IMPACT COMPLIANCE & TESTING

AIR EMISSION TEST REPORT

Title:	AIR EMISSION TEST REPORT FOR THE VERIFICATION OF AIR POLLUTANT EMISSIONS FROM LANDFILL GAS FUELED INTERNAL COMBUSTION ENGINES
Report Date:	February 13, 2020
Test Dates:	February 4, 2020

Facility Information	
Name:	Energy Developments Watervliet, LLC at the Orchard Hill Sanitary Landfill
Street Address:	3290 Hennessey Road
City, County:	Watervliet, Berrien
SRN:	N5719

Facility Permit Information	
RO Permit No.:	MI-ROP-N5719-2016
Emission Units:	EUICEENGINE1-S2 and EUICEENGINE2-S2

Testing Contractor	
Company:	Impact Compliance & Testing, Inc.
Mailing Address:	37660 Hills Tech Drive Farmington Hills, MI 48331
Phone:	(734) 464-3880
Project No.:	1900205

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF AIR POLLUTANT EMISSIONS
FROM
LANDFILL GAS FUELED INTERNAL COMBUSTION ENGINES

ENERGY DEVELOPMENTS WATERVLIET, LLC
AT THE ORCHARD HILL SANITARY LANDFILL

1.0 INTRODUCTION

Energy Developments Watervliet, LLC (EDL) operates two (2) Caterpillar (CAT®) Model No. G3520C gas fueled reciprocating internal combustion engine and electricity generator sets (RICE gensets) at the Orchard Hill Sanitary Landfill in Watervliet, Berrien County, Michigan. The two (2) landfill gas (LFG) fueled RICE gensets are identified as emission units EUICEENGINE1-S2 and EUICEENGINE2-S2 (collectively flexible emission group FGICEENGINES-S2) in Section 2 of Michigan Renewable Operating Permit (ROP) No. MI-ROP-N5719-2016 issued by the Michigan Department of Environment, Great Lakes, and Energy-Air Quality Division (EGLE-AQD).

The conditions of MI-ROP-N5719-2016:

1. Allow for the installation and operation of two (2) spark ignition, lean burn RICE gensets (CAT® Model G3520C) that use treated landfill gas as fuel.

2. Require the permittee to conduct performance testing according to 40 CFR 60.4244 for each engine in FGICEENGINES-S2 every 8,760 hours of operation or three years, whichever occurs first, to demonstrate compliance.

The compliance testing was performed by Impact Compliance & Testing, Inc. (ICT), a Michigan-based environmental consulting and testing company. ICT representatives Tyler J. Wilson and Blake Beddow performed the field sampling and measurements February 4, 2020.

The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan that was reviewed and approved by the EGLE-AQD. Mr. Matthew Karl and Mr. Matt Deskins of the EGLE-AQD observed portions of the compliance testing.

Questions regarding this emission test report should be directed 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
Director of North America HSE & Compliance
Energy Developments
608 S. Washington Avenue
Lansing, MI 48933
PO Box 15217, Lansing, MI 48901
(517) 896-4417
Dan.Zimmerman@edlenergy.com

Report Certification

This test report was prepared by ICT based on field sampling data collected by ICT. Facility process data were collected and provided by EDL employees or representatives. This test report has been reviewed by EDL representatives and approved for submittal to EGLE-AQD. A test report certification form (EQP 5736) signed by the facility's Responsible Official accompanies this report.

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:

Tyler J. Wilson
Senior Project Manager
Impact Compliance & Testing, Inc.

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 General Process Description

Landfill gas (LFG) containing methane is generated in the Orchard Hill Sanitary Landfill from the anaerobic decomposition of disposed waste materials. The LFG is collected from both active and capped landfill cells using a system of wells (gas collection system). The collected LFG is transferred to the Granger LFG power station facility where it is treated and used as fuel for the two (2) RICE. Each RICE is connected to an electricity generator that produces electricity that is transferred to the local utility.

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 treated LFG.

2.3 Sampling Locations

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

The exhaust stack sampling ports for the CAT® Model G3520C engines (EUICEENGINE1-S2 – EUICEENGINE2-S2) are located in individual exhaust stacks with an inner diameter of 13.25 inches. Each stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location greater than 24 feet (>21.7 duct diameters) upstream and greater than 96.0 inches (>7.2 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 1 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

The conditions of ROP No. MI-ROP-N5917-2016 and 40 CFR Part 60 Subpart JJJJ require EDL to test each engine contained in FGICEENGINES-S2 for carbon monoxide (CO), nitrogen oxides (NOx), and volatile organic compounds (VOCs) every 8,760 hours of operation.

3.2 Operating Conditions During the Compliance Tests

The testing was performed while the RICE generator sets were operated at maximum operating conditions (1,600 kW electricity output +/- 10%). EDL representatives provided the generator electricity output (kW) in 15-minute intervals for each test period. The generator kW output ranged between 1,567 and 1,621 kW during the test periods.

Fuel flowrate (lb/hr), fuel methane content (%), and inlet pressure (psi) were also recorded by facility representatives at 15-minute intervals for each test period. The RICE fuel consumption rate ranged between 2,203 and 2,267 lb/hr, fuel methane content ranged between 52.1 and 52.6%, and inlet pressure was consistently 3.5 psi during the test periods.

In addition, the engine serial number and operating hours were recorded by the facility operators at the beginning of Test No. 1 for each RICE.

Appendix 2 provides operating records provided by EDL 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 the LFG fueled RICE (EUICEENGINE1-S2 and EUICEENGINE2-S2) were each sampled for three (3) one-hour test periods during the compliance testing performed February 4, 2020.

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

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	EUICEENGINE1-S2	EUICEENGINE2-S2
Generator output (kW)	1,605	1,596
Engine output (bhp)	2,240	2,227
Engine LFG fuel use (lb/hr)	2,220	2,237
LFG methane content (%)	52.4	52.2
Inlet Pressure (psi)	3.5	3.5
Exhaust temperature (^{o}F)	783	787

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

	NOx Emission Rates		CO Emission Rates		VOC Emission Rates	
Emission Unit	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
EUICEENGINE1-S2	3.39	0.69	12.5	2.54	0.57	0.12
EUICEENGINE2-S2	3.32	0.68	12.2	2.48	0.52	0.11
Permit Limit	4.94	1.0	17.3	3.5	-	1.0

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A test protocol for the air emission testing was reviewed and approved by 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 1	Exhaust gas velocity measurement locations were determined based on the physical stack arrangement and requirements in USEPA Method 1.
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 an NDIR instrumental analyzer.
USEPA Method 25A / ALT-096	Exhaust gas VOC (as NMHC) concentration was determined using a flame ionization analyzer equipped with methane separation column.

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 once for each test. 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 onsite, prior to the test event, 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 3 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 was measured continuously throughout each test period in accordance with USEPA Method 3A. The CO_2 content of the exhaust was monitored using a Servomex 1440D single beam single wavelength (SBSW) infrared gas analyzer. The O_2 content of the exhaust was monitored using a Servomex 1440D 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 content 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 4 provides O_2 and CO_2 calculation sheets. Raw instrument response data are provided in Appendix 5.

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 42c High Level chemiluminescence NO_X analyzer and a TEI Model 48i 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 4 provides CO and NOx calculation sheets. Raw instrument response data are provided in Appendix 5.

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

The VOC emission rate was determined by measuring the nonmethane hydrocarbon (NMHC or NMOC) concentration in the engine exhaust gas. 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.

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 NMOC from gas-fueled reciprocating internal combustion engines (RICE) in that it uses USEPA Method 25A and 18 (ALT-066, ALT-078 and ALT-096).

Samples of the exhaust gas were delivered directly to the instrumental analyzer using the Teflon® heated sample line to prevent condensation. The sample to the NHMC analyzer was not conditioned to remove moisture. Therefore, VOC measurements correspond to standard conditions with no moisture correction (wet basis).

Prior to, and at the conclusion of each test, the instrument was calibrated using mid-range calibration (propane) and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document).

Appendix 4 provides VOC calculation sheets. Raw instrument response data for the NMHC analyzer is provided in Appendix 5.

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

5.1 Exhaust Gas Flow

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.

5.2 NOx 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_x concentration is greater than or equal to 90% of the expected value.

The NO_2 – NO conversion efficiency test satisfied the USEPA Method 7E criteria (measured NO_x concentration was 95.9% of the expected value, i.e., greater than 90% of the expected value as required by Method 7E).

5.3 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 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 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.

5.4 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure NOx, 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.

5.5 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 NOx, 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, NOx, and CO in nitrogen and zeroed using hydrocarbon free nitrogen. The NMHC/NMOC (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.

5.6 Determination of Exhaust Gas Stratification

A stratification test was performed for the RICE 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 each RICE exhaust stack indicate that the measured CO, O_2 and CO_2 concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the RICE exhaust gas was considered to be unstratified and the compliance test sampling was performed at a single sampling location within the RICE exhaust stack.

5.7 Meter Box Calibrations

The Nutech Model 2010 sampling 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 Nutech metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

5.8 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.

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.

Appendix 6 presents test equipment quality assurance data for the emission test equipment (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, and Pitot tube, pyrometer, barometer, and scale 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 Engine Nos. 1 and 2 are less than the allowable limits specified in MI-ROP-N5917-2016 for Emission Unit Nos. EUICEENGINE1-S2 and EUICEENGINE2-S2:

- 3.5 grams per brake-horsepower hour (g/bhp-hr) and 17.3 pounds per hour (pph) for CO;
- 1.0 g/bhp-hr and 4.94 pph for NOx; 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 protocol. The engine-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.

Table 6.1 Measured exhaust gas conditions and NO_x, CO, and VOC air pollutant emission rates for Engine No. 1 (EUICEENGINE1-S2)

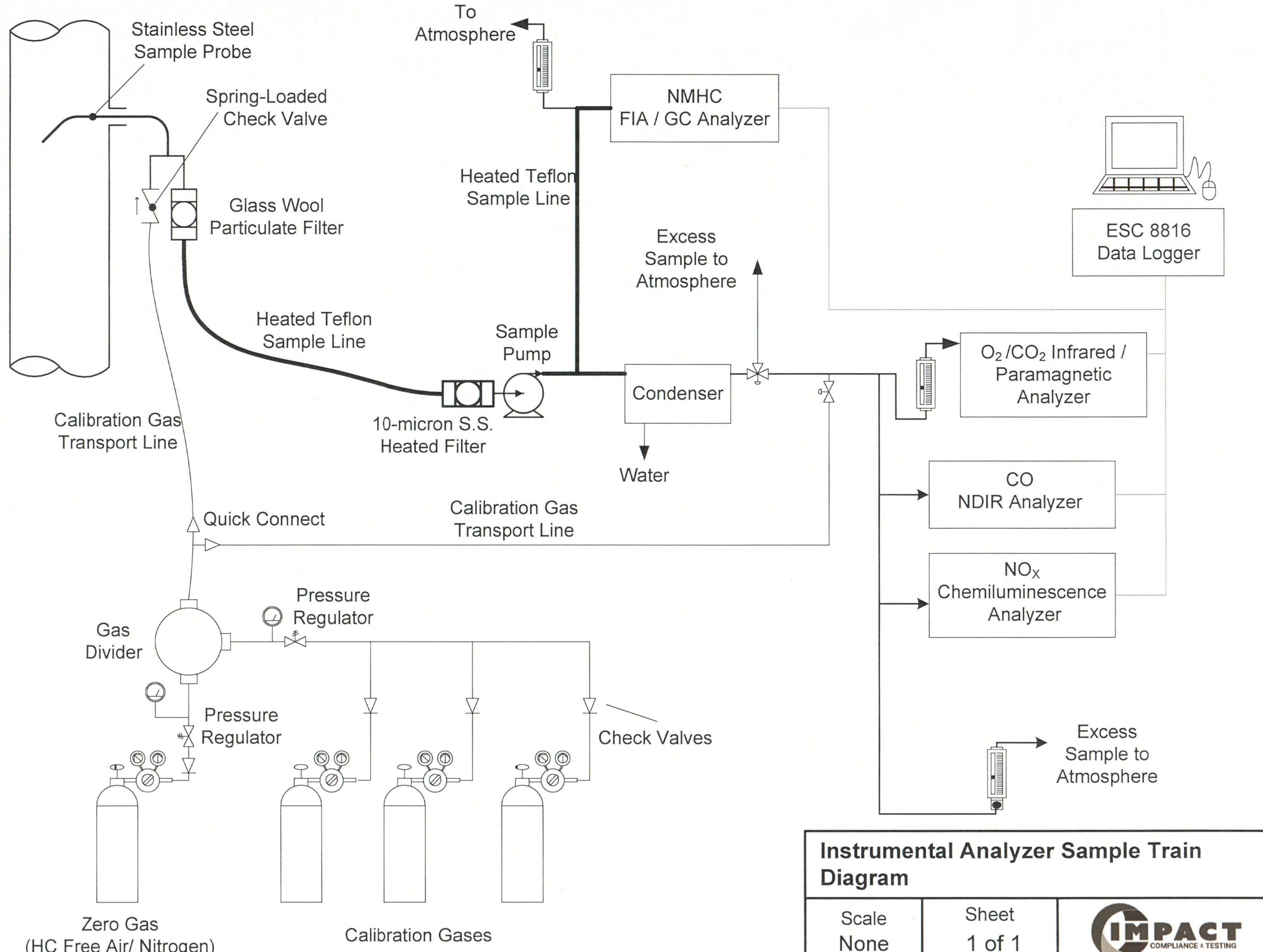
Test No. Test date Test period (24-hr clock)	1 2/4/2020 1129-1229	2 2/4/2020 1244-1344	3 2/4/2020 1401-1501	Three Test Average
Fuel flowrate (lb/hr)	2,219	2,217	2,224	2,220
Generator output (kW)	1,597	1,605	1,613	1,605
Engine output (bhp)	2,229	2,240	2,251	2,240
LFG methane content (%)	52.3	52.4	52.5	52.4
Inlet Pressure (psi)	3.5	3.5	3.5	3.5
Exhaust Gas Composition				
CO_2 content (% vol)	11.2	11.1	10.9	11.1
O_2 content (% vol)	8.83	8.88	9.09	8.93
Moisture (% vol)	11.6	10.9	12.3	11.6
Exhaust gas temperature (^oF)	781	790	779	783
Exhaust gas flowrate (dscfm)	4,250	4,273	4,220	4,248
Exhaust gas flowrate (scfm)	4,806	4,796	4,811	4,804
Nitrogen Oxides				
NO_X conc. (ppmvd)	112	112	110	111
NO_X emissions (lb/hr)	3.42	3.43	3.32	3.39
Permitted emissions (lb/hr)	-	-	-	*4.94*
NO_X emissions (g/bhp*hr)	0.70	0.70	0.67	0.69
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*
Carbon Monoxide				
CO conc. (ppmvd)	683	679	668	677
CO emissions (lb/hr)	12.7	12.7	12.3	12.5
Permitted emissions (lb/hr)	-	-	-	*17.3*
CO emissions (g/bhp*hr)	2.58	2.56	2.48	2.54
*Permitted emissions (g/bhp*hr)*	-	-	-	*3.5*
Volatile Organic Compounds				
VOC conc. (ppmv C3)	17.5	17.4	17.1	17.3
VOC emissions (lb/hr)	0.58	0.57	0.56	0.57
VOC emissions (g/bhp*hr)	0.12	0.12	0.11	0.12
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*

Table 6.2 Measured exhaust gas conditions and NO_x, CO, and VOC air pollutant emission rates for Engine No. 2 (EUICEENGINE2-S2)

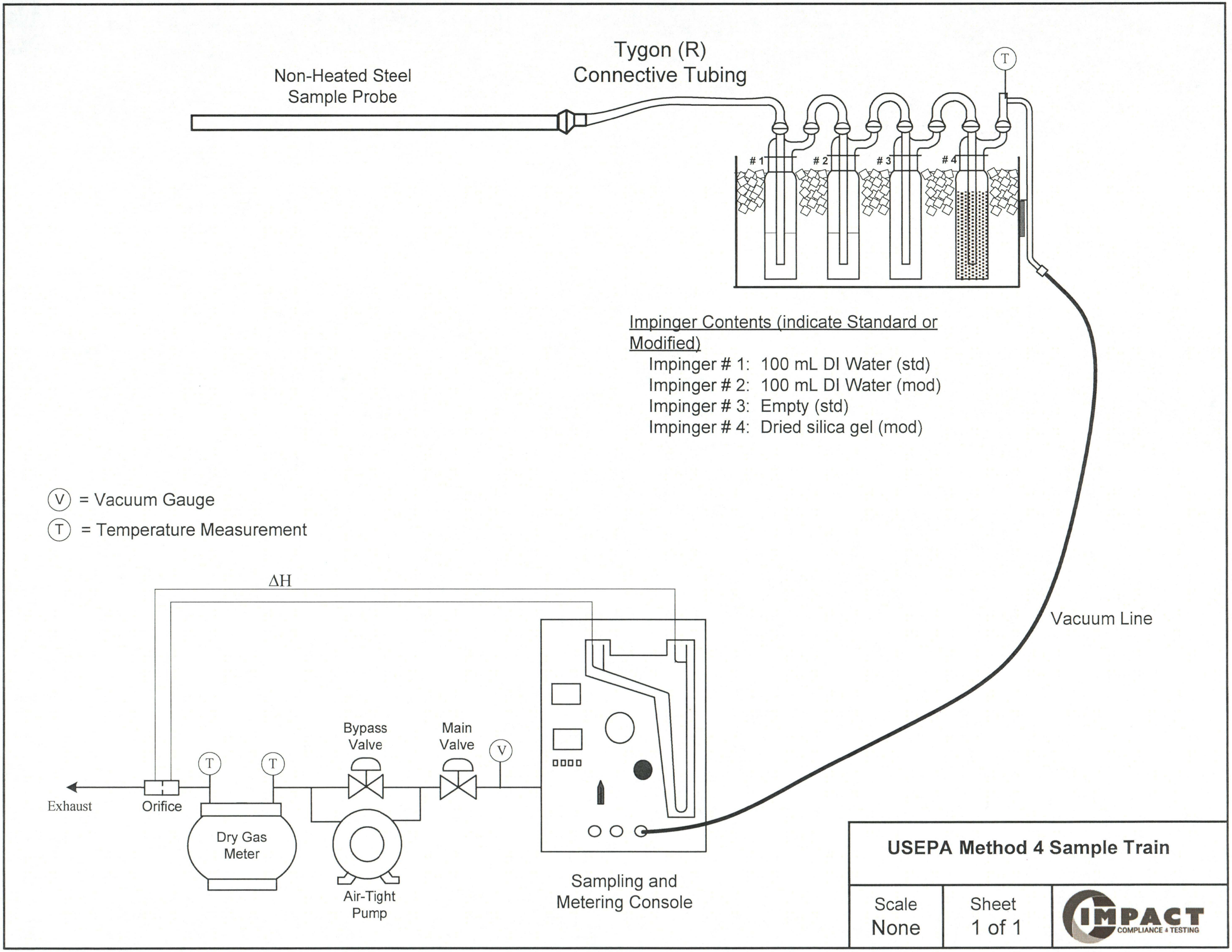
Test No. Test date Test period (24-hr clock)	1 2/4/2020 745-845	2 2/4/2020 901-1001	3 2/4/2020 1015-1115	Three Test Average
Fuel flowrate (lb/hr)	2,242	2,241	2,229	2,237
Generator output (kW)	1,597	1,603	1,588	1,596
Engine output (bhp)	2,229	2,237	2,216	2,227
LFG methane content (%)	52.1	52.2	52.2	52.2
Inlet Pressure (psi)	3.5	3.5	3.5	3.5
Exhaust Gas Composition				
CO_2 content (% vol)	11.2	11.1	11.1	11.1
O_2 content (% vol)	8.91	8.95	8.96	8.94
Moisture (% vol)	11.2	12.3	11.0	11.5
Exhaust gas temperature (^oF)	783	784	793	787
Exhaust gas flowrate (dscfm)	4,248	4,165	4,309	4,241
Exhaust gas flowrate (scfm)	4,785	4,751	4,840	4,792
Nitrogen Oxides				
NO_X conc. (ppmvd)	109	107	112	109
NO_X emissions (lb/hr)	3.33	3.19	3.45	3.32
Permitted emissions (lb/hr)	-	-	-	*4.94*
NO_X emissions (g/bhp*hr)	0.68	0.65	0.71	0.68
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*
Carbon Monoxide				
CO conc. (ppmvd)	664	655	654	657
CO emissions (lb/hr)	12.3	11.9	12.3	12.7
Permitted emissions (lb/hr)	-	-	-	*17.3*
CO emissions (g/bhp*hr)	2.51	2.41	2.52	2.48
*Permitted emissions (g/bhp*hr)*	-	-	-	*3.5*
Volatile Organic Compounds				
VOC conc. (ppmv C3)	15.9	15.6	15.9	15.8
VOC emissions (lb/hr)	0.52	0.51	0.53	0.52
VOC emissions (g/bhp*hr)	0.11	0.10	0.11	0.11
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*

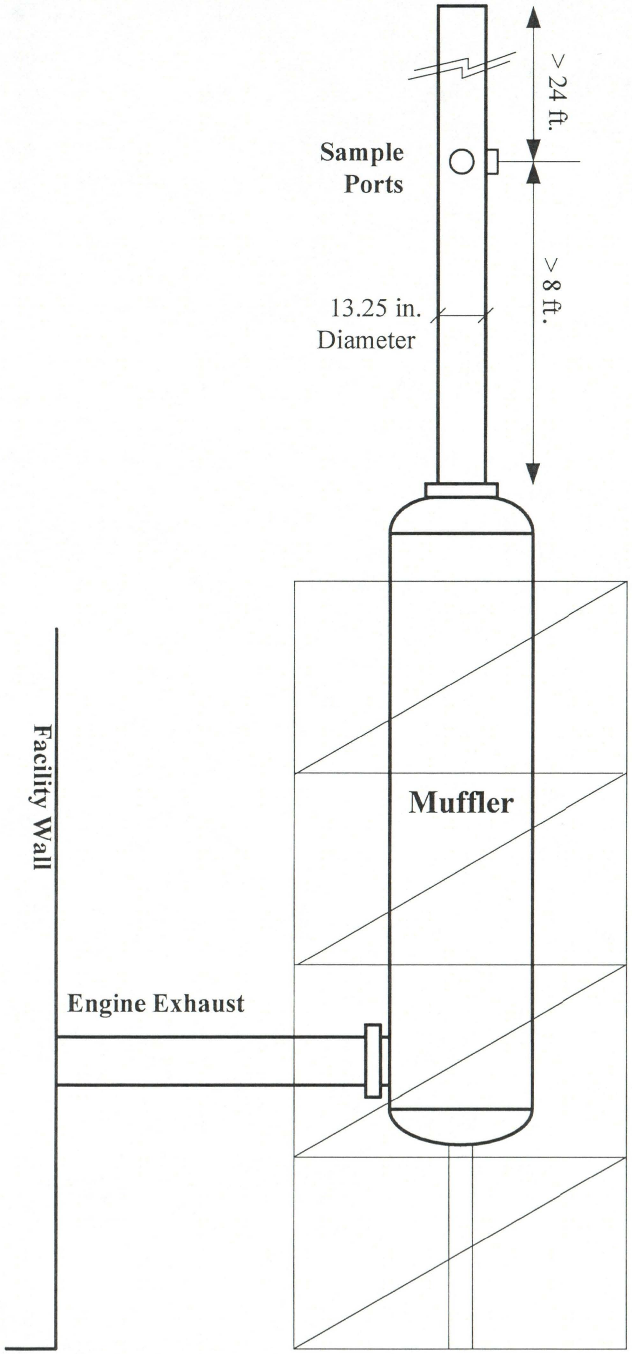
APPENDIX 1

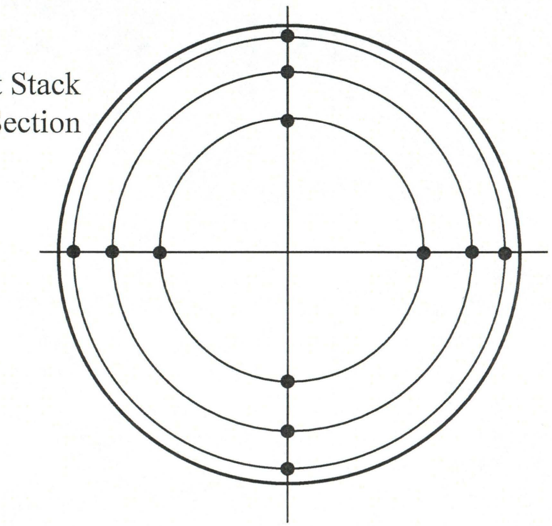
- Figures 1-A & 1-B – Sampling Train Diagrams
- Figure 1-C – IC Engines Nos. 1 & 2 Exhaust Sample Locations



Instrumental Analyzer Sample Train Diagram		
Scale None	Sheet 1 of 1	IMPACT COMPLIANCE & TESTING


Tygon (R)
Connective Tubing
Non-Heated Steel
Sample Probe
T
1
2
3
4
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
ΔH
Vacuum Line
Bypass
Valve
Main
Valve
V
T
T
Exhaust
Orifice
Dry Gas
Meter
Air-Tight
Pump
Sampling and
Metering Console
USEPA Method 4 Sample Train
Scale
None
Sheet
1 of 1





Velocity sample locations as measured from stack wall

Pt. #	in.
1	0.58
2	1.93
3	3.92
4	9.33
5	11.32
6	12.67

11/25/14	EDL - Watervliet Exhaust Sample Location, CAT G3520 RICE		
	Scale None	Sheet 1 of 1	IMPACT COMPLIANCE & TESTING