

COMPLIANCE TEST REPORT

for

CARBON MONOXIDE EMISSIONS (CO)

UNITS 11-1 to 11-5

SRN: B2804

**Wilmot Substation
Kingston Twp., Michigan**

November 26-29, 2018

**Prepared By
Environmental Management & Resources
Environmental Field Services Group
DTE Corporate Services, LLC
7940 Livernois H-136
Detroit, MI 48210**

DTE Energy®





CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY	III
1.0 INTRODUCTION	1
2.0 SOURCE DESCRIPTION	1
3.0 SAMPLING AND ANALYTICAL PROCEDURES	2
3.1 OXYGEN AND CARBON MONOXIDE (USEPA METHODS 3A AND 10).....	2
3.1.1 Sampling Method.....	2
3.1.2 O ₂ and CO Sampling Train.....	2
3.1.3 Sampling Train Calibration	3
3.1.4 Sampling Duration & Frequency.....	3
3.1.5 Quality Control and Assurance (O ₂ and CO).....	3
3.1.6 Data Reduction.....	3
4.0 OPERATING PARAMETERS	3
5.0 RESULTS.....	4
6.0 CERTIFICATION STATEMENT	5

RESULTS TABLES

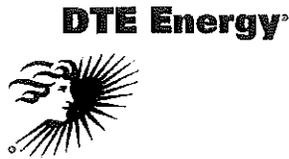
Table No. 1.....	Unit 11-1 Carbon Monoxide (CO) Emission Testing Results
Table No. 2.....	Unit 11-2 Carbon Monoxide (CO) Emission Testing Results
Table No. 3.....	Unit 11-3 Carbon Monoxide (CO) Emission Testing Results
Table No. 4.....	Unit 11-4 Carbon Monoxide (CO) Emission Testing Results
Table No. 5.....	Unit 11-5 Carbon Monoxide (CO) Emission Testing Results

FIGURES

- 1 Units 11-1 to 11-5 Stack Drawing & Sampling Location
- 2 USEPA Method 3A/10 Sampling Train

APPENDICES

- A MDEQ Test Plan
- B Analyzer Data
- C Equipment and Analyzer Calibration Data
- D Example Calculations
- E Operational Data



EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group, performed emissions testing on five (5) 3,600 Brake-HP diesel engines located at the Wilmot Substation in Kingston Twp, Michigan. The fieldwork, performed on November 26-29, 2018, was conducted to satisfy requirements of 40CFR Part 63 Subpart ZZZZ. Emission tests were performed on Units 11-1 to 11-5 to determine carbon monoxide (CO) emissions.

The results of the emissions testing are highlighted below:

CO Emissions Test Results Wilmot Substation November, 2018

Date	Unit	Average CO Outlet Concentration (ppm ¹)
11-26-18	11-1	17.4
11-27-18	11-2	21.1
11-27-18	11-3	19.1
11-29-18	11-4	14.6
11-28-18	11-5	17.3

Subpart ZZZZ Limit⁽¹⁾ Limit the concentration of CO in the stationary RICE exhaust to 23 ppmvd or less at 15% O₂; or Reduce CO emissions by 70% or more



1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group, performed emissions testing on five (5) 3,600 Brake-HP diesel engines located at the Wilmot Substation in Kingston Twp, Michigan. The fieldwork, performed on November 26-29, 2018 was conducted to satisfy requirements of 40CFR Part 63 Subpart ZZZZ. Emission tests were performed on Units 11-1 to 11-5 to determine carbon monoxide (CO) emissions.

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 3A and 10.

The fieldwork was performed in accordance with EPA Reference Methods, the requirements outlined in 40CFR Part 63 Subpart ZZZZ, and EM&R's Intent to Test¹, Test Plan Submittal, which was approved in a letter by Mr. Tom Gasloli from the Michigan Department of Environmental Quality (MDEQ), dated May 1, 2018. The following EM&R personnel participated in the testing program: Mr. Thomas Snyder, Environmental Specialist, Mr. Fred Meinecke, Senior Technician, and Mr. Mark Grigereit, Principal Engineer. Mr. Rahn Ledesma, Reliability Supervisor with DTE Electric, provided process coordination for the testing program. Mr. Tom Gasloli witnessed portions of the emissions testing.

2.0 SOURCE DESCRIPTION

The Wilmot Substation located at 5977 East Bevins Rd, Kingston Twp., Michigan, employs the use of five EM&D, MP45, 20 cylinder, 3,600 Horse Power diesel engines (Units 11-1 to 11-5). The engines generate supplemental electrical power during peak electrical demand periods or when required for load stability. On site diesel generators produce the electrical power supply which is sent to the electrical grid. Each unit is capable of producing approximately 2.5 GMW at full load conditions.

The emissions from the engines are exhausted through individual catalyst beds and to the atmosphere through individual exhaust stacks.

During the emissions testing the engines were operated at 100% load conditions (2.5 MW).

A schematic representation of the engines exhausts and sampling locations are presented in Figure 1. Sampling was performed in the duct prior to and downstream of the catalyst bed.

¹ MDEQ, Test Plan, Submitted April 24, 2018. (Attached-Appendix A)

² MDEQ, Approval Letter (Attached-Appendix A)



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	Oxygen	Instrumental Analyzer Method
USEPA Method 10	Carbon Monoxide	NDIR Instrumental Analyzer Method

3.1 OXYGEN AND CARBON MONOXIDE (USEPA METHODS 3A AND 10)

3.1.1 Sampling Method

Oxygen (O₂) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)". The O₂ analyzer utilizes a paramagnetic sensor.

Carbon monoxide (CO) emissions were evaluated using USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources". The CO analyzer utilizes a NDIR detector.

3.1.2 O₂ and CO Sampling Train

The EPA Methods 3A and 10 sampling systems at the inlet and outlet (Figure 2) consisted of the following components:

- (1) Single-point stainless steel sampling probe with a cindered filter.
- (2) Heated Teflon™ sampling line.
- (3) Universal® and MAK® gas conditioners with a particulate filter.
- (4) Flexible unheated Teflon™ sampling line.
- (5) Servomex 1400 O₂/CO₂ gas analyzer and TECO 48i NDIR CO gas analyzer.
- (6) USEPA Protocol 1 calibration gases.
- (7) Data Acquisition System.



3.1.3 Sampling Train Calibration

The O₂ / CO sampling trains were calibrated according to procedures outlined in USEPA Methods 3A & 10. Zero, span, and mid range calibration gases were introduced directly into the CO and O₂ analyzers to determine the instruments linearity. A zero and mid range span gas was then introduced through the entire sampling system to determine sampling system bias for each analyzer. Additional system calibrations were performed at the completion of each test.

3.1.4 Sampling Duration & Frequency

The emissions testing of each engine consisted of triplicate 60-minute samples at the inlet and exhaust of the catalyst. Stratification testing was conducted at three points across the diameter of the exhaust duct during the first run on each engine. Emissions testing of the first run demonstrated an absence of stratification (<1%), therefore a single centroid sampling point was selected. Sampling was performed simultaneously for O₂ and CO. Data was recorded as 1-minute averages.

3.1.5 Quality Control and Assurance (O₂ and CO)

All sampling and analytical equipment was calibrated per the guidelines referenced in Methods 3A 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.

3.1.6 Data Reduction

The O₂ and CO emission readings in percent (%) and parts per million (ppm) were recorded at 10-second intervals and averaged to 1-minute increments. The CO emissions were normalized to 15% O₂, and that number was used to determine CO % Emissions testing (DE) as required by 40CFR Part 63 Subpart ZZZZ. Emission calculations are based upon calculations found in USEPA Methods 3A, 7E, 10 and 19. Example calculations can be found in Appendix D.

The 1-minute O₂ and CO readings collected can be found in Appendix B.

4.0 OPERATING PARAMETERS

The test program included the collection of catalyst inlet temperature (°F), catalyst pressure drop ("H₂O), and crank case vacuum ("H₂O). Ambient temperature (°F), Relative Humidity (%), and Barometric Pressure (in) were also gathered from the closest weather station. Operational and atmospheric data collected during the testing is located in Appendix E.



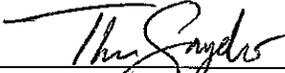
5.0 RESULTS

Tables 1-5 present the CO emissions @ 15% O₂ results from Units 11-1 to 11-5. The CO emissions are presented in parts per million (ppm) for the inlet and outlet and the emissions testing in percent (%). Also presented are the Oxygen inlet and outlet in percent (%), the catalyst inlet temperature in degrees Fahrenheit (°F), and pressure drop across the catalyst in inches of water ("H₂O). The results of the testing indicate that Units 11-1 to 11-5 comply with 40CFR Part 63 Subpart ZZZZ requirements of CO emissions less than 23 ppm @ 15% O₂.

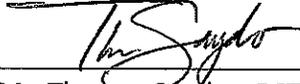


6.0 CERTIFICATION STATEMENT

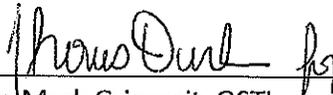
"I certify that I believe the information provided in this document is true, accurate, and complete. Results of testing are based on the good faith application of sound professional judgment, using techniques, factors, or standards approved by the Local, State, or Federal Governing body, or generally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



Thomas Snyder, QSTI

This report prepared by: 

Mr. Thomas Snyder, QSTI
Environmental Specialist, Field Services Group
Environmental Management and Resources
DTE Energy Corporate Services, LLC

This report reviewed by: 

Mr. Mark Grigereit, QSTI
Principal Engineer, Field Services Group
Environmental Management and Resources
DTE Energy Corporate Services, LLC

DTE Energy



RESULTS TABLES

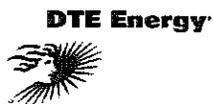


TABLE NO. 1
CARBON MONOXIDE (CO) EMISSION TESTING RESULTS
 Unit 11-1 Wilmot Substation
 November 26, 2018

Test	Time	Load (MW)	Catalyst Inlet Temperature (°F)	Catalyst Pressure Drop ($"H_2O$)	Oxygen ⁽¹⁾		CO Emissions @ 15% O ₂ ⁽¹⁾		Destruction Efficiency (%)
					Inlet (%)	Outlet (%)	Inlet (ppm)	Outlet (ppm)	
Run - 1	10:45-11:45	2.5	716	0.003	12.9	12.9	57.9	17.1	70.6
Run - 2	11:53-12:53	2.5	704	0.005	12.8	12.8	56.7	17.8	68.6
Run - 3	13:01-14:01	<u>2.5</u>	<u>673</u>	<u>0.005</u>	<u>12.8</u>	<u>12.8</u>	<u>55.1</u>	<u>17.4</u>	<u>68.3</u>
	Avg:	2.5	697	0.004	12.8	12.8	56.6	17.4	69.2

⁽¹⁾ Corrected for analyzer drift per USEPA method 7E

40CFR Part 63 Subpart ZZZZ Limit: limit exhaust CO to 23ppmvd @ 15% O₂ or; reduce CO Emissions by 70% or more

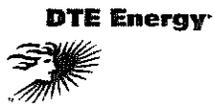


TABLE NO. 2
CARBON MONOXIDE (CO) EMISSION TESTING RESULTS
 Unit 11-2 Wilnot Substation
 November 27, 2018

Test	Time	Load (MW)	Catalyst Inlet Temperature (°F)	Catalyst Pressure Drop ($"H_2O$)	Oxygen ⁽¹⁾		CO Emissions @ 15% O ₂ ⁽¹⁾		Destruction Efficiency (%)
					Inlet (%)	Outlet (%)	Inlet (ppm)	Outlet (ppm)	
Run - 1	8:32-9:32	2.5	486	0.005	12.7	12.7	64.9	21.9	66.3
Run - 2	9:41-10:41	2.5	503	0.006	12.7	12.7	63.8	20.7	67.5
Run - 3	10:50-11:50	<u>2.5</u>	<u>528</u>	<u>0.006</u>	<u>13.0</u>	<u>12.7</u>	<u>63.9</u>	<u>20.5</u>	<u>67.8</u>
	Avg:	2.5	506	0.006	12.8	12.7	64.2	21.0	67.2

⁽¹⁾ Corrected for analyzer drift per USEPA method 7E

40CFR Part 63 Subpart ZZZZ Limit: limit exhaust CO to 23ppmvd @ 15% O₂ or; reduce CO Emissions by 70% or more



TABLE NO. 3
CARBON MONOXIDE (CO) EMISSION TESTING RESULTS
 Unit 11-3 Wilmot Substation
 November 27, 2018

Test	Time	Load (MW)	Catalyst Inlet Temperature (°F)	Catalyst Pressure Drop (¹ H ₂ O)	Oxygen ⁽¹⁾		CO Emissions @ 15% O ₂ ⁽¹⁾		Destruction Efficiency (%)
					Inlet (%)	Outlet (%)	Inlet (ppm)	Outlet (ppm)	
Run - 1	12:14-13:14	2.5	519	0.005	12.3	12.3	109.4	19.6	82.1
Run - 2	13:23-14:23	2.5	527	0.004	12.3	12.3	105.8	18.9	82.1
Run - 3	14:31-15:31	<u>2.5</u>	<u>555</u>	<u>0.005</u>	<u>12.3</u>	<u>12.3</u>	<u>104.7</u>	<u>18.9</u>	<u>82.0</u>
	Avg:	2.5	534	0.005	12.3	12.3	106.6	19.1	82.1

⁽¹⁾ Corrected for analyzer drift per USEPA method 7E

40CFR Part 63 Subpart ZZZZ Limit: limit exhaust CO to 23ppmvd @ 15% O₂ or; reduce CO Emissions by 70% or more

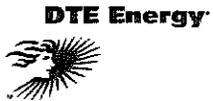


TABLE NO. 4
CARBON MONOXIDE (CO) EMISSION TESTING RESULTS
 Unit 11-4 Wilmot Substation
 November 29, 2018

Test	Time	Load (MW)	Catalyst Inlet Temperature (°F)	Catalyst Pressure Drop ($"H_2O$)	Oxygen ⁽¹⁾		CO Emissions @ 15% O ₂ ⁽¹⁾		Destruction Efficiency (%)
					Inlet (%)	Outlet (%)	Inlet (ppm)	Outlet (ppm)	
Run - 1	10:09-11:09	2.5	476	0.005	12.9	12.9	56.7	15.4	72.8
Run - 2	11:19-12:19	2.5	486	0.005	13.0	13.0	55.3	14.2	74.3
Run - 3	12:28-13:28	<u>2.5</u>	<u>500</u>	<u>0.005</u>	<u>12.9</u>	<u>13.0</u>	<u>55.5</u>	<u>14.1</u>	<u>74.7</u>
	Avg:	2.5	487	0.005	12.9	13.0	55.8	14.6	73.9

⁽¹⁾ Corrected for analyzer drift per USEPA method 7E

40CFR Part 63 Subpart ZZZZ Limit: limit exhaust CO to 23ppmvd @ 15% O₂ or; reduce CO Emissions by 70% or more

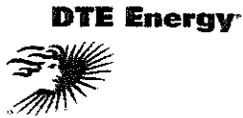
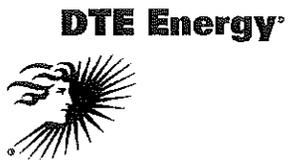


TABLE NO. 5
CARBON MONOXIDE (CO) EMISSION TESTING RESULTS
 Unit 11-5 Wilmot Substation
 November 28, 2018

Test	Time	Load (MW)	Catalyst Inlet Temperature (°F)	Catalyst Pressure Drop (¹ H ₂ O)	Oxygen ⁽¹⁾		CO Emissions @ 15% O ₂ ⁽¹⁾		Destruction Efficiency (%)
					Inlet (%)	Outlet (%)	Inlet (ppm)	Outlet (ppm)	
Run - 1	10:38-11:38	2.5	493	0.003	12.7	12.7	65.7	18.7	71.6
Run - 2	11:45-12:45	2.5	495	0.003	12.7	12.7	64.2	17.1	73.4
Run - 3	12:57-13:57	<u>2.5</u>	<u>515</u>	<u>0.004</u>	<u>12.7</u>	<u>12.7</u>	<u>63.3</u>	<u>16.2</u>	<u>74.4</u>
	Avg:	2.5	501	0.003	12.7	12.7	64.4	17.3	73.1

⁽¹⁾ Corrected for analyzer drift per USEPA method 7E

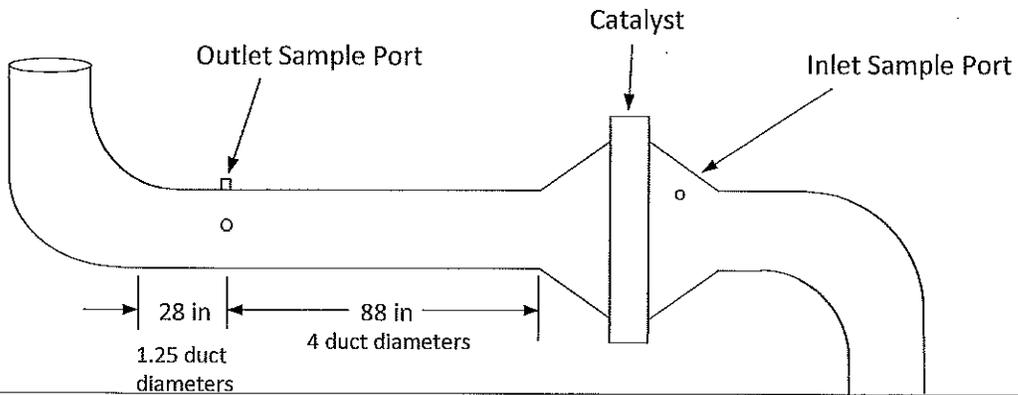
40CFR Part 63 Subpart ZZZZ Limit: limit exhaust CO to 23ppmvd @ 15% O₂ or; reduce CO Emissions by 70% or more



FIGURES



Figure 1 – Sampling Location
Wilmot Diesel Generators
November 26-29, 2018

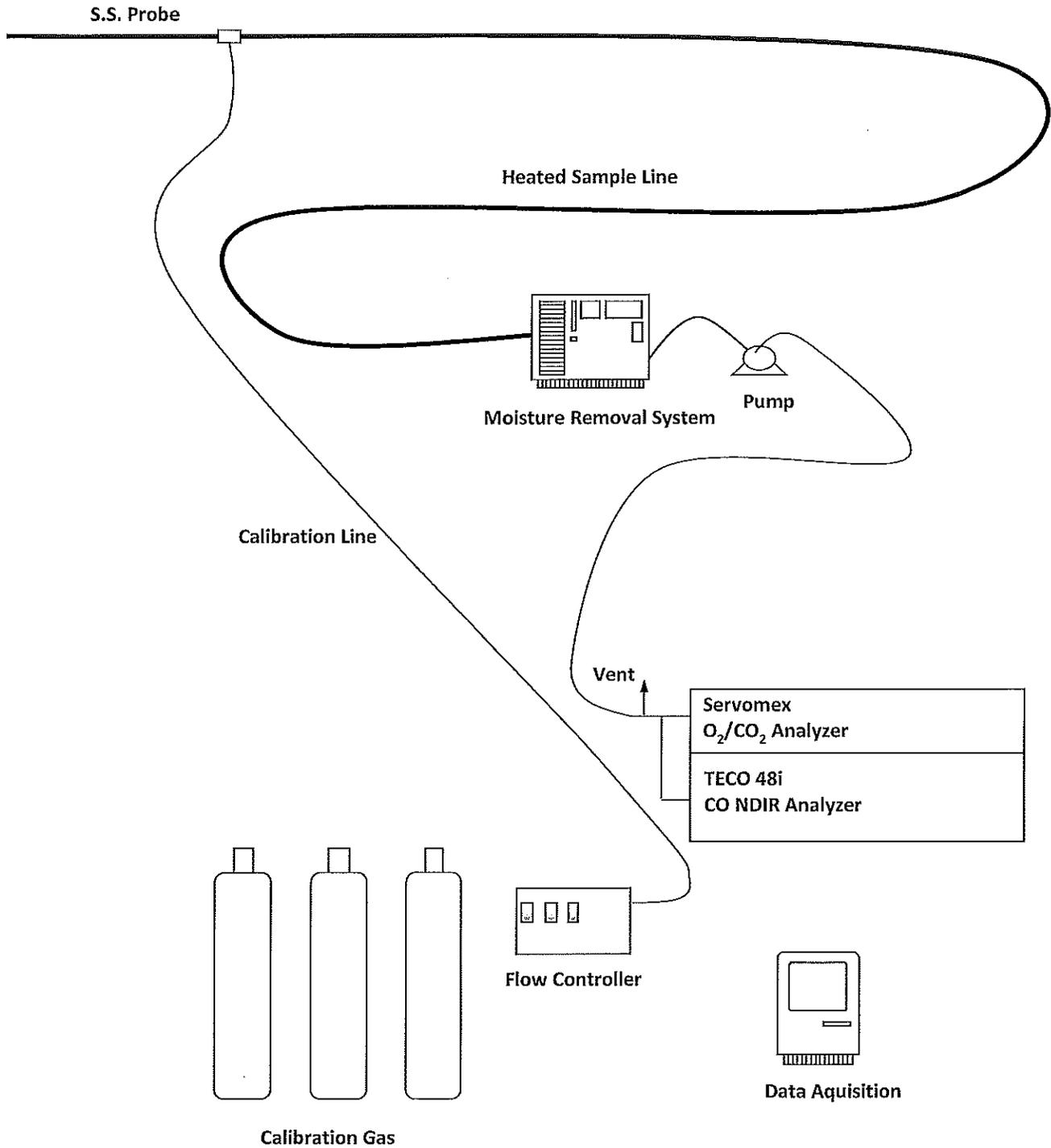


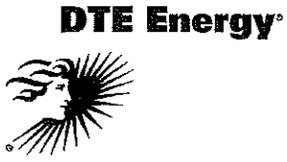
Outlet	Distance
Point 1	3.67 in
Point 2	11.00 in
Point 3	18.33 in

Duct Diameter = 22 in

Diesel Generator

**Figure 2 – EPA Methods 3A/10
Wilmot Diesel Generators
November 26-29, 2018**





APPENDIX A

MDEQ TEST PLAN