mostardi platt

Compliance Emissions Test Report

Lansing Board of Water & Light
Delta Energy Park Facility
EUCTGHRSG2
Permit to Install 74-18C
Lansing, Michigan
May 31, 2023

Report Submittal Date
June 30, 2023

Project No. M231206B

Crown Point, IN | Mendota Heights, MN | Denver, CO | Henderson, NV

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Elmhurst, Illinois 60126
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1.0 EXECUTIVE SUMMARY

Mostardi Platt performed a compliance emissions test program on the EUCTGHRSG2 Combined Cycle while firing natural gas at the Lansing Board of Water & Light, Delta Energy Park Facility in Lansing, Michigan. The purpose of the test program was to demonstrate compliance with requirements for emission rate in accordance with Permit to Install 74-18C at maximum achievable load. This report summarizes the results of the test program and test methods utilized.

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

TEST INFORMATION		
Test Location	**Test Date**	**Test Parameters**
EUCTGHRSG2	May 31, 2023	Total Particulate Matter (TPM), Nitrogen Oxide (NO_X), Volatile Organic Compounds (VOC)

All testing, sampling, analytical, and calibration procedures used for this test program was performed as described in the *Code of Federal Regulations*, Title 40, Part 60, Appendix A (40CFR60), Methods 1, 2, 3A, 4, 5, 7E, and 25A; Method 202, 40CFR51, and Appendix M; and the latest revisions thereof. Selected results of the test program are summarized below. A complete summary of emission test results follows the narrative portion of this report.

Operating data provided by Lansing Board of Water & Light is included in Appendix E.

Source	Pollutant Tested	Emissions Limit	Emission Rate
EUCTGHRSG2 (Combined Cycle)	TPM	$PM_{2.5}$ 6.02 lb/hr	0.851 lb/hr
		PM_{10} 6.02 lb/hr	0.851 lb/hr
	NO_X @ 15% O_2	3 ppm @ 15% O_2	2.19 @ 15% O_2
	NOx	60 lb/hr	4.27 lb/hr
	VOC	3 ppm @ 15% O_2	0.00 @ 15% O_2

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 PO Box 13007 Lansing, Michigan 48912-1610	Mr. Nathan Hude Environmental Compliance Specialist (517) 702-6170 (phone) nathan.hude@lbwl.com
Test Facility	Lansing Board of Water and Light Delta Energy Park Facility 3725 South Canal Road Lansing, MI 48917	
Testing Company Supervisor	Mostardi Platt 888 Industrial Drive Elmhurst, IL 60126	Mr. Jacob Howe Senior Project Manager 630-993-2100 (phone) jhowe@mp-mail.com

The test crew consisted of A. Benninghoff, E. Thomas, J. Meade and J. Howe of Mostardi Platt.

2.0 TEST METHODOLOGY

Emission testing was conducted following the United States Environmental Protection Agency (USEPA) methods specified in 40CFR60, Appendix A in addition the Mostardi Platt Quality Manual. Schematics of the test section diagrams and sampling trains used are included in Appendix A and B respectively. Calculation nomenclature are included in Appendix C. The computerized reference method test data is included in Appendix D. Process data as provided by Lansing Board of Water & Light are also included in Appendix E.

The following methodologies were used during the test program:

Methods 1 and 2 Volumetric Flowrate Determination

Gas velocity and volumetric flowrate are determined at the stack test location using Reference Methods 1 and 2 from the Method 5 sampling train.

Velocity pressures were determined by traversing the test location with an S-type pitot tube. Temperatures were measured using K-type thermocouples with calibrated digital temperature indicators. The molecular weight and moisture content of the gases are determined to permit the calculation of the volumetric flowrate. Sampling points utilized were determined using Method 1, 40CFR60, following the table below.

Location	Diameter	Upstream Diameters	Downstream Diameters	Test Parameters	Number of Sampling Points
EUCTGHRSG2	10 Feet	1.8	5.5	NOx/VOC/O_2/CO_2	12 (stratification) 3 for Runs 2 and 3

Method 3A Oxygen and Carbon Dioxide Determination

Stack gas oxygen (O_2) and carbon dioxide (CO_2) concentrations were determined in accordance with USEPA Method 3A, 40CFR60, Appendix A. A Servomex analyzer was used to determine the CO_2 and O_2 concentrations in the manner specified in the Method. The instrument has a

paramagnetic detector and the CO_2 and O_2 operate in the nominal range of 0% to 25% with the specific range determined by the high-level calibration gas. High-range calibrations were performed using USEPA Protocol gas. Zero nitrogen (a low ppm pollutant in balance nitrogen calibration gases) was introduced during other instrument calibrations to check instrument zero. High- and a mid-range % CO_2 and O_2 levels in balance nitrogen were also introduced. Zero and mid-range calibrations were performed using USEPA Protocol gas after each test run. Copies of the gas cylinder certifications are found in Appendix H. This testing met the performance specifications as outlined in the Method.

Method 5 Filterable Particulate Matter Determination

Exhaust gas FPM concentrations and emission rates were determined in accordance with Method 5. An Environmental Supply Company sampling train was used to sample stack gas at an isokinetic rate, as specified in the Method. Particulate matter in the sample probe was recovered using an acetone wash. The probe wash and filter catch were analyzed by Mostardi Platt in accordance with the Method. Laboratory analysis data are included in Appendix E. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Method 202 Condensable Particulate Determination

Stack gas condensable particulate matter concentrations and emission rates were determined in accordance with USEPA Method 202, in conjunction with the Method 5 filterable particulate sampling. This method applies to the determination of condensable particulate matter (CPM) emissions from stationary sources. It is intended to represent condensable matter as material that condenses after passing through a filter and as measured by this method.

The CPM was collected in the impinger portion of the Method 5 (Appendix A, 40CFR60) type sampling trains. The impinger contents were immediately purged after each run with nitrogen (N_2) to remove dissolved sulfur dioxide (SO_2) gases from the impinger contents. The impinger solution was then extracted with hexane. The organic and aqueous fractions were then taken to dryness and the residues weighed. A correction was made for any ammonia present due to laboratory analysis procedures. The total of both fractions represents the CPM.

Laboratory analysis data are included in Appendix E. All the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Method 7E Nitrogen Oxides Determination

Stack gas NO_X concentrations and emission rates were determined in accordance with USEPA Method 7E, 40CFR60, Appendix A. A Thermo Scientific Model 42i-HL Chemiluminescence Nitrogen Oxides Analyzer was used to determine nitrogen oxides concentrations, in the manner specified in the Method. The instrument operated in the nominal range of 0 ppm to 100 ppm with the specific range determined by the high-level span calibration gas.

The Model 42i operates on the principle that nitric oxide (NO) and ozone (O_3) react to produce a characteristic luminescence with an intensity linearly proportional to the NO concentration. Infrared light emission results when electronically excited NO_2 molecules decay to lower energy states. Specifically,

$$NO+O_3 \rightarrow NO_2+O_2+hv$$

Nitrogen dioxide (NO_2) must first be transformed into NO before it can be measured using the chemiluminescent reaction. NO_2 is converted to NO by a molybdenum NO_2-to-NO converter

heated to about 329°C. The flue gas sample is drawn into the Model 42*i* through the sample bulkhead. The sample flows through a capillary, and then to the mode solenoid valve. The solenoid valve routes the sample either straight to the reaction chamber (NO mode) or through the NO_2-to-NO converter and then to the reaction chamber (NO_x mode). A flow sensor prior to the reaction chamber measures the sample flow. Dry air enters the Model 42*i* through the dry air bulkhead, passes through a flow switch, and then through a silent discharge ozonator. The ozonator generates the ozone needed for the chemiluminescent reaction. At the reaction chamber, the ozone reacts with the NO in the sample to produce excited NO_2 molecules. A photomultiplier tube (PMT) housed in a thermoelectric cooler detects the luminescence generated during this reaction. From the reaction chamber, the exhaust travels through the ozone (O_3) converter to the pump and is released through the vent.

The NO and NO_X concentrations calculated in the NO and NO_X modes are stored in memory. The difference between the concentrations is used to calculate the NO_2 concentration. The Model 42i outputs NO, NO_2, and NO_X concentrations to the front panel display, the analog outputs, and also makes the data available over the serial or ethernet connection.

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 USEPA Protocol gases introduced at the probe, before and after each test run. This testing met the performance specifications as outlined in the Method.

A list of calibration gases used and the results of all calibration and other required quality assurance checks are found in Appendix G. Copies of the gas cylinder certifications are found in Appendix H. The NO_2 to NO converter test can be found in Appendix I. This testing met the performance specifications as outlined in the Method.

Method 25A Volatile Organic Compound (VOC) Determination

The Method 25A sampling and measurement system meets the requirements for sampling of volatile organic compounds (VOCs) set forth by the USEPA. In particular, it meets the requirements of USEPA Reference Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," 40CFR60, Appendix A. This method applies to the measurement of total gaseous organic concentration of hydrocarbons. With this method, gas samples are extracted from the sample locations through heated Teflon sample lines to the analyzers.

The FIDs used during this program was a Thermo 51i analyzer. It is a highly sensitive FID that provides a direct reading of total organic vapor concentrations with linear ranges of 0-100 ppm by volume. The instrument was calibrated using ultra-zero air and methane in air EPA Protocol standards. The calibrations were performed before and after sampling with calibration checks performed between each test run. Sample times and locations were logged simultaneously on data loggers.

Calculations were performed by computer or by hand. An explanation of the nomenclature and calculations along with the complete test results is included in the appendix. Also appended are calibration data and copies of the raw field data sheets.

3.0 TEST RESULT SUMMARIES

Client: Lansing Board of Water & Light
Facility: Delta Energy Park Facility
Test Location: EUCTGHRSG2 (Combined Cycle)
Test Method: 5/202

Source Condition	Full Load	Full Load	Full Load	
Date	5/31/23	5/31/23	5/31/23	
Start Time	6:25	9:15	12:02	
End Time	8:41	11:26	14:27	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	221.2	220.3	219.6	220.4
Flue Gas Moisture, percent by volume	9.3%	9.3%	9.7%	9.4%
Average Flue Pressure, in. Hg	28.93	28.93	28.93	28.93
Gas Sample Volume, dscf	110.245	108.069	108.109	108.808
Average Gas Velocity, ft/sec	63.766	62.446	62.472	62.895
Gas Volumetric Flow Rate, acfm	300,492	294,268	294,391	296,384
Gas Volumetric Flow Rate, dscfm	204,228	200,209	199,665	201,367
Gas Volumetric Flow Rate, scfm	225,195	220,828	221,151	222,391
Average $\%CO_2$ by volume, dry basis	4.6	4.4	4.0	4.3
Average $\%O_2$ by volume, dry basis	13.1	13.7	14.5	13.8
Isokinetic Variance	102.9	102.9	103.2	103.0
Standard Fuel Factor Fd, dscf/mmBtu	8,710.0	8,710.0	8,710.0	8,710.0
Filterable Particulate Matter (Method 5)				
grams collected	0.00227	0.00199	0.00150	0.00192
grains/acf	0.0002	0.0002	0.0001	0.0002
grains/dscf	0.0003	0.0003	0.0002	0.0003
lb/hr	0.556	0.488	0.366	0.470
lb/1000 lb of stack gas	0.001	0.001	0.000	0.001
lb/mmBtu (Standard Fd Factor)	0.0011	0.0010	0.0009	0.0010
Condensable Particulate Matter (Method 202)				
grams collected	0.00133	0.00196	0.00138	0.00156
grains/acf	0.0001	0.0002	0.0001	0.0001
grains/dscf	0.0002	0.0003	0.0002	0.0002
lb/hr	0.326	0.480	0.337	0.381
lb/1000 lb of stack gas	0.000	0.001	0.000	0.000
lb/mmBtu (Standard Fd Factor)	0.0006	0.0010	0.0008	0.0008
Total Particulate Matter (5/202)				
grams collected	0.00360	0.00395	0.00288	0.00348
grains/acf	0.0003	0.0004	0.0002	0.0003
grains/dscf	0.0005	0.0006	0.0004	0.0005
lb/hr	0.882	0.968	0.703	0.851
lb/1000 lb of stack gas	0.001	0.001	0.001	0.001
lb/mmBtu (Standard Fd Factor)	0.0017	0.0020	0.0017	0.0018

Lansing Board of Water and Light Delta Energy Park EUCTGHRSG2 (Combined Cycle) Reference Method Test Data									
Test No.	Date	Start Time	End Time	NO_x, ppmvd	Flowrate, DSCFM	NO_x, lb/mmBtu	NOx, lb/hr	NOx ppmvd @ 15% O2	O_2, % (dry)
1	5/31/2023	7:00	7:20	3.0	204,228	0.008	4.40	2.24	13.0
2	5/31/2023	7:38	7:58	3.0	204,228	0.008	4.37	2.23	13.0
3	5/31/2023	8:14	8:34	3.0	204,228	0.008	4.37	2.22	12.9
Average Runs 1-3				3.0	204,228	0.008	4.38	2.23	13.0
4	5/31/2023	9:00	9:20	2.9	200,209	0.008	4.19	2.17	13.0
5	5/31/2023	9:39	9:59	3.0	200,209	0.008	4.31	2.23	13.0
6	5/31/2023	10:15	10:35	2.9	200,209	0.008	4.22	2.16	12.9
Average Runs 4-6				3.0	200,209	0.008	4.24	2.19	12.9
7	5/31/2023	10:58	11:18	2.9	199,665	0.008	4.21	2.16	12.9
8	5/31/2023	11:37	11:57	3.0	199,665	0.008	4.23	2.17	12.9
9	5/31/2023	12:12	12:32	2.9	199,665	0.008	4.10	2.11	12.9
Average Runs 7-9				2.9	199,665	0.008	4.18	2.15	12.9
Average Runs 1-9				3.0	201,367	0.008	4.27	2.19	12.9

Lansing Board of Water & Light Delta Energy Park EUCTHRSG2 (Combined Cycle) Gaseous Summary Normal Load										
Test No.	Date	Start Time	End Time	Moisture, %	Flowrate, DSCFM	Flowrate, SCFM	O2% dry	THC ppm as C_3H_8 (wet)	THC ppm as C_3H_8 (dry)	VOC ppm @ 15% O2 (dry)
1	05/31/23	07:00	08:34	9.3	204,228	225,195	13.1	0.0	0.0	0.0
2	05/31/23	09:00	10:35	9.3	200,209	220,828	13.7	0.0	0.0	0.0
3	05/31/23	10:58	12:32	9.7	199,665	221,151	14.5	0.0	0.0	0.0
Average				9.4	201,367	222,391	13.8	0.0	0.0	0.0

4.0 CERTIFICATION

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

As the program 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. The test program was performed in accordance with the test methods and the Mostardi Platt Quality Manual, as applicable.

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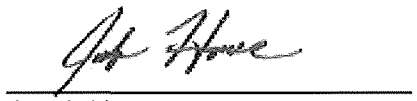
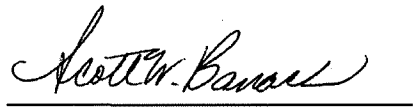


Jacob Howe — Program Manager

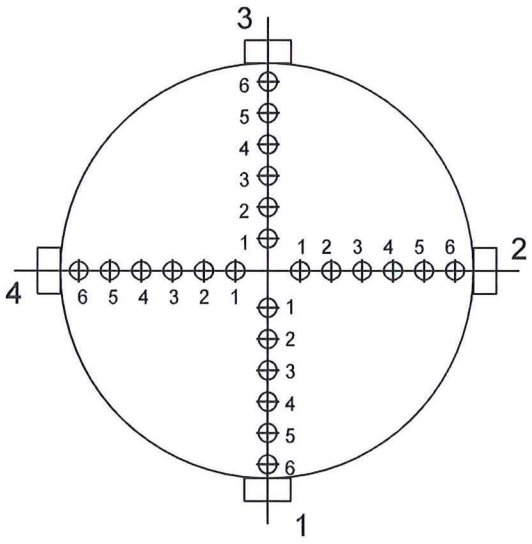


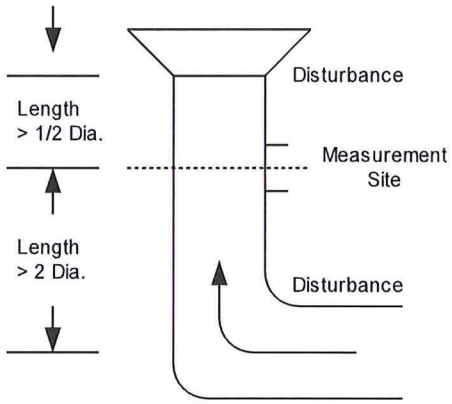
Scott W. Banach — Quality Assurance

APPENDICES

Appendix A - Test Section Diagrams

EQUAL AREA TRAVERSE FOR ROUND DUCTS





Job: Lansing Board of Water & Light

Delta Energy Park

Lansing, MI

Date: May 31, 2023

Test Location: EUCTGHRSG2 (COMB)

Duct Diameter: 10 Feet

Duct Area: 78.54 Square Feet

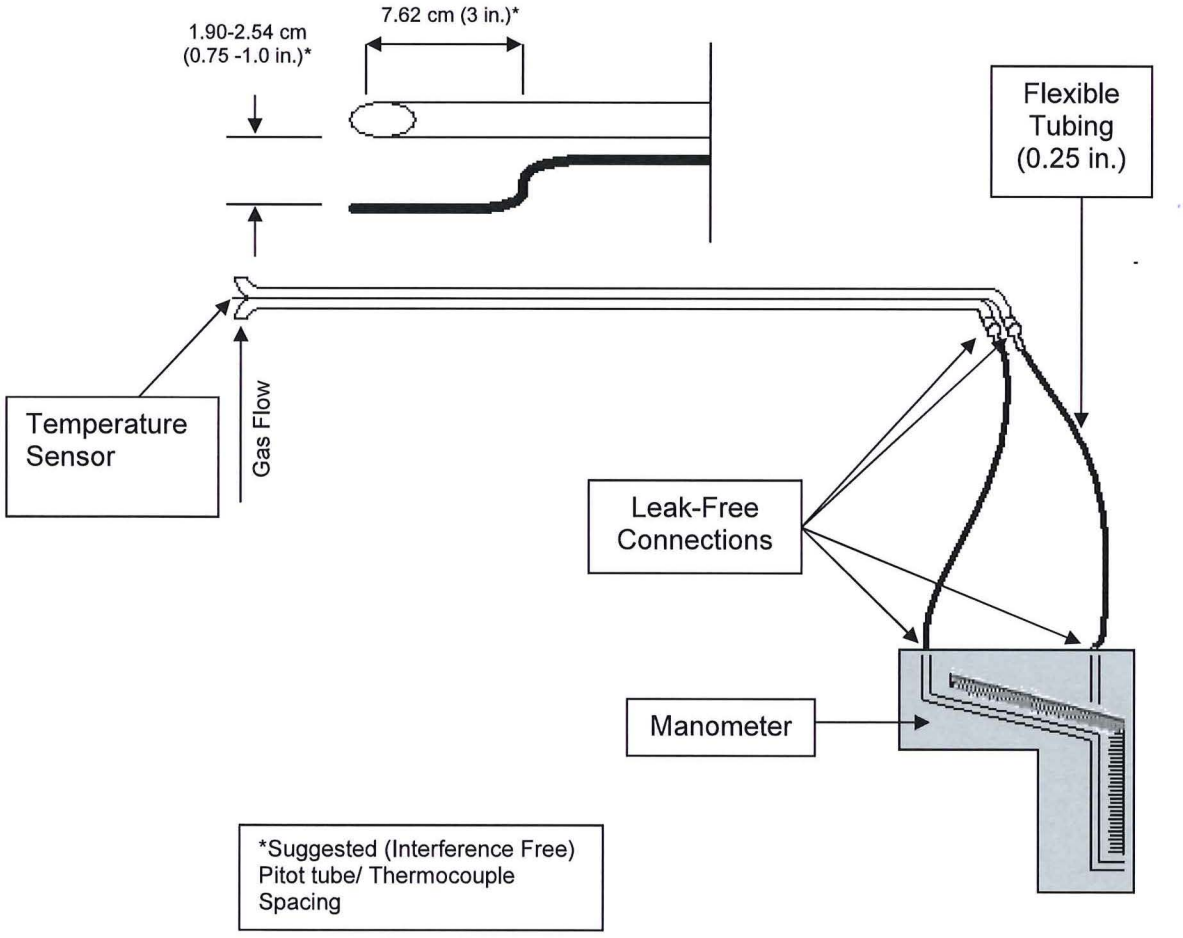
No. Points Across Diameter: 12

No. of Ports: 4

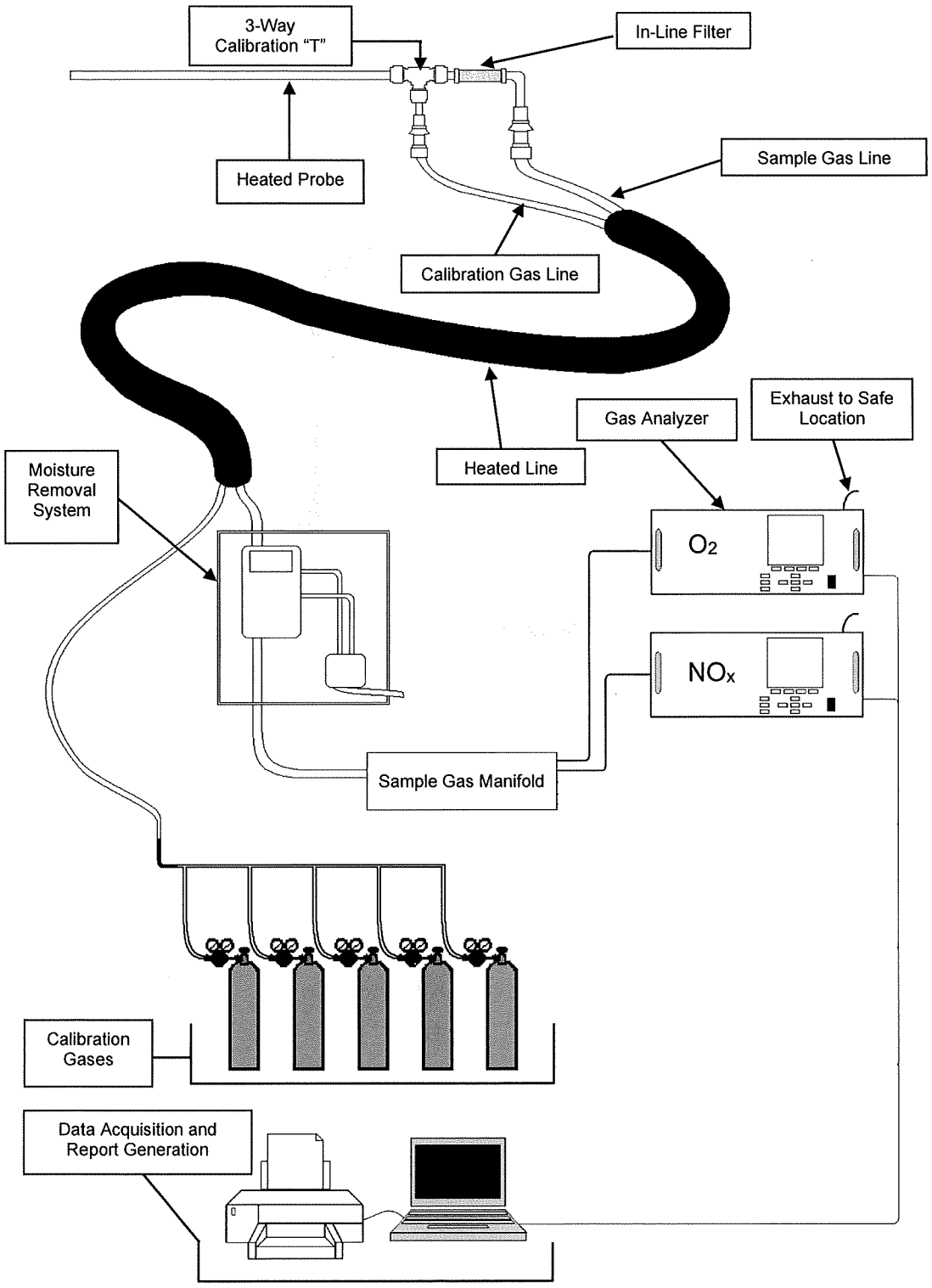
Port Length: 6 Inches

Appendix B - Sample Train Diagrams

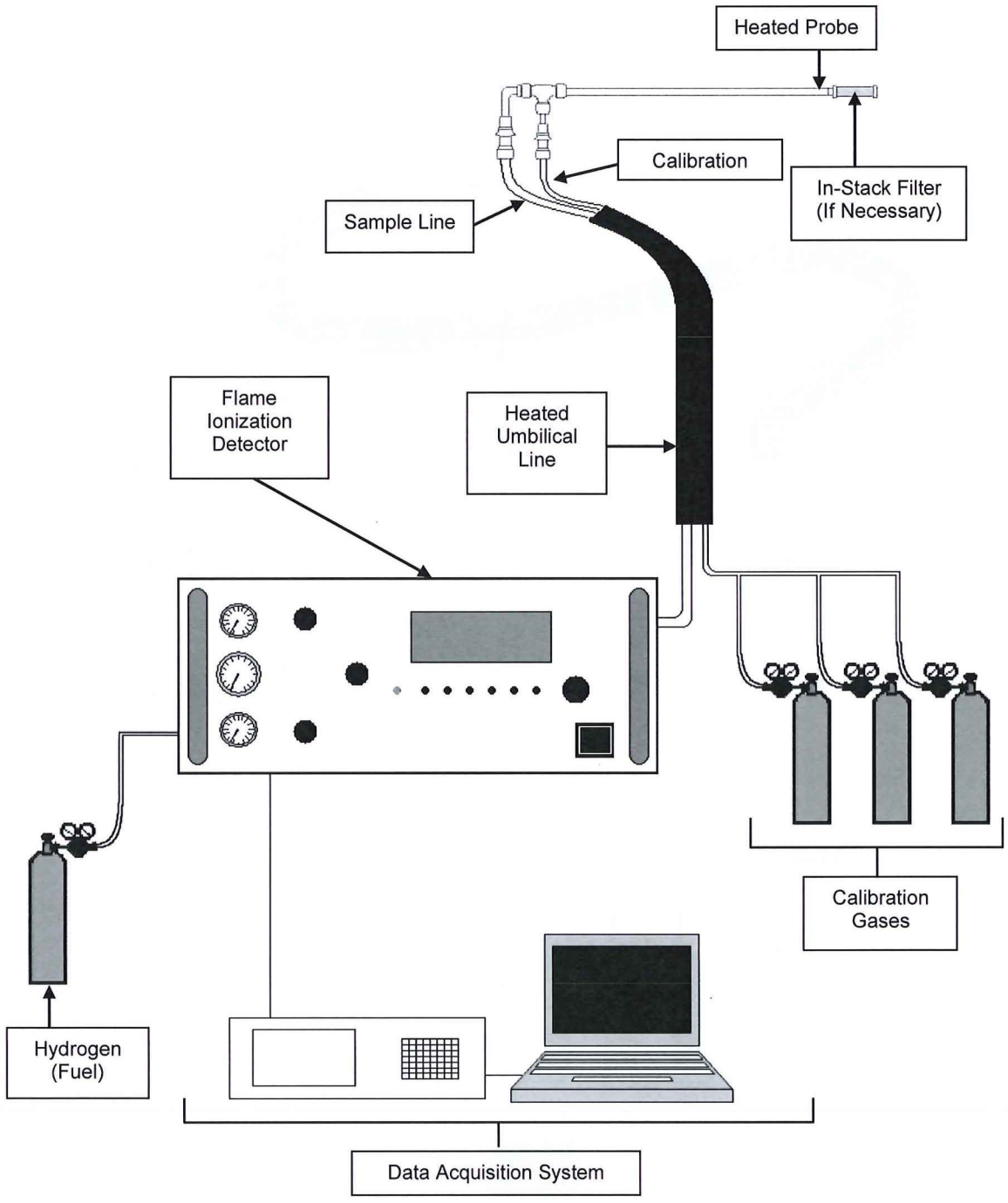
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



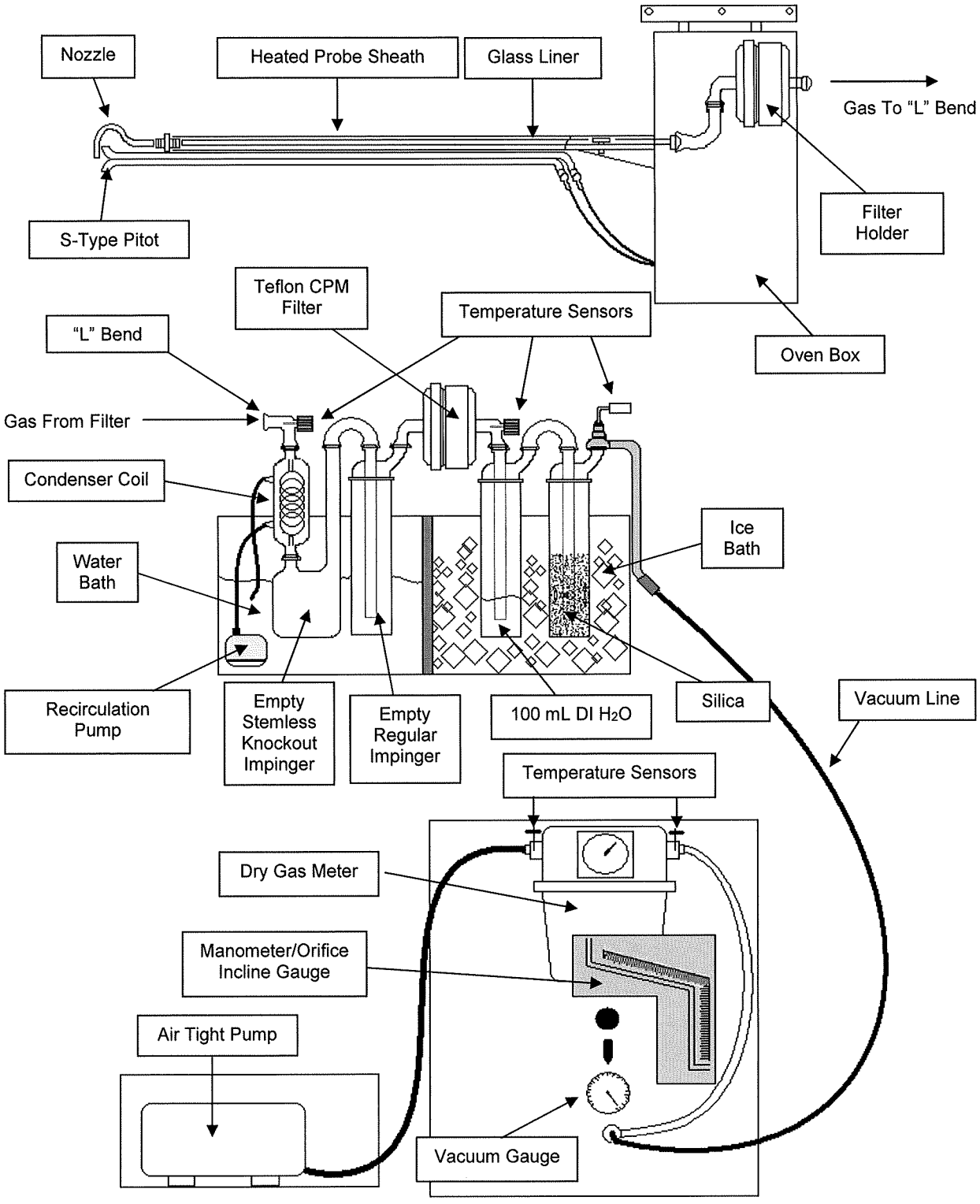
USEPA Methods 3A and 7E Extractive Gaseous Sampling Diagram



USEPA Method 25A – Total Gaseous Organic Compound Sample Train



USEPA Method 5/202- Filterable/Condensable Particulate Matter



Appendix C - Calculation Nomenclature and Formulas