

## 1.0 Introduction

Alliance Source Testing, LLC (AST) was retained by Sumpter Energy Associates, LLC (SEA) to conduct compliance testing at the SEA Pine Tree Acres (PTA) Phase II facility located in Lenox, Michigan. The facility operates under Michigan Department of Environment Great Lakes, and Energy-Air Quality Division (EGLE-AQD), MI-PTI-N5984-2019. Testing was conducted on two (2) engines to demonstrate compliance with the facility's EGLE-AQD permit and 40 CFR 60 Subpart JJJJ .

Compliance testing was conducted to determine the concentration and emission rates of nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>) and non-methane-ethane volatile organic compounds (NMEVOC). Testing consisted of three (3) 60-minute test runs for each source. Performance testing was conducted while the engines were operating at the highest achievable load at current site conditions. The Test Report Summary (TRS) provides the results from the compliance testing, including the three (3) run average, with comparisons to the applicable limits. Any difference between the summary results listed in the TRS and the detailed results contained in the appendices is due to rounding for presentation.

In addition to the performance testing, fuel samples were collected and analyzed for hydrogen sulfide (H<sub>2</sub>S), total reduced sulfur (TRS) and chlorinated compounds. The TRS content of the fuel was 29.2 ppmv.

## 1.1 Facility and Process Description

The SEA PTA Phase II facility consists of two (2) Caterpillar (CAT®) Model No. 3520C landfill gas fueled reciprocating internal combustion engines (RICE) that are identified in ROP No. MIROP-N5984-2019 as Emission Unit ID: EU-ICENGINE8 and EU-ICENGINE9 (Flexible Group ID: FG-ICENGINE2).

The CAT G3520C IC engines are operated at base load conditions (i.e., 100% of design capacity). The amount of landfill gas that is used by each engine is dependent on its methane content. At the minimum fuel quality utilization value of 420 Btu/cf (LHV), the maximum fuel use rate of each IC engine is approximately 580 cfm. The CAT® G3520C IC engine will be tested while operations occur at (or near + 10% of design capacity) the following power generation and fuel use rates:

- Engine Power: 2,242 brake horsepower
- Electricity Generation: 1,600 kilowatts
- Heat Input (LHV): 14.67 MMBtu/hr

The CAT® G3520 IC engines use an electronic air-to-fuel ratio controller to fire lean fuel mixtures and produce low combustion by-product emissions. Emissions from the combustion of LFG are released into the ambient air through a stack connected to the IC engine exhaust manifold and noise muffler.

RECEIVED

## 1.2 Project Team

Personnel involved in this project are identified in the following table.

**Table 1-1**  
**Project Team**

<b>Facility Personnel</b>	Jason Neumann – EPP
<b>Regulatory Personnel</b>	Mark Dziadosz – EGLE
<b>AST Personnel</b>	Tyler Branca Anthony Delfratte

## 1.3 Test Protocol and Notification

Testing was conducted in accordance with the test protocol submitted to the EGLE-AQD by SEA.

# Testing Methodology

## 2.0 Testing Methodology

The emissions testing program was conducted in accordance with the U.S. EPA Reference Test Methods listed in Table 2-1. Method descriptions are provided below while quality assurance/quality control data is provided in Appendix C.

**Table 2-1**  
**Source Testing Methodology**

Parameter	U.S. EPA Reference Test Methods	Notes/Remarks
Volumetric Flow Rate	1 & 2	Full Velocity Traverses
Oxygen/Carbon Dioxide	3A	Instrumental Analysis
Moisture Content	4	Volumetric / Gravimetric Analysis
Sulfur Dioxide	6C	Instrumental Analysis
Nitrogen Oxides	7E	Instrumental Analysis
Carbon Monoxide	10	Instrumental Analysis
Non-Methane/Ethane Volatile Organic Compounds	ALT-106	Instrumental Analysis
Gas Dilution System Certification	205	--

### 2.1 U.S. EPA Reference Test Methods 1 & 2 – Volumetric Flow Rate

The sampling location and number of traverse (sampling) points were selected in accordance with U.S. EPA Reference Test Method 1. To determine the minimum number of traverse points, the upstream and downstream distances were equated into equivalent diameters and compared to Figure 1-2 in U.S. EPA Reference Test Method 1.

Full velocity traverses were conducted in accordance with U.S. EPA Reference Test Method 2 to determine the average stack gas velocity pressure, static pressure and temperature. The velocity and static pressure measurement system consisted of a pitot tube and inclined manometer. The stack gas temperature was measured with a K-type thermocouple and pyrometer.

### 2.2 U.S. EPA Reference Test Method 3A – Oxygen/Carbon Dioxide

The oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) testing was conducted in accordance with U.S. EPA Reference Test Method 3A. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, heated Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. The quality control measures are described in Section 2.9.

### 2.3 U.S. EPA Reference Test Method 4 – Moisture Content

The stack gas moisture content was determined in accordance with U.S. EPA Reference Test Method 4. The gas conditioning train consisted of a series of chilled impingers. The impingers were pre and post-measured to determine the amount of moisture condensed during each test run.

#### **2.4 U.S. EPA Reference Test Method 6C – Sulfur Dioxide**

The sulfur dioxide (SO<sub>2</sub>) testing was conducted in accordance with U.S. EPA Reference Test Method 6C. Data was collected online and reported in one-minute averages. The sampling system consisted of a heated stainless steel probe, heated Teflon sample line(s), gas conditioning system and the identified analyzer. The quality control measures are described in Section 2.9.

#### **2.5 U.S. EPA Reference Test Method 7E – Nitrogen Oxides**

The nitrogen oxides (NO<sub>x</sub>) testing was conducted in accordance with U.S. EPA Reference Test Method 7E. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless steel probe, heated Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. The quality control measures are described in Section 2.9.

#### **2.6 U.S. EPA Reference Test Method 10 – Carbon Monoxide**

The carbon monoxide (CO) testing was conducted in accordance with U.S. EPA Reference Test Method 10. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless steel probe, heated Teflon sample line(s), gas conditioning system, and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the gas. The quality control measures are described in Section 2.9.

#### **2.7 U.S. EPA Reference Test Method ALT-106 – Non Methane-Ethane Hydrocarbons**

The non-methane-ethane hydrocarbons (NMEHC) testing was conducted in accordance with U.S. EPA Alternate Test Method ALT-106. EPA Method 25A is incorporated by reference. The sampling system consisted of a stainless steel probe, heated Teflon sample line(s) and the identified gas analyzer. NMEVOC content is measured every four minutes and fifteen points are recorded per sixty minute test. The GC with backflush separates methane and ethane from all other hydrocarbons (residual). The residual VOC is directly measured and reported on a propane basis. The quality control measures are described in Section 2.10.

#### **2.8 U.S. EPA Reference Test Method 205 – Gas Dilution System Certification**

A calibration gas dilution system field check was conducted in accordance with U.S. EPA Reference Method 205. Multiple dilution rates and total gas flow rates were utilized to force the dilution system to perform two dilutions on each mass flow controller. The diluted calibration gases were sent directly to the analyzer, and the analyzer response recorded in an electronic field data sheet. The analyzer response agreed within 2% of the actual diluted gas concentration. A second Protocol 1 calibration gas, with a cylinder concentration within 10% of one of the gas divider settings described above, was introduced directly to the analyzer, and the analyzer response recorded in an electronic field data sheet. The cylinder concentration and the analyzer response agreed within 2%. These steps were repeated three (3) times. Copies of the Method 205 data can be found in the Quality Assurance/Quality Control Appendix.

#### **2.9 Quality Assurance/Quality Control – U.S. EPA Reference Methods 3A, 6C, 7E and 10**

Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Low Level gas was introduced directly to the analyzer. After adjusting the analyzer to the Low Level gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated

RECEIVED  
FEB 03 2022  
AIR QUALITY DIVISION

for the Mid Level gas. Next, High Level gas was introduced directly to the analyzer, and the response recorded when it was stable. All values were within 2.0 percent of the Calibration Span or 0.5 ppmv absolute difference.

High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe and the time required for the analyzer reading to reach 95 percent or 0.5 ppm (whichever was less restrictive) of the gas concentration was recorded. The analyzer reading was observed until it reached a stable value, and this value was recorded. Next, Low Level gas was introduced at the probe and the time required for the analyzer reading to decrease to a value within 5.0 percent or 0.5 ppm (whichever was less restrictive) was recorded. If the Low Level gas was zero gas, the response was 0.5 ppm or 5.0 percent of the upscale gas concentration (whichever was less restrictive). The analyzer reading was observed until it reached a stable value and this value was recorded. The measurement system response time and initial system bias were determined from these data. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv absolute difference

High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe. After the analyzer response was stable, the value was recorded. Next, Low-Level gas was introduced at the probe, and the analyzer value recorded once it reached a stable response. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv absolute difference or the data was invalidated and the Calibration Error Test and System Bias were repeated. Drift between pre- and post-run System Bias was within 0.5 ppmv absolute difference or the Calibration Error Test and System Bias were repeated.

To determine the number of sampling points, a gas stratification check was conducted prior to initiating testing. The pollutant concentrations were measured at three points (16.7, 50.0 and 83.3 percent of the measurement line). Each traverse point was sampled for a minimum of twice the system response time. The pollutant concentration at each traverse point did not differ more than 5% or 0.5 ppm (whichever was less restrictive) of the average pollutant concentration. Therefore, single point sampling was conducted during the test runs. Copies of stratification check data can be found in the Quality Assurance/Quality Control Appendix.

An NO<sub>2</sub> – NO converter check was performed on the analyzer prior to initiating testing. An approximately 50 ppm nitrogen dioxide cylinder gas was introduced directly to the NO<sub>x</sub> analyzer and the instrument response was recorded in an electronic data sheet. The instrument response was within +/- 10 percent of the cylinder concentration.

A Data Acquisition System with battery backup was used to record the instrument response in one (1) minute averages. The data was continuously stored as a \*.CSV file in Excel format on the hard drive of a computer. At the completion of testing, the data was also saved to the AST server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at AST's office, all written and electronic data was relinquished to the report coordinator and then a final review was performed by the Project Manager.

**2.10 Quality Assurance/Quality Control – U.S. EPA Reference Method ALT-106**

EPA Protocol 1 Calibration Gases – Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Zero gas was introduced through the sampling system to the analyzer. After adjusting the analyzer to the Zero gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas, and the time required for the analyzer reading to reach 95 percent of the gas concentration was recorded to determine the response time. Next, Mid and Low-Level gases were introduced through the

sampling system to the analyzer, and the response was recorded when it was stable. All values were within +/- 5% of the calibration gas concentrations.

A separation efficiency check was performed using a certified (+/- 2%) blend of propane and ethane in nitrogen. All values were within 5% of the cylinder concentration.

Post Test Drift Checks – Mid Level gas was introduced through the sampling system. After the analyzer response was stable, the value was recorded. Next, Zero gas was introduced through the sampling system, and the analyzer value recorded once it reached a stable response. The Analyzer Drift was less than 3 percent of the Calibration Span.

Data Collection – A Data Acquisition System with battery backup was used to record the instrument response (analog 0-10 volt signal) in one (1) minute averages. The data was continuously stored as a \*.CSV file in Excel format on the hard drive of a desktop computer. At the completion of the emissions testing the data was also saved to disk.