1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a compliance emissions test program for Lansing Board of Water and Light on March 12, 2021 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	March 12, 2021	Nitrogen Oxides (NO_x), Carbon Monoxide (CO), Carbon Dioxide (CO_2), Oxygen (O_2) 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	March 12, 2021	VOC (as C_3H_8)	1.0 g/bhp-hr^{-1}	0.59 g/bhp-hr^{-1}
		VOC (as C_3H_8)	86 ppmvd @ 15% O_2	41.58 ppmvd @ 15% O_2
		CO	4.0 g/bhp-hr^{-1}	2.2 g/bhp-hr^{-1}
		CO	540 ppmvd @ 15% O_2	247.87 ppmvd @ 15% O_2
		NO_x	2.0 g/bhp-hr^{-1}	0.7 g/bhp-hr^{-1}
		NO_x	160 ppmvd @ 15% O_2	44.47 ppmvd @ 15% O_2

Emissions on g/bhp-hr^{-1} 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) 490-3069 (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. Chris Jensen Project Manager (630) 993-2100 (phone) cjensen@mp-mail.com

The test crew consisted of Messrs. J. Gross, M. Friduss and C. Jensen of Mostardi Platt.

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	>0.5	>2.0	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_2)/Carbon Dioxide (CO_2) Determination

Stack gas O_2 and CO_2 were determined in accordance with Method 3A. A Thermo iQ 410 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_2O 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 F.

Method 7E Nitrogen Oxide (NO_X) Determination

Stack gas nitrogen oxide concentrations and emission rates were determined in accordance with Method 7E. A Thermo Fisher 42i 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 250ºF. 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 Thermo Fisher 48i 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 250ºF. 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_4) 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_4 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_4 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 & Light
REO Town Plant
Emergency RICE Engine
Gaseous Summary
Normal Load

Test No.	Date	Start Time	End Time	Kilowatts	Brake Horse Power	NO_x ppmvd	CO ppmvd	CO_2 % (dry)	O_2 % (dry)	Moisture, %	Flowrate, DSCFM	NMHC ppm as C_3H_8 (wet)	CH_4 ppm as CH_4 (wet)	NMHC ppm as C_3H_8 (dry)
1	03/12/21	7:55	8:54	1200.1	1609.4	89.0	484.6	6.5	9.3	11.6	3,658	70.1	1,051.7	79.3
2	03/12/21	9:35	10:34	1201.6	1611.4	87.8	489.2	6.3	9.3	12.1	3,730	72.9	1,094.2	82.9
3	03/12/21	11:10	12:09	1201.6	1611.4	85.5	488.2	6.4	9.3	12.2	3,735	72.9	1,096.0	83.0
Average				1,201.1	1,610.7	87.4	487.3	6.4	9.3	12.0	3,708	72.0	1,080.6	81.8

Emission Rate Summary

Test No.	Date	Start Time	End Time	Fd Factor, dscf/MMBtu	O2 based NOx lb/MMBtu	O2 based CO lb/MMBtu	O2 based VOC as C3H8 lb/MMBtu	NO_x @ 15% O_2	CO @ 15% O_2	NMHC @ 15% O_2
1	03/12/21	7:55	8:54	8,710.0	0.167	0.553	0.142	45.27	246.48	40.33
2	03/12/21	9:35	10:34	8,710.0	0.165	0.558	0.149	44.66	248.82	42.18
3	03/12/21	11:10	12:09	8,710.0	0.160	0.557	0.149	43.49	248.31	42.23
Average				8,710.0	0.164	0.556	0.147	44.47	247.87	41.58

Test No.	Date	Start Time	End Time	NO_x lb/hr	CO lb/hr	VOC as C3H8 lb/hr	NO_x g/bhp-hr	CO g/bhp-hr	NMHC (VOC) g/bhp-hr
1	03/12/21	7:55	8:54	2.33	7.73	1.99	0.7	2.2	0.56
2	03/12/21	9:35	10:34	2.35	7.96	2.12	0.7	2.2	0.60
3	03/12/21	11:10	12:09	2.29	7.95	2.12	0.6	2.2	0.60
Average				2.32	7.88	2.08	0.7	2.2	0.59

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

_____ Program Manager

Christopher E. Jensen

_____ Quality Assurance

Jeffrey M. Crivlare

APPENDICES

Appendix A - Operating Data

Log Time Stamp	Fuel, Lb/Hr	Output, kW
03-12-2021 07:55:00	538.8	1211.0
03-12-2021 07:56:00	540.6	1211.2
03-12-2021 07:57:00	536.5	1199.6
03-12-2021 07:58:00	533.6	1187.1
03-12-2021 07:59:00	543.2	1194.8
03-12-2021 08:00:00	537.5	1213.9
03-12-2021 08:01:00	540.2	1209.9
03-12-2021 08:02:00	541.8	1213.2
03-12-2021 08:03:00	536.9	1195.8
03-12-2021 08:04:00	538.9	1202.5
03-12-2021 08:05:00	530.1	1190.5
03-12-2021 08:06:00	537.7	1202.5
03-12-2021 08:07:00	533.8	1197.9
03-12-2021 08:08:00	537.7	1196.5
03-12-2021 08:09:00	540.6	1199.5
03-12-2021 08:10:00	534.6	1206.7
03-12-2021 08:11:00	536.5	1204.6
03-12-2021 08:12:00	536.9	1203.1
03-12-2021 08:13:00	536.5	1194.3
03-12-2021 08:14:00	539.0	1198.5
03-12-2021 08:15:00	538.6	1198.7
03-12-2021 08:16:00	540.2	1202.1
03-12-2021 08:17:00	538.5	1198.7
03-12-2021 08:18:00	535.3	1198.9
03-12-2021 08:19:00	543.0	1205.7
03-12-2021 08:20:00	540.0	1193.1
03-12-2021 08:21:00	538.9	1197.0
03-12-2021 08:22:00	540.4	1202.9
03-12-2021 08:23:00	540.1	1206.4
03-12-2021 08:24:00	536.2	1194.1
03-12-2021 08:25:00	538.3	1190.5
03-12-2021 08:26:00	537.3	1204.9
03-12-2021 08:27:00	537.3	1195.7
03-12-2021 08:28:00	538.7	1199.3
03-12-2021 08:29:00	535.1	1200.6
03-12-2021 08:30:00	533.0	1202.5
03-12-2021 08:31:00	532.5	1193.9
03-12-2021 08:32:00	531.5	1190.3
03-12-2021 08:33:00	536.9	1198.5
03-12-2021 08:34:00	537.8	1198.2
03-12-2021 08:35:00	534.4	1202.2
03-12-2021 08:36:00	540.8	1198.0
03-12-2021 08:37:00	538.3	1193.1
03-12-2021 08:38:00	535.9	1193.9
03-12-2021 08:39:00	534.6	1191.6
03-12-2021 08:40:00	535.5	1190.8
03-12-2021 08:41:00	539.3	1207.2
03-12-2021 08:42:00	542.1	1197.6
03-12-2021 08:43:00	539.9	1203.8
03-12-2021 08:44:00	537.1	1209.5
03-12-2021 08:45:00	535.2	1206.6
03-12-2021 08:46:00	539.1	1205.8
03-12-2021 08:47:00	537.9	1203.7
03-12-2021 08:48:00	536.7	1199.4
03-12-2021 08:49:00	536.9	1196.1
03-12-2021 08:50:00	537.4	1202.6
03-12-2021 08:51:00	537.1	1198.5
03-12-2021 08:52:00	537.4	1196.8
03-12-2021 08:53:00	534.8	1198.4
03-12-2021 08:54:00	534.0	1206.8

Log Time Stamp	Fuel, Lb/Hr	Output, kW
03-12-2021 09:35:00	537.4	1203.3
03-12-2021 09:36:00	540.7	1213.4
03-12-2021 09:37:00	542.7	1213.7
03-12-2021 09:38:00	542.0	1198.1
03-12-2021 09:39:00	535.7	1203.9
03-12-2021 09:40:00	542.2	1203.8
03-12-2021 09:41:00	535.9	1194.6
03-12-2021 09:42:00	534.2	1198.9
03-12-2021 09:43:00	536.0	1202.3
03-12-2021 09:44:00	538.6	1211.7
03-12-2021 09:45:00	536.6	1205.1
03-12-2021 09:46:00	531.8	1189.9
03-12-2021 09:47:00	536.9	1201.6
03-12-2021 09:48:00	537.8	1209.3
03-12-2021 09:49:00	536.3	1190.8
03-12-2021 09:50:00	538.0	1201.0
03-12-2021 09:51:00	535.6	1193.1
03-12-2021 09:52:00	533.8	1190.7
03-12-2021 09:53:00	538.3	1196.6
03-12-2021 09:54:00	536.5	1193.0
03-12-2021 09:55:00	535.7	1200.9
03-12-2021 09:56:00	534.8	1203.7
03-12-2021 09:57:00	535.6	1196.8
03-12-2021 09:58:00	538.7	1198.0
03-12-2021 09:59:00	537.9	1188.1
03-12-2021 10:00:00	534.6	1208.9
03-12-2021 10:01:00	541.5	1211.6
03-12-2021 10:02:00	538.1	1202.0
03-12-2021 10:03:00	538.4	1206.8
03-12-2021 10:04:00	542.1	1193.3
03-12-2021 10:05:00	539.4	1198.3
03-12-2021 10:06:00	541.1	1195.0
03-12-2021 10:07:00	540.3	1205.6
03-12-2021 10:08:00	535.5	1201.3
03-12-2021 10:09:00	536.2	1205.4
03-12-2021 10:10:00	535.1	1197.9
03-12-2021 10:11:00	539.4	1203.0
03-12-2021 10:12:00	539.9	1200.5
03-12-2021 10:13:00	538.7	1208.3
03-12-2021 10:14:00	540.1	1196.2
03-12-2021 10:15:00	537.7	1201.3
03-12-2021 10:16:00	540.6	1204.9
03-12-2021 10:17:00	539.2	1200.5
03-12-2021 10:18:00	538.0	1211.5
03-12-2021 10:19:00	536.1	1190.6
03-12-2021 10:20:00	537.3	1201.7
03-12-2021 10:21:00	535.6	1201.1
03-12-2021 10:22:00	538.6	1202.3
03-12-2021 10:23:00	537.8	1199.5
03-12-2021 10:24:00	537.2	1232.7
03-12-2021 10:25:00	538.1	1204.6
03-12-2021 10:26:00	539.5	1210.7
03-12-2021 10:27:00	536.3	1196.4
03-12-2021 10:28:00	533.3	1201.6
03-12-2021 10:29:00	534.6	1201.7
03-12-2021 10:30:00	538.5	1201.6
03-12-2021 10:31:00	535.6	1197.1
03-12-2021 10:32:00	533.2	1197.8
03-12-2021 10:33:00	536.5	1195.1
03-12-2021 10:34:00	540.0	1205.2

Log Time Stamp	Fuel, Lb/Hr	Output, kW
03-12-2021 11:10:00	533.4	1199.7
03-12-2021 11:11:00	538.4	1201.7
03-12-2021 11:12:00	532.6	1188.7
03-12-2021 11:13:00	536.4	1199.3
03-12-2021 11:14:00	537.8	1203.0
03-12-2021 11:15:00	542.5	1201.9
03-12-2021 11:16:00	537.3	1195.4
03-12-2021 11:17:00	537.4	1198.2
03-12-2021 11:18:00	535.9	1188.9
03-12-2021 11:19:00	536.9	1204.7
03-12-2021 11:20:00	536.4	1199.2
03-12-2021 11:21:00	535.8	1203.9
03-12-2021 11:22:00	535.9	1196.7
03-12-2021 11:23:00	535.9	1201.4
03-12-2021 11:24:00	536.2	1202.3
03-12-2021 11:25:00	537.9	1212.1
03-12-2021 11:26:00	538.8	1208.8
03-12-2021 11:27:00	539.1	1201.2
03-12-2021 11:28:00	540.2	1210.7
03-12-2021 11:29:00	535.2	1202.8
03-12-2021 11:30:00	541.2	1206.6
03-12-2021 11:31:00	537.2	1198.8
03-12-2021 11:32:00	536.9	1203.2
03-12-2021 11:33:00	537.6	1202.2
03-12-2021 11:34:00	536.9	1202.1
03-12-2021 11:35:00	535.3	1200.8
03-12-2021 11:36:00	532.3	1191.5
03-12-2021 11:37:00	536.4	1209.8
03-12-2021 11:38:00	538.8	1205.9
03-12-2021 11:39:00	538.4	1200.0
03-12-2021 11:40:00	535.3	1200.2
03-12-2021 11:41:00	534.5	1190.5
03-12-2021 11:42:00	537.6	1198.2
03-12-2021 11:43:00	537.2	1207.7
03-12-2021 11:44:00	529.7	1193.5
03-12-2021 11:45:00	537.1	1200.7
03-12-2021 11:46:00	535.9	1203.8
03-12-2021 11:47:00	536.3	1194.3
03-12-2021 11:48:00	536.0	1199.1
03-12-2021 11:49:00	535.8	1207.5
03-12-2021 11:50:00	535.8	1197.7
03-12-2021 11:51:00	533.2	1196.1
03-12-2021 11:52:00	538.6	1205.2
03-12-2021 11:53:00	538.0	1207.7
03-12-2021 11:54:00	535.3	1198.5
03-12-2021 11:55:00	536.1	1200.5
03-12-2021 11:56:00	535.5	1203.8
03-12-2021 11:57:00	537.5	1204.1
03-12-2021 11:58:00	538.4	1206.6
03-12-2021 11:59:00	534.3	1203.1
03-12-2021 12:00:00	536.5	1197.8
03-12-2021 12:01:00	535.5	1205.6
03-12-2021 12:02:00	531.3	1196.2
03-12-2021 12:03:00	541.6	1214.9
03-12-2021 12:04:00	539.3	1202.5
03-12-2021 12:05:00	536.1	1205.5
03-12-2021 12:06:00	535.2	1197.3
03-12-2021 12:07:00	537.9	1209.4
03-12-2021 12:08:00	537.7	1205.3
03-12-2021 12:09:00	538.7	1198.5

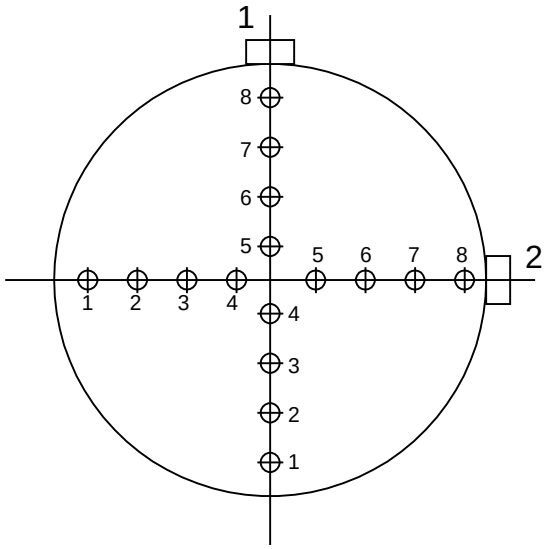
Run1	Fuel, Lb/Hr	Output, kW
07:55-08:04	538.8	1203.9
08:05-08:14	536.3	1199.4
08:15-08:24	539.1	1199.8
08:25-08:34	535.8	1197.5
08:35-08:44	537.8	1198.8
08:45-08:54	536.7	1201.5
Run Average	537.4	1200.1

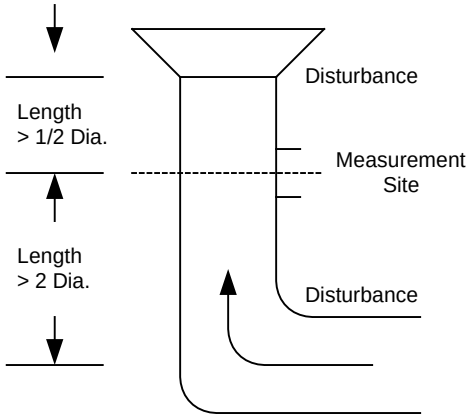
Run2	Fuel, Lb/Hr	Output, kW
09:35-09:44	538.5	1204.4
09:45-09:54	536.1	1197.1
09:55-10:04	537.8	1201.0
10:05-10:14	538.6	1201.2
10:15-10:24	537.8	1204.6
10:25-10:34	536.6	1201.2
Run Average	537.6	1201.6

Run3	Fuel, Lb/Hr	Output, kW
11:10-11:19	536.8	1198.1
11:20-11:29	537.1	1203.9
11:30-11:39	537.1	1202.1
11:40-11:49	535.5	1199.5
11:50-11:59	536.3	1202.3
12:00-12:09	537.0	1203.3
Run Average	536.6	1201.6

Appendix B - Test Section Diagrams

EQUAL AREA TRAVERSE FOR ROUND DUCTS

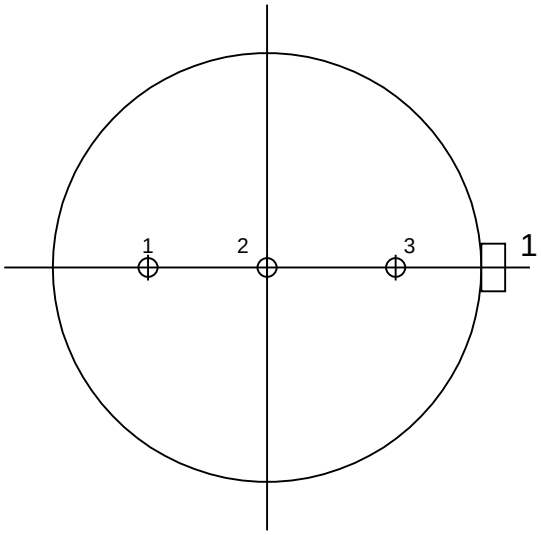


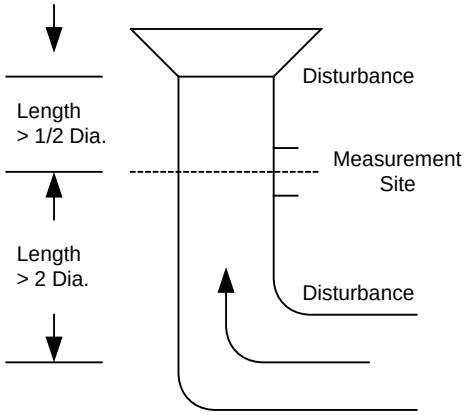


Job:	Lansing Board of Water and Light REO Town Plant
Date:	March 12, 2021
Test Location:	Emergency RICE Engine
Stack Diameter (Feet):	1.125
Stack Area (Square Feet):	0.99
No. Sample Points Across Diameter:	8
No. of Ports:	2
Port Length (Inches):	5.5

Distance from inside wall at port to traverse point:

GASEOUS TRAVERSE FOR ROUND DUCTS





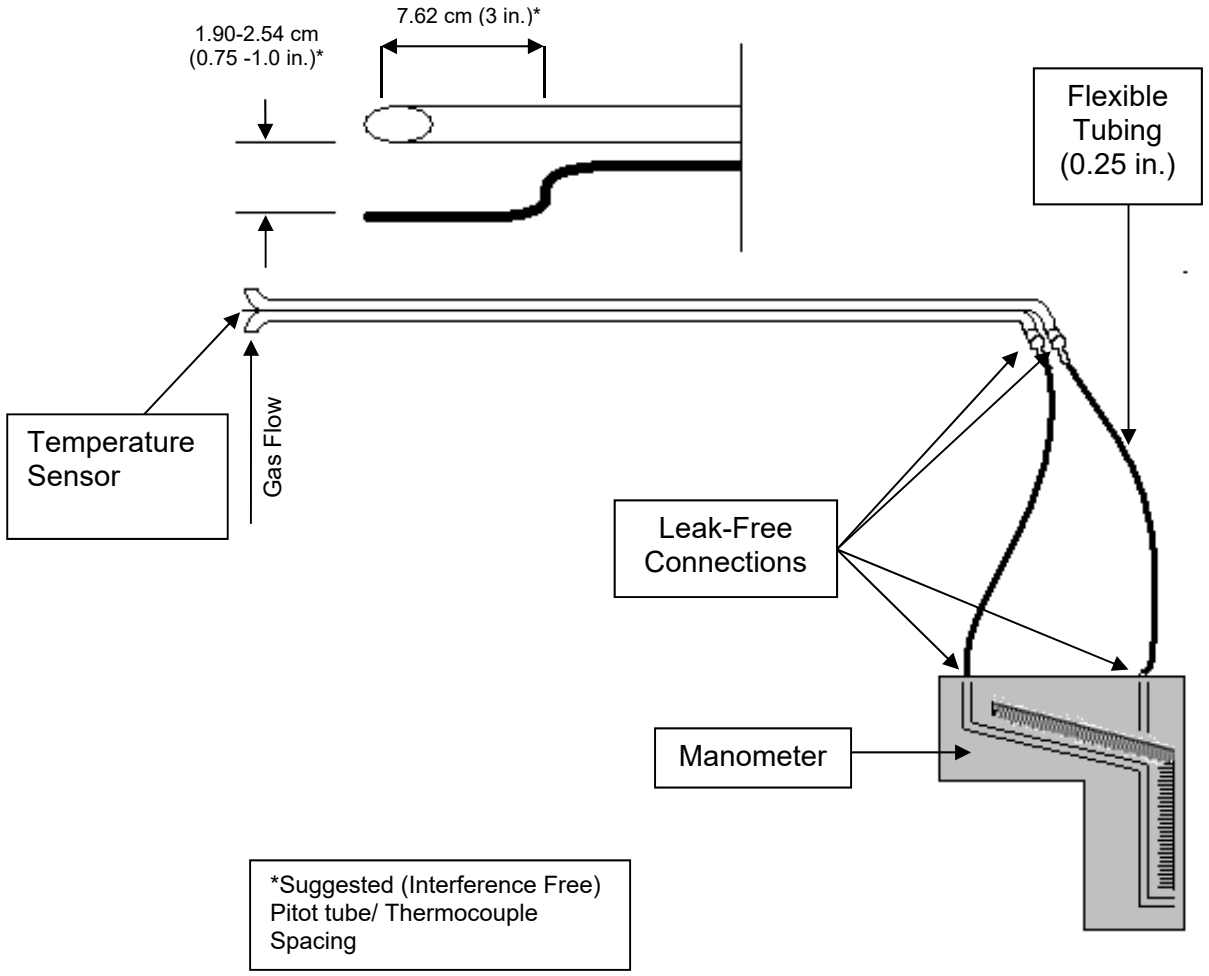
Job:	Lansing Board of Water and Light REO Town Plant
Date:	March 12, 2021
Test Location:	Emergency RICE Engine
Stack Diameter:	1.125 Feet
Stack Area:	0.99 Square Feet
No. Sample Points:	3

Distance from Inside Wall To Traverse Point:

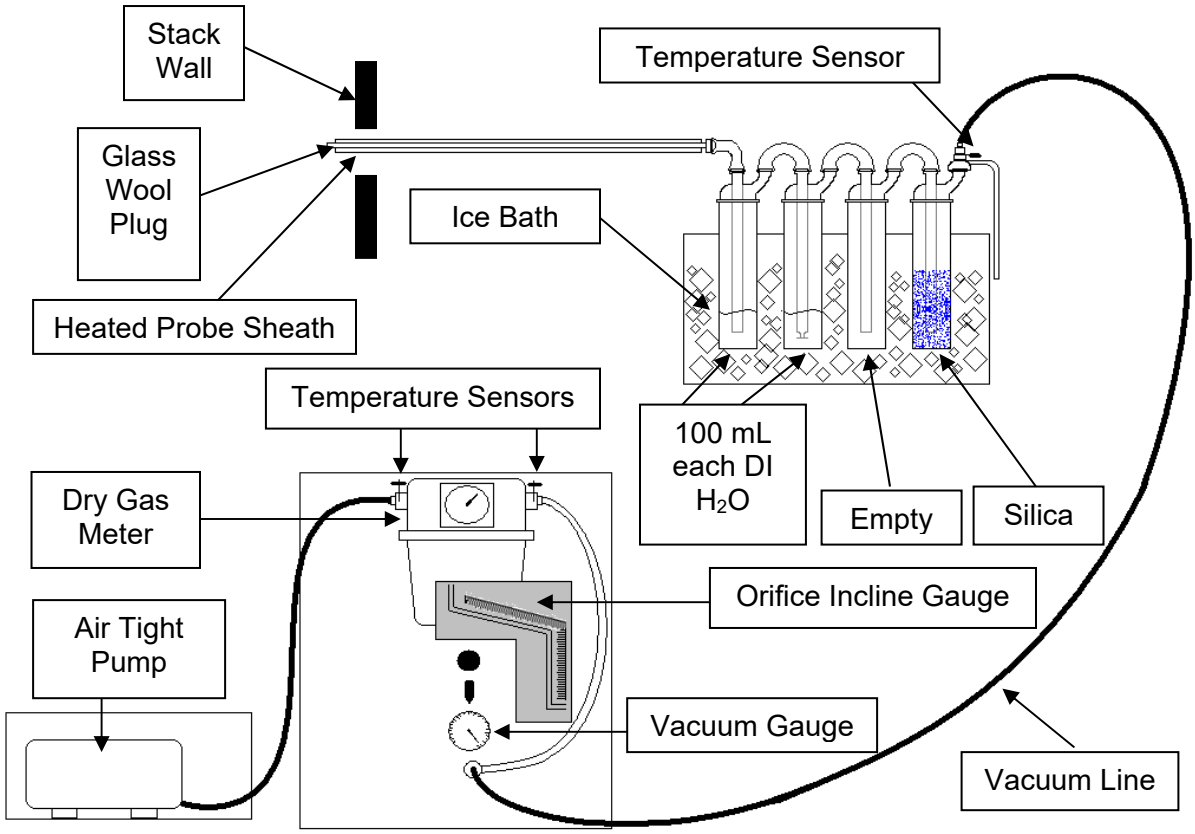
1. 83.3 % of diameter
2. 50.0 % of diameter
3. 16.7 % of diameter

Appendix C - Sample Train Diagrams

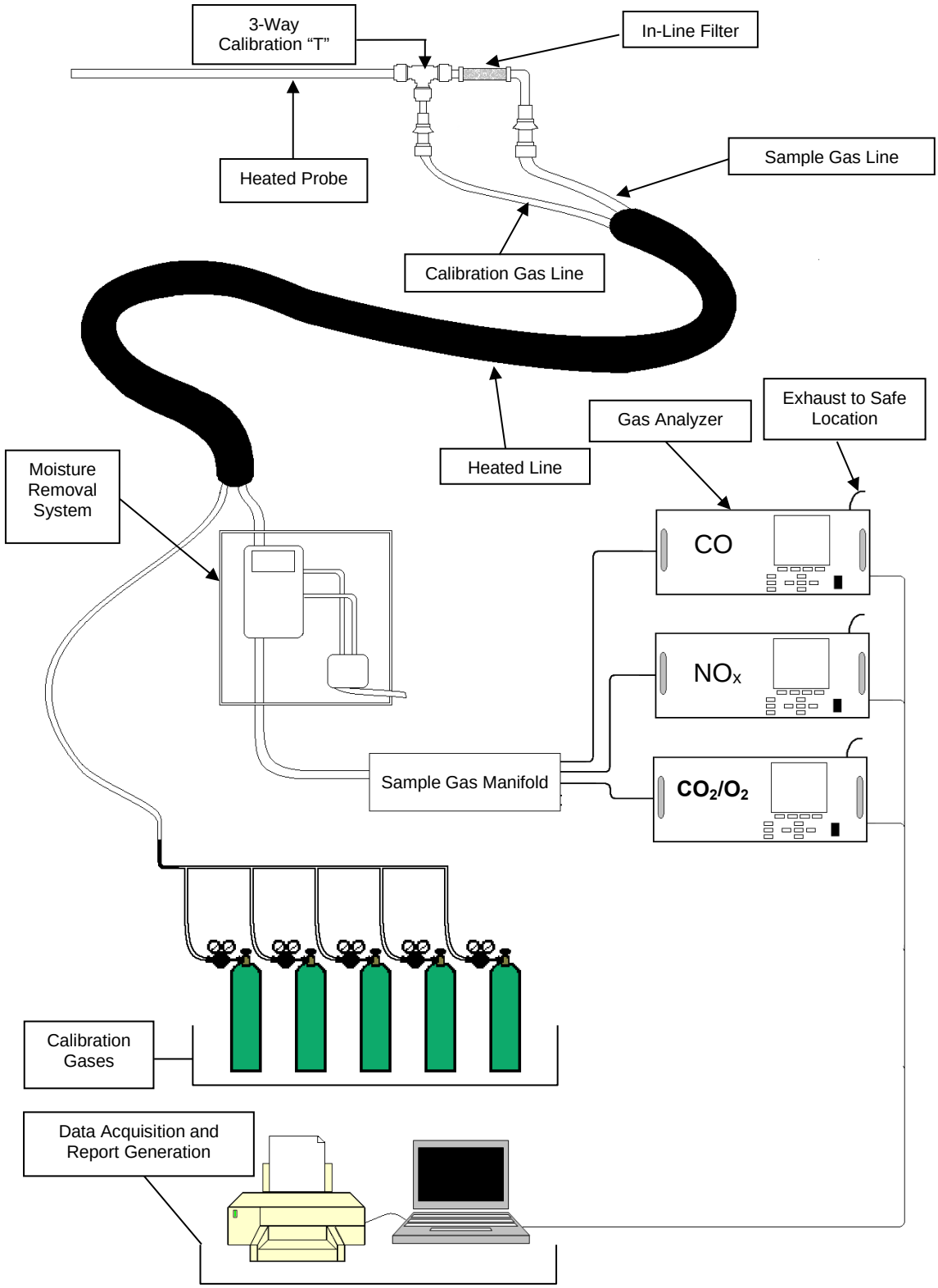
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



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