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EMISSIONS TEST REPORT

for

OXIDES OF NITROGEN (NO_X), CARBON MONOXIDE (CO), AND NON-METHANE NON-ETHANE ORGANIC COMPOUNDS (NMNEOC)

Milford Compressor Station – EMERGENCY GENERATOR

DTE GAS

MILFORD COMPRESSOR STATION
Milford, Michigan

September 26, 2018

Prepared By
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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 Milford Compressor Station located in Milford, Michigan. The fieldwork was performed on September 26, 2018, to satisfy requirements of the Michigan Department of Environmental Quality (MDEQ) Permit to Install (PTI) No. 185-15A and 40CFR Part 60 Subpart JJJJ. Emissions tests were performed on the emergency generator (EUN EM GEN) for oxides of nitrogen (NO_x), carbon monoxide (CO), and non-methane non-ethane organic compounds (NMEOC).

The results of the emissions testing are highlighted below:

Emissions Testing Summary – Emergency Generator
Milford Compressor Station
Milford, MI
September 26, 2018

	Oxides of Nitrogen (ppmvd @ 15% O_2)	Oxides of Nitrogen (lb/hr)	Carbon Monoxide (ppmvd @ 15% O_2)	Carbon Monoxide (lb/hr)	NMNE Organic Compounds (ppmvd @ 15% O_2)
EUN EM GEN	69.3	0.86	242	1.91	ND
Permit Limit	160	4.0	540	11.0	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 Milford Compressor Station located in Milford, Michigan. The fieldwork was performed on September 26, 2018, to satisfy requirements of the Michigan Department of Environmental Quality (MDEQ) Permit to Install (PTI) No. 185-15A and 40CFR Part 60 Subpart JJJJ. Emissions tests were performed on the emergency generator (EUN EM GEN) for oxides of nitrogen (NO_x), carbon monoxide (CO), and non-methane non-ethane organic compounds (NMEOC).

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 3A, 4, 7E, 10, 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 the Michigan Department of Environmental Quality (MDEQ)[2]. The following EM&R personnel participated in the testing program: Mr. Jason Logan, Environmental Specialist, Mr. Mark Westerberg, Senior Environmental Specialist, and Mr. Steven Anderson, Environmental Specialist. Mr. Logan was the project leader.

Ms. Chris Conley, DTE Gas, provided on-site support of the testing. Ms. Regina Hines, MDEQ, reviewed the test plan and observed portions of the testing.

2.0 SOURCE DESCRIPTION

The Milford Compressor Station located at 3515 Childs Lake Road, Milford, Michigan, employs the use of one natural gas-fired 1,818 horsepower (hp) emergency generator (EUN EM GEN) 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.

The emissions from the emergency generator exhaust directly to the atmosphere through a vertical exhaust stacks. The engine was operated at greater than 90% of the maximum load during the testing.

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

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[1] MDEQ, Test Plan, Submitted August 17, 2018. (Attached-Appendix A)

[2] MDEQ, Acceptance Letter, September 11, 2018. (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	CO_2 and O_2	Paramagnetic Analyzer
USEPA Method 4	Moisture Content	Weight Gain in Chilled Impingers
USEPA Method 7E	Nitrogen Oxides	Chemiluminescent Analyzer
USEPA Method 10	Carbon Monoxide	NDIR Analyzer
USEPA Method 19	Mass Emissions Calculations	Heat Input
USEPA Method 25A	Total Hydrocarbons	FID
ASTM D6348	Methane and Ethane	FTIR

3.1 MOISTURE (USEPA METHOD 4)

3.1.1 Sampling Method

Determination of the moisture content of the exhaust gas was performed using USEPA Method 4, "Determination of Moisture Content in Stack Gases". The moisture was collected in glass impingers, and the percentage of water was then derived from calculations outlined in USEPA Method 4. Thirty minute moisture tests were conducted in conjunction with each gaseous emissions test.

The EPA Method 4 sampling system consisted of the following:

(1) Stainless-steel sample probe (located in centroid of the exhaust stack)
(2) Unheated flexible line

(3) Set of four (4) Greenburg-Smith (GS) glass impingers:
   a. The first and second each containing 100 milliliters (mL) of water
   b. The third impinger dry
   c. The fourth impinger containing approximately 300 grams of silica gel desiccant
(4) Environmental Supply® control case equipped with a pump, dry gas meter, and calibrated orifice

Upon completion of each test, the impinger volumes were measured to determine moisture content of the gas stream using the calculations found in USEPA Method 4. After measuring and recording the liquid volumes, the solution was discarded.

Field data sheets for the Method 4 are located in Appendix B.

3.1.2 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in EPA Method 5. Calibration data is provided in Appendix C.

3.2 CARBON DIOXIDE AND OXYGEN (USEPA METHOD 3A)

3.2.1 Sampling Method

Oxygen (O_2) and Carbon Dioxide (CO_2) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)". The analyzers utilize paramagnetic sensors. Testing was performed simultaneously with the gaseous emissions testing.

The EPA Method 3A sampling system (Figure 2) consisted of the following:

(1) Single-point sampling probe (traversed across the exhaust stack)
(2) Heated PTFE sampling line
(3) MAK® gas conditioner with particulate filter
(4) Flexible unheated PTFE sampling line
(5) Servomex 1400 O_2/CO_2 gas analyzer
(6) Appropriate USEPA Protocol 1 calibration gases
(7) Data Acquisition System

3.2.2 Sampling Train Calibration

The O_2 and CO_2 analyzers were calibrated according to procedures outlined in USEPA Methods 3A and 7E. Zero, span, and mid-range calibration gases were introduced directly into the analyzer to verify the instruments 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.

3.2.3 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in Methods 3A and 7E. Calibration gases were EPA Protocol 1 gases and the concentrations were within the acceptable ranges (40-60% mid-range and span) specified in Method 7E. Calibration gas certification sheets are located in Appendix C.

3.2.4 Data Reduction

Data collected during the emissions testing was recorded at 10-second intervals and averaged in 1-minute increments. The O_2/CO_2 emissions were recorded in percent (%). The 1-minute readings collected during the testing are located in Appendix B.

3.3 NITROGEN OXIDES AND CARBON MONOXIDE (USEPA METHODS 7E AND 10)

3.3.1 Sampling Method

Nitrogen oxide (NO_x) emissions were evaluated using USEPA Method 7E, "Determination of Oxides of Nitrogen Emissions from Stationary Sources". The NO_x analyzer utilizes a chemiluminescent detector. Carbon monoxide (CO) emissions were evaluated using USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources". The CO analyzer utilizes a non-dispersive infrared (NDIR) detector. Triplicate 60-minute tests were performed on each engine exhaust.

The EPA Methods 7E and 10 sampling system (Figure 2) consisted of the following:

(1) Stainless-steel sample probe (traversed across the exhaust stack)
(2) Heated PTFE sampling line
(3) MAK® gas conditioner with particulate filter
(4) Flexible unheated PTFE sampling line
(5) TECO 42i Chemilumenecent NO/NO_x gas analyzer, and TECO 48i NDIR CO gas analyzer
(6) Appropriate USEPA Protocol 1 calibration gases
(7) Data Acquisition System.

3.3.2 Sampling Train Calibration

The NO_x / CO sampling train was calibrated according to procedures outlined in USEPA Method 7E and 10. Zero, span, and mid-range calibration gases were introduced directly into each analyzer to verify the instruments linearity. A zero and mid-range gas for each pollutant was then introduced through the entire sampling system to determine sampling system bias for each analyzer at the completion of each test.

3.3.3 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in Methods 7E and 10. Calibration gases were EPA Protocol 1 gases and the concentrations were within the acceptable ranges (40-60% mid-range and span) specified in Method 7E. Calibration gas certification sheets are located in Appendix C.

DTE performed a NO_x converter efficiency test by directly challenging the NO_x analyzer with a nitrogen dioxide (NO_2) calibration gas of 50.6 ppm. The instrument measured 46.9 ppm, or 92.7% of 50.6, which satisfies the conversion efficiency requirement in USEPA Method 7E.

3.3.4 Data Reduction

Data collected during the emissions testing was recorded at 10-second intervals and averaged in 1-minute increments. The NO_x and CO emissions were recorded in parts per million, dry (ppmvd). The 1-minute readings collected are located in Appendix B.

Emissions calculations, based on calculations located in USEPA Methods 7E, 10, and 19, are located in Appendix E. The NO_x and CO emissions data collected during the testing was reduced to parts per million corrected to 15% oxygen on a dry basis (ppmvd @ 15% O_2) and pounds per hour (lb/hr).

3.4 MASS EMISSIONS (USEPA METHOD 19)

3.4.1 Sampling Method

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

Sample emissions calculations are presented in Appendix E.

3.5 TOTAL HYDROCARBON COMPOUNDS (USEPA METHOD 25A)

3.5.1 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 3) 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

3.5.2 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.

3.5.3 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 in Appendix C.

3.5.4 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 3.7) were also converted from wet to dry at a propane standard, then adjusted to 15% oxygen. The dry, adjusted methane and ethane concentrations were subtracted from the dry, adjusted THC concentration to calculate NMNEOC concentration for comparison to the NSPS emission limits.

3.6 METHANE AND ETHANE CONCENTRATION (ASTM METHOD D6348)

3.6.1 Sampling Method

Methane and ethane emissions were evaluated using a modified ASTM Method D6348, "Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy". DTE personnel collected exhaust gas in a 10-liter Tedlar™ bag, which was then analyzed at an off-site laboratory via FTIR. Samples were collected simultaneously with the Total Hydrocarbon (Method 25A) sampling.

The vacuum pump flowrate was set to allow for a constant rate, integrated sample, collected for the duration of each test run.

The sampling system followed the procedures specified in Method 18 Section 8.2.1, Integrated Bag Sampling & Analysis.

The sampling system (Figure 5) consisted of the following:

(1) Stainless Steel Probe
(2) PTFE sampling line
(2) Sampling lung with 10-liter Tedlar™ bag
(3) Vacuum pump with regulator.

3.6.2 Sampling Train Calibration

The FTIR was calibrated according to procedures outlined in ASTM Method D6348. Nitrogen, propane, methane, and ethylene gas standards were injected pre and post sample analysis to confirm concentrations.

3.6.3 Data Reduction

Results from the methane sampling were used to determine the non-methane organic compound concentration from the source. Methane emissions were subtracted from total organic compound emissions (as determined by Method 25A).

The methane and ethane were converted dry, at a propane standard, in order to subtract from the THC measured in the field. Units were reduced to NMNEOC ppmvd at 15% O_2 for comparison to the NSPS emission standard.

Analytical results for ethane and methane can be found in Appendix D.

4.0 OPERATING PARAMETERS

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

Operational data is presented in Appendix F.

5.0 DISCUSSION OF RESULTS

Table No. 1 presents the emission testing results from EUN EM GEN while operating at greater than 90% of full load conditions. The NO_X and CO emissions are reduced to lb/hr and ppmvd at 15% O_2. NMOC emissions are reduced to ppmvd, as propane, at 15% O_2. Additional test

data presented for each test includes the engine load in percentage (%), heat input (MMBtu/hr), and emissions (ppm). EUN EM GEN demonstrated compliance with NO_X, CO, and NMOC emission limits as stated in Michigan Permit to Install No. 185-15A 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."

Jason Logan, QSTI

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Emissions Testing Results
EUN EM GEN
DTE Gas, Milford Compressor Station
Milford, MI

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Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	09/26/18	09/26/18	09/26/18	
Sampling Start Time	9:30-10:30	10:55-11:55	12:08-13:08	
Gross Dry BTU	1063	1063	1063	1,063
Electrical Output (kW)	1212	1212	1212	1,212
Load (%)	93%	93%	93%	93%
Fuel Flow (100 scf/hr)	33.1	33.4	33.1	33.2
Heat Input Rate (MMBtu/Hr)	3.5	3.6	3.5	3.5
Average O_2 Content (%, dry)	9.0	9.0	9.1	9.0
Average O_2 Content (%, dry, corrected)[1]	9.0	9.1	9.1	9.1
Moisture Content (%)	4.5	7.6	14.8	9.0
Average CO Concentration (ppmvd)	485.8	491.2	483.5	486.9
Average CO Concentration (ppmvd, corrected)[1]	484.5	489.9	482.9	485.8
Average CO Concentration (ppmvd, at 15% O2)	**240.9**	**244.4**	**241.4**	**242.2**
Permit Limit (ppmvd, at 15% O2)				**540**
Average CO Concentration (lb/MMBtu)	0.54	0.55	0.54	0.54
Average CO Emission Rate (lb/hr)	**1.90**	**1.94**	**1.90**	**1.91**
Permit Limit (lb/hr)				**11.0**
Average NO_x Concentration (ppmvd)	134.5	134.6	132.4	133.9
Average NO_x Concentration (ppmvd, corrected)[1]	138.9	139.7	138.2	138.9
Average NO_x Concentration (ppmvd, @ 15% O2)	**69.0**	**69.7**	**69.1**	**69.3**
Permit Limit (ppmvd, at 15% O2)				**160**
Average NO_x Concentration (lb/MMBtu)	0.24	0.25	0.24	0.24
Average NO_x Emission Rate (lb/hr)	**0.86**	**0.87**	**0.86**	**0.86**
Permit Limit (lb/hr)				**4.0**
THC Concentration (ppmv, as propane)	243.5	262.2	265.3	257.0
THC Concentration (ppmv, as propane corrected)[1]	239.4	261.4	262.5	254.4
THC Concentration (ppmv, as propane) (dry)	228.7	241.4	223.6	231.2
THC Concentration (ppmvd, as propane, @ 15% O2)	113.7	120.5	111.7	115.3
Methane Concentration (ppmv) (wet)	845.1	889.6	862.3	865.7
Methane Concentration (ppmv) (dry)	807.4	821.7	734.4	787.8
Methane Concentration (ppmvd, as propane)	269.1	273.9	244.8	262.6
Methane Concentration (ppmvd, as propane, @ 15% O2)	133.8	136.7	122.4	130.9
Ethane Concentration (ppmv) (wet)	29.9	30.2	29.7	29.9
Ethane Concentration (ppmv) (dry)	28.6	27.9	25.3	27.3
Ethane Concentration (ppmvd, as propane)	19.0	18.6	16.9	18.2
Ethane Concentration (ppmvd, as propane, @ 15% O2)	9.47	9.28	8.43	9.1
NMNEOC (ppmvd, as propane, @ 15% O2)	**-29.6**	**-25.5**	**-19.1**	**-24.7**
Permit Limit (ppmvd, as propane, @ 15% O2)				**86**

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

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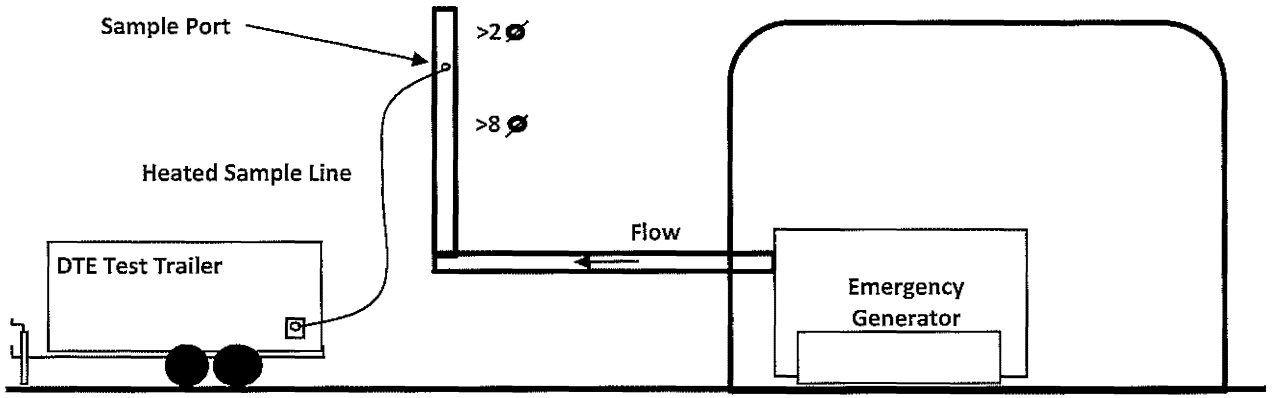
Figure 1 – Sample Location
Milford Compressor Station – Emergency Generator
September 26, 2018



Stack Diameter 17.25"

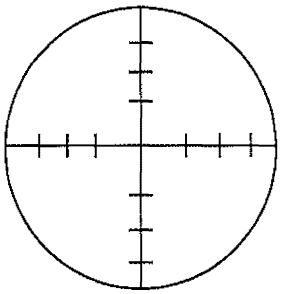


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Figure 2 – USEPA Method 3A/7E/10 Sampling Train
Milford Compressor Station
Emergency Generator
September 26, 2018

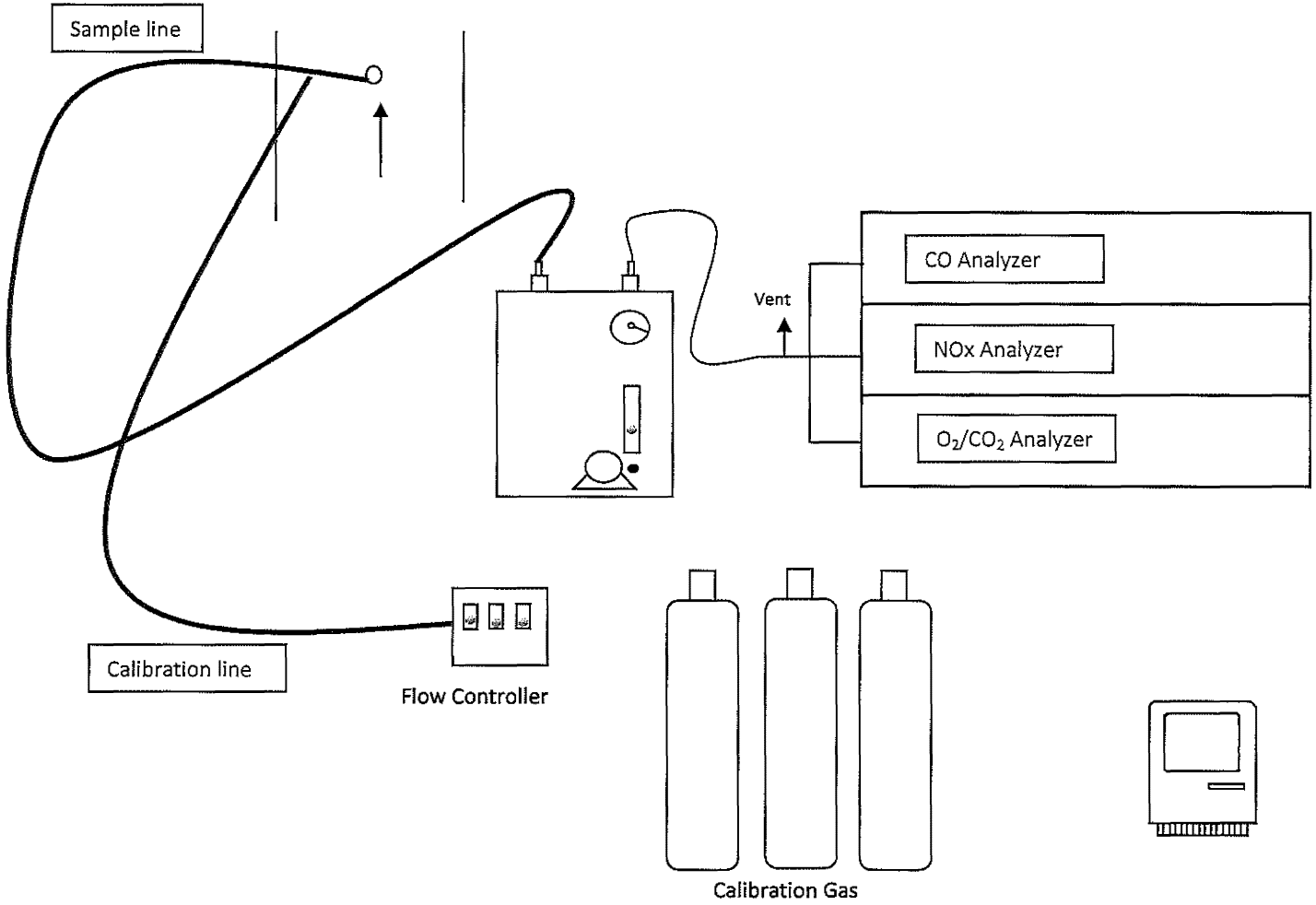

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Figure 3 – USEPA Method 25A Sampling Train
Milford Compressor Station
Emergency Generator
September 26, 2018

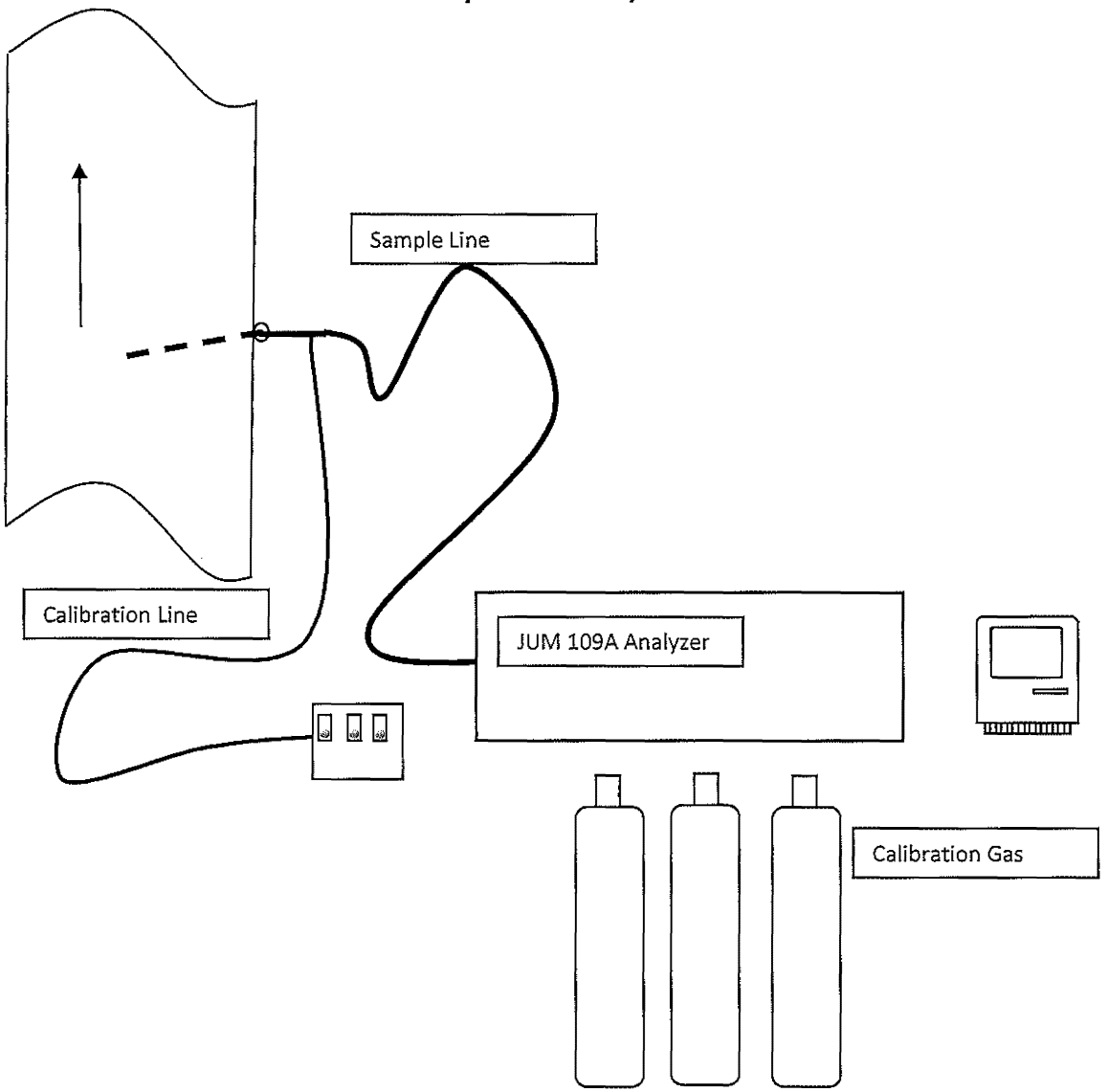

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Figure 4 – USEPA Method 4 Moisture Train
Milford Compressor Station
Emergency Generator
September 26, 2018

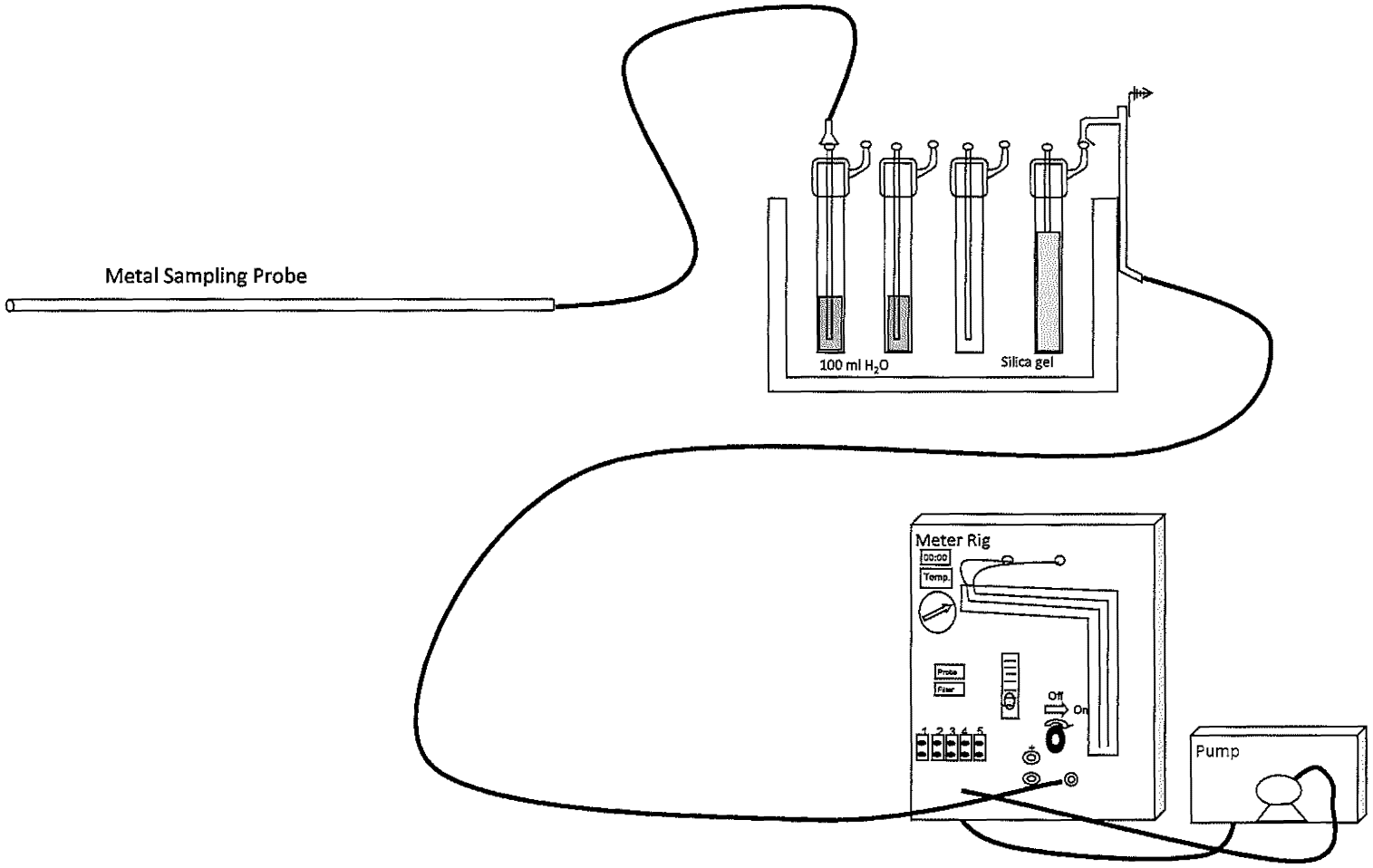

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Figure 5 – USEPA Method 18 Sampling Bags
Milford Compressor Station
Emergency Generator
September 26, 2018