dickman with EGLE also witnessed a portion of the field test program on October 12, 2020.

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. Andrew Secord Environmental Scientist	Environmental Information Logistics, LLC 2401 W. Ridge Road Gladwin, Michigan 48624	(248) 420-4233

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. Justin Obermeyer Environmental Manager	Republic Services, Inc. 15550 68th Ave. Coopersville, Michigan 49404	(616) 431-6173

2.0 SUMMARY OF RESULTS

On October 12, 2020, the utility flare operated at an average inlet volumetric flow rate of approximately 966 standard cubic feet per minute (scfm) as measured and calculated by USEPA Methods 1A and 2C, or 1,427 scfm as averaged from the manually recorded process flow meter data (1,532 scfm as averaged from the data recorder data).

The average test results were:

1) visible emissions: 0 minutes, 5 seconds (accumulated, total),
2) average net heating value of the gas being combusted: 14.61 megajoules per standard cubic meter (MJ/scm), and
3) average exhaust gas exit velocity: 46.1 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 76.7 fps).

The test results demonstrate that that utility flare meets the performance requirements of §60.18, and thus also satisfies the requirements of 60.752(b)(2)(iii)(B), at the test flow rate.

3.0 SOURCE DESCRIPTION

Manistee County Landfill 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.

Manistee County Landfill employs a gas collection and control system to meet the requirements of Subpart WWW. 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 a treatment system for removal of sulfur compounds. The utility flare serves as primary control for the landfill gas collection system.

The utility flare is designed to meet the requirements of 60.753(b)(2)(iii) at a flow rate up to 1,200 scfm. The utility flare was tested at a flow rate of approximately 1,532 scfm as measured by the installed process flow meter, or 966 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, 2020, may be considered 'typical' for the gas quality directed to the flare: methane, 43.9%; carbon dioxide, 15.5%; oxygen, 2.7%; and nitrogen, 37.9%. The landfill gas temperature at the utility flare inlet averaged 81°F.

The utility flare is 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, 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 ALS Environmental, Simi Valley, California for analysis. ALS 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.

ALS 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 ALS 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 §60.18(c)(1)(A). 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. EIL estimated the stack gas moisture content from previous test data at Manistee County Landfill.

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, 2020, EIL observed an accumulated total of 0 minutes, 5 seconds of visible emissions from the utility flare FL-01 exhaust. The limit for visible emissions is less than 5 minutes per 2-hour time period [60.18(c)(1)].

On October 12, 2020, the average net heating value of the gas being combusted was 14.61 MJ/scm. The requirement for net heating value is >7.45 MJ/scm [60.18(c)(3)(ii)].

On October 15, 2020, the average stack gas exit velocity, calculated from field data, was 46.1 fps. The limit is <60 fps [60.18(c)(4)(i)], or less than the Maximum Permitted Velocity, V_{max}, calculated to be 76.7 fps [60.18(c)(4)(iii)].

The October 15, 2020 results demonstrate that the utility flare meets the performance requirements of §60.18, and thus satisfies 40 CFR 60.752(b)(2)(iii).

EIL notes variations and/or anomalies in normal sample collection procedures or process conditions.

While the analytical results and flow rates calculated from field data are consistent and repeatable test to test, there is a large discrepancy between the average Method 2 flow rate results (966 scfm) and the average process flow meter data results (1,532 scfm). This discrepancy is attributed to suspected fouling of the process flow meter probe, as illustrated in the process flow meter data presented in Appendix A. The data presents an instantaneous flow rate measurement every two (2) minutes. There is clearly wide variability between individual data points, to greater than 1,000 scfm changes over 2 minutes, that is not realistic. Furthermore, towards the end of Test No. 3, the process flow meter data began to stabilize, and the flow rate for the hour after the flare performance test was completed averaged 855 scfm based on the process flow meter data.

EIL does not believe the process flow meter data during the flare performance test was accurate or representative. EIL notes that at an average inlet flow rate of 1,532 scfm, the average stack gas exit velocity would be 73.1 fps, which is still less than the V_{max} (76.7 fps).

EIL expected ALS to provide moisture fraction data, however they did not. When inquired, ALS responded that they do not perform moisture analysis. EIL therefore estimated a moisture fraction of 3 percent, based on historical data from prior samples obtained at Manistee County Landfill (2017 Tier 2, 2.5% moisture), and knowledge of moisture results at multiple other landfill utility flares (2 to 4% moisture, typical).

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. The gas collection and control system (GCCS) Design Plan is presented in Appendix D. The GCCS Plan Addendum is presented in Appendix E. Appendices D and E provide information required under 60.757(g).

This report prepared by: ______________________
Andrew D. Secord
Environmental Scientist

November 16, 2020

TABLES

Table 1

Utility Flare Inlet Volumetric Flow Rate and Flare Exit Velocity
Harland's Sanitary Landfill, Inc. / Manistee County Landfill
Manistee, Michigan
October 12, 2020

Parameter	Test 1	Test 2	Test 3	Average
Inlet Volumetric Flow Rate (scfm) – Measured Field Data	932.9	914.7	1,050.1	965.9
Exit Tip Diameter (inches)	8	8	8	
Exit Tip Cross-Sectional Area (ft^2)	0.3491	0.3491	0.3491	
Allowable Exit Velocity (fps)[1]	**60**	**60**	**60**	**60**
Maximum Permitted Velocity, V_{max} (fps)[2]	**74.0**	**76.9**	**79.4**	**76.7**
Calculated Exit Velocity (fps)	**44.5**	**43.7**	**50.1**	**46.1**

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

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Table 2

Utility Flare Inlet Gas Net Heating Value
Harland's Sanitary Landfill, Inc. / Manistee County Landfill
Manistee, Michigan
October 12, 2020

Parameter	Test 1	Test 2	Test 3	Average
Flare Inlet Gas Methane Content (%)	42.4	44.0	45.3	43.9
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)	**14.11**	**14.64**	**15.07**	**14.61**

1 USEPA Office of Air Quality Planning And Standards' Control Cost Manual
2 40 CFR 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

EIL ENVIRONMENTAL INFORMATION

FIGURES

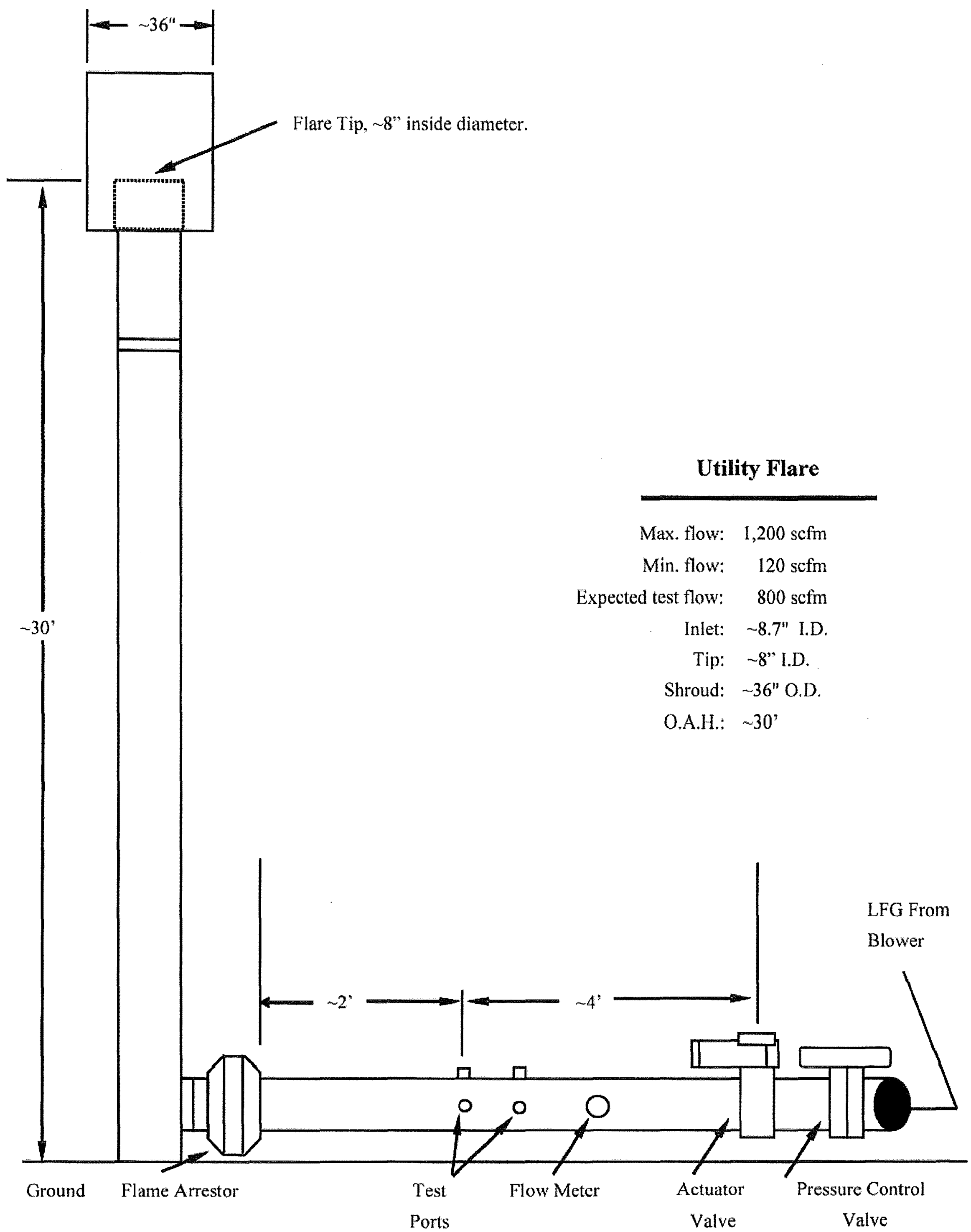

Figure 1
Representative utility flare duct and stack arrangement, approximate test port locations, Manistee County Landfill, in Manistee, Michigan.

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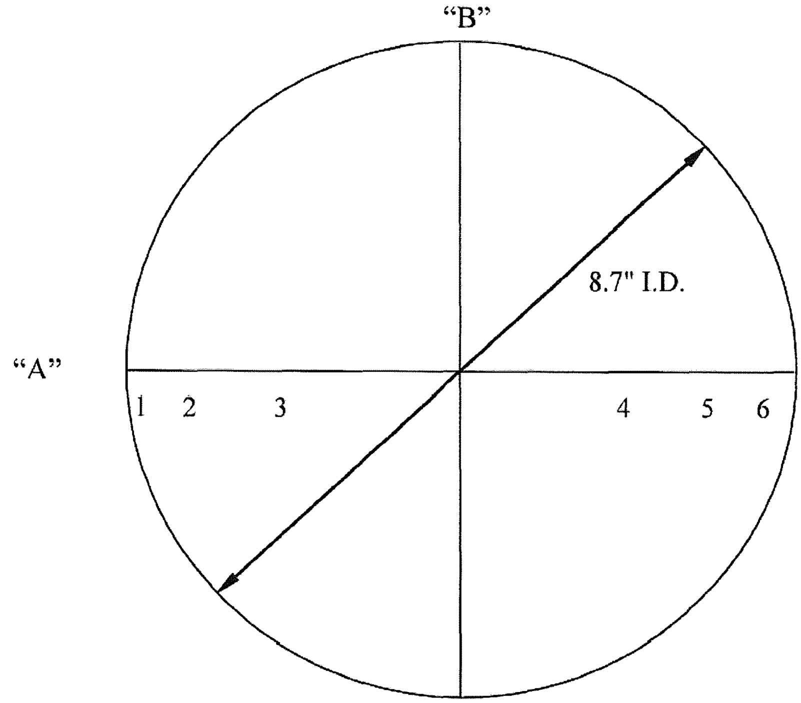

Traverse Point Number	Distance From Wall (inches)
1	0.50
2	1.27
3	2.58
4	6.12
5	7.43
6	7.50

Figure 2
Traverse point numbers and locations, enclosed flare inlet
Manistee County Landfill in Manistee, Michigan.

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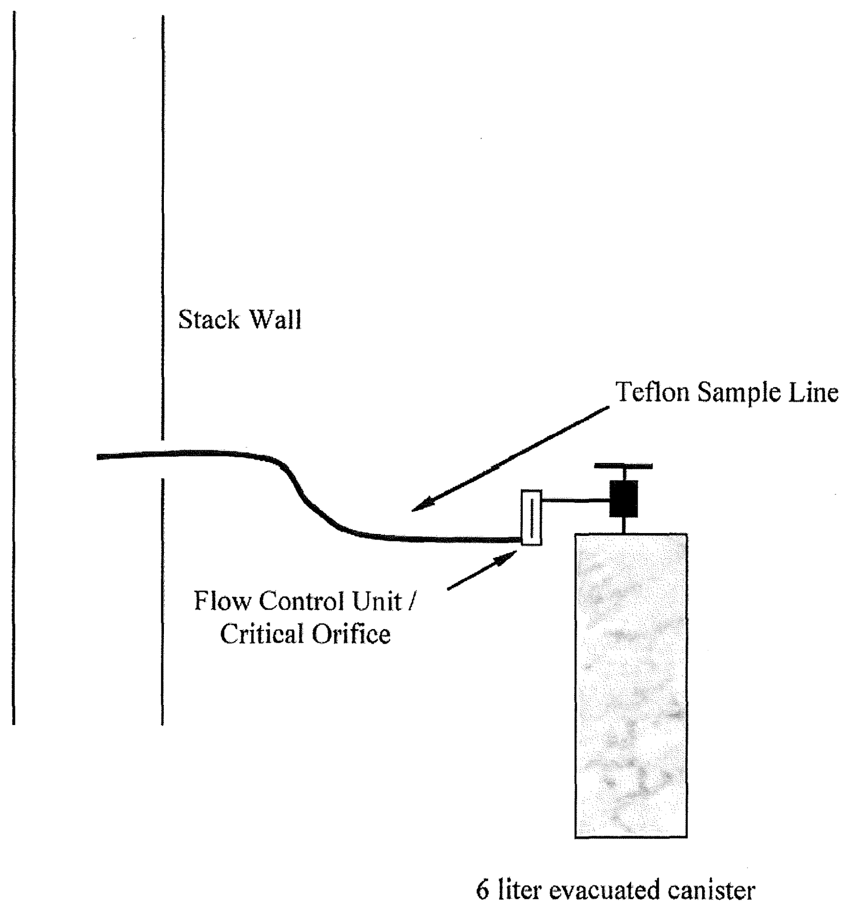

Figure 3
USEPA Method 3C sample train used at the utility flare inlet duct at Manistee County Landfill in Manistee, Michigan.

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