



## 1. EMISSION TEST SUMMARY

Energy Developments Coopersville (EDL) operates a gas-fired reciprocating internal combustion engine and electricity generator set (RICE genset) at the Ottawa County Farms Landfill in Coopersville, Ottawa County, Michigan.

This summary provides site-specific information for the proposed test event. The following sections (2 through 10) provide emission test procedures that are common to many engine testing projects managed by EDL and have been previously submitted to and approved by the State of Michigan Department of Environment, Great Lakes, and Energy-Air Quality Division (EGLE-AQD).

Site Name	Energy Developments Coopersville Located at the Ottawa County Farms Landfill
Permit Number	MI-ROP-N3294-2019
Test Date	February 23, 2021

Engine ID and Specifications			
Emission Unit ID	Power Rating	Generator Rating	Stack Diameter
EUENGINE7	2,233 HP	1,600 kW	13.5 inch

Pollutants and Limits			
Emission Unit ID	CO Limits	NOx Limits	VOC Limits
EUENGINE7	16.2 lb/hr & 3.3 g/bhp-hr	4.92 lb/hr & 1.0 g/bhp-hr	3.2 lb/hr & 0.65 g/bhp-hr

The compliance emission testing will be performed pursuant to conditions of ROP No. MI-ROP-N3294-2019 and the federal Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (the SI-RICE NSPS; 40 CFR Part 60 Subpart JJJJ), which requires that testing be performed every 8,760 operating hours or three years, whichever occurs first (unless the engine has been certified by the manufacturer as specified in the SI-RICE NSPS). The limits presented in the table above are the most stringent for each pollutant and may be less than the SI-RICE NSPS standards.

## 2. IDENTIFICATION AND DESCRIPTION OF THE SOURCE TO BE TESTED

### 2.1 Contact Person(s) for Source and Stack Test Protocol Information

Questions concerning the source and Stack Test Protocol should be addressed to:

Tyler J. Wilson  
Senior Project Manager  
Impact Compliance & Testing, Inc.  
37660 Hills Tech Drive  
Farmington Hills, MI 48331  
(734) 464-3880  
Tyler.Wilson@impactCandT.com

Mr. Dan Zimmerman  
Senior Compliance Manager  
Energy Developments  
P.O. Box 15217  
Lansing, MI 48901  
(517) 896-4417  
Dan.Zimmerman@edlenergy.com

### 2.2 Identification and Description of Source to be Tested

EDL plans to test one (1) CAT® Model No. G3520C RICE genset (EUENGINE7) at the Energy Developments Coopersville renewable energy power station. The unit is fired exclusively with landfill gas (LFG) that is recovered from the Ottawa County Farms Landfill and treated prior to use.

### 2.3 Type and Typical Quantity of Raw and Finished Materials Used in each Process

The RICE genset is typically operated at base load conditions (i.e., at, or near, 100% output). A certain heat input rate is required to maintain base load conditions. Therefore, the actual volumetric flowrate of fuel (treated LFG) is dependent on the fuel heating value, or methane content.

### 2.4 Description of Cyclical or Batch Operations

The RICE operating conditions are expected to be continuous and relatively constant during the test periods.

### 2.5 Basic Operating Parameters Used to Regulate the Process

Following startup of the engine (once the engine is at a steady-state condition) the process operates automatically. The engine 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.

### 2.6 Rated Capacity of the Processes

The CAT® Model No. G3520C engine generator set will be tested while operations occur at, or near (within  $\pm 10\%$ ), maximum design capacity (see specifications presented in the Emission Test Summary).

Attachment 1 provides a diagram of the exhaust stack and emission test sampling location.

**3. DESCRIPTION OF THE CONTROL EQUIPMENT**

The LFG fueled RICE is not equipped with add-on emission control equipment. The electronic air-to-fuel ratio controller automatically adjusts the air-to-fuel ratio and ignition timing to maintain efficient fuel combustion, which minimizes air pollutant emissions. Exhaust gas is exhausted directly to atmosphere through a noise muffler and vertical exhaust stack.

**4. POLLUTANTS TO BE MEASURED**

The exhaust gas from the RICE will be sampled and analyzed to determine the concentration of carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), and volatile organic compounds (VOC as non-methane hydrocarbon (NMHC or NMOC)).

<b>Parameter / Analyte</b>	<b>Sampling Methodology</b>	<b>Analytical Methodology</b>
Velocity traverses	USEPA Method 1	Selection of sample and velocity traverse locations by physical stack measurements
Volumetric flow rate	USEPA Method 2	Measurement of velocity head using a Type-S Pitot tube and inclined manometer
Oxygen and Carbon dioxide	USEPA Method 3A	Zirconia ion or paramagnetic detector for oxygen and infrared for carbon dioxide
Moisture	USEPA Method 4	Moisture determination by gravimetric water gain in chilled impingers
Nitrogen oxides	USEPA Method 7E	Chemiluminescence instrumental analyzer
Carbon monoxide	USEPA Method 10	NDIR instrumental analyzer
Non-methane hydrocarbons	USEPA Method 25A / ALT-096	FID instrument with internal methane separation column

In addition to the sampling and analytical methods presented in the table above, USEPA Method 205, "Verification of Dilution Systems for Field Instrument Calibrations", will be used to verify dilution system linearity.

**5. DETAILED SAMPLING AND ANALYTICAL PROCEDURES**

The compliance test will consist of three (3) one-hour test periods, in which CO, NO<sub>x</sub>, VOC, O<sub>2</sub>, and CO<sub>2</sub> concentrations, and moisture content will be determined for the RICE exhaust gas stream.

Exhaust gas volumetric flowrate and molecular weight will be measured to calculate the CO, NO<sub>x</sub>, and VOC mass emission rates (pounds per hour, lb/hr). Electricity generation rate (kilowatt, kW) will be recorded during each test period to calculate the CO, NO<sub>x</sub>, and VOC emission rate in grams per brake horsepower-hour (g/bhp-hr).

#### 5.1 Velocity traverse locations & stack gas velocity measurements (USEPA Methods 1 & 2)

Prior to commencing the engine emission performance test field measurements, stack gas sampling locations (i.e., pollutant concentration and velocity pressure measurement locations) will be determined in accordance with USEPA Method 1.

To determine hourly pollutant emission rates, the stack gas velocity and volumetric flowrate will be measured using USEPA Method 2 once for each sampling period. Gas velocity (pressure) measurements will be conducted at each traverse point of the stack with an S-type Pitot tube and red-oil manometer. Temperature measurements will be conducted at each traverse point using a K-type thermocouple and a calibrated digital thermometer. Once the molecular weight and moisture content of the engine exhaust gas is obtained, the stack exhaust volumetric flowrate will be determined.

#### 5.2 Measurement of carbon dioxide and oxygen content (USEPA Method 3A)

RICE exhaust CO<sub>2</sub> and O<sub>2</sub> content measurements will be performed concurrently during each air pollutant sampling period using an instrumental analyzer in accordance with Method 3A. A Servomex single beam single wavelength (SBSW) infrared gas analyzer (or equivalent) will be used to measure the CO<sub>2</sub> content in the exhaust gas; a Servomex gas analyzer that uses a paramagnetic sensor (or equivalent) will be used to measure the exhaust gas O<sub>2</sub> content.

A continuous sample of the RICE exhaust gas will be delivered to the instrument analyzers using an extractive gas sampling system that prevents condensation or contamination of the sample. The exhaust gas samples will be conditioned (i.e., dried) prior to being introduced to the instrument analyzer.

Attachment 2 provides specifications for the instrumental analyzers and a description of the extractive gas sampling system.

#### 5.3 Determination of moisture content constant rate sampling (USEPA Method 4)

The engine exhaust gas moisture content will be determined in accordance with the USEPA Method 4 chilled impinger method for each sample period. A sample of the engine exhaust gas will be extracted at a constant rate and moisture in the sample gas will be collected in a chilled impinger train. The moisture catch will be determined gravimetrically (or volumetrically) based on the water gain measured in the impinger train. A non-heated probe will be used to collect the moisture sample since the engine exhaust temperature will be approximately 800°F and there is no risk of condensation within the sample probe. During sampling, a single representative sample location will be used in lieu of collecting the sample across the velocity traverse profile. At 5-minute intervals, sampling train data will be recorded. Sampling will continue until at least the minimum sample volume, specified in

USEPA Method 4 (21 scf), is achieved (approximately 35 minutes).

Attachment 3 provides a sample train diagram and description of the USEPA Method 4 sampling procedures.

#### 5.4 Measurement of NO<sub>x</sub> and CO by instrumental analyzers (USEPA Methods 7E & 10)

RICE exhaust NO<sub>x</sub> concentrations will be determined during each test run sample period using a Thermo Environmental Instruments, Inc. (TEI) Model 42c NO-NO<sub>2</sub>-NO<sub>x</sub> analyzer (or equivalent) that uses chemiluminescence technology for the measurement of NO<sub>x</sub> concentrations in accordance with USEPA Method 7E.

RICE exhaust CO concentrations will be determined during each test run sample period using a CO analyzer that utilizes non-dispersive infrared (NDIR) technology (TEI Model 48i, California Analytical Instruments (CAI) Fuji ZRF, or equivalent) in accordance with USEPA Method 10 for direct measurement of CO concentration in exhaust gases.

A continuous sample of the RICE exhaust gas will be delivered to the instrument analyzer using the extractive gas sampling system described in Attachment 2. The exhaust gas samples will be conditioned (i.e., dried) prior to being introduced to the instrument analyzer. Therefore, CO and NO<sub>x</sub> measurements correspond to standard conditions with moisture correction (dry basis).

The instrumental analyzers will be calibrated using certified concentrations of NO<sub>x</sub> and CO in nitrogen. The calibration gases will be diluted (using a certified gas divider) with nitrogen to obtain intermediate NO<sub>x</sub> and CO concentrations and to demonstrate linearity of the instrument analyzer.

#### 5.5 Measurement of VOC concentrations (USEPA Method 25 / ALT-096)

VOC as non-methane hydrocarbon (NMHC or NMOC) concentrations in the RICE exhaust will be determined using a TEI, Model 55i Methane-NMHC analyzer in accordance with USEPA Method 25A and Alternate Method (ALT) 096 for direct measurement of NMHC concentrations in RICE exhaust gas.

The TEI 55i is an automated batch analyzer that repeatedly collects and analyzes samples of the exhaust gas stream that are drawn into the instrument by the internal sampling pump. The sampled gas is separated by an internal gas chromatography (GC) column into methane and non-methane fractions and each fraction is analyzed separately using a flame ionization detector (FID), in accordance with USEPA Method 25A. The NMHC concentration will be reported relative to a propane calibration standard (parts per million as propane, C<sub>3</sub>) and the molecular weight of propane will be used to calculate NMOC mass emissions.

A continuous sample of the RICE exhaust gas will be delivered to the VOC instrument analyzer using an extractive gas sampling system described in Attachment 2. The exhaust gas sample will bypass the sample condenser be delivered directly to the NMHC

instrumental analyzer. Therefore, VOC measurements correspond to standard conditions with no moisture correction (wet basis).

The VOC instrument will be calibrated using certified propane concentrations in hydrocarbon-free air. The calibration gases will be diluted (using a certified gas divider) with hydrocarbon-free air to obtain intermediate concentrations and to demonstrate linearity of the instrument analyzer.

The USEPA Office of Air Quality Planning and Standards (OAQPS) has issued several alternate test methods approving the use of the TEI 55-series analyzer as an effective instrument for measuring VOC from gas-fueled RICE in that it uses USEPA Method 25A (ALT-066, ALT-078, and ALT-096).

Attachment 4 presents the Approval Letter for the use of USEPA ALT-096.

## 6. NUMBER AND LENGTH OF SAMPLING RUNS

The emission performance tests will consist of three (3), one-hour sampling periods for CO, NOx, and VOC concentrations measurements for the engine. Exhaust gas flowrate measurements will be performed once for each test period.

## 7. ESTIMATED FLUE GAS CONDITIONS

Sampling Location	Temperature (°F)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	Moisture (%)
Engine Exhaust	785	9.6	10.0	10.5

## 8. PROJECTED PROCESS OPERATING CONDITIONS

For the compliance demonstration, the RICE-generator set will be operated within +/- 10% of rated design capacity (see specifications presented in the Emission Test Summary).

## 9. PROCESS OR CONTROL EQUIPMENT DATA TO BE COLLECTED

For each one-hour test period, EDL personnel will monitor fuel use (scfm), LFG methane content (%), and power output (kW) of the generator connected to the RICE that is being tested. Data will be recorded continuously or at least every 15 minutes.

Engine horsepower output cannot be directly measured. However, it can be calculated based on a linear relationship between recorded generator output using the generator set efficiency:

Engine HP = generator output (kW) x rated horsepower (HP) / rated electricity output (kW)

## 10. FIELD QA/QC PROCEDURES

### 10.1 Exhaust Gas Velocity

The instruments used to measure exhaust gas velocity (barometer, pyrometer, scale, and Pitot tube) will be inspected and calibrated prior to use.

Prior to performing the initial engine exhaust stack velocity traverse, the pressure and static sides of the S-type Pitot tube and manometer lines will be leak-checked at the test site.

### 10.2 Instrument Calibration and System Bias Checks

At the beginning of each day of the testing program, initial three-point instrument calibrations will be performed for the NO<sub>x</sub>, CO, CO<sub>2</sub>, and O<sub>2</sub> analyzers by injecting calibration gas directly into the inlet sample port for each instrument. System bias checks will be performed prior to and at the conclusion of each sampling period by introducing an appropriate 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<sup>®</sup> heated sample line) and verifying 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 will be introduced to the NMHC analyzer, in series at a tee connection, which is installed between the sample probe and the particulate filter, through a spring-loaded check valve. After each one-hour test period, mid-range and zero gases will be 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 will be calibrated with USEPA Protocol 1 certified concentrations of CO<sub>2</sub>, O<sub>2</sub>, NO<sub>x</sub>, and CO in nitrogen and zeroed using nitrogen. The NMHC (VOC) instrument will be calibrated with USEPA Protocol 1 certified concentrations of propane in air and zeroed using hydrocarbon-free air. A STEC Model SGD-710C 10-step gas divider will be used to obtain intermediate calibration gas concentrations as needed.

### 10.3 Verification of gas dilution calibration equipment

A STEC Model SGD-710C 10-step gas divider will be used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified (within the last 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 delivers calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 will be followed prior to use of gas divider.

### 10.4 NO<sub>2</sub> – NO Converter Test

The NO<sub>2</sub> – NO conversion efficiency of the instrumental analyzer used to measure NO<sub>x</sub> for this compliance test event will be verified prior to the commencement of the performance

tests. A USEPA Protocol 1 certified NO<sub>2</sub> calibration gas will be used to verify the efficiency of the NO<sub>2</sub> – NO converter. The instrument analyzer NO<sub>2</sub> – NO converter uses a catalyst at high temperatures to convert the NO<sub>2</sub> to NO for measurement. The conversion efficiency of the instrument analyzer will be deemed acceptable if the calculated NO<sub>2</sub> – NO conversion efficiency is greater than or equal to 90%.

#### 10.5 Sampling System Response Time Determination

The response time of the sampling system will be determined prior to the commencement of the engine performance tests 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 will be determined using a stopwatch. Each test period will begin once the instrument sampling probe has been in place for at least twice the system response time.

#### 10.6 Determination of Exhaust Gas Stratification

Prior to conducting the test program (or as part of the first sampling period), a stratification test will be performed in order to determine representative stack gas sampling locations (i.e., pollutant concentration measurement locations) in accordance with the preliminary traverse procedures specified in Section 8.1.2 of USEPA Method 7E. Three points along a line passing through the centroid of the stack, located at 16.7, 50.0 (centroid), and 83.3%, will be sampled for a minimum twice the response time.

#### 10.7 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure NO<sub>x</sub>, CO, O<sub>2</sub>, and CO<sub>2</sub> have had an interference response test performed 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.

#### 10.8 Meter Box Calibrations

The dry gas meter and gas sampling console, which will be used to extract a measured amount of exhaust gas from the stack for moisture content determinations, will be calibrated prior to and after the testing program. This calibration uses the critical orifice calibration technique presented in USEPA Method 5.

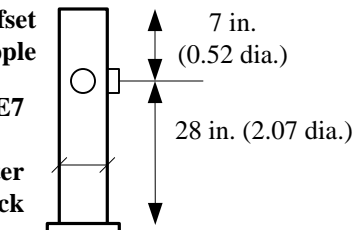
The digital pyrometer in the isokinetic metering console will be calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.



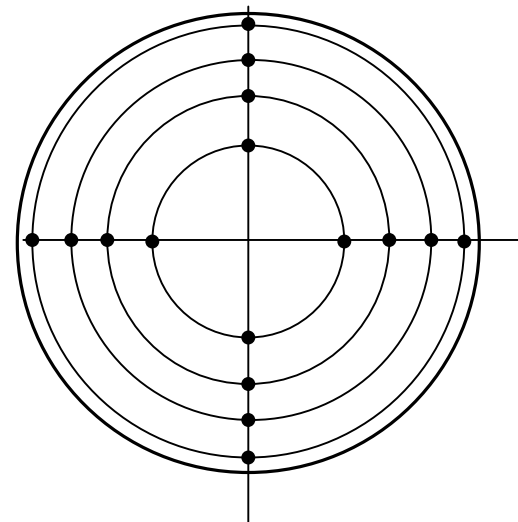
**Attachment 1**

Engine Exhaust Sampling Location

**Sample Ports**  
**90 degrees offset**  
**+3.00 inch Nipple**  
**EURICENGINE7**  
**13.5 in. diameter**  
**exhaust stack**

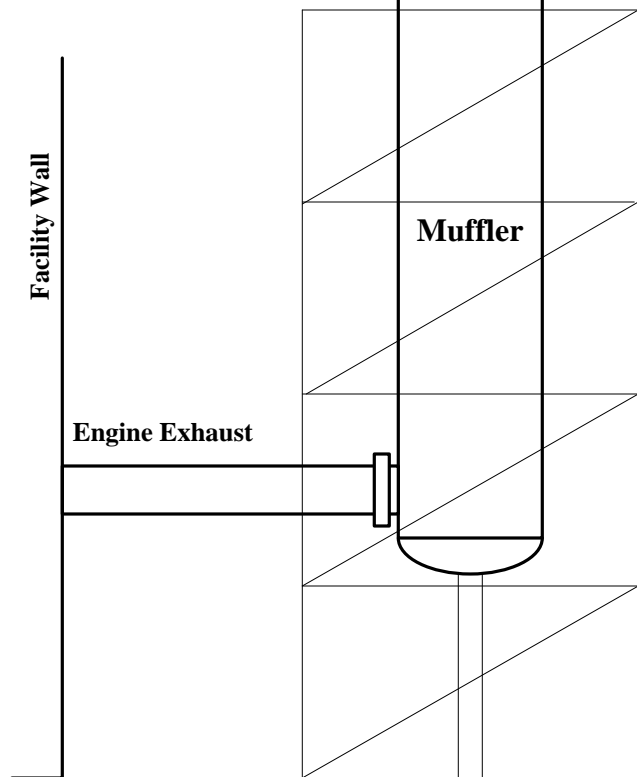


Exhaust Stack  
 Cross-Section with  
 Traverse Points



Velocity sample locations as  
 measured from stack wall

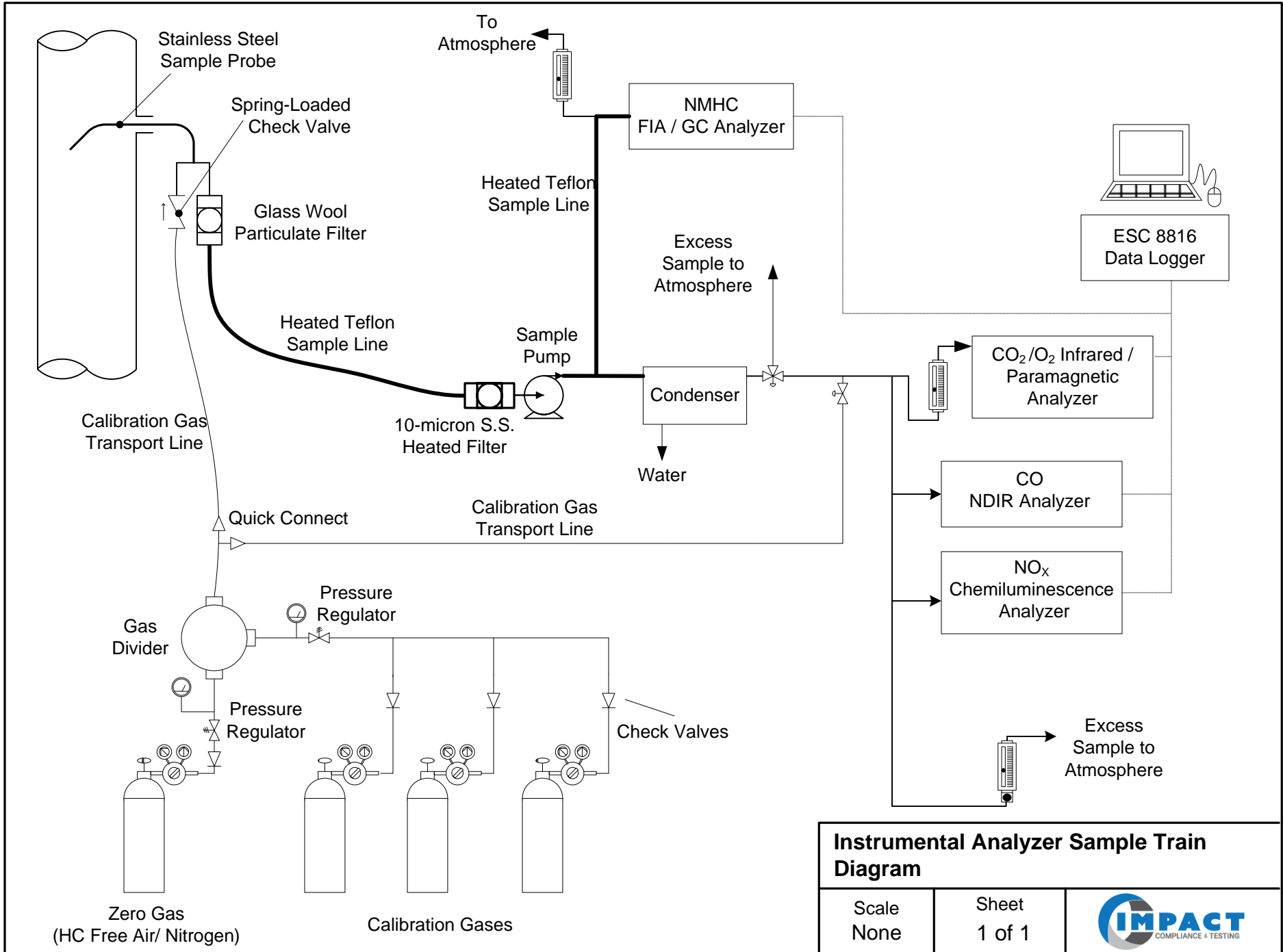
Pt. #	in.
1	0.50
2	1.4
3	2.6
4	4.4
5	9.1
6	10.9
7	12.1
8	13.0



4/27/2016 BB	<b>EDL Coopersville Generating Station</b> <b>Exhaust Sample Location, CAT® G3520 ICE</b>		
3/22/2018 TW			
	Scale None	Sheet 1 of 1	<b>ICT</b>

**Attachment 2**

Extractive Gas Sampling Procedures



**Instrumental Analyzer Sample Train Diagram**

Scale  
None

Sheet  
1 of 1



## ATTACHMENT 2

### USEPA Methods 3A, 7E, 10, and 25A / ALT 096 Sampling Train Diagram USEPA Methods 3A, 7E, 10, and 25A / ALT 096 Extractive Gas Sampling Procedures

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#### **Extractive Gas Sampling System**

The extractive gas sampling system that serves the instrumental analyzers used for Methods 3A, 7E, 10, and 25A / ALT 096 is configured as described below.

Sample probe – Stainless-steel or equivalent single opening probe will be located in the centroid of the stack or moved across the diameter as required by the stratification test.

Tee and check valve - A stainless steel “Tee” will be installed between the sample probe and a stainless-steel particulate filter to allow the introduction of calibration gases through a stainless-steel spring-loaded check valve into the sampling system. When sampling, the spring-loaded check valve is normally closed, though upon the introduction of pressurized calibration gas from a remote Teflon® line, the check valve opens and allows the calibration gases to be introduced near the base of the sample probe. During this sampling system bias check procedure, excess calibration gas exits the sampling probe tip to avoid the introduction of process gas or ambient air during calibration.

Heated sample line – A heated Teflon® line will be used to transport the sample gas from the stack to the instrument trailer. The heated Teflon® line is equipped with a temperature controller which maintains the temperature of the sample line at approximately 250°F to prevent moisture condensation.

Sample pump and flow control valve – A single head 100% oil-free vacuum pump fitted with a stainless-steel flow control valve will be used to transfer sampled gases from the heated sample line to the instrumental analyzer. The vacuum pump is leak-free and non-reactive to the gases being sampled. Subsequent sample transport lines and fittings are either stainless steel or Teflon®.

Sample gas manifold – From the vacuum pump, a sample gas manifold constructed of Teflon® transport lines and stainless steel “Tee” fittings are used to continuously deliver the sampled gas to the instrumental analyzer. Since certain instrumental analyzers are equipped with an internal sampling pump, the end of the sample gas manifold has an atmospheric dump (or bypass discharge vent) to avoid over-pressurization of the instrumental analyzer.

Gas Conditioner - A thermoelectric condenser (Universal Analyzer Model 3080-SS) utilizing the "Peltier Effect" equipped with a peristaltic pump will be used to remove moisture from the sampled gas stream that is directed to the instrumental analyzers (except the VOC analyzer which receives filtered but unconditioned sample gas), which require a conditioned (or dry) gas samples. From the moisture removal system, a sample gas manifold constructed of Teflon® transport lines and stainless-steel Tee fittings will be used to continuously deliver the sampled gas to the instrumental analyzers. Since the instrumental

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analyzers are equipped with internal sampling pumps, the end of the sample gas manifold is equipped with an atmospheric dump (or bypass discharge vent) to avoid over pressurization of the instrumental analyzers.

Data Logger – An ESC Model 8816 data logging system will be used to continuously monitor the analog output of each instrumental analyzer and record that data as 1-minute averages.

### **Quality Assurance / Calibration Procedures**

Upon site arrival, the instrumental analyzers will be set-up in accordance with the manufacturer's written recommended procedures. Upon setting the appropriate range for the instrument, zero and appropriate span gases are introduced sequential order to set the instrument's zero and span pots.

In the field prior to the first test run, appropriate high-range, mid-range, and low-range span gases are introduced directly to the instruments through an instrument calibration line in order to determine the analyzer calibration error. Following the analyzer calibration error determination an appropriate up-scale gas (which most closely matches the expected concentration) and zero gas will be introduced in series at the "Tee" in the sampling system through the spring-loaded check valve. This dynamic calibration procedure serves to document the required sampling system bias check, and the analyzer's response time to achieve a stable reading.

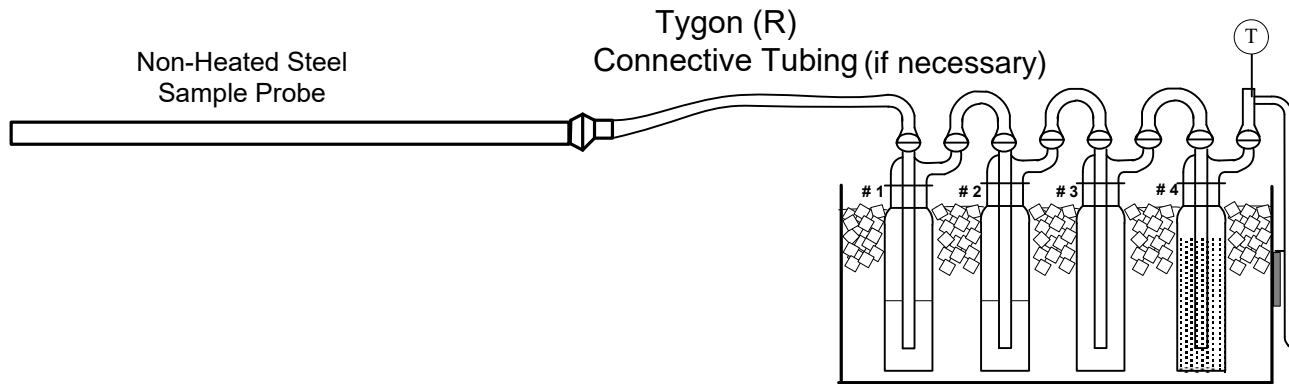
The start of the test run occurs when the data acquisition system records a consistent instrumental analyzer response (at least twice the system response time). After one hour of data is obtained, an appropriate up-scale and downscale (zero gas) will be re-introduced in series at the "Tee" in the sampling system. The post-run system bias check will be used to check against the method's performance specifications for calibration drift and zero drift error. The FID will be calibrated similarly using mid-level and zero gases as directed in USEPA Method 25A.

### Calibration gas dilution equipment

A STEC Model SGD-710C 10-step gas divider will be used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified (within the last 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 delivers calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 will be followed prior to use of gas divider.

**Attachment 3**

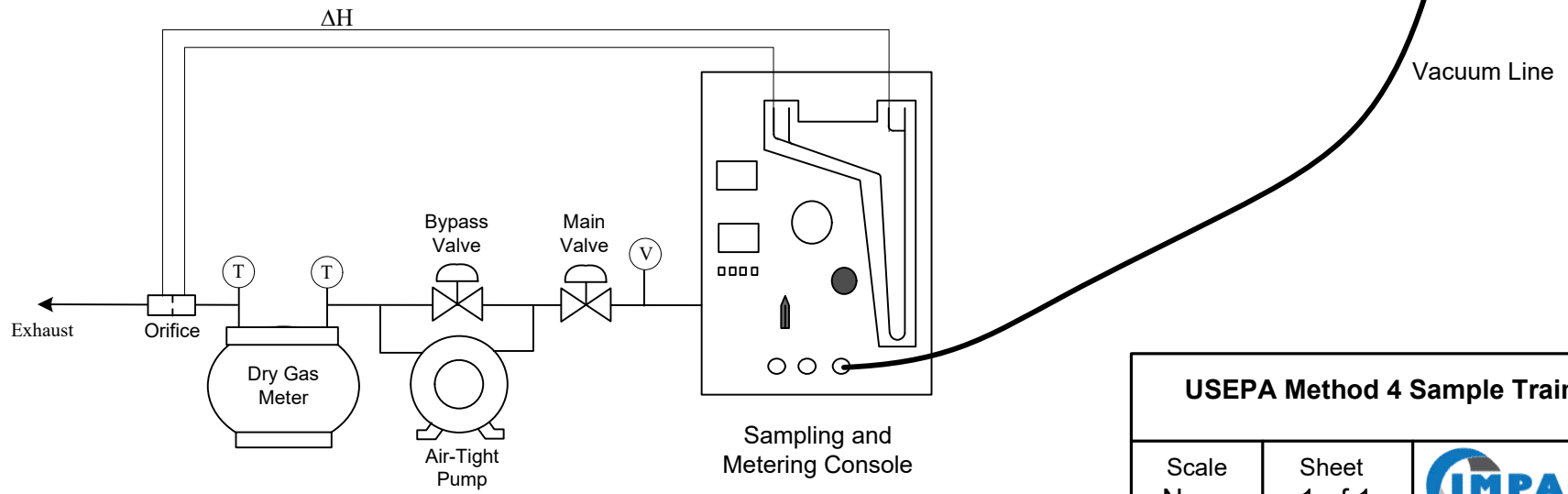
USEPA Method 4 Moisture Procedures



Impinger Contents (indicate Standard or Modified)

- Impinger # 1: 100 mL DI Water (std)
- Impinger # 2: 100 mL DI Water (mod)
- Impinger # 3: Empty (std)
- Impinger # 4: Dried silica gel (mod)

(V) = Vacuum Gauge  
 (T) = Temperature Measurement



USEPA Method 4 Sample Train		
Scale None	Sheet 1 of 1	



### ATTACHMENT 3

USEPA Method 4 Sampling Train Diagram  
USEPA Method 4 Moisture Train Sampling Procedures

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#### Exhaust Gas Moisture Determination - USEPA Method 4 Chilled Impinger

The moisture content of the exhaust gas will be determined in accordance with the USEPA Method 4 chilled impinger method. A gas sample will be extracted at a constant rate from the source and bubbled through a condenser where moisture will be removed from the sample stream and determined gravimetrically.

The moisture sampling train consisted of a non-heated probe (as exhaust temperatures will be approximately 800°F), connected to the first chilled impinger by a borosilicate glass connector or a sufficient length of tubing. The impinger train will consist of four (4) impingers, connected in series and immersed in an ice bath. Crushed ice will be placed around the impingers to keep the temperatures of the gases leaving the last impinger at 68 °F or less. Each impinger will be weighed gravimetrically before and after each test to determine the net moisture gain. The impinger train will be constructed and charged as follows:

1. Modified Greensburg-Smith (G-S) impinger containing 100 ml of distilled water;
2. Standard G-S impinger containing 100 ml of distilled water;
3. Modified G-S impinger, dry, to serve as a knockout; and
4. Modified G-S impinger containing approximately 200 - 300 grams of pre-dried silica gel and glass fiber.

An umbilical line will be used to connect the sample probe and impinger train to the isokinetic metering system. The umbilical line includes type K thermocouples, used to measure the impinger outlet.

A dry gas meter and gas sampling console will be used to maintain a constant sampling rate. The system consists of a vacuum gauge, leak-free carbon vane pump, calibrated dry gas meter and thermocouples. The thermocouples will be connected to a digital thermometer that displays temperature readings from the thermocouples on the umbilical line and dry gas meter.

Prior to each test run, the moisture sampling train will be assembled and leak-checked at the sampling site by plugging the inlet to the probe and pulling a vacuum of approximately 15 inches Hg. At the conclusion of the test run, a posttest leak check will be performed by drawing a vacuum equal to or greater than the highest vacuum measured during the test run and compared to the acceptable criteria of USEPA Method 4, Section 8.1.3.2 (A 60-second leakage rate in excess of 4 percent of the average sampling rate or 0.00057 m<sup>3</sup>/min (0.020 cfm), whichever is less, is unacceptable).

During sampling, a single representative sample location will be used in lieu of collecting the sample across the velocity traverse profile for 30 minutes. This sample time is adequate to obtain the required minimum sample volume required by USEPA Method 4. At 5-minute intervals, sampling train data will be recorded. An aneroid-type barometer will be used to

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measure the barometric pressure of the ambient air. All sampling data will be recorded on field data sheets. Percent moisture will be calculated using the measured mass gain of the impingers along with the metering console and calibration data.