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AIR EMISSION TEST REPORT

Title	NSPS EMISSION TEST REPORT FOR GAS FUELED INTERNAL COMBUSTION ENGINES
Report Date	May 29, 2019
Test Dates	May 1, 2019

Facility Information	
Name	City of Midland Wastewater Treatment Plant
Street Address	2125 Austin St.
City, County	Midland, Midland

Facility Permit Information			
Permit No.:	MI-ROP-N6004-2019	Facility SRN :	N6004

Testing Contractor	
Company	Impact Compliance & Testing, Inc.
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Phone	(517) 268-0043
Project No.	1900131

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

NSPS EMISSION TEST REPORT
FOR
GAS FUELED INTERNAL COMBUSTION ENGINES

CITY OF MIDLAND
WASTEWATER TREATMENT PLANT

1.0 INTRODUCTION

The City of Midland operates two (2) Caterpillar (CAT®) Model No. G3520C gas-fired reciprocating internal combustion engines (RICE) and electricity generator sets at the City of Midland Wastewater Treatment Plant (WWTP) in Midland, Midland County, Michigan. TheRICE are fueled with digester gas produced at the treatment plant and by landfill gas (LFG) thatis produced at the City of Midland Landfill. The digester gas and LFG fueled RICE generatorsets are identified as emission units EUICENGINE1 and EUICENGINE2 in RenewableOperating Permit MI-ROP-N6004-2019 issued by the Michigan Department of Environment, Great Lakes, and Energy-Air Quality Division (EGLE-AQD).

The RICE are subject to the Standards of Performance for Spark Ignition Reciprocating Internal Combustion Engines (SI-RICE NSPS), 40 CFR Part 60 Subpart JJJJ. Conditions of MI-ROP-N6004-2019 specify that *… the permittee shall conduct an initial performance test for EUICENGINE1 and EUICENGINE2 within one year after startup of the engine and every 8760 hours of operation … to demonstrate compliance with the emission limits in 40 CFR 60.4233(e) … If a performance test is required, the performance test shall be conducted according to 40 CFR 60.4244.*

Compliance testing was most recently performed in May 2019 to measure volatile organic compounds (VOC), nitrogen oxides (NOx) and carbon monoxide (CO) concentrations and emission rates from the two gas fired RICE pursuant to the testing requirements specified in MI-ROP-N6004-2019 and the SI-RICE NSPS. This test report presents the results of emission compliance testing performed May 1, 2019 by Impact Compliance & Testing, Inc. representatives Blake Beddow and Jory VanEss. The project was coordinated by City of Midland Landfill Superintendent Scott O'Laughlin. Ms. Gina McCann and Mr. DavePatterson of the EGLE-AQD were on-site to observe portions of the compliance testing. The sampling and analysis were performed using procedures specified in the Test Plan submitted to the EGLE-AQD and approved by the regulatory agency on March 13, 2019.

Questions regarding this emission test report should be directed to:

Jory VanEss
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Mr. Scott O'Laughlin
City of Midland Landfill Superintendent
City of Midland
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Midland, Michigan 48642
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Report Certification

This test report was prepared by Impact Compliance & Testing, Inc. (ICT) based on field sampling data collected by ICT. Facility process data were collected and provided by City of Midland employees or representatives. This test report has been reviewed by City of Midland representatives and approved for submittal to the EGLE.

I certify that the testing was conducted in accordance with the specified test methods and submitted test plan unless otherwise specified in this report. I believe the information provided in this report and its attachments are true, accurate, and complete.

Report Prepared By:

Jory VanEss
Environmental Consultant
Impact Compliance & Testing, Inc.

Blake Beddow
Environmental Consultant
Impact Compliance & Testing, Inc.

I certify that the facility and emission units were operated at maximum routine operating conditions for the test event. Based on information and belief formed after reasonable inquiry, the statements and information in this report are true, accurate and complete.

Responsible Official Certification:

Scott O'Laughlin
City of Midland Landfill Superintendent

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 General Process Description

Gas containing methane is produced in the City of Midland WWTP and City of Midland Landfill from the anaerobic decomposition of waste materials. The gas is collected and directed to the City of Midland gas-to-energy facility where it is used as fuel for the RICE generators that produce electricity.

The gas-to-energy facility primarily consists of gas treatment equipment and two (2) CAT® Model No. G3520C RICE that are connected to individual electricity generators.

2.2 Rated Capacities and Air Emission Controls

The CAT® Model No. G3520C RICE has a rated output of 2,233 brake-horsepower (bhp) and the connected generator has a rated electricity output of 1,600 kilowatts (kW). The engine is designed to fire low-pressure, lean fuel mixtures (e.g., LFG) and is equipped with an air-to-fuel ratio controller that monitors engine performance parameters and automatically adjusts the air-to-fuel ratio and ignition timing to maintain efficient fuel combustion.

The RICE-generator sets are not equipped with add-on emission control devices. Air pollutant emissions are minimized through the proper operation of the gas treatment system and efficient fuel combustion in the engines.

The fuel consumption rate is regulated automatically to maintain the heat input rate required to support engine operations and is dependent on the fuel heat value (methane content) of the fuel.

2.3 Sampling Locations

The RICE exhaust gas is directed through mufflers and is released to the atmosphere through dedicated vertical exhaust stacks with vertical release points. The two (2) CAT® Model G3520C RICE exhaust stacks are identical.

The exhaust stack sampling ports for EUICENGINE1 and 2 are located in individual exhaust stacks with an inner diameter of 15.5 inches. The ports are located upstream of the engine muffler in a horizontal section of the exhaust pipe. Each stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location 52 inches (3.35 duct diameters) upstream and 60 inches (3.87 duct diameters) downstream from any flow disturbance and satisfies the USEPA Method 1 criteria for a representative sample location.

Individual traverse points were determined in accordance with USEPA Method 1.

Appendix A provides diagrams of the emission test sampling locations.

3.0 SUMMARY OF TEST RESULTS AND OPERATING CONDITIONS

3.1 Purpose and Objective of the Tests

Conditions of MI-ROP-N6004-2019 and the SI-RICE NSPS require the City of Midland WWTP to test both engines for CO, NOx and VOC emissions every 8,760 hours of operation. Previous testing was done June 27, 2017 (29,106 engine hours) and January 3, 2018 (26,332 engine hours) for EUICENGINE1 and EUICENGINE2, respectively. Testing of engines occurred within 8,760 hours of previous testing. EUICENGINE1 had 37,616 engine hours and EUICENGINE2 had 30,473 engine hours.

3.2 Operating Conditions During the Compliance Tests

The testing was performed while the City of Midland WWTP RICE-generator sets were operated at maximum operating conditions (1,600 kW electricity output +/- 10%). City landfill representatives provided the kW output in 15-minute intervals for each test period. The average hourly generator kW output ranged between 1,566 and 1,590 kW for the test periods.

Landfill gas and digester gas fuel flowrate (cubic feet per minute) and fuel methane content (%) were also recorded by City of Midland WWTP facility operators at 15-minute intervals for each test period. The average hourly LFG fuel consumption rate ranged between 490 and 503 scfm, average hourly digester gas fuel flowrate ranged between 35.9 and 48.5 and the average hourly methane content ranged between 55.4 and 55.9%.

Appendix B provides the electronic operating records provided by City of Midland WWTP representatives for the test periods.

Engine output (bhp) cannot be measured directly and was calculated based on the recorded electricity output, the calculated CAT® Model G3520C generator efficiency (96.1%), and the unit conversion factor for kW to horsepower (0.7457 kW/hp).

Engine output (bhp) = Electricity output (kW) / (0.961) / (0.7457 kW/hp)

Table 3.1 presents a summary of the average engine operating conditions during the test periods.

3.3 Summary of Air Pollutant Sampling Results

The gases exhausted from EUICENGINE1 and EUICENGINE2 were sampled for three (3) one-hour test periods during the compliance testing performed May 1, 2019.

Table 3.2 presents the average measured CO, NOx and VOC emission rates for each RICE (average of the three test periods for each engine).

The average measured air pollutant emission rates are less than the limits specified in MI-ROP-N6004-2019. Test results for each one hour sampling period are presented in Section 6.0 of this report.

Table 3.1 Average engine operating conditions during the test periods

Engine Parameter	EUICENGINE1	EUICENGINE2
Generator output (kW)	1,589	1,568
Engine output (bhp)	2,217	2,188
Engine LFG fuel use (scfm)	500	493
Engine Digester fuel use (scfm)	44.4	36.1
LFG methane content (%)	55.7	55.6

Table 3.2 Average measured emission rates for each RICE (three-test average)

	CO Emission Rates		NOx Emission Rates		VOC Emission Rates	
Emission Unit	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
EUICENGINE1	14.2	2.91	2.96	0.61	0.50	0.10
EUICENGINE2	13.0	2.70	3.26	0.68	0.65	0.13
Permit Limit		*4.2*		*1.0*		*1.0*

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A test protocol for the air emission testing was reviewed and approved by the EGLE-AQD. This section provides a summary of the sampling and analytical procedures that were used during the testing periods.

4.1 Summary of Sampling Methods

USEPA Method 2	Exhaust gas velocity pressure was determined using a Type-S Pitot tube connected to a red oil incline manometer; temperature was measured using a K-type thermocouple connected to the Pitot tube.
USEPA Method 3A	Exhaust gas O_2 and CO_2 content was determined using zirconia ion/paramagnetic and infrared instrumental analyzers, respectively.
USEPA Method 4	Exhaust gas moisture was determined based on the water weight gain in chilled impingers.
USEPA Method 7E	Exhaust gas NOx concentration was determined using chemiluminescence instrumental analyzers.
USEPA Method 10	Exhaust gas CO concentration was measured using NDIR instrumental analyzers.
USEPA Method 25A / ALT-096	Exhaust gas VOC (as NMHC) concentration was determined using flame ionization analyzers equipped with GC columns.

4.2 Exhaust Gas Velocity Determination (USEPA Method 2)

The RICE exhaust stack gas velocities and volumetric flow rates were determined using USEPA Method 2 prior to and after each test period. An S-type Pitot tube connected to a red-oil manometer was used to determine velocity pressure at each traverse point across the stack cross section. Gas temperature was measured using a K-type thermocouple mounted to the Pitot tube. The Pitot tube and connective tubing were leak-checked prior to each traverse to verify the integrity of the measurement system.

The absence of significant cyclonic flow for the exhaust configuration was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each velocity traverse point with the planes of the face openings of the Pitot tube perpendicular to the stack cross-sectional plane. The Pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

Appendix C provides exhaust gas flowrate calculations and field data sheets.

4.3 Exhaust Gas Molecular Weight Determination (USEPA Method 3A)

CO_2 and O_2 content in the RICE exhaust gas streams were measured continuously throughout each test period in accordance with USEPA Method 3A. The CO_2 content of the exhaust was monitored using a Servomex 4100 single beam single wavelength (SBSW) infrared gas analyzer. The O_2 content of the exhaust was monitored using a Servomex 4100 gas analyzer that uses a paramagnetic sensor.

During each sampling period, a continuous sample of the RICE exhaust gas stream was extracted from the stack using a stainless steel probe connected to a Teflon® heated sample line. The sampled gas was conditioned by removing moisture prior to being introduced to the analyzers; therefore, measurement of O_2 and CO_2 concentrations correspond to standard dry gas conditions. Instrument response data were recorded using an ESC Model 8816 data acquisition system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages.

Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document). Sampling times were recorded on field data sheets.

Appendix D provides O_2 and CO_2 calculation sheets. Raw instrument response data are provided in Appendix E.

4.4 Exhaust Gas Moisture Content (USEPA Method 4)

Moisture content of the RICE exhaust gas was determined in accordance with USEPA Method 4 using a chilled impinger sampling train. The moisture sampling was performed concurrently with the instrumental analyzer sampling. During each sampling period a gas sample was extracted at a constant rate from the source where moisture was removed from the sampled gas stream using impingers that were submersed in an ice bath. At the conclusion of each sampling period, the moisture gain in the impingers was determined gravimetrically by weighing each impinger to determine net weight gain.

4.5 NOx and CO Concentration Measurements (USEPA Methods 7E and 10)

NOx and CO pollutant concentrations in the RICE exhaust gas streams were determined using a Thermo Environmental Instruments, Inc. (TEI) Model 42i High Level chemiluminescence NO_X analyzer and a TEI Model 48c infrared CO analyzer.

Throughout each test period, a continuous sample of the engine exhaust gas was extracted from the stack using the Teflon® heated sample line and gas conditioning system and delivered to the instrumental analyzers. Instrument response for each analyzer was recorded on an ESC Model 8816 data acquisition system that logged data as one-minute averages. Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias.

Appendix D provides CO and NO_X calculation sheets. Raw instrument response data are provided in Appendix E.

4.6 Measurement of Volatile Organic Compounds (USEPA Method 25A/ALT-096)

VOC emission rate was determined by measuring the nonmethane hydrocarbon (NMHC) concentration in the exhaust gas for each RICE. NMHC pollutant concentration was determined using a TEI Model 55i Methane / Nonmethane hydrocarbon analyzer. The TEI 55i analyzer contains an internal gas chromatograph column that separates methane from non-methane components. The concentration of NMHC in the sampled gas stream, after separation from methane, is determined relative to a propane standard using a flame ionization detector in accordance with USEPA Method 25A.

Throughout each one-hour test period, a continuous sample of the RICE exhaust gas was extracted from the stack using the Teflon® heated sample line described in Section 4.3 of this document, and delivered to the instrumental analyzer. The sampled gas was not conditioned prior to being introduced to the analyzer; therefore, the measurement of NMHC concentration corresponds to standard wet gas conditions. Instrument NMHC (VOC) response for the analyzer was recorded on an ESC Model 8816 data logging system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages. Prior to, and at the conclusion of each test, the instrument was calibrated using mid-range calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document).

Appendix D provides VOC calculation sheets. Raw instrument response data for the NMHC analyzer is provided in Appendix E.

5.0 <u>QA/QC ACTIVITIES</u>

5.1 Exhaust Gas Flow Measurement

Prior to arriving onsite, the instruments used during the source test to measure exhaust gas properties and velocity (barometer, pyrometer, and Pitot tube) were calibrated to specifications outlined in the sampling methods.

The Pitot tube and connective tubing were periodically leak-checked to verify the integrity of the measurement system.

The absence of significant cyclonic flow for the exhaust configuration was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each velocity traverse point with the planes of the face openings of the Pitot tube perpendicular to the stack cross-sectional plane. The Pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

5.2 NO_x Converter Efficiency Test

The NO_2 – NO conversion efficiency of the Model 42c analyzer was verified prior to the testing program. A USEPA Protocol 1 certified concentration of NO_2 was injected directly into the analyzer, following the initial three-point calibration, to verify the analyzer's conversion efficiency. The analyzer's NO_2 – NO converter uses a catalyst at high temperatures to convert the NO_2 to NO for measurement. The conversion efficiency of the analyzer is deemed acceptable if the measured NO_2 concentration is within 90% of the expected value.

The NO_2 – NO conversion efficiency test satisfied the USEPA Method 7E criteria (measured NO_x concentration was greater than 90% of the expected value, as required by Method 7E).

5.3 Sampling System Response Time Determination

The response time of the sampling system was determined prior to the compliance test program by introducing upscale gas and zero gas, in series, into the sampling system using a tee connection at the base of the sample probe. The elapsed time for the analyzer to display a reading of 95% of the expected concentration was determined using a stopwatch.

The TEI Model 55i VOC analyzer exhibited the longest system response time at 130 seconds. Results of the response time determinations were recorded on field data sheets. For each test period, test data were collected once the sample probe was in position for at least twice the maximum system response time.

5.4 Determination of Exhaust Gas Stratification

A stratification test was performed for the engine exhaust stack. The stainless-steel sample probe was positioned at sample points correlating to 16.7, 50.0 (centroid) and 83.3% of the stack diameter. Pollutant concentration data were recorded at each sample point for a minimum of twice the maximum system response time.

The recorded concentration data for the engine exhaust stack indicate that the measured NO_X concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the engine exhaust gas was considered to be unstratified and the compliance test sampling was performed at a single representative sampling location within each engine exhaust stack.

5.5 Gas Divider Certification (USEPA Method 205)

A STEC Model SGD-710C 10-step gas divider was used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified, within the previous 12 months, with a primary flow standard in accordance with Method 205. When cut with an appropriate zero gas, the ten-step STEC gas divider delivered calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas that was introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 were followed prior to use of gas divider. The field evaluation yielded no errors greater than 2% of the triplicate measured average and no errors greater than 2% from the expected values.

5.6 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure NO_X, CO, O_2 and CO_2 have had an interference response test preformed prior to their use in the field pursuant to the interference response test procedures specified in USEPA Method 7E. The appropriate interference test gases (i.e., gases that would be encountered in the exhaust gas stream) were introduced into each analyzer, separately and as a mixture with the analyte that each analyzer is designed to measure. All of analyzers exhibited a composite deviation of less than 2.5% of the span for all measured interferent gases. No major analytical components of the analyzers have been replaced since performing the original interference tests.

5.7 Instrument Calibration and System Bias Checks

At the beginning of each day of the testing program, initial three-point instrument calibrations were performed for the NO_x, CO, CO_2 and O_2 analyzers by injecting calibration gas directly into the inlet sample port for each instrument. System bias checks were performed prior to and at the conclusion of each sampling period by introducing the upscale calibration gas and zero gas into the sampling system (at the base of the stainless-steel sampling probe prior to the particulate filter and Teflon® heated sample line) and determining the instrument response against the initial instrument calibration readings.

At the beginning of each test day, appropriate high-range, mid-range, and low-range span gases followed by a zero gas were introduced to the NMHC analyzer, in series at a tee connection, which is installed between the sample probe and the particulate filter, through a poppet check valve. After each one hour test period, mid-range and zero gases were re-introduced in series at the tee connection in the sampling system to check against the method's performance specifications for calibration drift and zero drift error.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO_2, O_2, NO_x, and CO in nitrogen and zeroed using hydrocarbon free nitrogen. The NMHC (VOC) instrument was calibrated with USEPA Protocol 1 certified concentrations of propane in air and zeroed using hydrocarbon-free air. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

5.8 Meter Box Calibrations

The dry gas metering console, which was used for exhaust gas moisture content sampling, was calibrated prior to and after the testing program. This calibration uses the critical orifice calibration technique presented in USEPA Method 5. The metering console calibration exhibited no data outside the acceptable ranges presented in USEPA Method 5.

The digital pyrometer in the metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

Appendix 6 presents test equipment quality assurance data (NO_2 – NO conversion efficiency test data, instrument calibration and system bias check records, calibration gas and gas divider certifications, interference test results, meter box calibration records, Pitot tube calibration records).

6.0 RESULTS

6.1 Test Results and Allowable Emission Limits

Engine operating data and air pollutant emission measurement results for each one hour test period are presented in Tables 6.1 and 6.2.

The measured air pollutant concentrations and emission rates for EUICENGINE1 and EUICENGINE2 are less than the allowable limits specified in MI-ROP-N6004-2019:

- 1.0 g/bhp-hr for NO_X;
- 4.2 g/bhp-hr for CO; and
- 1.0 g/bhp-hr for VOC.

6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with the approved test protocols. The RICE-generator sets were operated within 10% of maximum output (1,600 kW generator output) and no variations from the normal operating conditions of the RICE occurred during the engine test periods. There were no variations from the approved sampling procedures during the engine test periods.

Table 6.1 Measured exhaust gas conditions and NOx, CO and VOC air pollutant emission rates City of Midland WWTP Engine No. 1 (EUICENGINE1)

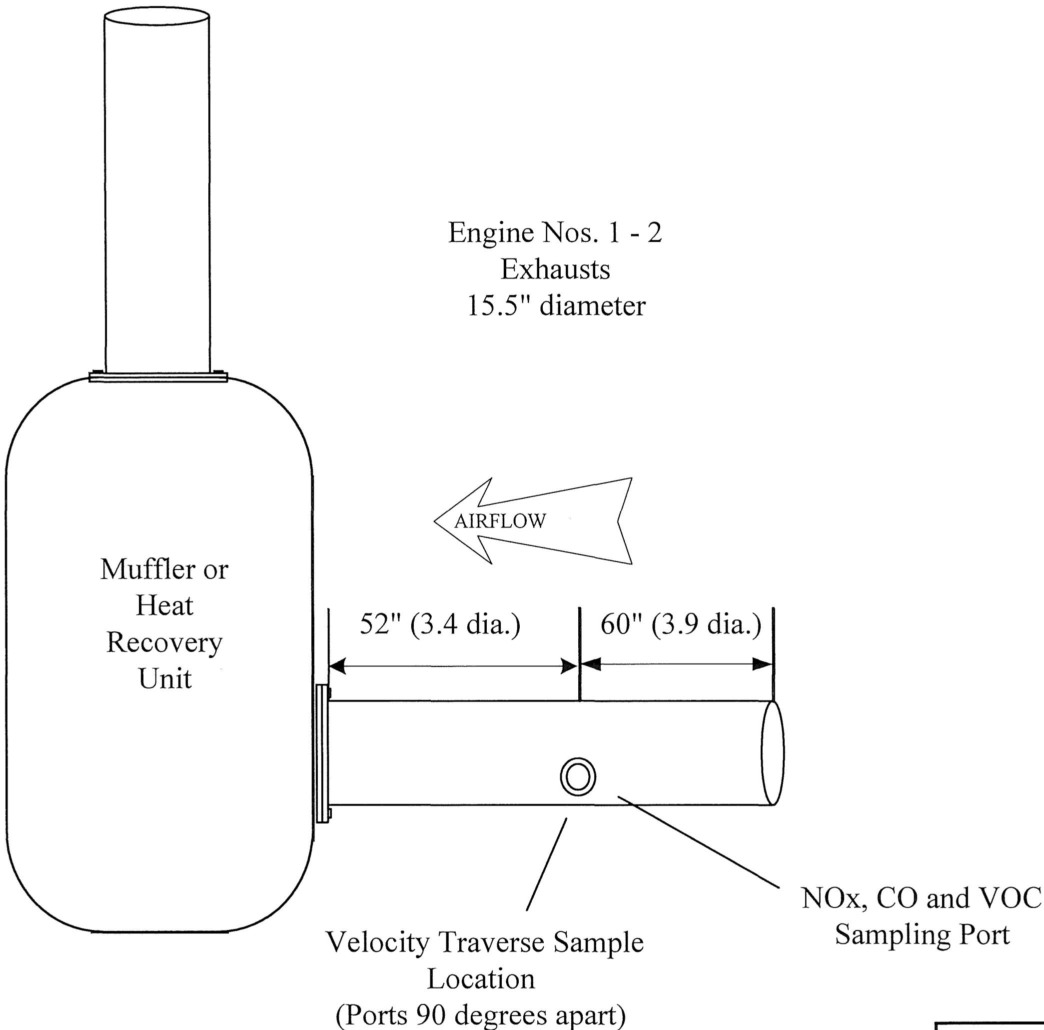
Test No. Test Date Test Period (24-hr clock)	1 5/1/19 07:25-08:25	2 5/1/19 08:50-09:50	3 5/1/19 10:37-11:37	Test Avg.
Generator output (kW)	1,590	1,588	1,588	1,589
Engine Horsepower (Hp)	2,219	2,215	2,215	2,217
Engine Fuel Use (scfm)	503	499	499	500
Exhaust gas composition				
CO_2 content (% vol)	11.1	11.1	11.1	11.1
O_2 content (% vol)	8.32	8.33	8.30	8.32
Moisture (% vol)	10.8	13.6	8.7	11.0
Exhaust gas flowrate				
Standard conditions (scfm)	5,009	4,930	4,892	4,944
Dry basis (dscfm)	4,468	4,259	4,467	4,398
Nitrogen oxides emission rates				
NO_X conc. (ppmvd)	93.7	94.4	93.8	93.9
NO_X emissions (lb/hr NO_2)	3.00	2.88	3.01	2.96
NO_X emissions (g/bhp-hr)	0.61	0.59	0.62	0.61
NO_X permit limit (g/bhp-hr)				*1.00*
Carbon monoxide emission rates				
CO conc. (ppmvd)	740	740	743	741
CO emissions (lb/hr)	14.4	13.8	14.5	14.2
CO emissions (g/bhp-hr)	2.95	2.82	2.96	2.91
CO permit limit (g/bhp-hr)				*4.20*
VOC/NMHC emission rates				
VOC conc. (ppmv C_3)	14.7	14.5	14.6	14.6
VOC emissions (lb/hr)	0.51	0.49	0.49	0.50
VOC emissions (g/bhp-hr)	0.10	0.10	0.10	0.10
VOC permit limit (g/bhp-hr)				*1.0*

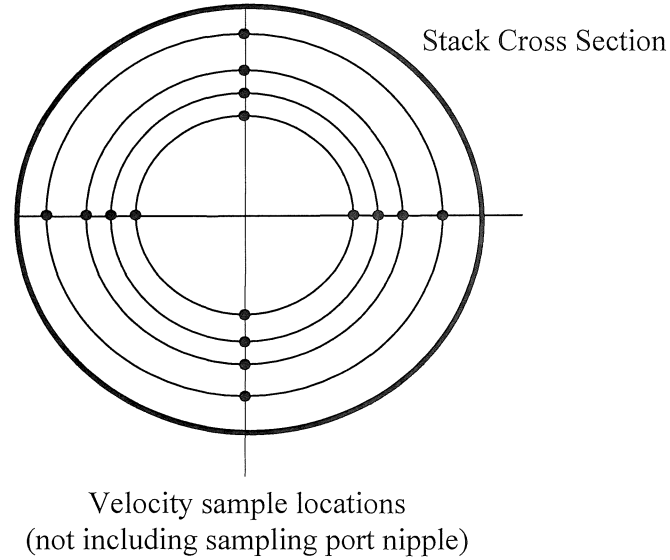
Table 6.2 Measured exhaust gas conditions and NOx, CO and VOC air pollutant emission rates City of Midland WWTP Engine No. 2 (EUICENGINE2)

Test No. Test Date Test Period (24-hr clock)	1 5/1/19 12:45-13:45	2 5/1/19 14:13-15:13	3 5/1/19 15:41-16:41	 Test Avg.
Generator output (kW)	1,566	1,566	1,572	1,568
Engine Horsepower (Hp)	2,219	2,215	2,215	2,217
Engine Fuel Use (scfm)	490	495	496	493
Exhaust gas composition				
CO_2 content (% vol)	10.9	10.9	10.9	10.9
O_2 content (% vol)	8.57	8.55	8.56	8.56
Moisture (% vol)	14.0	12.6	8.7	11.8
Exhaust gas flowrate				
Standard conditions (scfm)	4,904	4,917	4,732	4,851
Dry basis (dscfm)	4,217	4,297	4,318	4,277
Nitrogen oxides emission rates				
NO_X conc. (ppmvd)	108	107	104	106
NO_X emissions (lb/hr NO_2)	3.26	3.30	3.23	3.26
NO_X emissions (g/bhp-hr)	0.68	0.69	0.67	0.68
NO_X permit limit (g/bhp-hr)				*1.00*
Carbon monoxide emission rates				
CO conc. (ppmvd)	694	700	695	696
CO emissions (lb/hr)	12.8	13.1	13.1	13.0
CO emissions (g/bhp-hr)	2.66	2.73	2.71	2.70
CO permit limit (g/bhp-hr)				*4.20*
VOC/NMHC emission rates				
VOC conc. (ppmv C_3)	19.3	19.7	19.5	19.5
VOC emissions (lb/hr)	0.65	0.66	0.63	0.65
VOC emissions (g/bhp-hr)	0.14	0.14	0.13	0.13
VOC permit limit (g/bhp-hr)				*1.0*

APPENDIX A

- Figure A-1 – Process Flow Diagram
- Figure A-2 – IC Engine Nos. 1 – 2 Sample Port Diagram





1	0.50"
2	1.63"
3	3.01"
4	5.01"
5	10.5"
6	12.5"
7	13.9"
8	15.0"

7/16/15	**Midland WWTP IC Engine Nos. 1 - 2 Exhaust Sample Locations**		
	Scale None	Sheet 1 of 1	Impact Compliance Project No.1900131

APPENDIX B

- Facility Operating Records

Landfill Gas Fueled Internal Combustion Engine Process Operating Data

Facility Name: GTE
Location: Midland, MI
Test Date: 5-1-19

Engine ID: Gen 1
Serial No.: GZJ00431
Operating Hrs.: 37666

TEST NO. 1
Start Time: 7:25

	Generator Output (kw)	Engine Fuel Use (scfm)	Fuel CH4 (%)	Inlet Pressure (psi)	Air / Fuel Ratio	Digester scfm
0 min	1581	503	55.43	23.4	8.8	43.2
15 min	1589	502	55.48	23.0	8.7	42.9
30 min	1590	507	55.47	23.5	8.8	42.9
45 min	1602	502	55.46	23.1	8.7	42.7
60 min	1590	503	55.57	23.6	8.7	45.2

Stop Time: 8:25

TEST NO. 2
Start Time: 8:50

	Generator Output (kw)	Engine Fuel Use (scfm)	Fuel CH4 (%)	Inlet Pressure (psi)	Air / Fuel Ratio	Digester scfm
0 min	1597	501	55.52	23.2	8.7	46.1
15 min	1587	496	55.80	23.1	8.8	49.5
30 min	1598	498	55.64	23.2	8.8	49.4
45 min	1571	499	55.66	23.5	8.7	48.7
60 min	1585	499	55.88	23.3	8.8	49.0

Stop Time: 9:50

TEST NO. 3
Start Time: 10:37

	Generator Output (kw)	Engine Fuel Use (scfm)	Fuel CH4 (%)	Inlet Pressure (psi)	Air / Fuel Ratio	Digester scfm
0 min	1600	501	55.82	23.1	8.7	41.8
15 min	1579	499	55.92	23.5	8.8	41.6
30 min	1547	498	55.93	23.2	8.8	41.2
45 min	1604	497	55.91	23.5	8.7	41.2
60 min	1608	501	55.99	23.3	8.8	41.3

Stop Time: 11:37

Operator Initials: DPW

Note - Operating hours are recorded at the beginning of the first test.

Landfill Gas Fueled Internal Combustion Engine Process Operating Data

Facility Name: GTE
Location: Midland, MI
Test Date: 5-1-19

Engine ID: Gen 2
Serial No.: GZJ00432
Operating Hrs.: 30473

TEST NO. 1
Start Time: 12:45

	Generator Output (kw)	Engine Fuel Use (scfm)	Fuel CH4 (%)	Inlet Pressure (psi)	Air / Fuel Ratio	Digester scfm
0 min	1551	485	56.06	23.6	9.0	42.0
15 min	1563	490	55.96	23.2	9.0	38.4
30 min	1563	490	55.89	23.1	9.0	33.9
45 min	1574	492	55.78	24.4	9.0	31.6
60 min	1577	492	55.78	23.2	9.0	33.4

Stop Time: 1:45

TEST NO. 2
Start Time: 2:13

	Generator Output (kw)	Engine Fuel Use (scfm)	Fuel CH4 (%)	Inlet Pressure (psi)	Air / Fuel Ratio	Digester scfm
0 min	1554	496	55.70	23.2	9.0	35.7
15 min	1566	495	55.77	23.5	9.0	35.8
30 min	1577	496	55.59	23.2	9.0	36.2
45 min	1571	495	55.55	23.4	8.9	36.1
60 min	1560	491	55.43	23.2	8.9	36.2

Stop Time: 3:13

TEST NO. 3
Start Time: 3:41

	Generator Output (kw)	Engine Fuel Use (scfm)	Fuel CH4 (%)	Inlet Pressure (psi)	Air / Fuel Ratio	Digester scfm
0 min	1572	498	55.36	23.2	8.9	36.4
15 min	1548	498	55.48	23.3	8.9	36.2
30 min	1591	492	55.47	23.3	8.9	36.3
45 min	1578	495	55.50	23.1	8.9	36.4
60 min	1571	495	55.37	23.6	8.9	36.5

Stop Time: 4:41

Operator Initials: DPW

Note - Operating hours are recorded at the beginning of the first test.