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## Compliance Emissions Test Report

**Lansing Board of Water and Light  
REO Town Plant  
Emergency RICE Engine  
Lansing, Michigan  
February 23, 2024**

**Report Submittal Date  
March 19, 2024**

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Mostardi Platt

**Project No. M241101**



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## 1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a compliance emissions test program for Lansing Board of Water and Light on February 23, 2024 at the REO Town Plant on the Emergency RICE Engine in Lansing, Michigan. This report summarizes the results of the test program and test methods used.

The test location, test date, and test parameters are summarized below.

Test Location	Test Date	Test Parameters
Emergency RICE Engine	February 23, 2024	Nitrogen Oxides (NO <sub>x</sub> ), Carbon Monoxide (CO), Carbon Dioxide (CO <sub>2</sub> ), Oxygen (O <sub>2</sub> ) and Volatile Organic Compounds (VOCs)

The purpose of the test program was to evaluate the emissions of the above test parameters with the regulation permit limits. Selected results of the test program are summarized below. A complete summary of emission test results follows the narrative portion of this report.

TEST RESULTS				
Test Location	Test Date	Test Parameter	Emission Limits	Emission Rates
Emergency RICE Engine	February 23, 2024	VOC (as C <sub>3</sub> H <sub>8</sub> )	1.0 g/bhp-hr <sup>1</sup>	0.6 g/bhp-hr <sup>1</sup>
		VOC (as C <sub>3</sub> H <sub>8</sub> )	86 ppmvd @ 15% O <sub>2</sub>	37.3 ppmvd @ 15% O <sub>2</sub>
		CO	4.0 g/bhp-hr <sup>1</sup>	2.2 g/bhp-hr <sup>1</sup>
		CO	540 ppmvd @ 15% O <sub>2</sub>	253.0 ppmvd @ 15% O <sub>2</sub>
		NO <sub>x</sub>	2.0 g/bhp-hr <sup>1</sup>	0.6 g/bhp-hr <sup>1</sup>
		NO <sub>x</sub>	160 ppmvd @ 15% O <sub>2</sub>	39.3 ppmvd @ 15% O <sub>2</sub>

Emissions on g/bhp-hr<sup>1</sup> basis were calculated using Kilowatt data supplied by Lansing Board of Water and Light as shown in Appendix A. The identifications of the individuals associated with the test program are summarized below.

TEST PERSONNEL INFORMATION		
Location	Address	Contact
Test Coordinator	Lansing Board of Water and Light 1232 Haco Drive P.O. Box 13007 Lansing, Michigan 48912	Mr. Nathan Hude Environmental Compliance Specialist (517) 702-6170 (phone) Nathan.Hude@lbwl.com
Test Facility	REO Town Plant 1201 South Washington Avenue Lansing, Michigan 48917	
Testing Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, IL 60126	Mr. Christopher E. Jensen Senior Project Manager (630) 993-2100 (phone) cjensen@mp-mail.com

The test crew consisted of Messrs. C. Buglio, J. Dockins, and C. Jensen of Mostardi Platt.

<sup>1</sup> g/bhp-hr: gram per brake horsepower hour

## 2.0 TEST METHODOLOGY

Emission testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A. Schematics of the test section diagrams and sampling trains used are included in Appendix B and C, respectively. Calculation examples and nomenclature are included in Appendix D. Copies of analyzer print-outs and field data sheets for each test run are included in Appendices E and F, respectively.

The following methodologies were used during the test program:

### Method 1 Traverse Point Determination

Test measurement points were selected in accordance with Method 1 for volumetric flow. The characteristics of the measurement location are summarized below.

TEST POINT INFORMATION					
Location	Duct Diameter (Feet)	Area (Square Feet)	Upstream Disturbance Diameter	Downstream Disturbance Distance	Number of Sampling Points
Emergency RICE Engine	1.125	0.994	2.667	3.778	16 (volumetric flow) 3 (gaseous)

An absence of cyclonic flow test was performed and the test location met the less than 20 degree angle requirement.

### Gaseous Sampling Plan

Three points along 17%, 50%, and 83% of the stack diameter were used to sample gaseous emissions.

### Method 2 Volumetric Flowrate Determination

Gas velocity was measured following Method 2, for purposes of calculating stack gas volumetric flow rate. An S-type pitot tube, differential pressure gauge, thermal couple and temperature readout were used to determine gas velocity at each sample point. The molecular weight and moisture content of the gases were determined to permit the calculation of the volumetric flowrate. All the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G.

### Method 3A Oxygen (O<sub>2</sub>)/Carbon Dioxide (CO<sub>2</sub>) Determination

Stack gas O<sub>2</sub> and CO<sub>2</sub> were determined in accordance with Method 3A. A CO<sub>2</sub>/O<sub>2</sub> analyzer was used to determine stack gas oxygen and carbon dioxide content. All of the equipment used was calibrated in accordance with the specifications of the Method and calibration data are included in Appendix G. Copies of the gas cylinder certifications are included in Appendix H.

### Method 4 Moisture Determination

USEPA Method 4, 40CFR60, Appendix A, was utilized to determine H<sub>2</sub>O content. 100 mL of water was added to each of the first two impingers, the third was left empty, and the fourth was charged with approximately 200 grams of silica gel. The impingers were placed in an ice bath to maintain the sampled gas passed through the silica gel impinger outlet below 68°F in order to increase the

accuracy of the sampled dry gas volume measurement. Each sample was extracted through a glass lined probe heated to at or above 248°F at a constant sample rate of approximately 0.75 cubic feet per minute, which was maintained throughout the course of the test run. A minimum of 21 dry standard cubic feet was sampled for each run. After each run, a leak check of the sampling train was performed at a vacuum greater than the sampling vacuum to determine if any leakage had occurred during sampling. Following the leak check, the impingers were removed from the ice bath, water levels are measured, and the silica gel weight is recorded.

All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G.

### **Method 7E Nitrogen Oxide (NO<sub>x</sub>) Determination**

Stack gas nitrogen oxide concentrations and emission rates were determined in accordance with Method 7E. A nitrogen oxide analyzer was used to determine nitrogen oxide concentrations, in the manner specified in the Method.

Stack gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 250°F. Excess moisture in the stack gas was removed using a refrigerated condenser. The entire system was calibrated in accordance with the Method, using certified calibration gases introduced at the probe, before and after each test run.

A list of calibration gases used and the results of all calibration and other required quality assurance checks can be found in Appendix G. Copies of calibration gas certifications can be found in Appendix H.

### **Method 10 Carbon Monoxide (CO) Determination**

Stack gas carbon monoxide concentrations and emission rates were determined in accordance with Method 10. A carbon monoxide analyzer was used to determine carbon monoxide concentrations, in the manner specified in the Method.

Stack gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 250°F. Excess moisture in the stack gas was removed using a refrigerated condenser. The entire system was calibrated in accordance with the Method, using certified calibration gases introduced at the probe, before and after each test run.

A list of calibration gases used and the results of all calibration and other required quality assurance checks can be found in Appendix G. Copies of calibration gas certifications can be found in Appendix H.

### **Method 18/25A Volatile Organic Compound (VOC) Determination**

Non-methane hydrocarbon (NMHC) concentrations and emission rates and methane (CH<sub>4</sub>) concentrations were determined in accordance with Methods 18 and 25A. A Thermo 55i Gas Chromatograph/Flame Ionization Detector (GC/FID) was used to determine NMHC concentrations and CH<sub>4</sub> concentrations. Stack gas was delivered to the system via a Teflon® sampling line, heated to a minimum temperature of 300°F.

The system was calibrated before and after each test run using certified calibration gases of propane for the NMHC determination and methane for the CH<sub>4</sub> determination. Calibration data are presented in Appendix G. Copies of gas certifications are presented in Appendix H.

### 3.0 TEST RESULT SUMMARY

Lansing Board of Water and Light REO Town Plant Emergency RICE Engine Gaseous Summary																
Test No.	Date	Start Time	End Time	NO <sub>x</sub> ppmvd	CO ppmvd	CO <sub>2</sub> % (dry)	O <sub>2</sub> % (dry)	Moisture, %	Flowrate, DSCFM	Flowrate, SCFM	NMHC ppm as C <sub>3</sub> H <sub>8</sub> (wet)	CH <sub>4</sub> ppm as CH <sub>4</sub> (wet)	NMHC ppm as C <sub>3</sub> H <sub>8</sub> (dry)	Kilowatts	Brake Horse Power	
1	02/23/24	08:25	09:25	73.2	465.3	6.2	10.0	11.1	4,063	4,570	63.1	967.3	71.0	1,291.0	1,731.3	
2	02/23/24	10:00	11:00	76.2	492.9	6.5	9.4	13.1	3,992	4,541	61.2	859.5	70.4	1,291.0	1,731.3	
3	02/23/24	11:30	12:30	76.0	491.1	6.5	9.5	12.0	3,960	4,528	63.3	999.5	71.9	1,291.0	1,731.3	
<b>Average</b>				75.1	483.1	6.4	9.6	12.1	4,005	4,546	62.5	942.1	71.1	1,291.0	1,731.3	

Emission Rate Summary																
Test No.	Date	Start Time	End Time	Fd Factor, dscf/MMBtu	O <sub>2</sub> based NO <sub>x</sub> lb/MMBtu	O <sub>2</sub> based CO lb/MMBtu	O <sub>2</sub> based VOC as C <sub>3</sub> H <sub>8</sub> lb/MMBtu	NO <sub>x</sub> lb/hr	CO lb/hr	VOC as C <sub>3</sub> H <sub>8</sub> lb/hr	NO <sub>x</sub> ppmvd @ 15% O <sub>2</sub>	CO ppmvd @ 15% O <sub>2</sub>	NMHC ppmvd @ 15% O <sub>2</sub>	NO <sub>x</sub> g/bhp-hr	CO g/bhp-hr	NMHC (VOC) g/bhp-hr
1	02/23/24	08:25	09:25	8,710.0	0.146	0.565	0.135	2.13	8.24	2.22	39.6	251.9	38.4	0.6	2.2	0.6
2	02/23/24	10:00	11:00	8,710.0	0.144	0.567	0.127	2.18	8.58	2.19	39.1	252.9	36.1	0.6	2.2	0.6
3	02/23/24	11:30	12:30	8,710.0	0.145	0.570	0.131	2.16	8.48	2.23	39.3	254.2	37.2	0.6	2.2	0.6
<b>Average</b>				8,710.0	0.145	0.567	0.131	2.16	8.43	2.21	39.3	253.0	37.3	0.6	2.2	0.6



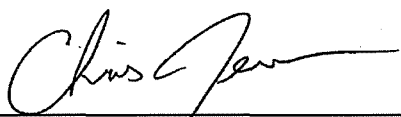
## 4.0 CERTIFICATION

MOSTARDI PLATT is pleased to have been of service to Lansing Board of Water and Light. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

### CERTIFICATION

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

MOSTARDI PLATT



\_\_\_\_\_  
Christopher E. Jensen

Program Manager



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Scott W. Banach

Quality Assurance

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## APPENDICES

## Appendix A - Operating Data

## Run1 REO EUNGENGINE

Log Time Stamp	kW Output	Fuel, Lb/Hr	Log Time Stamp	kW Output	Fuel, Lb/Hr
02-23-2024 08:25:00	1293	585.9	02-23-2024 08:56:00	1292	586.9
02-23-2024 08:26:00	1294	585.3	02-23-2024 08:57:00	1291	585.5
02-23-2024 08:27:00	1293	586.2	02-23-2024 08:58:00	1293	586.0
02-23-2024 08:28:00	1293	586.7	02-23-2024 08:59:00	1292	585.0
02-23-2024 08:29:00	1295	584.6	02-23-2024 09:00:00	1292	586.1
02-23-2024 08:30:00	1293	585.0	02-23-2024 09:01:00	1291	586.3
02-23-2024 08:31:00	1291	585.6	02-23-2024 09:02:00	1291	583.9
02-23-2024 08:32:00	1295	586.1	02-23-2024 09:03:00	1291	585.5
02-23-2024 08:33:00	1294	585.6	02-23-2024 09:04:00	1291	585.3
02-23-2024 08:34:00	1293	586.2	02-23-2024 09:05:00	1290	586.5
02-23-2024 08:35:00	1293	585.2	02-23-2024 09:06:00	1290	585.3
02-23-2024 08:36:00	1294	586.7	02-23-2024 09:07:00	1289	585.8
02-23-2024 08:37:00	1292	585.3	02-23-2024 09:08:00	1287	585.6
02-23-2024 08:38:00	1293	585.3	02-23-2024 09:09:00	1291	584.8
02-23-2024 08:39:00	1292	587.4	02-23-2024 09:10:00	1289	585.1
02-23-2024 08:40:00	1291	584.7	02-23-2024 09:11:00	1290	585.1
02-23-2024 08:41:00	1292	585.7	02-23-2024 09:12:00	1291	584.9
02-23-2024 08:42:00	1291	582.6	02-23-2024 09:13:00	1292	586.0
02-23-2024 08:43:00	1293	586.5	02-23-2024 09:14:00	1292	586.0
02-23-2024 08:44:00	1291	587.9	02-23-2024 09:15:00	1290	583.7
02-23-2024 08:45:00	1293	586.8	02-23-2024 09:16:00	1290	585.9
02-23-2024 08:46:00	1293	585.4	02-23-2024 09:17:00	1289	585.5
02-23-2024 08:47:00	1293	586.2	02-23-2024 09:18:00	1289	584.0
02-23-2024 08:48:00	1292	585.9	02-23-2024 09:19:00	1292	586.0
02-23-2024 08:49:00	1291	585.3	02-23-2024 09:20:00	1292	584.4
02-23-2024 08:50:00	1291	585.3	02-23-2024 09:21:00	1291	584.4
02-23-2024 08:51:00	1290	585.6	02-23-2024 09:22:00	1289	585.4
02-23-2024 08:52:00	1291	583.6	02-23-2024 09:23:00	1289	584.9
02-23-2024 08:53:00	1293	584.9	02-23-2024 09:24:00	1289	585.7
02-23-2024 08:54:00	1293	583.1	02-23-2024 09:25:00	1290	583.9
02-23-2024 08:55:00	1290	584.9	Run Average:	1291	585

## Run2 REO EUNGINE

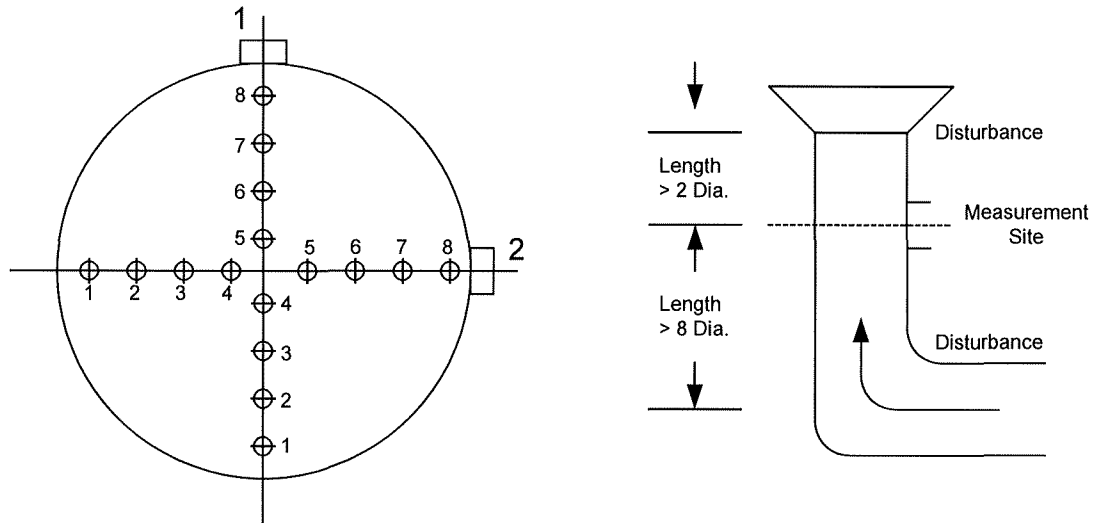
Log Time Stamp	kW Output	Fuel, Lb/Hr	Log Time Stamp	kW Output	Fuel, Lb/Hr
02-23-2024 10:00:00	1290	583.1	02-23-2024 10:31:00	1290	585.4
02-23-2024 10:01:00	1290	583.7	02-23-2024 10:32:00	1292	584.4
02-23-2024 10:02:00	1293	585.6	02-23-2024 10:33:00	1292	584.6
02-23-2024 10:03:00	1292	586.0	02-23-2024 10:34:00	1292	583.3
02-23-2024 10:04:00	1292	582.2	02-23-2024 10:35:00	1292	582.9
02-23-2024 10:05:00	1290	583.6	02-23-2024 10:36:00	1290	585.4
02-23-2024 10:06:00	1291	583.6	02-23-2024 10:37:00	1290	584.4
02-23-2024 10:07:00	1292	584.4	02-23-2024 10:38:00	1290	585.0
02-23-2024 10:08:00	1292	584.6	02-23-2024 10:39:00	1291	584.5
02-23-2024 10:09:00	1292	584.7	02-23-2024 10:40:00	1291	584.1
02-23-2024 10:10:00	1292	583.6	02-23-2024 10:41:00	1291	585.0
02-23-2024 10:11:00	1292	585.4	02-23-2024 10:42:00	1291	585.5
02-23-2024 10:12:00	1291	584.7	02-23-2024 10:43:00	1292	582.5
02-23-2024 10:13:00	1292	586.2	02-23-2024 10:44:00	1292	585.5
02-23-2024 10:14:00	1292	584.8	02-23-2024 10:45:00	1292	583.9
02-23-2024 10:15:00	1291	583.0	02-23-2024 10:46:00	1291	584.9
02-23-2024 10:16:00	1291	584.2	02-23-2024 10:47:00	1293	585.3
02-23-2024 10:17:00	1292	583.2	02-23-2024 10:48:00	1290	585.6
02-23-2024 10:18:00	1292	584.8	02-23-2024 10:49:00	1289	582.4
02-23-2024 10:19:00	1293	582.9	02-23-2024 10:50:00	1292	584.3
02-23-2024 10:20:00	1292	584.7	02-23-2024 10:51:00	1293	584.1
02-23-2024 10:21:00	1293	584.2	02-23-2024 10:52:00	1291	587.3
02-23-2024 10:22:00	1292	584.5	02-23-2024 10:53:00	1291	583.9
02-23-2024 10:23:00	1291	584.3	02-23-2024 10:54:00	1291	583.8
02-23-2024 10:24:00	1290	583.7	02-23-2024 10:55:00	1291	584.7
02-23-2024 10:25:00	1292	585.3	02-23-2024 10:56:00	1291	584.3
02-23-2024 10:26:00	1293	584.9	02-23-2024 10:57:00	1290	583.8
02-23-2024 10:27:00	1291	586.1	02-23-2024 10:58:00	1292	584.2
02-23-2024 10:28:00	1291	583.6	02-23-2024 10:59:00	1293	584.9
02-23-2024 10:29:00	1293	585.5	02-23-2024 11:00:00	1292	582.8
02-23-2024 10:30:00	1292	586.4	Run Average:	1291	584

## Run3 REO EUNGENGINE

Log Time Stamp	kW Output	Fuel, Lb/Hr	Log Time Stamp	kW Output	Fuel, Lb/Hr
02-23-2024 11:30:00	1291	584.7	02-23-2024 12:01:00	1291	584.0
02-23-2024 11:31:00	1291	582.8	02-23-2024 12:02:00	1293	584.7
02-23-2024 11:32:00	1291	586.5	02-23-2024 12:03:00	1291	586.5
02-23-2024 11:33:00	1292	584.2	02-23-2024 12:04:00	1292	583.9
02-23-2024 11:34:00	1292	584.1	02-23-2024 12:05:00	1293	583.7
02-23-2024 11:35:00	1291	584.6	02-23-2024 12:06:00	1292	584.4
02-23-2024 11:36:00	1293	583.7	02-23-2024 12:07:00	1292	584.5
02-23-2024 11:37:00	1292	584.3	02-23-2024 12:08:00	1292	585.3
02-23-2024 11:38:00	1292	585.5	02-23-2024 12:09:00	1293	584.5
02-23-2024 11:39:00	1292	583.3	02-23-2024 12:10:00	1291	584.2
02-23-2024 11:40:00	1293	583.9	02-23-2024 12:11:00	1291	583.8
02-23-2024 11:41:00	1293	584.9	02-23-2024 12:12:00	1291	584.6
02-23-2024 11:42:00	1292	582.7	02-23-2024 12:13:00	1293	585.4
02-23-2024 11:43:00	1291	583.8	02-23-2024 12:14:00	1291	584.3
02-23-2024 11:44:00	1292	584.1	02-23-2024 12:15:00	1293	584.7
02-23-2024 11:45:00	1289	585.8	02-23-2024 12:16:00	1291	583.6
02-23-2024 11:46:00	1293	584.4	02-23-2024 12:17:00	1289	583.1
02-23-2024 11:47:00	1293	583.0	02-23-2024 12:18:00	1291	583.3
02-23-2024 11:48:00	1292	585.3	02-23-2024 12:19:00	1293	582.7
02-23-2024 11:49:00	1289	585.3	02-23-2024 12:20:00	1291	585.2
02-23-2024 11:50:00	1293	586.0	02-23-2024 12:21:00	1293	585.2
02-23-2024 11:51:00	1290	583.1	02-23-2024 12:22:00	1293	585.2
02-23-2024 11:52:00	1291	584.2	02-23-2024 12:23:00	1290	582.8
02-23-2024 11:53:00	1291	584.7	02-23-2024 12:24:00	1293	582.7
02-23-2024 11:54:00	1290	584.7	02-23-2024 12:25:00	1289	583.5
02-23-2024 11:55:00	1292	583.9	02-23-2024 12:26:00	1292	583.0
02-23-2024 11:56:00	1293	584.1	02-23-2024 12:27:00	1292	583.4
02-23-2024 11:57:00	1292	582.9	02-23-2024 12:28:00	1293	584.8
02-23-2024 11:58:00	1293	585.4	02-23-2024 12:29:00	1292	584.2
02-23-2024 11:59:00	1291	584.5	02-23-2024 12:30:00	1291	584.3
02-23-2024 12:00:00	1292	585.5	Run Average:	1291	584

## Appendix B - Test Section Diagrams

## EQUAL AREA TRAVERSE FOR ROUND DUCTS



Job: Lansing Board of Water and Light  
REO Town Plant

Date: February 23, 2024

Test Location: Emergency RICE Engine

Stack Diameter (Feet): 1.125

Stack Area (Square Feet): 0.99

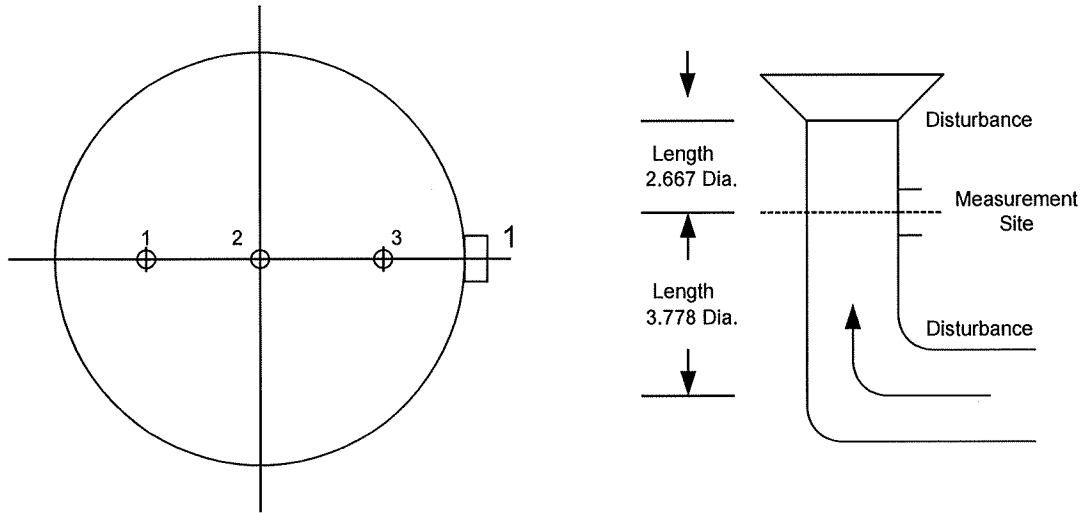
No. Sample Points Across  
Diameter: 8

No. of Ports: 2

Port Length (Inches): 5.5



## GASEOUS TRAVERSE FOR ROUND DUCTS



Job: Lansing Board of Water and Light  
REO Town Plant

Distance from Inside Wall  
To Traverse Point:

Date: February 23, 2024

1. 83.3 % of diameter
2. 50.0 % of diameter
3. 16.7 % of diameter

Test Location: Emergency RICE Engine

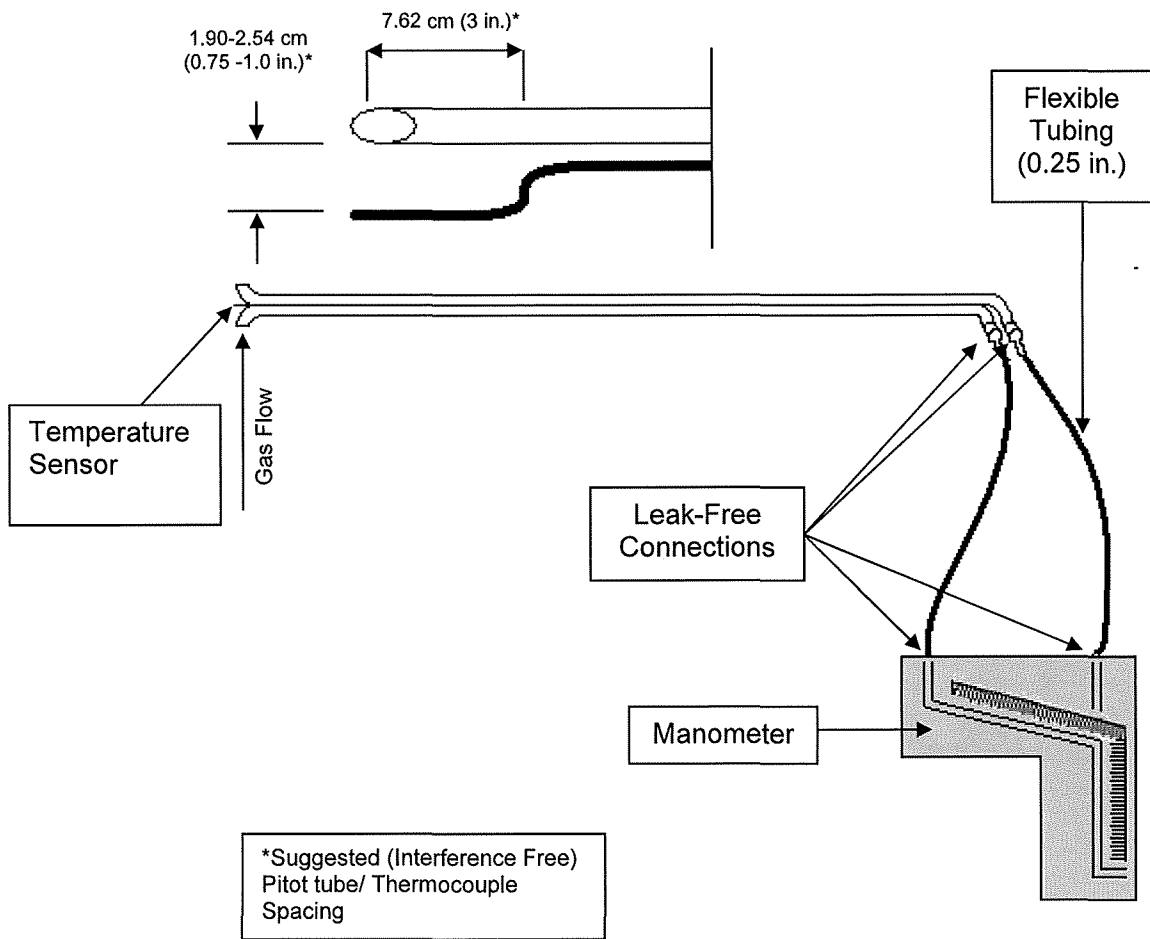
Stack Diameter: 1.125 Feet

Stack Area: 0.99 Square Feet

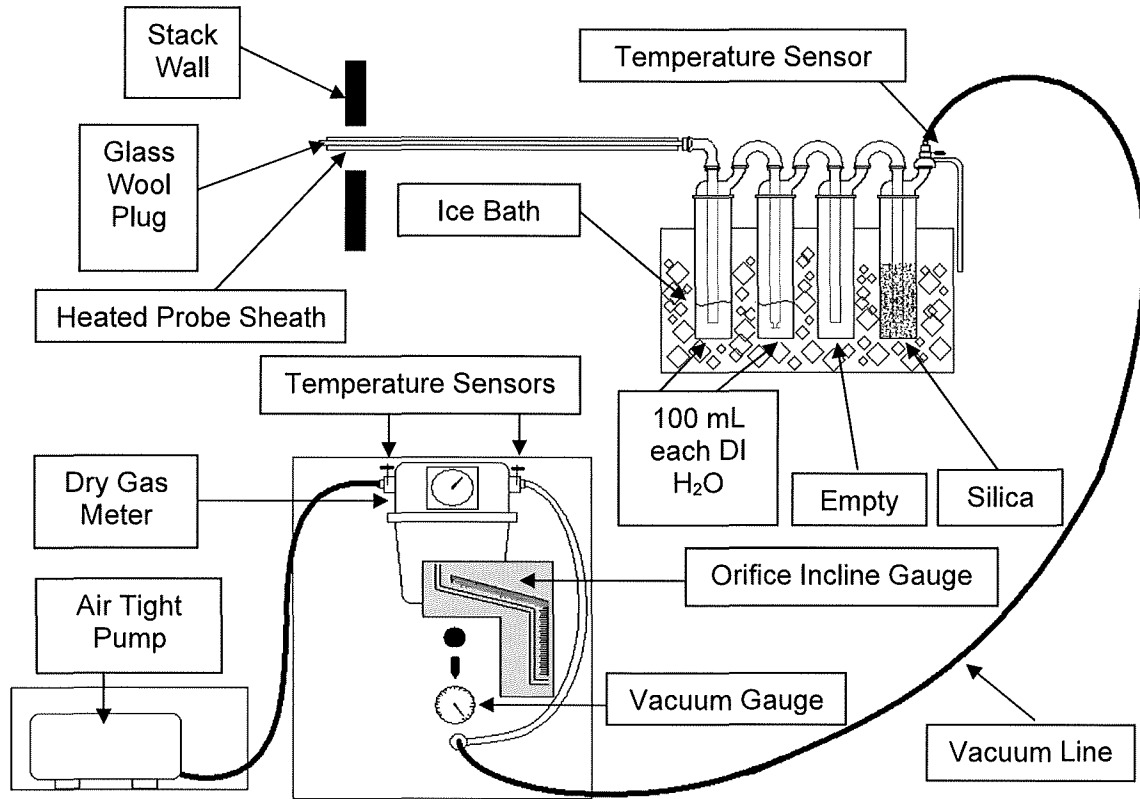
No. Sample Points: 3

## Appendix C - Sample Train Diagrams

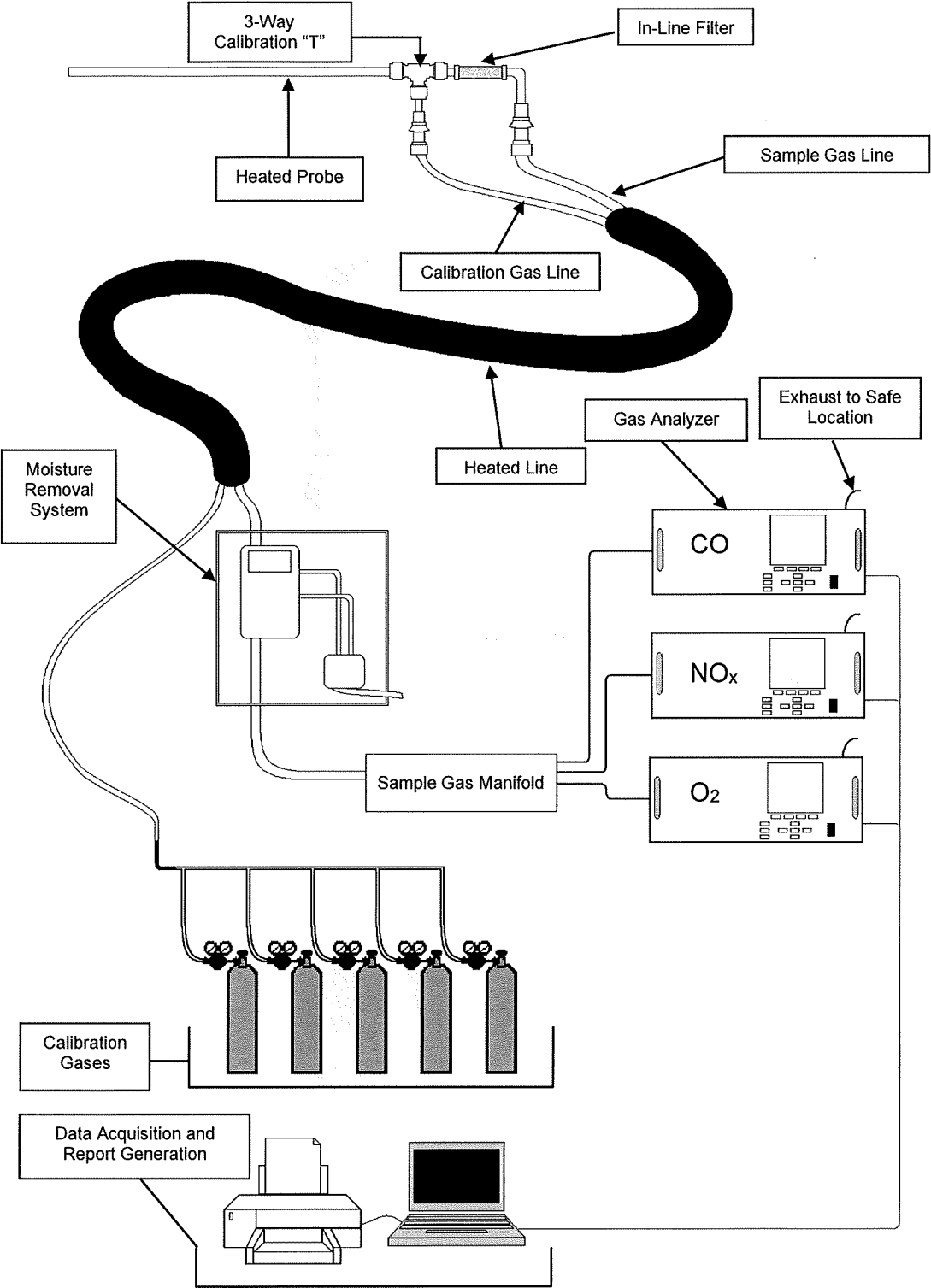
# USEPA Method 2 – Type S Pitot Tube Manometer Assembly



# USEPA Method 4- Moisture Content Sample Train Diagram



# USEPA Methods 3A, 7E, and 10 Extractive Gaseous Sampling Diagram



# USEPA Method 25A/18 – Total Gaseous Organic Compound Sample Train

