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Non-Methane Organic Compound Emissions Test Report
Enclosed Flare #4 Exhaust

Woodland Meadows RDF
Wayne, Michigan

June 12, 2015

Prepared for:
Woodland Meadows RDF
5900 Hannan Road
Wayne, Michigan 48184

Prepared by:
Air Quality Specialist, Inc.
672 N. Milford Road, Suite 152
Highland, Michigan 48357
248.887.7565

RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating (RO) Permit program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as described in General Condition No. 22 in the RO Permit and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name: Woodland Meadows RDF County: Wayne

Source Address: 5900 Hannan Road City: Wayne

AQD Source ID (SRN): M4449 RO Permit No.: MI-ROP-M4449-2012 RO Permit Section No.: 01

Please check the appropriate box(es):

☐ **Annual Compliance Certification (General Condition No. 28 and No. 29 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the RO Permit.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the RO Permit, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (General Condition No. 23 of the RO Permit)**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 05/07/2015 To 05/07/2015

Additional monitoring reports or other applicable documents required by the RO Permit are attached as described:

Flare #4 Compliance Test Report

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete, and that any observed, documented or known instances of noncompliance have been reported as deviations, including situations where a different or no monitoring method is specified by the RO Permit.

Charles H. Cassie	Senior District Manager	734-326-0993
Name of Responsible Official (print or type)	Title	Phone Number

Signature of Responsible Official Date: 6-17-15

EXECUTIVE SUMMARY

Woodland Meadows RDF retained Air Quality Specialist, Inc. (AQSI) to conduct tests to measure the total non-methane organic compound (NMOC) emissions of the new enclosed flare #4 at the facility located in Wayne, Michigan.

The purpose of the test program was to measure the exhaust NMOC concentration of the enclosed flare (dry basis as hexane, corrected to 3 percent oxygen) to determine compliance with the emissions limitation contained in State of Michigan Renewable Operating Permit No. MI-ROP-M4449-2012 and 40 CFR, Part 60, Subpart WWW.

AQSI conducted the fieldwork on May 6 and 7, 2015, in accordance with the test plan submitted to Michigan Department of Environmental Quality (MDEQ) dated April 1, 2015. Mr. Andrew Secord and Mr. Jeremy Chrobak with AQSI, and Mr. Barry Boulianne with BT Environmental Consulting, Inc. (BTEC), conducted the tests. Ms. Jill Zimmerman with MDEQ – Detroit Field Office stated that MDEQ does not normally review or approve test plans for this type of test event. MDEQ personnel did not elect to witness the field test program. The NMOC test results were:

Source	Run 1	Run 2	Run 3	Average
Flare #4 Average Outlet NMOC Concentration [a, b] (ppmv, hexane at 3% O_2)	0.4	0.4	0.4	0.4

[a] dry basis
[b] flare combustion chamber set-point temperature: 1,650 °F.

NMOC: non-methane organic compound
°F: degrees Fahrenheit
ppm: parts per million (volume)
O_2: oxygen

1.0 INTRODUCTION

Woodland Meadows RDF retained Air Quality Specialist, Inc. (AQSI) to conduct tests to measure the total non-methane organic compound (NMOC) emissions of the new enclosed flare #4 exhaust stack at their facility located in Wayne, Michigan.

The purpose of the test program was to measure the exhaust NMOC concentration of the enclosed flare (dry basis as hexane, corrected to 3 percent oxygen) to determine compliance with the emissions limitation contained in State of Michigan Renewable Operating Permit (ROP) No. MI-ROP-M4449-2012, and 40 CFR, Part 60, Subpart WWW.

The test program followed the provisions outlined in Title 40, *Code of Federal Regulations,* Part 60, Appendix A, Method 25A "Determination of Total Gaseous Organic Concentration Using A Flame Ionization Analyzer." AQSI performed the NMOC tests with a J.U.M Engineering Model 109A methane/non-methane flame ionization analyzer.

AQSI conducted the fieldwork on May 6 and 7, 2015, in accordance with the test plan submitted to Michigan Department of Environmental Quality (MDEQ) dated April 1, 2015. Mr. Andrew Secord and Mr. Jeremy Chrobak with AQSI, and Mr. Barry Boulianne with BT Environmental Consulting, Inc. (BTEC), conducted the tests. Ms. Jill Zimmerman with MDEQ – Detroit Field Office stated that MDEQ does not normally review or approve test plans for this type of test event. MDEQ personnel did not elect to witness the field test program. Mr. Daniel Buscetta with Woodland Meadows RDF provided on-site coordination for the tests.

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/Fax
Mr. Andrew Secord Environmental Scientist	Air Quality Specialist, Inc. 672 N. Milford Road, Suite 152 Highland, Michigan 48357	(248) 887-7565 (248) 887-3913

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

Name and Title	Company	Telephone/Fax
Mr. Paul Mazanec, P.E. Division Engineer	Woodland Meadows RDF 5900 Hannan Road Wayne, Michigan 48184	(734) 326-8230 (734) 326-9245

2.0 SUMMARY OF RESULTS

The enclosed flares (#1, #2, #3, and #4) at Woodland Meadows RDF serve as landfill gas control devices. Each flare is designed to maintain a combustion chamber set-point temperature. The new enclosed flare #4 was tested at a combustion chamber set-point temperature of 1,650 °F to demonstrate compliance with ROP No. MI-ROP-M4449-2012, and 40 CFR, Part 60, Subpart WWW, NMOC emission limits.

AQSI performed a verification of the calibration gas divider on May 7, 2015, in accordance with United States Environmental Protection Agency (USEPA) Method 205. The gas divider produced gas concentrations with less than 1% variability between triplicate gas dilutions, and generated a gas concentration that was accurate to within 1% of a Protocol 1 gas standard. The method criteria is less than 2% difference between dilutions, and less than 2% difference between the average dilution response and the Protocol 1 gas standard. The results demonstrate that the gas divider met the validation requirements of USEPA Method 205.

AQSI conducted an exhaust stack stratification test on May 6, 2015, in accordance with USEPA Method 7E. The results demonstrate that the stack gas was unstratified. AQSI collected the subsequent May 7, 2015 pollutant measurements from the centroid of the enclosed flare exhaust stack.

On May 7, 2015, Flare #4 was operated at a combustion chamber set-point temperature of 1,650 °F (as measured from the top of three installed thermocouples), and an average landfill gas flow rate of approximately 2,185 scfm. The test results for Flare #4 was an average exhaust NMOC concentration of 0.4 ppm, dry basis as hexane, corrected to 3 percent oxygen.

The emissions limit is an exhaust concentration less than 20 ppm by volume, dry basis as hexane, at 3 percent oxygen [40 CFR 60.752(b)(2)(iii)(B)]. The test results demonstrate that new enclose flare #4 meets the emission limit of 60.752(b)(2)(iii)(B) at the minimum combustion chamber set-point temperature.

3.0 SOURCE DESCRIPTION

The enclosed flares at Woodland Meadows RDF are used as auxiliary control devices for landfill gas emissions. New enclosed flare #4 sits at the base of an exhaust stack that is 120" inside diameter, and approximately 40 feet tall.

Enclosed flares #4 is equipped with a burner, and is rated for landfill gas flow rate of up to 2,500 scfm. Landfill gas flow is variable, and depends on both 1), demand for landfill gas by a third-party entity, and 2), landfill gas production in the landfill.

Each enclosed flare combusts landfill gas. The composition of the gas varies, but these values are typical: methane, 45% – 55%; carbon dioxide, 35% – 45%; oxygen, <2%; balance gas (nitrogen and minor constituents), 1% – 10%.

The combustion chamber temperature and landfill gas flow to the burner of the enclosed flares is monitored and recorded at least once every 15 minutes. Enclosed flare #4 is equipped with an automatic shutdown that activates if the minimum combustion chamber set-point temperature cannot be maintained. Flare temperature and flow rate data for the test dates is presented in Appendix C.

4.0 SAMPLE AND ANALYTICAL PROCEDURES

AQSI performed measurements in accordance with procedures specified in the USEPA *Standards of Performance for New Stationary Sources.* The sample collection and analytical methods used in the test program are indicated in the table below. Figure 1 depicts the sample site.

Parameter	Method	Analytical Method
Oxygen	USEPA Method 3A	Instrument Analyzer
Moisture Content	USEPA Method 4	Impinger Method
NMOC	USEPA Method 25A	FID Instrument Analyzer
USEPA Method 205	Gas divider verification	Check dilution for repeatability, and against a Protocol 1 standard.

4.1 Exhaust Gas Oxygen Concentration (USEPA Method 3A)

AQSI used USEPA Method 3A, "*Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrument Analyzer Procedure),*" to measure exhaust gas O_2 concentration for the correction of the measured NMOC concentration to dry basis, as hexane at 3% oxygen, per 60.752(b)(2)(iii(B).

The Method 3A sample train consisted of a stainless steel probe, a Teflon® sample line maintained at ~275°F, a non-contact thermoelectric sample conditioner to remove moisture, a sample pump, a bypass manifold, and the oxygen instrument analyzer. AQSI operated the analyzer in the 0 to 25 percent range.

AQSI calibrated the Method 3A analyzer with three gases in the 0 – 100 percent of span. AQSI used a "Nitrogen Zero Air" (99.99% nitrogen) gas standard that represents less than 0.25 percent of the instrument span as the "zero air." AQSI used a USEPA Protocol 1 gas that contained 20.02 percent oxygen (balance nitrogen) to set the instrument span. AQSI used a USEPA Protocol 1 gas that contained 9.90 percent oxygen to demonstrate instrument linearity, calibration error, system bias, and drift checks.

Figure 2 depicts the USEPA Method 3A sample train. The field and computer-generated calibration data sheets and USEPA Protocol 1 gas certification sheets are presented in Appendix B. The data acquisition (DAS) files are included on the compact disk as Appendix E.

4.2 Exhaust Gas Moisture Content (USEPA Method 4)

AQSI measured the exhaust gas moisture content of the enclosed flare by USEPA Method 4, *"Determination of Moisture Content in Stack Gases"*. AQSI conducted triplicate, 30-minute (minimum) sample runs on the enclosed flare #4 exhaust to determine the average exhaust gas moisture content. The moisture was collected in glass impingers, and the percentage of water vapor volume was derived from calculations.

Figure 3 depicts the USEPA Method 4 sample train. The field data sheets and calculated moisture contents are presented in Appendix A. The dry gas meter calibration sheet is provided in Appendix B.

4.3 Outlet Non-Methane Organic Compounds (USEPA Method 25A)

AQSI measured the non-methane organic compound concentrations at the enclosed flare exhaust according to USEPA Method 25A, *"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"*. Three 60-minute test runs were conducted on the enclosed flare #4 exhaust stack. Samples were collected through a probe and heated sample line, and into the analyzer, in accordance with USEPA Method 25A procedures. AQSI used a J.U.M. Engineering Model 109A methane/non-methane hydrocarbon analyzer to determine the methane/non-methane hydrocarbon concentration in the exhaust of the enclosed flare.

The J.U.M. 109A utilizes two flame ionization detectors (FID) in order to report the instantaneous parts per million by volume (ppmv) for total hydrocarbons (THC), in concentration equivalents to the calibration gas (methane), as well as the instantaneous ppmv for methane (as methane). The instrument splits the gas stream to the two FID. One FID ionizes all of the hydrocarbons in the gas stream sample into carbon, which is then detected as a concentration of total hydrocarbons. The concentration of THC, as an analog (voltage) signal, is sent to the data acquisition system (DAS), where the signal output is recorded at 4-second intervals. The THC results are averaged based on the overall duration of the test. The second FID reports methane only. The sample enters a chamber that contains a catalyst that destroys all of the hydrocarbons present in the gas stream other than methane. As with the THC sample, the methane gas concentration is sent to the DAS and recorded. The methane results are averaged based on the overall duration of the test. The non-methane organic compound (NMOC) concentration is the average THC concentration (as methane), minus the average methane concentration.

AQSI imported the raw text files produced by the DAS into Microsoft® Excel, and then broke out calibration events and test runs into individual sheets (tabs). Test run data was averaged for each channel, and the average concentration used to calculate results.

A drawing of the sample train used for the NMOC test program is presented in Figure 4. The field and computer-generated calibration data sheets and USEPA Protocol 1 gas certification sheets are presented in Appendix B. The data acquisition (DAS) files are included on the compact disk as Appendix E.

4.4 Verification of Gas Dilution Systems (USEPA Method 205)

AQSI used USEPA Method 205, *"Verification of Gas Dilution Systems for Field Instrument Calibrations,"* to demonstrate that the gas divider accurately and repeatedly provides known concentrations of calibration gas by controlled dilution of a known Protocol 1 gas standard.

The gas dilution system met the precision and accuracy requirements of Method 205. The gas divider factory calibration certificate and performance verification data are provided in Appendix B.

5.0 RESULTS AND DISCUSSION

On May 7, 2015, new Flare #4 was operated at a combustion chamber set-point temperature of 1,650 °F and an average landfill gas flow rate of approximately 2,185 scfm. The test results for Flare #4 was an average exhaust NMOC concentration of 0.4 ppm, dry basis as hexane, corrected to 3 percent oxygen.

The emissions limit is an exhaust concentration less than 20 ppm by volume, dry basis as hexane, at 3 percent oxygen [40 CFR 60.752(b)(2)(iii)(B)]. The test results demonstrate that new enclosed flare #4 meets the emission limit of 60.752(b)(2)(iii)(B) at the tested flow rate capacity and minimum combustion chamber set-point temperatures.

AQSI performed a pre-test stratification test on May 6, 2015. The test was conducted in accordance with Method 7E. AQSI measured the diluent (O_2) concentration at six (6) points in the enclosed flare exhaust. AQSI first accessed the exhaust stack from the east port, and sampled at the centroid for 3 minutes. AQSI then moved the probe tip out to a position that represented approximately 16.7 percent of the stack cross-section and sampled for 3 minutes. AQSI then angled the probe tip towards the north port, to a position that represented approximately 16.7 percent of the stack cross-section, and sampled for 3 minutes.

At the completion of the east port "traverse," AQSI moved the sample probe to the south port, and, after a period of time of at least twice the measurement system response time, again sampled at the centroid for 3 minutes. AQSI then moved the probe tip out to a position that represented approximately 16.7 percent of the stack cross-section and sampled for 3 minutes. AQSI then angled the probe tip towards the west port, to a position that represented approximately 16.7 percent of the stack cross-section, and sampled for 3 minutes.

AQSI compared the individual points' average results to the mean value. The results show that the average concentration data from point to point was consistent, with a mean concentration of 12.27 percent oxygen, and a range from 12.12 percent to 12.55 percent. These results are within the ±5% criteria to substantiate "no stratification." AQSI collected all subsequent pollutant concentrations from the centroid of the exhaust stack.

AQSI demonstrated the gas dilution system performance at the completion of the NMOC tests on May 7, 2015. AQSI chose to demonstrate the gas divider with the Method 25A FID, due to the inherent linearity of the FID. Controlled dilutions of 89.7 and 49.7 ppm, respectively, were directed to the analyzer, in triplicate, to demonstrate precision.

The instrument response to the triplicate 89.7 ppm dilutions was 89.3 ppm, 89.2 ppm, and 89.2 ppm, respectively. The average instrument response to the 89.7 ppm dilution was 89.2 ppm. The instrument response to the triplicate 49.7 ppm dilutions was 49.7 ppm, 49.6 ppm, and 49.6 ppm, respectively. The average instrument response to the 49.7 ppm dilution was 49.6 ppm.

The results demonstrate that all individual injections agree to within 0.1% of the average response to the 89.7 ppm dilution and 0.2% of the average response to the 49.7 ppm dilution. The average responses (89.2 ppm and 49.6 ppm) were within 0.6% and 0.2% of the 89.7 ppm and 49.7 ppm dilutions, respectively. The acceptance criteria are within 2% for both parameters.

The FID was then challenged, in triplicate, with a 90.7 ppm Protocol 1 gas standard to check the accuracy of the dilution. The average instrument response was 90.6 ppm, and agrees to within 0.1% of the Protocol 1 gas standard. The acceptance criterion is within 2% agreement.

The results demonstrate that the gas divider met the verification criteria of Method 205.

AQSI notes that there were variations and/or anomalies in normal sample collection procedures:

1. The maximum rated flow rate capacity of the new enclosed flare #4 is 2,500 scfm. However, that rating is based on a landfill gas quality of 50 percent methane. The gas quality to the flare was actually approximately 55 percent methane, or 10 percent higher than design. Rough calculation showed that reducing landfill gas flow rate to approximately 2,275 scfm (at 55 percent methane) would be equivalent to 2,500 scfm at 50 percent methane. Thus, the tested flow rate (2,185 scfm) represents approximately 96 percent of rated capacity (2,185 / 2,275 = 0.96) at 55 percent methane.

2. The in-stack average total hydrocarbon, methane, and NMOC concentrations were at or near 0.0 ppm. The hydrocarbon analyzer was operated on the 0 – 100 ppm range (as methane), and has an accuracy of 1 percent of scale (1 ppm). AQSI performed all NMOC-correction calculations using a 1.0 ppm raw (in-stack) NMOC concentration.

3. Test No. 1 moisture data (4.3%) was anomalously low vs. Test Nos. 2 and 3 data. AQSI suspects that some liquid was back-purged from the first impinger during the post-test leak check. AQSI used the average moisture content from Test Nos. 2 and 3 as the Test No. 1 moisture value for NMOC concentration correction.

A detailed run-specific summary of the results of the tests on the new enclosed flare #4 exhaust stack is presented in Tables 1 and 2.

There was no major maintenance performed on enclosed flare #4 in the last 3 months; enclosed flare #4 is a new installation (December 2014).

MDEQ personnel did not witness the test program. AQSI quality assurance (QA) procedures included an analyzer linearity and calibration error on the Method 25A sample system. The sample system passed these QA checks, as well as all post-test drift and error checks. The Method 3A sample system passed all calibration error, linearity, system bias, and response time checks, as well as all post-test drift and error checks. The moisture train was leak-checked before and after each test in accordance with USEPA Method 4. The sample system passed all leak checks.

Raw field and computer-calculated data used in the determination of the enclosed flare average NMOC emission concentration is presented in Appendix A. Equipment and analyzer calibration data sheets are presented in Appendix B. Flare station temperature and flow rate recorder data are presented in Appendix C. Sample calculations are presented in Appendix D.

Copies of the Method 3A and 25A DAS output files, raw flare station flow and temperature data files, and Microsoft® Excel spreadsheets are included on the compact disk in the back-cover pocket (as Appendix E).

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

This report reviewed by: _____
Dana A. Oleniacz
President

June 12, 2015

TABLES

Table 1

Non-methane Organic Compound Concentration Test Results
Woodland Meadows RDF
Enclosed Flare #4 Exhaust
Wayne, Michigan
May 7, 2015

Test No.	NMOC (ppm CH_4)	O_2 (%)	Moisture (%)	NMOC - corrected (ppm as hexane)
1	1.0	13.35	10.3	**0.4**
2	1.0	12.13	9.2	**0.4**
3	1.0	12.16	11.4	**0.4**
Averages:	**1.0**	**12.55**	**10.3**	**0.4**

NMOC: Non-methane organic compounds, as total hydrocarbons
ppm: parts per million (volume)
CH_4: methane
O_2: oxygen, drift-corrected concentration
%: percent
B_{ws}: % moisture / 100

Equation: $NMOC_{(hexane)} = [NMOC_{(methane)} * 17.9 / (20.9 - \%O_2)] / [6 * (1 - B_{ws})]$

Note 1: Actual THC/CH4/NMOC ppm were 0.0 to -1.0 ppm, reported as MDL (1.0 ppm)
Note 2: Run 1 moisture is average of Run 2 & 3; Run 1 moisture anomalously low (4.3%)

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Table 2

Oxygen Concentration Test Results
Woodland Meadows RDF
Enclosed Flare #4 Exhaust
Wayne, Michigan
May 7, 2015

Test No.	C_{avg} (% O_2)	C_o (% O_2)	C_{ma} (% O_2)	C_m (% O_2)	C_{gas} (% O_2)
1	13.56	0.14	9.90	10.09	**13.35**
2	12.22	0.07	9.90	9.99	**12.13**
3	12.18	0.00	9.90	9.92	**12.16**
Averages:	**12.20**	**0.04**	**9.90**	**9.96**	**12.54**

C_{avg}: Average gas concentration indicated by gas analyzer, dry basis, percent.
C_o: Average of the initial and final system bias check responses for the zero gas, percent.
C_{ma}: Actual concentration of the upscale calibration gas, percent.
C_m: Average of the initial and final system bias check responses for the span gas, percent.
C_{gas}: Corrected effluent gas concentration, dry basis, percent.
%: percent
O_2: oxygen

Equation: $C_{gas} = (C_{avg} - C_o) * C_{ma} / (C_m - C_o)$

AQS Inc.

FIGURES

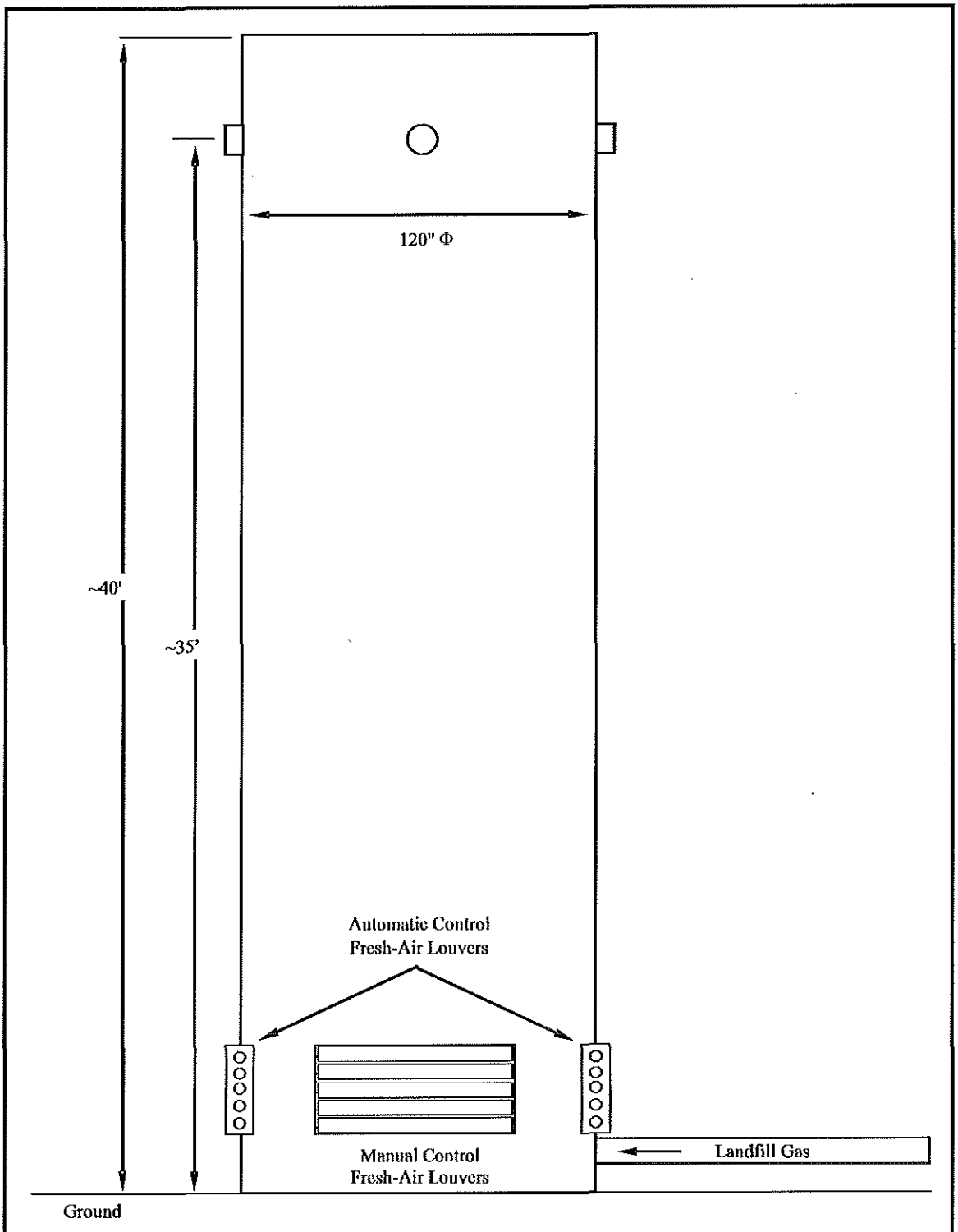

Figure 1
Enclosed flare #4 representative exhaust sample port locations, at Woodland Meadows RDF in Wayne, Michigan.

Air Quality Specialist, Inc.
May 6 and 7, 2015

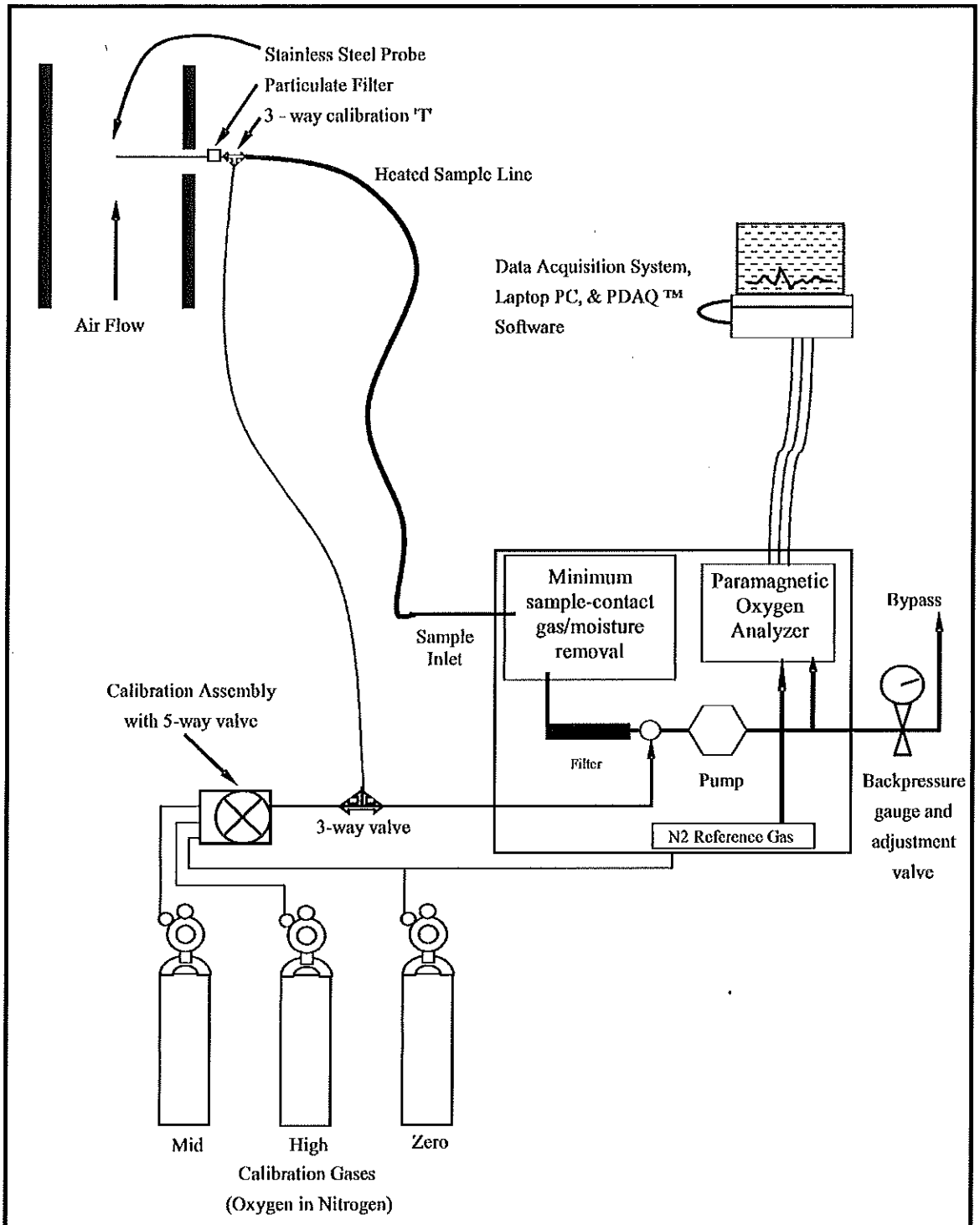

Figure 2
USEPA Method 3A sample train for the enclosed flare exhaust stack at Woodland Meadows RDF in Wayne, Michigan.

Air Quality Specialist, Inc.
May 6 and 7, 2015

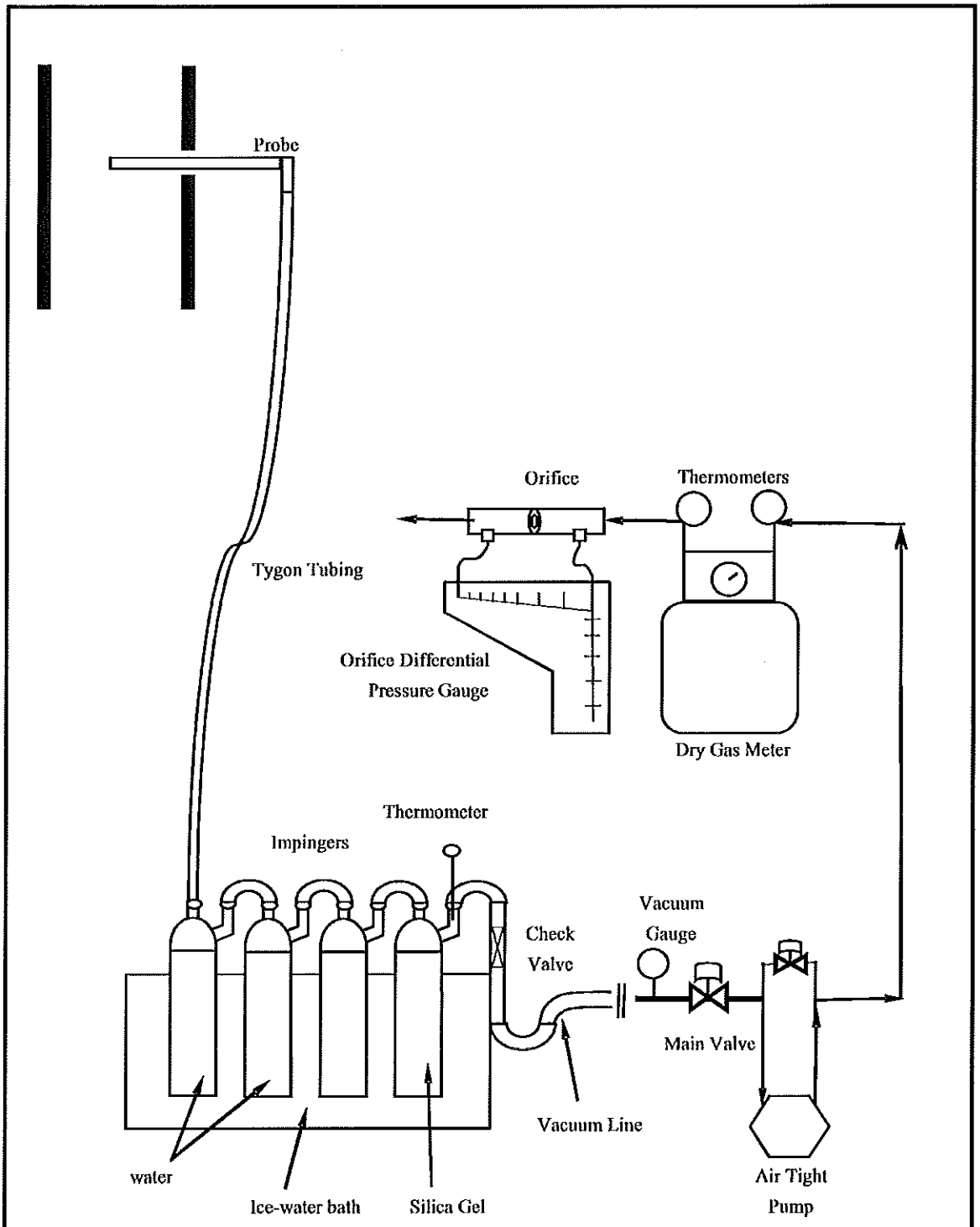

Figure 3
USEPA Method 4 sample train used at enclosed flare exhaust stack at Woodland Meadows RDF in Wayne, Michigan.

Air Quality Specialist, Inc.
May 6 and 7, 2015

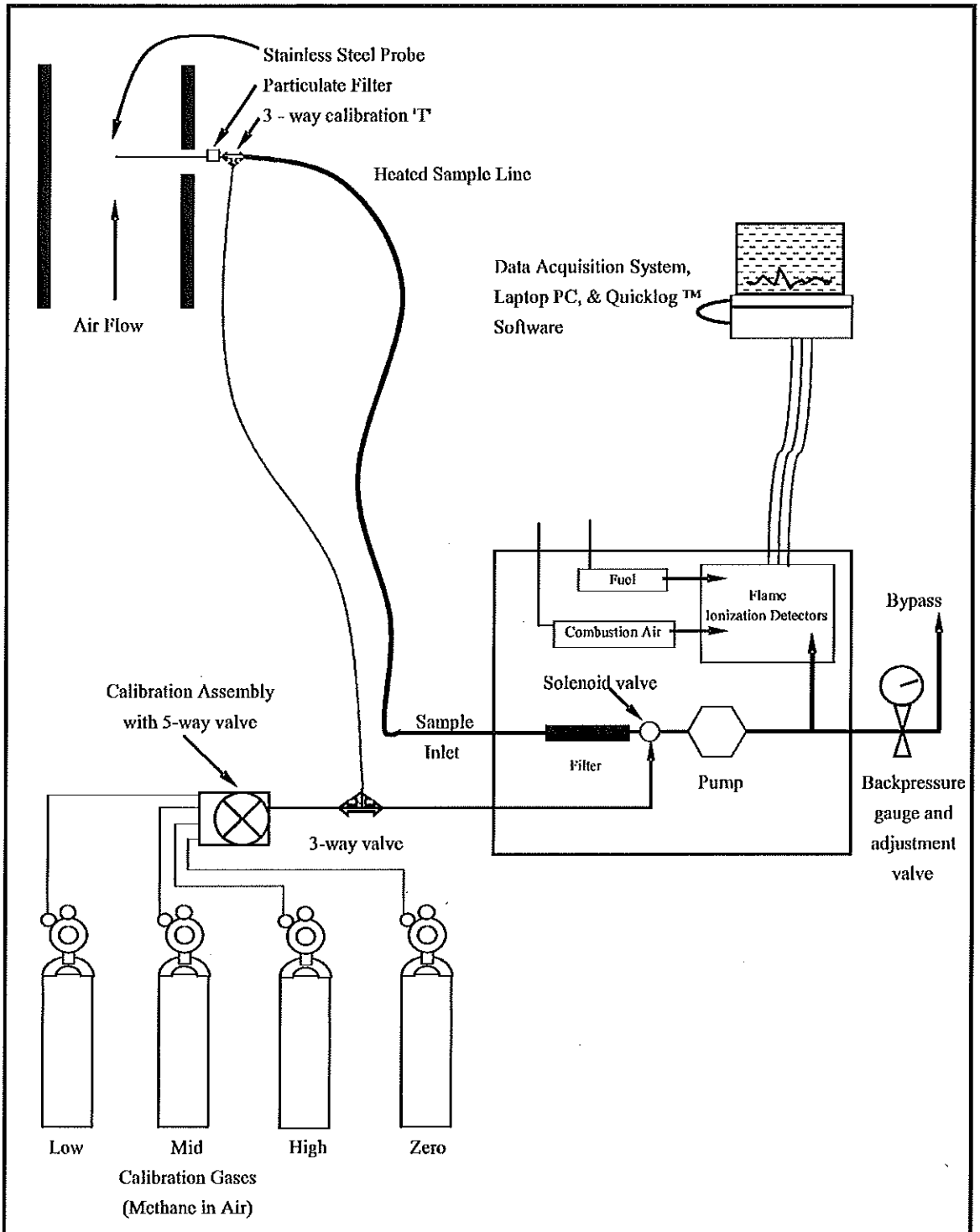

Figure 4
USEPA Method 25A sample train used at the enclosed flare exhaust stack at Woodland Meadows RDF in Wayne, Michigan.

Air Quality Specialist, Inc.
May 6 and 7, 2015