

# FINAL REPORT



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AIR QUALITY DIVISION

## SEBEWAING LIGHT AND WATER

SEBEWAING, MICHIGAN

### SOURCE TESTING REPORT

RWDI #2300344

JANUARY 24, 2023

#### SUBMITTED TO

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## EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by Sebewaing Light and Water (SLW) to complete the source testing program at their Pine Street Power Plant located in Sebewaing, Michigan. SLW operates two (2) engines (referred to as EUGEN7 or Engine 7 and EUGEN8 or Engine 8) that burns natural gas for electrical power generation. Please note that the engines are referred to as Engine 7 and 8 throughout the remainder of the report, tables, and appendices. The test program was conducted to fulfill the requirements of the Michigan Department of Environment, Great Lakes and Energy (EGLE) Air Permit to Install (PTI) number 146-17A and 40 CFR Part 60, NSPS Subpart JJJJ. The test included measurements of total oxides of nitrogen (NO<sub>x</sub>), carbon monoxide (CO), volatile organic compounds (VOCs, defined as non-methane hydrocarbons not including formaldehyde) and formaldehyde (HCOH) on both engines. These emissions were calculated while the engines were operated within 10% of 100% peak load (or highest achievable load) combusting natural gas (~100% of Full Load for each Engine). And lastly, exhaust air flow rate was determined on all engines at the exhaust test ports. Testing was conducted on December 6<sup>th</sup> and 7<sup>th</sup>, 2022.

The following tables represent a summary of the stack testing results.

### Summary of Engine#7 Emission Data:

Parameter	Symbol	Units	Average	Corrected to 15% O <sub>2</sub>	Limits
Nitrogen Oxides	NO <sub>x</sub>	ppmvd	65.3	41.4	82
Carbon Monoxide	CO	ppmvd	95.8	60.7	270
VOCs (as propane)	VOC	ppmvd	9.8	6.2	60
Formaldehyde	HCOH	ppmvd	18.8	11.9	-
Oxygen	O <sub>2</sub>	% <sub>dry</sub>	11.5	-	-
Nitrogen Oxides	NO <sub>x</sub>	g/HP-hr	0.44	-	0.50
Carbon Monoxide	CO	g/HP-hr	0.39	-	0.90
VOCs (as propane)	VOC	g/HP-hr	0.06	-	0.70
Formaldehyde	HCOH	lbs/bhp-hr	1.81E-04	-	-



**Summary of Engine#7 Exhaust Data and Power Ratings:**

Parameter	Units	Average
Stack Gas Temperature	°F	596.2
Stack Gas Moisture	%	9.70
Velocity	ft/sec	116.6
Actual Flowrate	cfm	27,852
Dry Reference Flowrate	Dscfm	12,406
Average Horsepower	HP	6017 (99.90% of Full Load)

**Summary of Engine#8 Emission Data:**

Parameter	Symbol	Units	Average	Corrected to 15% O <sub>2</sub>	Limits
Nitrogen Oxides	NO <sub>x</sub>	ppmvd	61.2	39.2	82
Carbon Monoxide	CO	ppmvd	71.0	45.4	270
VOCs (as propane)	VOC	ppmvd	10.0	6.4	60
Formaldehyde	HCOH	ppmvd	16.2	10.8	-
Oxygen	O <sub>2</sub>	% <sub>dry</sub>	11.5	-	-
Nitrogen Oxides	NO <sub>x</sub>	g/HP-hr	0.43	-	0.50
Carbon Monoxide	CO	g/HP-hr	0.30	-	0.90
VOCs (as propane)	VOC	g/HP-hr	0.07	-	0.70
Formaldehyde	HCOH	lbs/bhp-hr	1.62E-04	-	-

**Summary of Engine#8 Exhaust Flow and Power Rating Data:**

Parameter	Units	Average
Stack Gas Temperature	°F	640
Stack Gas Moisture	%	9.47
Velocity	ft/sec	96.6
Actual Flowrate	cfm	23,039
Dry Reference Flowrate	dscfm	9,843
Average Horsepower	HP	4,595 (99.9% of Full Load)



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# 1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by Sebewaing Light and Water (SLW) to complete the source testing program at their Pine Street Power Plant located in Sebewaing, Michigan. SLW operates two (2) engines (referred to as EUGEN7 or Engine 7 and EUGEN8 or Engine 8) that burns natural gas for electrical power generation. Please note that the engines are referred to as Engine 7 and 8 throughout the remainder of the report, tables, and appendices. The test program was conducted to fulfill the requirements of the Michigan Department of Environment, Great Lakes and Energy (EGLE) Air Permit to Install (PTI) number 146-17A and 40 CFR Part 60, NSPS Subpart JJJJ. The test program included measurements of total oxides of nitrogen (NO<sub>x</sub>), carbon monoxide (CO), volatile organic compounds (VOCs, defined as non-methane hydrocarbons not including formaldehyde) and formaldehyde (HCOH) on both engines (Engine 7 and 8). These emissions were calculated while the engines were operated within 10% of 100% peak load (or highest achievable load) (each at ~100% load) combusting natural gas. Exhaust air flow rate was determined on both engines during each of the tests.

Testing was conducted on December 6<sup>th</sup> and 7<sup>th</sup> of 2022. Results from the sampling program are presented in the **Tables Section** of the report, with more detailed sampling results provided in the **Appendices**. Copies of the approval letter and related correspondence are provided in **Appendix A**.

This stack testing study consisted of the following parameters:

- Velocity, flow rate and temperature;
- Nitrogen oxides (NO<sub>x</sub>);
- Carbon Monoxide (CO);
- Oxygen (O<sub>2</sub>);
- Volatile Organic Compounds (VOCs);
- Formaldehyde (HCOH); and
- Moisture (%).

## 2 SOURCE DESCRIPTION

### 2.1 Facility Description

SLW- Pine Street Plant is a power generation facility that operates two (2) natural gas fired, four-cycle lean-burn internal combustion reciprocating engines. Both engines are equipped with an oxidation catalyst that controls engine exhaust before venting into the atmosphere. For the purposes of the test protocol, Engine#7 (Emission Unit-EUGEN7 rated at 6,023HP / 4.4MW generation capacity) and Engine#8 (Emission Unit- EUGEN8 rated at 4,601HP / 3.4MW generation capacity) are required to be tested for CO, NO<sub>x</sub>, VOCs and HCOH to determine compliance with the air permit, Michigan Air Toxics Rule R 336.1225 and NSPS Subpart JJJJ regulations.

The heated filter and line were maintained at approximately 375°F and the MKS MultiGas 2030 FTIR and MAX Analytical ASC-10ST gas components were at 375°F. The end of the probe was connected to a heated Teflon sample line, which delivers the sample gases from the stack to the FTIR system. The heated sample line is designed to maintain the gas temperature above 250°F in order to prevent condensation of stack gas moisture within the line. The sample was then routed through a manifold system and introduced to the individual CEM's for measurement. As recommended by EGLE, the sample line and heated filter were heated to 375°F.

The ASC-10ST was used to deliver calibration gases (Calibration Transfer Standard (CTS), QA Spike and Nitrogen) to the FTIR in direct (to analyzer) and system (to probe) modes.

A laptop computer was utilized for operating the MKS MultiGas 2030 FTIR and MAX Analytical ASC-10ST sampling console and logging the multi-gas FTIR data. Data was logged as one-minute averages for the actual test period (FTIR PRN files and Spectra). All concentration data were determined using the MKS 2030 MultiGas FTIR software. A typical MKS 2030 FTIR and ASC-10 ST configuration is depicted in **Figure 1**.

For oxygen measurement, an EPA Method 3A compliant Brand Gaus Model 4710 wet O<sub>2</sub> analyzer was used. Prior to testing, sample system bias checks and instrument linearity checks (calibration error) were completed in compliance with EPA Method 3A. In addition, the analysers were calibrated (zeroed and span checked) at the completion of each run. A data logger system programmed to collect and record data at 1- second intervals was used to compute and record one-minute average concentrations. The average was drift corrected using pre and post drift checks and changed from wet to dry using stack moisture content.



**Figure 1:** MKS MultiGas 2030 FTIR and ASC-10ST



## 5 RESULTS

The flow and emissions data for this study are presented in the 'Tables' section of this report. Detailed information regarding each test run can be found in the corresponding appendix. Below is a summary of the applicable Table ID for each corresponding test parameter.

Parameter	Table	Appendix
Stack Gas Characteristics	3 & 4	B and C
Nitrogen Oxides	1 & 2	B
Carbon Monoxide	1 & 2	B
Oxygen	1 & 2	B
Carbon Dioxide	1 & 2	B
Carbon Monoxide	1 & 2	B
VOCs	1 & 2	B
Formaldehyde	1 & 2	B

Field notes are presented in **Appendix D**. All calibration information for the equipment used for the program is included in **Appendix E**. Detailed example calculations for each measured pollutant is provided in **Appendix G**.

### 5.1 Discussion of Results

The measured concentrations for all contaminants were less than the maximum limits outlined in State of Michigan Department of Environment, Great Lakes and Energy (EGLE) Air Permit to Install (PTI) number 146-17A, Michigan Air Toxics Rule R 336.1225 and NSPS Subpart JJJJ regulations.

## 6 OPERATING CONDITIONS

Operating conditions during the sampling were monitored by SLW Operations as requested by EGLE for the following parameters:

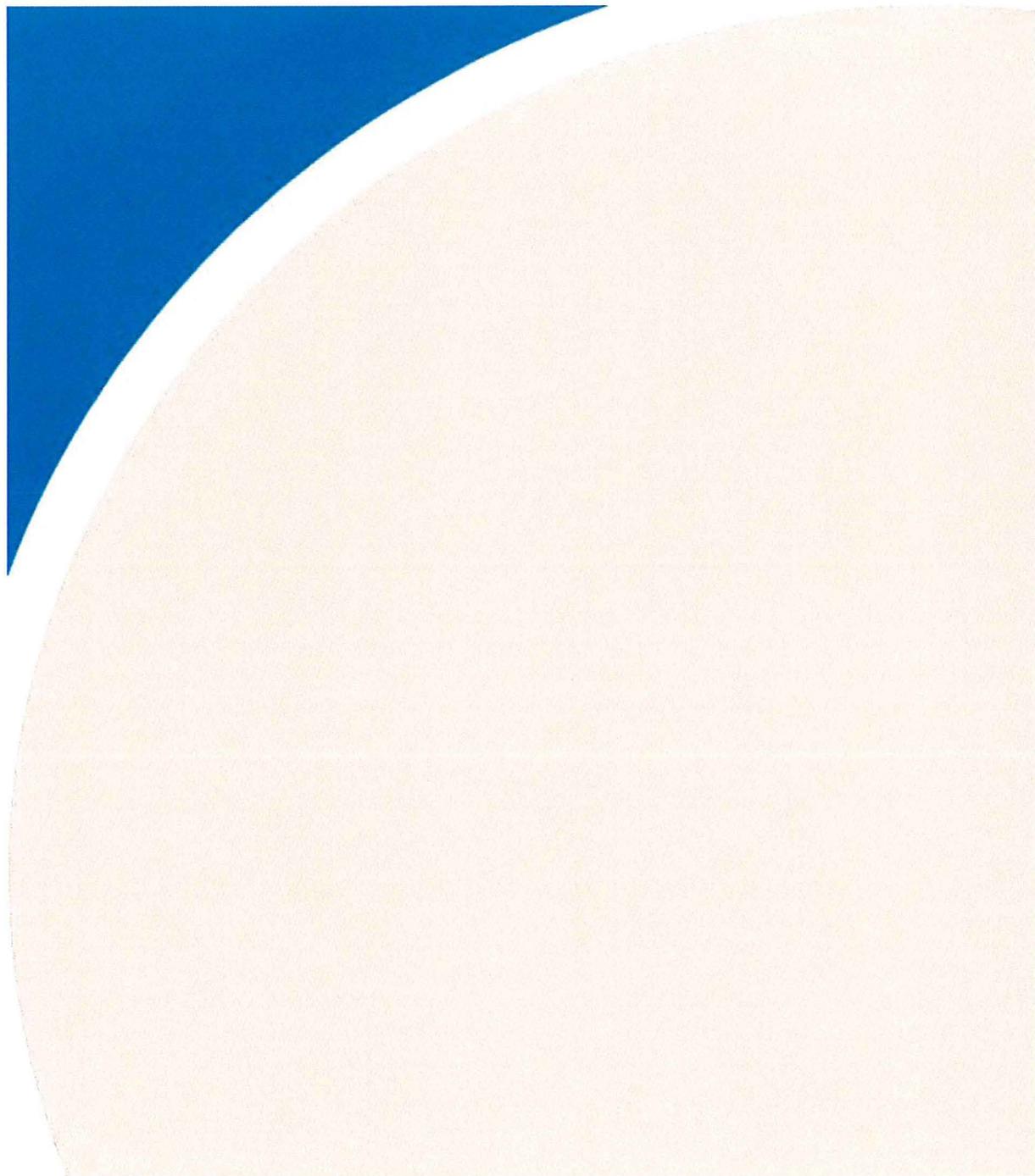
- Natural gas usage
- Air to fuel ratio
- Engine exhaust temperature
- Pressure drop over the oxidation catalyst
- Hour meter reading

All process data is provided in **Appendix F**.

Contact was maintained between the process operators and the sampling team throughout the testing. A member of the RWDI sampling team contacted the operator before each test, to ensure that the process was at normal operating conditions.

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## TABLES



# TABLE 1: Engine#7 Emission Results

Sebewaing Light and Water- Pine Street Plant

**Facility:** Pine Street  
**City:** Sebewaing, MI  
**Source:** Engine#7  
**Date:** 12/7/2022

	Symbol	Units	Test #1	Test #2	Test #3	Average	Corrected to 15% O <sub>2</sub>	Limits
Nitrogen Oxides Concentration	NO <sub>x</sub>	ppmvd	65.6	65.1	65.3	65.3	41.4	82
Carbon Monoxide Concentration	CO	ppmvd	94.6	96.0	96.9	95.8	60.7	270
VOCs (as propane) Concentration	VOC	ppmvd	9.7	9.8	9.9	9.8	6.2	60
Formaldehyde Concentration	HCOH	ppmvd	18.4	18.6	19.3	18.8	11.9	-
Oxygen Concentration	O <sub>2</sub>	% <sub>dry</sub>	11.6	11.6	11.4	11.5	-	-
Nitrogen Oxides Concentration	NO <sub>x</sub>	g/HP-hr	0.44	0.44	0.44	0.44	-	0.50
Carbon Monoxide Concentration	CO	g/HP-hr	0.38	0.39	0.40	0.39	-	0.90
VOCs (as propane) Concentration	VOC	g/HP-hr	0.06	0.06	0.06	0.06	-	0.70
Formaldehyde Concentration	HCOH	lbs/bhp-hr	1.76E-04	1.80E-04	1.87E-04	1.81E-04	-	-

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## TABLE 2: Engine#8 Emission Results

Sebewaing Light and Water- Pine Street Plant

**Facility:** Pine Street  
**City:** Sebewaing, MI  
**Source:** Engine#8  
**Date:** 12/6/2022

	Symbol	Units	Test #1	Test #2	Test #3	Average	Corrected to 15% O <sub>2</sub>	Limits
Nitrogen Oxides Concentration	NO <sub>x</sub>	ppmvd	61.3	61.3	61.1	61.2	38.8	82
Carbon Monoxide Concentration	CO	ppmvd	70.7	71.0	71.2	71.0	45.0	270
VOCs (as propane) Concentration	VOC	ppmvd	9.9	9.9	10.1	10.0	6.3	60
Formaldehyde Concentration	HCOH	ppmvd	16.2	16.2	16.2	16.2	10.3	-
Oxygen Concentration	O <sub>2</sub>	% <sub>dry</sub>	11.5	11.4	11.6	11.5	-	-
Nitrogen Oxides Concentration	NO <sub>x</sub>	g/HP-hr	0.43	0.43	0.43	0.43	-	0.50
Carbon Monoxide Concentration	CO	g/HP-hr	0.30	0.30	0.30	0.30	-	0.90
VOCs (as propane) Concentration	VOC	g/HP-hr	0.07	0.07	0.07	0.07	-	0.70
Formaldehyde Concentration	HCOH	lbs/bhp-hr	1.62E-04	1.62E-04	1.63E-04	1.62E-04	-	-

### Table 3: Engine#7 Flow Measurements

Sebewaing Light and Water- Pine Street Plant

<b>Facility:</b>	Pine Street
<b>City:</b>	Sebewaing, MI
<b>Source:</b>	Engine#7
<b>Max Horspower:</b>	6023
<b>Max Kilowatt:</b>	4376

Parameter	Units	Run 1	Run 2	Run 3	Average
Stack Gas Temperature	°F	595.7	596.7	596.3	596.2
Stack Gas Moisture	%	9.72	9.69	9.69	9.70
Velocity	ft/sec	115.6	117.3	117.0	116.6
Actual Flowrate	cfm	27,573	27,992	27,992	27,852
Dry Reference Flowrate	dscfm	12,295	12,475	12,448	12,406
Average Horse Power	HP	6,016	6,013	6,022	6,017
Load	%	99.88	99.83	99.98	99.90

## Table 4: Engine#8 Flow Measurements

Sebewaing Light and Water- Pine Street Plant

<b>Facility:</b>	Pine Street
<b>City:</b>	Sebewaing, MI
<b>Source:</b>	Engine#8
<b>Max Horspower:</b>	4601
<b>Max Kilowatt:</b>	3334

Parameter	Units	Run 1	Run 2	Run 3	Average
Stack Gas Temperature	°F	640.2	639.3	639.8	639.8
Stack Gas Moisture	%	9.52	9.41	9.48	9.47
Velocity	ft/sec	96.9	96.3	96.5	96.6
Actual Flowrate	cfm	23,115	22,974	23,027	23,039
Dry Reference Flowrate	dscfm	9,867	9,826	9,837	9,843
Average Horse Power	HP	4,602	4,592	4,592	4,595
Load	%	100.02	99.80	99.80	99.88

# FIGURES

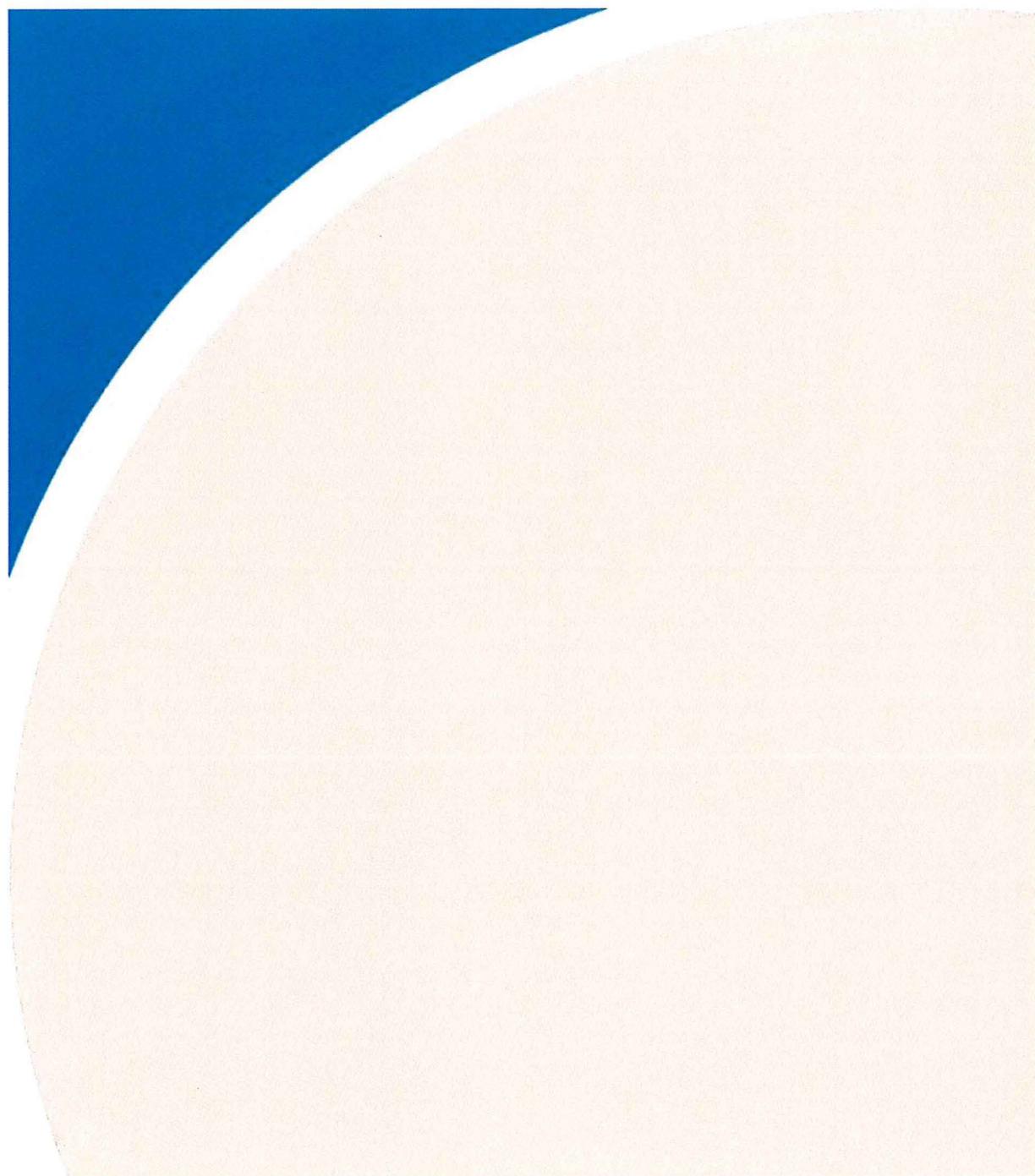
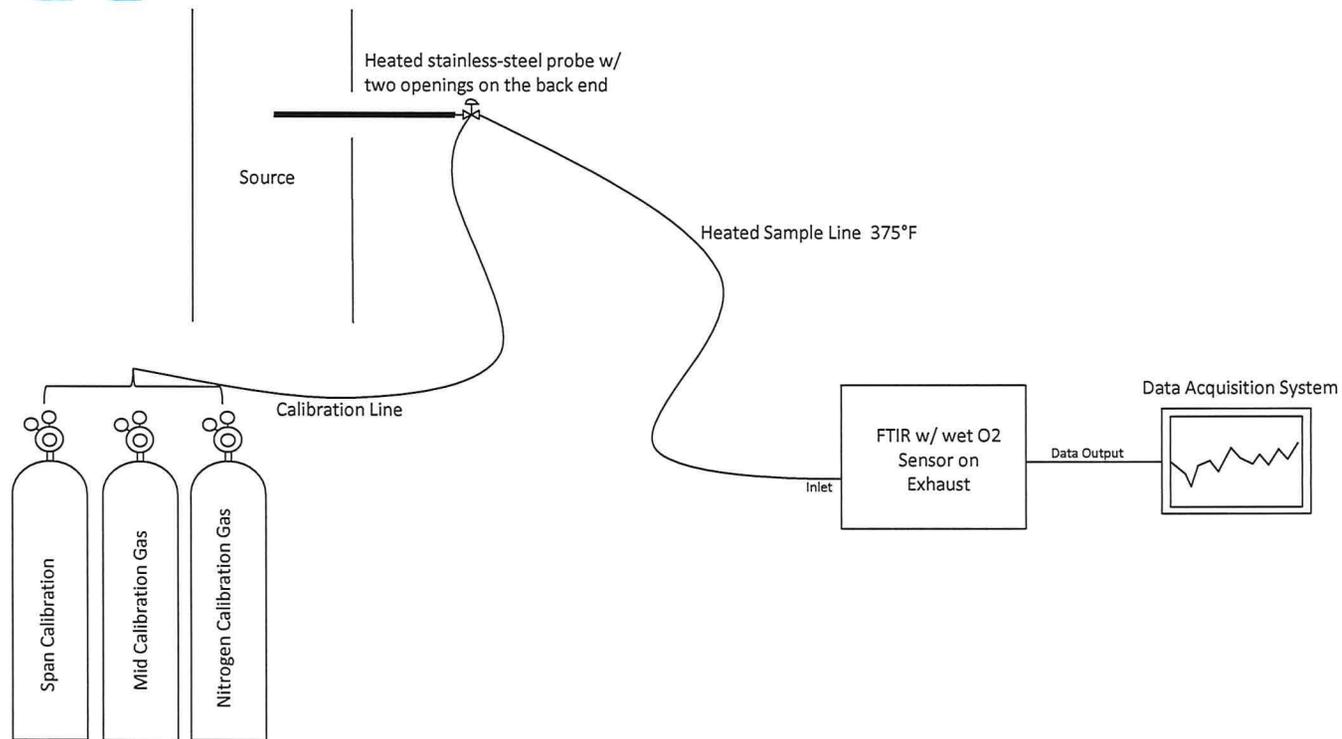




Figure No. #1: USEPA Method 3A Schematic (FTIR)



**USEPA Method 3A**  
**Sebewaing Light & Power**  
Pine Street  
Sebewaing, MI

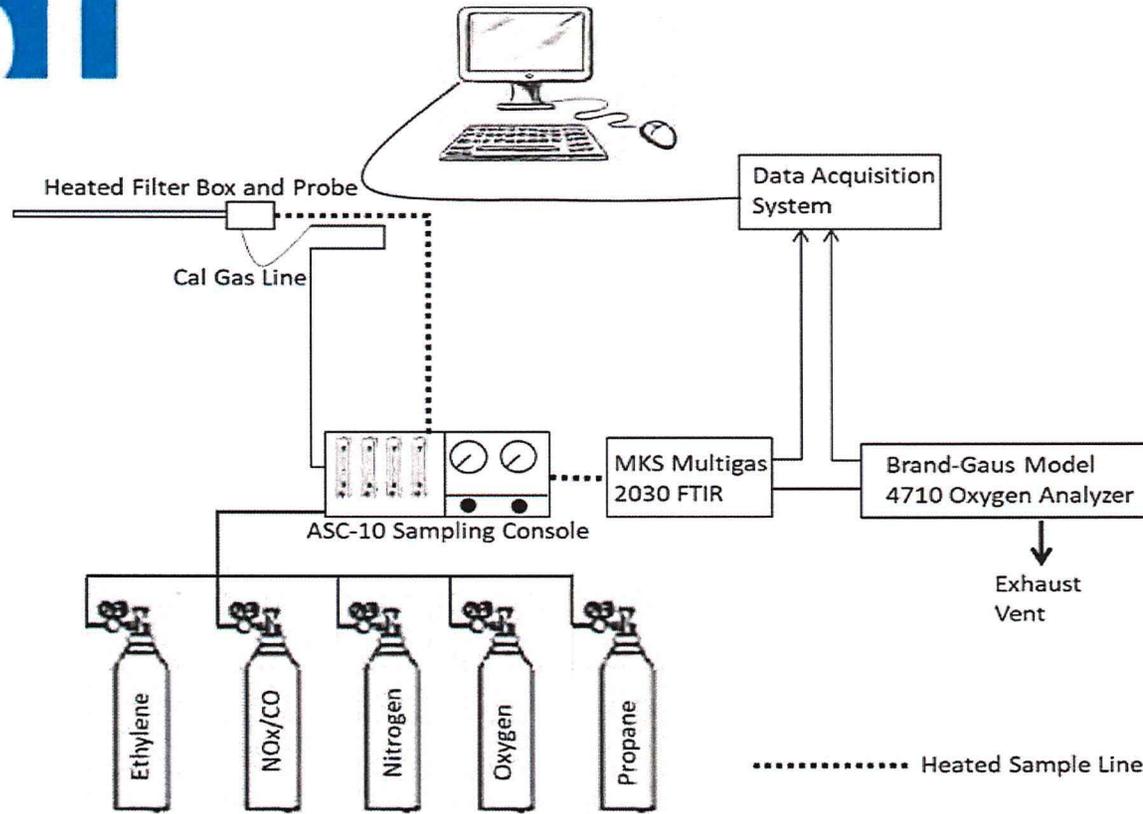
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**Date: December 6 to 7, 2022**





Figure No. #2



USEPA Method 320

Sebewaing Light & Power

Line Street

EUENG7 & EUENG8

Sebewaing, MI

Project 2300334

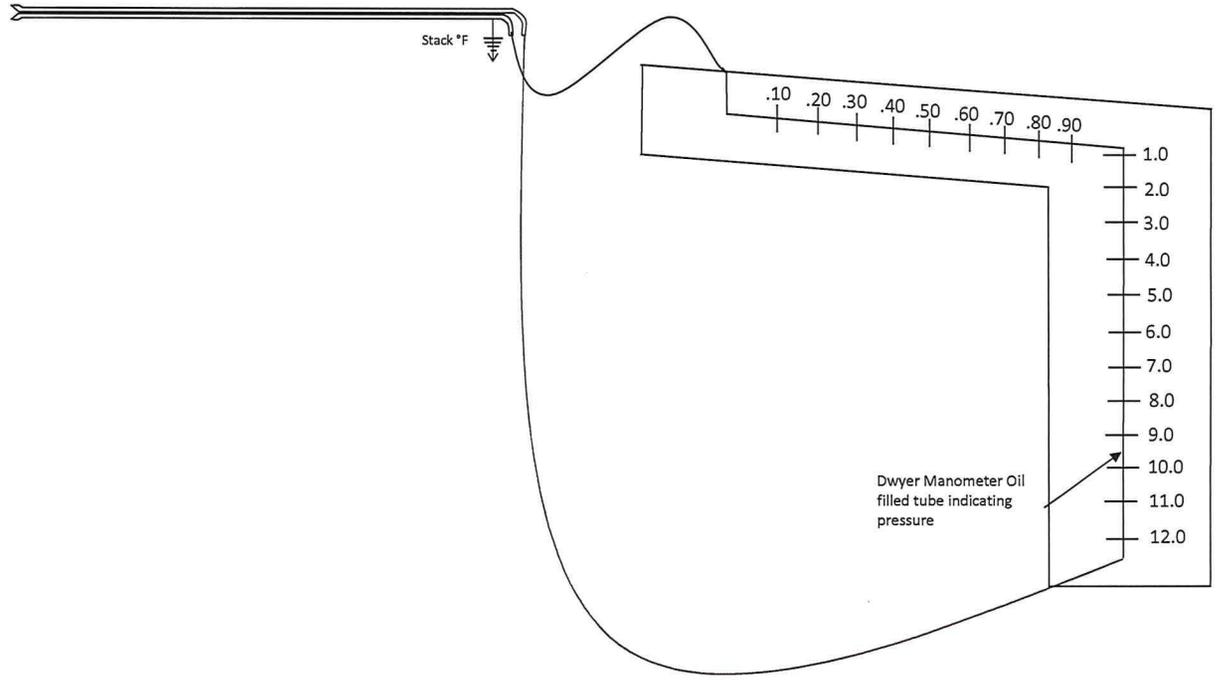
Date: December 6 to 7, 2022



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**USEPA Method 2**  
**Sebewaing Light & Power**  
Pine Street  
EUGEN7 & EUGEN8  
Sebewaing , MI

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Figure No. 3

Date: December 6 and 7, 2022

