EMISSIONS TEST REPORT

for

OXIDES OF NITROGEN (NO_X), CARBON MONOXIDE (CO), AND VOLATILE ORGANIC COMPOUNDS (VOC)

Willow Run Compressor Station – EUEMGRICE1

DTE GAS

WILLOW RUN COMPRESSOR STATION
Ypsilanti, Michigan

May 1, 2019

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EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group performed emissions testing at the DTE Gas Willow Run Compressor Station located in Ypsilanti, Michigan. The fieldwork was performed on May 1, 2019, to satisfy requirements of the Michigan Department of Environment, Great Lakes and Energy (EGLE) Permit to Install (PTI) No. 44-16A and 40CFR Part 60 Subpart JJJJ. Emissions tests were performed on the emergency generator (EUEMGRICE1) for oxides of nitrogen (NO_x), carbon monoxide (CO), and volatile organic compounds (VOC).

The results of the emissions testing are highlighted below:

Emissions Testing Summary – Emergency Generator
Willow Run Compressor Station
Ypsilanti, MI
May 1, 2019

	Oxides of Nitrogen (ppmvd @ 15% O_2)	Oxides of Nitrogen (lb/hr)	Carbon Monoxide (ppmvd @ 15% O_2)	Volatile Organic Compounds (ppmvd @ 15% O_2)
EUEMGRICE1	29.5	0.35	163.6	ND
Permit Limit	160	2.0	540	86

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1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group performed emissions testing at the DTE Gas Willow Run Compressor Station located in Ypsilanti, Michigan. The fieldwork was performed on May 1, 2019, to satisfy requirements of the Michigan Department of Environment, Great Lakes and Energy (EGLE) Permit to Install (PTI) No. 44-16A and 40CFR Part 60 Subpart JJJJ. Emissions tests were performed on the emergency generator (EUEMGRICE1) for oxides of nitrogen (NO_x), carbon monoxide (CO), and volatile organic compounds (VOC).

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 3A, 19, 25A, and ASTM D6348.

The fieldwork was performed in accordance with EPA Reference Methods, ASTM Methods and EM&R's Intent to Test[1], which was approved by EGLE[2]. The following EM&R personnel participated in the testing program: Mr. Jason Logan, Environmental Specialist, Mr. Mark Grigereit, Principal Engineer, and Mr. Thomas Snyder, Environmental Specialist. Mr. Logan was the project leader.

2.0 SOURCE DESCRIPTION

The Willow Run Compressor Station located at 3020 East Michigan Avenue, Ypsilanti, Michigan, employs the use of one natural gas-fired 1,818 horsepower (hp) emergency generator (EUEMGRICE1) nominally rated at 1,300 electrical kilowatts (ekW). The emergency generator is used to provide electrical power to the facility in the case of a power outage.

Emissions are routed through a vertical stack (SVEMGRICE1) and exhausted directly to the atmosphere. The engine was operated at greater than 90% of the maximum load (>1170 kW) during the testing.

A schematic representation of the engine exhaust and sampling location is presented in Figure 1.

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[1] DTE Test Plan, Submitted March 28, 2019. (Attached-Appendix A)

[2] EGLE, Acceptance Letter, April 4, 2019. (Attached-Appendix A)

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3.0 SAMPLING AND ANALYTICAL PROCEDURES

DTE Energy obtained emissions measurements in accordance with procedures specified in the USEPA *Standards of Performance for New Stationary Sources*. The sampling and analytical methods used in the testing program are indicated in the table below

Sampling Method	Parameter	Analysis
USEPA Method 3A	O_2	Paramagnetic Analyzer
USEPA Method 19	Mass Emissions Calculations	Heat Input
USEPA Method 25A	Total Hydrocarbons	FID
ASTM D6348	Methane, Ethane, NO_X, CO, and Moisture	FTIR

3.1 OXYGEN (USEPA METHOD 3A)

3.1.1 Sampling Method

Oxygen (O_2) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)" and ASTM D6348. O_2 was analyzed by instrumentation with paramagnetic sensors. Exhaust from the FTIR was used as the sample for the O_2 instrument.

The EPA Method 3A sampling system (Figure 3) consisted of the following:

(1) Single-point sampling probe
(2) Flexible heated PTFE sampling line
(3) Air Dimensions Heated Head Diaphragm Pump
(4) MKS MultiGas 2030 FTIR spectrometer
(5) Servomex 1400 analyzer
(6) Appropriate calibration gases
(7) Data Acquisition System

3.1.2 Sampling Train Calibration

The O_2 analyzer was calibrated according to procedures outlined in USEPA Methods 3A. Zero, span, and mid-range calibration gases were introduced directly into the instruments to verify linearity. A zero and mid-range gas for each diluent was then introduced through the entire sampling system to determine sampling system bias for each analyzer at the completion of each test.

3.1.3 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in Methods 3A. Calibration gases were EPA Protocol 1 gases and the concentrations were within the acceptable ranges specified in Method 7E.

Calibration gas certification sheets are located in Appendix C.

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3.1.4 Data Reduction

O_2 data collected during the emissions testing was recorded at 10-second intervals and averaged in 1-minute increments. O_2 emissions were recorded in percent (%) by volume on a dry basis.

Raw CEM data is located in Appendix B.

3.2 MASS EMISSIONS (USEPA METHOD 19)

3.2.1 Sampling Method

Pollutant mass emissions were calculated using procedures used in USEPA Method 19. Fuel flow (scf) was recorded during each test period and reduced to 100 scf/hr. The facility provided fuel heat content (btu/scf) at the start of the test day.

Sample emissions calculations are located in Appendix E.
Process data is located in Appendix F.

3.3 TOTAL HYDROCARBON COMPOUNDS (USEPA METHOD 25A)

3.3.1 Sampling Method

Total hydrocarbon compound (THC) emissions were evaluated using USEPA Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer". The THC analyzer utilizes a flame ionization detector (FID). The FID measures total hydrocarbon compounds (including Methane and Ethane). Triplicate 60-minute tests were performed on the engine exhaust.

The Method 25A sampling system (Figure 2) consisted of the following:

(1) Single-point sampling probe
(2) Heated PTFE sampling line
(3) JUM 109A® Total Hydrocarbon gas analyzer
(4) Appropriate USEPA Protocol 1 calibration gasses
(5) Data Acquisition System

3.3.2 Sampling Train Calibration

In accordance with USEPA Method 25A, a 4-point (zero, low, mid, and high) calibration check was performed on the THC analyzer. The analyzer was calibrated
with propane in the 0-1,000 ppm range. Calibration drift checks were performed at the completion of each run.

3.3.3 Quality Control and Assurance

The THC sampling equipment was calibrated with propane (C_3H_8) per the guidelines referenced in Methods 25A. Calibration gases were EPA Protocol 1 gases and the concentrations were within the acceptable ranges (25-35% low range, 45-55% mid-range and 80-90% of span).
Calibration gas certification sheets are located in Appendix C.

3.3.4 Data Reduction

Data collected during the emissions testing was recorded at 10-second intervals and averaged in 1-minute increments. The THC emissions were recorded in parts per million (ppm) as propane (C_3H_8). The 1-minute readings collected are in Appendix B.

THC concentrations were converted from wet to dry, then adjusted to 15% oxygen. Methane and ethane concentrations (by FTIR, Section 3.4) were also converted to ppmvd at 15% oxygen. The dry, adjusted

methane and ethane concentrations were subtracted from the dry, adjusted THC concentration to calculate VOC concentration for comparison to the NSPS emission limits.

3.4 OXIDES of NITROGEN, CARBON MONOXIDE, METHANE, ETHANE (ASTM METHOD D6348)

3.4.1 Sampling Method

Oxides of Nitrogen, Carbon Monoxide, Methane, and Ethane emissions were evaluated using ASTM Method D6348, "Measurement of Vapor Phase Organic Emissions by Extractive Fourier Transform Infrared (FTIR)". Triplicate 60-minute test runs were performed.

The ASTM D6348 sampling system (Figure 3) consisted of the following:

1) Single-point sampling probe
2) Flexible heated PTFE sampling line
3) Air Dimensions Heated Head Diaphragm Pump
4) MKS MultiGas 2030 FTIR spectrometer
5) Appropriate calibration gases
6) Data Acquisition System

The FTIR was equipped with a temperature controlled, 5.11 meter multipass gas cell maintained at 191°C. Gas flows and sampling system pressures were monitored using a rotometer and pressure transducer. All data was collected at 0.5 cm^{-1} resolution.

3.4.2 Sampling Train Calibration

The FTIR was calibrated per procedures outlined in ASTM Method D6348. Direct measurements of nitrogen, oxides of nitrogen (NO_x), carbon monoxide (CO), propane (C_3H_8), and ethylene (C_2H_4) gas standards were made at the test location to confirm concentrations.

A calibration transfer standard (CTS) was analyzed before and after testing at each location. The concentration determined for all CTS runs were within ±5% of the certified value of the standard. Ethylene was passed through the entire system to determine the sampling system response time and to ensure that the entire sampling system was leak-free.

Nitrogen was purged through the sampling system at each test location to confirm the system was free of contaminants.

NO_x, CO, and C_3H_8 gas standards were passed through the sampling system at each test location to determine the response time and confirm recovery.

NO_x, CO, and C_3H_8 spiking was performed to verify the ability of the sampling system to quantitatively deliver a sample containing NO_x, CO, and C_3H_8 from the base of the probe to the FTIR. Analyte spiking assures the ability of the FTIR to quantify NO_x, CO, and C_3H_8 in the presence of effluent gas.

As part of the spiking procedure, samples from each engine were measured to determine NO_x, CO, and C_3H_8 concentrations to be used in the spike recovery calculations. The determined sulfur hexafluoride (SF_6) concentration in the spiked and unspiked samples was used to calculate the dilution factor of the spike and thus used to calculate the concentration of the spiked NO_x, CO, and C_3H_8. The following equation illustrates the percent recovery calculation.

$$DF = \frac{SF_{6(spike)}}{SF_{6(direct)}}$$

(Sec. 9.2.3 (3) ASTM Method D6348)

$$CS = DF * Spike_{dir} + Unspike(1 - DF)$$

(Sec. 9.2.3 (4) ASTM Method D6348)

DF = Dilution factor of the spike gas
SF_6(direct) = SF6 concentration measured directly in undiluted spike gas
SF_6(spike) = Diluted SF_6 concentration measured in a spiked sample
Spikedir = Concentration of the analyte in the spike standard measured by the FTIR directly
CS = Expected concentration of the spiked samples
Unspike = Native concentration of analytes in unspiked samples

All analyte spikes were introduced using an instrument grade stainless steel rotometer. The spike target dilution ratio was 1:10 or less. All NO_x, CO, and C_3H_8 spike recoveries were within the ASTM D6348 allowance of ±30%.

3.4.3 Quality Control and Assurance

As part of the data validation procedure, reference spectra are manually fit to that of the sample spectra and a concentration is determined. The reference spectra are scaled to match the peak amplitude of the sample, thus providing a scale factor. The scale factor multiplied by the reference spectra concentration is used to determine the concentration value for the sample spectra. Sample pressure and temperature corrections are then applied to compute the final sample concentration. The manually calculated results are then compared with the software-generated results. The data is then validated if the two concentrations are within ± 5% agreement. If there is a difference greater than ± 5%, the spectra are reviewed for possible spectral interferences or any other possible causes that might lead to inaccurately quantified data. PRISM Analytical Technologies, Inc. validated the FTIR data.

Data validation reports are located in Appendix D.

3.4.4 Data Reduction

Each spectrum was derived from the coaddition of 64 scans, with a new data point generated approximately every one minute. The NO_x, CO, Methane, and Ethane emissions were recorded in parts per million (ppm) dry volume basis. The moisture content was recorded in percent (%). The FTIR data was validated by Prism Analytical Technologies, Inc.

Analytical results for ethane and methane are located in Appendix D.

4.0 OPERATING PARAMETERS

The test program included the collection of generator load (kW), fuel flow (scf) and fuel BTU content.

Operational data is located in Appendix F.

5.0 DISCUSSION OF RESULTS

Table No. 1 presents the emission testing results from EUEMGRICE1 while operating at greater than 90% of full load conditions. Additional test data presented for each test includes the engine load in percentage (%), heat input

(MMBtu/hr), and emissions (ppm). EUEMGRICE1 demonstrated compliance with NO_X, CO, and VOC emission limits as stated in Permit to Install No. 44-16A and the NSPS (40 CFR Part 60 Subpart JJJJ).

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6.0 CERTIFICATION STATEMENT

"I certify that I believe the information provided in this document is true, accurate, and complete. Results of testing are based on the good faith application of sound professional judgment, using techniques, factors, or standards approved by the Local, State, or Federal Governing body, or generally accepted in the trade."

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RESULTS TABLE

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TABLE NO. 1
EMISSIONS TEST RESULTS
DTE Gas - Willow Run Compressor Station
EUEMGRICE1
May 1, 2019

Test	Test Time	Unit Load (%)	O_2 Content (%, dry)[1]	NOx Concentration (ppmvd)	NOx Concentration (ppmvd @ 15% O_2)	NOx Emission Rate (lb/hr)	CO Concentration (ppmvd)	CO Concentration (ppmvd @ 15% O_2)	Methane Concentration (ppmvd @ 15% O_2)[2]	Ethane Concentration (ppmvd @ 15% O_2)[2]	THC Concentration (ppmvd @ 15% O_2)[2]	VOC Concentration (ppmvd @ 15% O_2)[2]
1	8:15-9:15	99%	9.5	56.9	29.6	0.35	309.7	160.9	190.3	18.7	179.7	-29.3
2	9:31-10:31	99%	9.6	56.8	29.5	0.36	313.3	163.0	194.0	19.0	189.6	-23.4
3	10:44-11:44	99%	9.5	56.9	29.5	0.35	321.6	166.9	195.8	19.2	196.0	-19.0
	Average:	99%	9.5	56.9	29.5	0.35	314.9	163.6	193.4	19.0	188.4	-23.9
	Permit Limit :				***160***	***2.0***		***540***				***25***

[1]Corrected for analyzer drift as per USEPA Method 7E

[2]At a propane standard

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FIGURES

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Figure 1 – Sampling Location
EUEMGRICE1
Willow Run Compressor Station
May 1, 2019

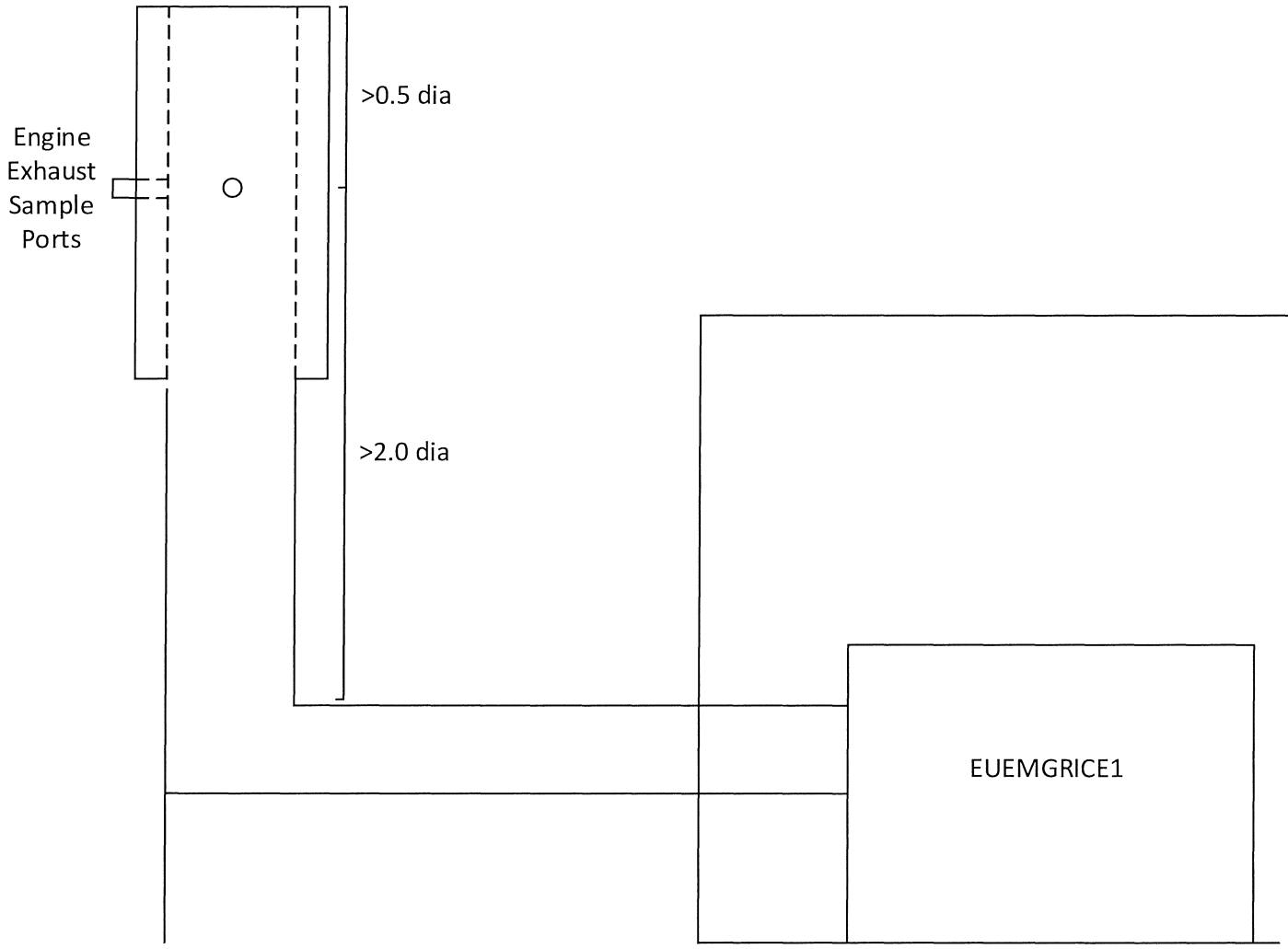

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Figure 2 – EPA Method 25A
EUEMGRICE1
Willow Run Compressor Station
May 1, 2019

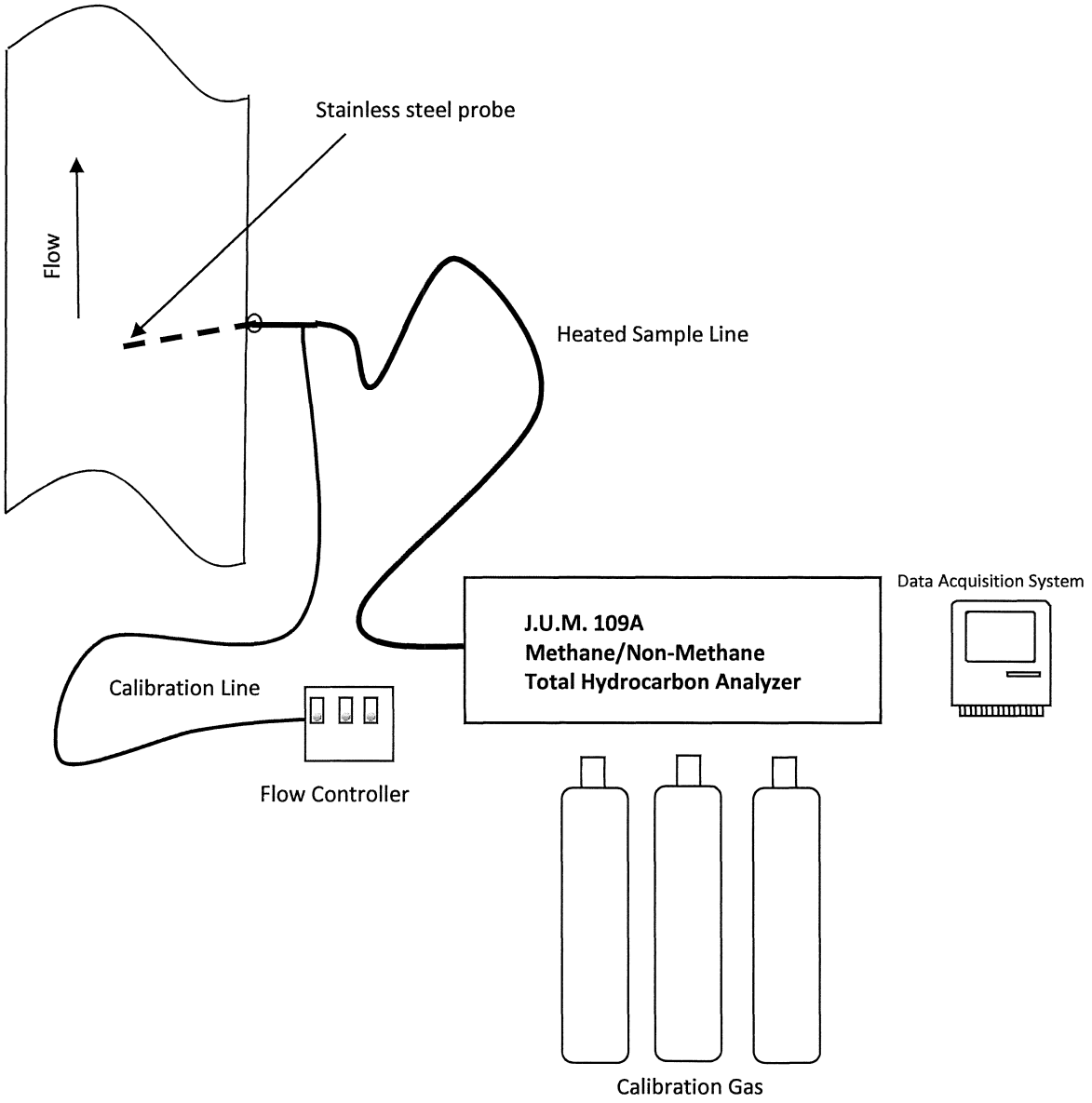

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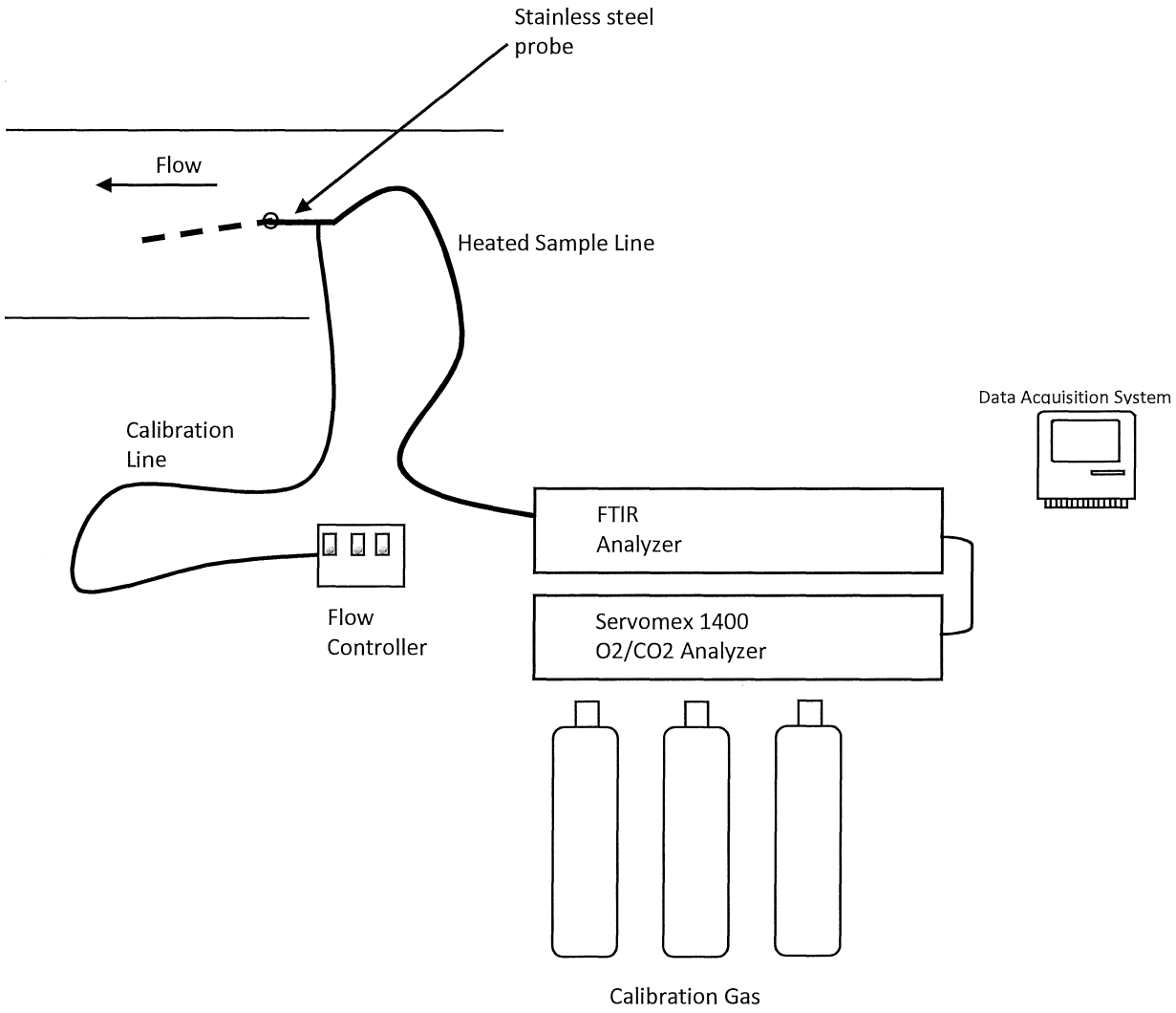
Figure 3 – ASTM D6348/3A
EUEMGRICE1
Willow Run Compressor Station
May 1, 2019



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APPENDIX A

EGLE TEST PLAN