

performed for

Holland Board of Public Works
1 Energy Park Way
Holland, MI 49423
Contact: Trista Gregorski
Telephone: (616) 355-1210
Cell: (231) 557-9246
e-mail: tgregorski@hollandbpw.com

performed at

Holland Board of Public Works
Holland Energy Park
1 Energy Park Way
Holland, MI 49423

Performed by

Network Environmental, Inc.
2629 Remico Street, Suite B
Grand Rapids, MI 49519
Contact: David D. Engelhardt
Telephone: (616) 530-6330
Fax: (616) 530-0001
e-mail: netenviro@aol.com

TABLE OF CONTENTS

	<u>Page</u>
I. Introduction	1
II. Presentation of Results	2-4
II.1 Table 1 – Carbon Monoxide (CO) Emission Results Summary	2
II.2 Table 2 – Oxides of Nitrogen (NO _x) Emission Results Summary	3
II.3 Table 3 – Total Hydrocarbon (VOC) Emission Results Summary	4
III. Discussion of Results	5-6
IV. Source Description	6
V. Sampling and Analytical Protocol	7-11
Figure 1 – NO _x , CO, O ₂ & CO ₂ Sampling Train	10
Figure 2 – Total Hydrocarbon (THC) & Methane Sampling Train	11

Appendices

Exhaust Gas Parameters	A
Source Operating Data	B
Data Acquisition System & Analyzer Calibration Data	C
Calibration Gas & Analyzer Specification Data	D
Analytical Data	E
Calculations	F
Raw Data	G

I. INTRODUCTION

Network Environmental, Inc. was retained by the Holland Board of Public Works to perform emission sampling on the natural gas fired emergency engine (EU-NGENGINE) located at the Holland Energy Park (HEP) in Holland, MI. The testing was required by Michigan Department of Environment, Great Lakes and Energy (EGLE) ROP Permit No. MI-ROP-P0465-2018 which includes the NSPS requirements for stationary spark ignition internal combustion engines (40 CFR Part 60, Subpart JJJJ).

The scope of this project was to determine the oxides of nitrogen (NO_x), carbon monoxide (CO), and total hydrocarbon (VOC) emissions from the emergency engine.

The following reference test methods were employed to conduct the sampling:

- Carbon Monoxide (CO) – U.S. EPA Method 10
- Oxides of Nitrogen (NO_x) – U.S. EPA Method 7E
- Total Hydrocarbons (VOC) minus Methane – U.S. EPA Methods 25A & 18
- Exhaust Gas Parameters (flow rate, temperature, moisture & density) – U.S. EPA Methods 1 through 4

The sampling was performed on May 11, 2023 by Stephan K. Byrd, Richard D. Eerdmans and David D. Engelhardt of Network Environmental, Inc.. Assisting with the sampling was Ms. Trista Gregorski of the Holland Board of Public Works.

II. PRESENTATION OF RESULTS

II.1 TABLE 1
CARBON MONOXIDE (CO) EMISSION RESULTS
NATURAL GAS FIRED EMERGENCY ENGINE (EU-NGENGINE)
HOLLAND BOARD OF PUBLIC WORKS
HOLLAND ENERGY PARK
HOLLAND, MI
MAY 11, 2023

Sample	Time	Air Flow Rate DSCFM ⁽¹⁾	CO Concentration PPM ⁽²⁾	CO Mass Rate Lbs/Hr ⁽³⁾	CO Mass Rate g/BHP-Hr ⁽⁴⁾
1	09:42-10:42	2,770	16.9	0.20	0.07
2	11:00-12:00	2,799	17.4	0.21	0.07
3	12:20-13:20	2,775	17.2	0.21	0.07
Average		2,781	17.2	0.21	0.07

- (1) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 in. Hg)
 (2) PPM = Parts Per Million (v/v) On A Dry Basis
 (3) Lbs/Hr = Pounds of CO Per Hour
 (4) g/BHP-Hr = Gram of CO Per Brake Horse Power Hour. Calculated using 1,325 BHP/Hr (supplied by Holland BPW)
 (5) **The CO emission limit from MI-ROP-P0465-2018 is 0.8 g/BHP-Hr**

RECEIVED
JUL 11 2023
AIR QUALITY DIVISION

**II.2 TABLE 2
OXIDES OF NITROGEN (NO_x) EMISSION RESULTS
NATURAL GAS FIRED EMERGENCY ENGINE (EU-NGENGINE)
HOLLAND BOARD OF PUBLIC WORKS
HOLLAND ENERGY PARK
HOLLAND, MI
MAY 11, 2023**

Sample	Time	Air Flow Rate DSCFM ⁽¹⁾	NO _x Concentration PPM ⁽²⁾	NO _x Mass Rate Lbs/Hr ⁽³⁾	NO _x Mass Rate g/BHP-Hr ⁽⁴⁾
1	09:42-10:42	2,770	183.8	3.64	1.25
2	11:00-12:00	2,799	180.4	3.61	1.23
3	12:20-13:20	2,775	178.1	3.53	1.21
Average		2,781	180.8	3.59	1.23

(1) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 in. Hg)

(2) PPM = Parts Per Million (v/v) On A Dry Basis

(3) Lbs/Hr = Pounds of NO_x Per Hour

(4) g/BHP-Hr = Gram of NO_x Per Brake Horse Power Hour. Calculated using 1,325 BHP/Hr (supplied by Holland BPW)

(5) **The NO_x emission limit from MI-ROP-P0465-2018 is 2 g/BHP-Hr**

**II.3 TABLE 3
TOTAL HYDROCARBON (VOC) EMISSION RESULTS
NATURAL GAS FIRED EMERGENCY ENGINE (EU-NGENGINE)
HOLLAND BOARD OF PUBLIC WORKS
HOLLAND ENERGY PARK
HOLLAND, MI
MAY 11, 2023**

Sample	Date	Time	Air Flow Rate SCFM ⁽¹⁾	THC Concentration PPM ⁽²⁾	Methane Concentration PPM ⁽³⁾	VOC Concentration (THC minus Methane) PPM ⁽⁴⁾	VOC Mass Rate Lbs/Hr ⁽⁵⁾	VOC Mass Rate g/BHP-Hr ⁽⁶⁾
1	05/11/23	09:42-10:42	3,192	144.5	95.0	49.5	1.08	0.37
2	05/11/23	11:00-12:00	3,227	139.8	91.0	48.8	1.08	0.37
3	05/11/23	12:20-13:20	3,217	140.3	90.7	49.6	1.09	0.37
Average			3,212	141.5	92.2	49.3	1.08	0.37

- (1) SCFM = Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 in. Hg)
(2) THC PPM = Parts Per Million (v/v) Of Total Hydrocarbons On A Wet (Actual) Basis As Propane
(3) Methane PPM = Parts Per Million (v/v) Of Methane On a Wet (Actual) Basis Calculated As Propane
(4) VOC PPM (THC Minus Methane) = Part Per Million (v/v) of VOC (THC Minus Methane) On A Wet (Actual) Basis As Propane
(5) VOC Lbs/Hr = Pounds Of VOC (THC Minus Methane) Per Hour Calculated As Propane
(6) g/BHP-Hr = Gram of VOC Per Brake Horse Power Hour. Calculated using 1,325 BHP/Hr (supplied by Holland BPW)
(7) **The VOC emission limit from MI-ROP-P0465-2018 is 0.5 g/BHP-Hr**

III. DISCUSSION OF RESULTS

The results of the emission sampling are summarized in Tables 1 through 3 (Sections II.1 through II.3).

The results are presented as follows:

III.1 CO

Table 1 – Carbon Monoxide (CO) Emission Results Summary

- Sample
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- CO Concentration (PPM) – Parts Per Million (v/v) on a Dry Basis
- CO Mass Emission Rate (Lbs/Hr) – Pounds of CO Per Hour
- CO Mass Emission Rate (g/BHP-Hr) – Grams of CO Per Brake Horse Power Hour. Calculated using 1,325 BHP/Hr (supplied by Holland BPW).

All the CO raw sample data was calibration corrected using Equation 7E-5 from U.S. EPA Method 7E.

III.2 NO_x

Table 2 – Oxides of Nitrogen (NO_x) Emission Results Summary

- Sample
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- NO_x Concentration (PPM) – Parts Per Million (v/v) on a Dry Basis
- NO_x Mass Emission Rate (Lbs/Hr) – Pounds of NO_x Per Hour
- NO_x Mass Emission Rate (g/BHP-Hr) – Grams of NO_x Per Brake Horse Power Hour. Calculated using 1,325 BHP/Hr (supplied by Holland BPW).

All the NO_x raw sample data was calibration corrected using Equation 7E-5 from U.S. EPA Method 7E.

III.3 VOC

Table 3 – Total Hydrocarbon (VOC) Emission Results Summary

- Sample
- Date
- Time
- Air Flow Rate (SCFM) – Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)

- THC Concentration (PPM) – Parts Per Million of THC (v/v) on a Wet (Actual) Basis as Propane
- Methane Concentration (PPM) – Parts Per Million of Methane (v/v) on a Wet (Actual) Basis as Propane
- VOC Concentration (THC Minus Methane) – Parts Per Million of VOC (THC Minus Methane) on a Wet (Actual) Basis as Propane
- VOC Mass Emission Rate (Lbs/Hr) – Pounds of VOC (THC Minus Methane) Per Hour As Propane
- VOC Mass Emission Rate (g/BHP-Hr) – Grams of VOC Per Brake Horse Power Hour. Calculated using 1,325 BHP/Hr (supplied by Holland BPW).

All the VOC raw sample data was calibration corrected using Equation 7E-5 from U.S. EPA Method 7E.

The methane concentrations were converted to a propane basis using a response factor of 3.0 (PPM Methane as Propane = PPM Methane/3.0). The VOC results were calculated taking the THC results minus the methane results (on a propane basis).

III.4 Emission Limits

The emission limits as specified in Permit No. MI-ROP-P0465-2018 are as follows:

Test Parameter	Limit
CO	0.8 grams/bhp-hr
NO _x	2 grams/bhp-hr
VOC	0.5 grams/bhp-hr

IV. SOURCE DESCRIPTION

The source sampled is a non-certified emergency engine (CAT G351LE) serving a 1,040kW generator. The engine is used to charge the batteries in the uninterruptible power supply (UPS) Battery System. The engine is equipped with an oxidation catalyst system. The rated capacity of this engine is 1,462 bhp. The engine was running at 1,325 bhp during the sampling. Source operating data during the testing can be found in Appendix B.

V. SAMPLING AND ANALYTICAL PROTOCOL

The sampling location was on the 11 inch I.D. exhaust stack with 2 sample ports in a location approximately 6 duct diameters downstream and approximately 8 duct diameters upstream from the nearest disturbances.

V.1 Carbon Monoxide – The CO sampling was conducted in accordance with U.S. EPA Reference Method 10. A Thermo Environmental Model 48C gas analyzer was used to monitor the exhaust. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the CO concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 92.9 PPM was used to establish the initial instrument calibration. A Calibration gas of 51.1 PPM was used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 51.1 PPM gas to determine the system bias. After each sample, a system zero and system injection of 51.1 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 1.

V.2 Oxides of Nitrogen – The NO_x sampling was conducted in accordance with U.S. EPA Reference Method 7E. A Thermo Environmental Model 42H gas analyzer was used to monitor the exhaust. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the NO_x concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 484.0 PPM was used to establish the initial instrument calibration. Calibration gases of 127.0 PPM and 251.0 PPM were used to determine the calibration error of the analyzer. A direct injection of 50.9 PPM nitrogen dioxide (NO₂) was performed to show the conversion efficiency of the monitor. The conversion efficiency was 94.30% (48.0 PPM). The sampling system (from the back of the stack probe to the analyzer) was injected using the 251.0 PPM gas to determine the system bias. After each sample, a system zero and system injection of

251.0 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 1.

V.3 Total Hydrocarbons (THC) – The THC sampling was conducted in accordance with U.S. EPA Reference Method 25A. A J.U.M. Model 3-500 flame ionization detector (FID) analyzer was used to monitor the exhaust. Sample gas was extracted through a heated probe. A heated teflon sample line was used to transport the exhaust gases to the analyzer. The analyzer produces instantaneous readouts of the total hydrocarbon (THC) concentrations (PPM).

The analyzer was calibrated by system injection (from the back of the stack probe to the analyzer) prior to the testing. A span gas of 491.0 PPM was used to establish the initial instrument calibration. Calibration gases of 152.0 PPM and 250.0 PPM were used to determine the calibration error of the analyzer. After each sample, a system zero and system injection of 250.0 PPM were performed to establish system drift and system bias during the test period. All calibration gases used were EPA Protocol Propane Calibration Gases. Three (3) samples were collected from the exhaust. Each sample was sixty (60) minutes in duration.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. Figure 2 is a diagram of the VOC sampling train.

V.4 Methane – The methane emissions were determined in accordance with U.S. EPA Reference Method 18. Integrated bag samples were collected from the exhaust of the FID sampling train. A heated teflon sample line was used to transport the exhaust gases to the train where the bags were collected. The samples were collected in Tedlar bags and analyzed for methane by GC/FID. Figure 2 is a diagram of the methane sampling train.

V.5 Oxygen & Carbon Dioxide – The O₂ & CO₂ sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Model 1400M portable stack gas analyzers were used to monitor the exhaust. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzers. The analyzers produce instantaneous readouts of the O₂ & CO₂ concentrations (%).

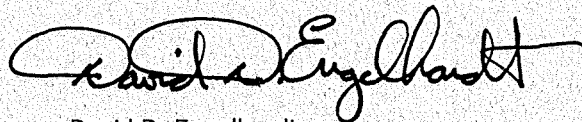
The analyzers were calibrated by direct injection prior to the testing. Span gases of 20.85% O₂ and 21.1% CO₂ were used to establish the initial instrument calibrations. Calibration gases of 12.0% O₂/5.95% CO₂ and 6.03% O₂/11.9% CO₂ were used to determine the calibration error of the analyzers. The sampling system (from the back of the stack probe to the analyzers) was injected using the 6.03% O₂/11.9% CO₂ gas to determine the system bias. After each sample, a system zero and system injection of 6.03% O₂/11.9% CO₂ were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 1.

V.6 Exhaust Gas Parameters – The exhaust gas parameters (air flow rate, temperature, moisture and density) were determined in conjunction with the other sampling by employing U.S. EPA Methods 1 through 4.

Three (3) velocity traverses and three (3) moisture sample were collected. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis.

This report was prepared by:



David D. Engelhardt
Vice President

This report was reviewed by:



Stephan K. Byrd
President

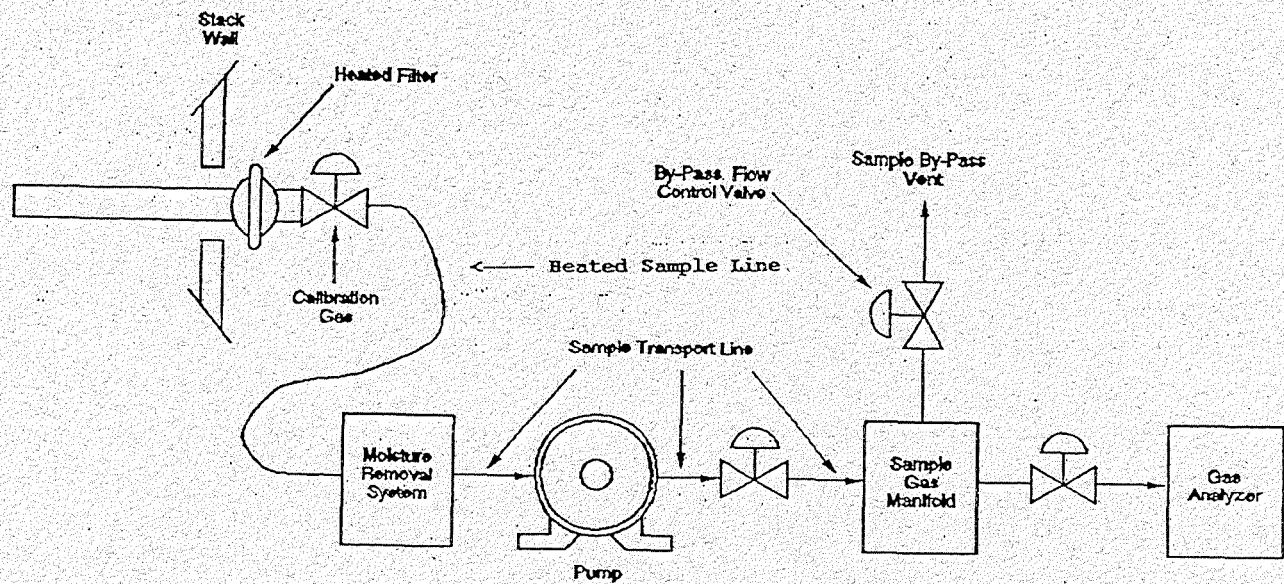


Figure 1
NO_x, CO, O₂ & CO₂
Sampling Train

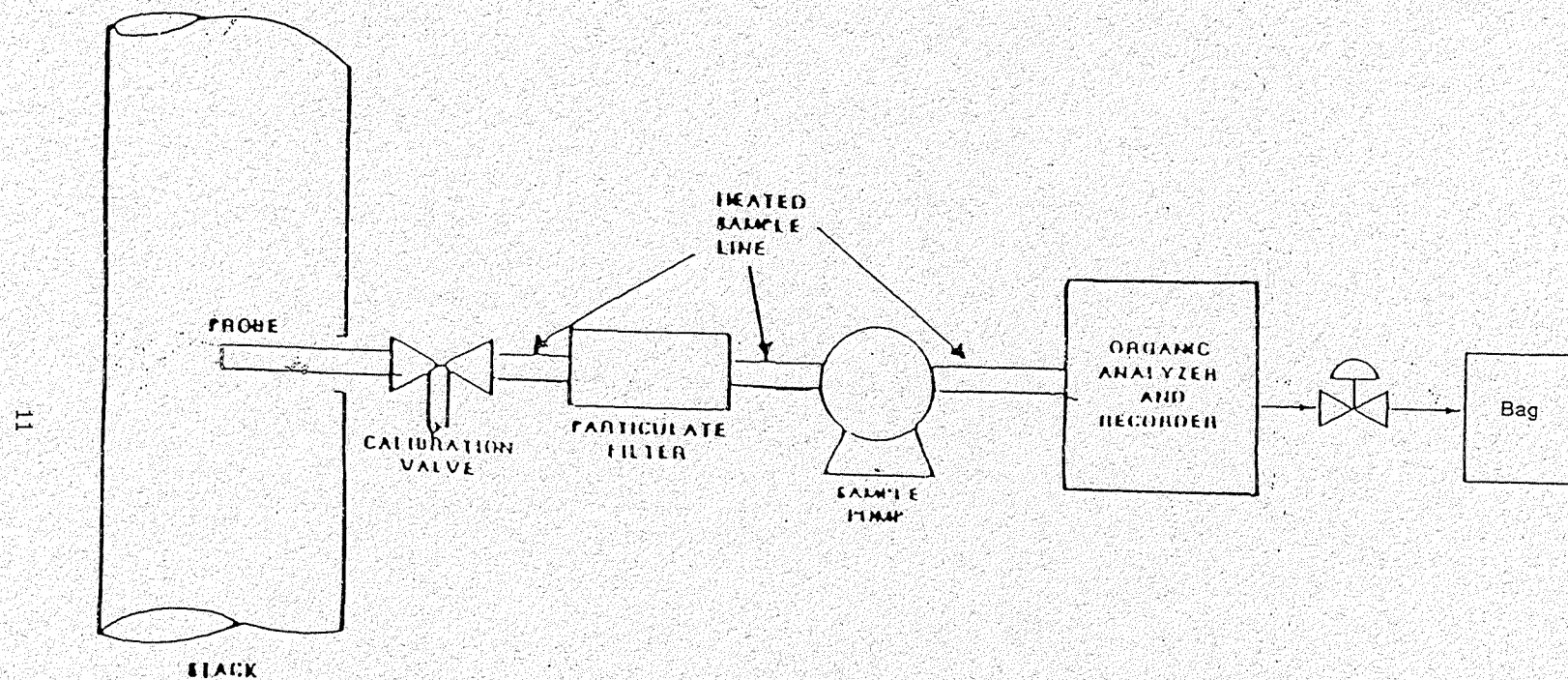


Figure 2
Total Hydrocarbon & Methane
Sampling Train