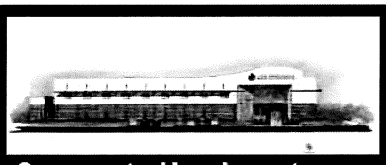
AIR HYGIENE, INC.

Testing Solutions for a Better World

EMISSION COMPLIANCE TEST FOR THE KILN MAIN STACK, FINISH MILL, AND CLINKER COOLER PREPARED FOR ST. MARYS CEMENT AT THE ST. MARYS CHARLEVOIX CHARLEVOIX, MICHIGAN SEPTEMBER 3-6, 2019

Permit No: M1-ROP-B1559-2014
SRN No: B1559



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FOR THE
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PREPARED FOR
ST. MARYS CEMENT
AT THE
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CHARLEVOIX, MICHIGAN
SEPTEMBER 3-6, 2019

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Cole McBride, QSTI
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certify that this testing was conducted and this report was created in conformance with the requirements of ASTM D7036

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CERTIFICATION OF INFORMATION

I certify under penalty of law that I believe the information provided in this document is true, accurate and complete. I am aware that there are significant civil and criminal penalties, including the possibility of fine or imprisonment or both, for submitting false, inaccurate or incomplete information.

Cole McBride, QSTI
Sr. Project Manager
Air Hygiene International, Inc.

September 11, 2019
Date

FACILITY CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attached documents and, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil and criminal penalties, including the possibility of fine or imprisonment or both, for submitting false, inaccurate or incomplete information.

I am the responsible official with direct knowledge and overall responsibility for the information contained in this report.

Matthew Simon
Name

Operations Manager
Title

Signature

10/29/19
Date

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Emissions Compliance Test
Kiln Main Stack, Finish Mill, and Clinker Cooler
St. Marys Cement
St. Marys Charlevoix
Charlevoix, Michigan
September 3-6, 2019

1.0 INTRODUCTION

Air Hygiene International, Inc. (Air Hygiene) has completed the Emissions Compliance Test for organic hazardous air pollutants (OHAPs) [benzene, toluene, styrene, naphthalene, xlyene (m, p, and o), formaldehyde, and acetaldehyde], particulate matter (PM), flow, moisture (H_2O), carbon dioxide (CO_2), and oxygen (O_2) from the exhaust of the Kiln Main Stack, Finish Mill, and Clinker Cooler for St. Marys Cement at the St. Marys Charlevoix near Charlevoix, Michigan. This report details the background, results, process description, and the sampling/analysis methodology of the stack sampling survey conducted on September 3-6, 2019.

1.1 TEST PURPOSE AND OBJECTIVES

The purpose of the test was to conduct a compliance emission test to document levels of selected pollutants at normal operating conditions for all test locations and with the raw mill off and raw mill on, for testing at the kiln main stack. The information will be used to confirm compliance with the operating permit issued by the Michigan Department of Environment, Great Lakes, and Energy (Michigan EGLE) and 40 Code of Federal Regulations (CFR) Part 63, Subpart LLL (Portland Cement MACT). The specific objective was to determine the emission concentration of OHAPs, PM, flow, H_2O, CO_2, and O_2 from the exhaust of St. Marys Cement's Kiln Main Stack, Finish Mill, and Clinker Cooler.

1.2 SUMMARY OF TEST PROGRAM

The following list details pertinent information related to this specific project:

1.2.1 Participating Organizations
- Michigan Department of Environment, Great Lakes, and Energy (Michigan EGLE)
- St. Marys Cement
- Fishbeck, Thompson, Carr & Huber, Inc.
- Air Hygiene

1.2.2 Industry
- Cement Production

1.2.3 Air Permit Requirements
- Permit Number: M1-ROP-B1559-2014 and PTI 140-15

1.2.4 Plant Location
- St. Marys Charlevoix near Charlevoix, Michigan
  - GPS Coordinates [Latitude 45.316252, Longitude -85.298356]
  - Physical Address: 16000 Bell Bay Road, Charlevoix, Michigan 49720
  - Federal Registry System / Facility Registry Service (FRS) No. – 110042084570
  - Source Classification Code (SCC) – 30500699, 30500614

1.2.5 Equipment Tested
- Kiln Main Stack, Finish Mill, and Clinker Cooler

1.2.6 Emission Points

- Exhaust from the Kiln Main Stack, Finish Mill, and Clinker Cooler
- For all PM testing, 12, 24, and 12 sampling points, respectively, in the exhaust ducts from the Kiln Main Stack, Finish Mill, and Clinker Cooler
- For all OHAPs testing, one sampling point in the exhaust duct from the Kiln Main Stack

1.2.7 Emission Parameters Measured

- OHAPs [benzene, toluene, styrene, naphthalene, xlyene (m, p, and o), formaldehyde, and acetaldehyde]
- PM
- Flow
- H_2O
- CO_2
- O_2

1.2.8 Dates of Emission Test

- September 3-6, 2019

1.2.9 Federal Certifications

- Stack Testing Accreditation Council AETB Certificate No. 3796.02
- International Standard ISO/IEC 17025:2005 Certificate No. 3796.01

1.3 KEY PERSONNEL

St. Marys Cement:	Ruben Plaza (ruben.plaza@vcimentos.com)	905-623-3341
St. Marys Cement:	Kelly Carr (kelly.carr@vcimentos.com)	231-350-3853
St. Marys Cement:	Laurie Leaman (laurie.leaman@vcimentos.com)	231-237-1387
Fishbeck, Thompson, Carr & Huber, Inc.:	Stephanie Jarrett (sajarrett@ftch.com)	248-324-2146
Michigan EGLE:	Jeremy Howe	231-878-6687
Air Hygiene:	Cole McBride (cmcbride@airhygiene.com)	918-307-8865
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Air Hygiene:	Atlas Melchert	918-307-8865

2.0 SUMMARY OF TEST RESULTS

Results from the sampling conducted on St. Marys Cement's Kiln Main Stack, Finish Mill, and Clinker Cooler located at the St. Marys Charlevoix on September 3-6, 2019 are summarized in the following table and relate only to the items tested.

TABLE 2.1
SUMMARY OF KILN STACK, FINISH MILL, AND CLINKER COOLER RESULTS

Parameter	Kiln Main Raw Mill Off	Kiln Main Raw Mill On	Permit Limits	Finish Mill	Permit Limits	Clinker Cooler	Permit Limits
Production Rate (ton/hr)	230.0	247.9	–	107.0	–	241.1	–
Benzene (ppm@7%O_2)	2.32	2.15	–	–	–	–	–
Toluene (ppm@7%O_2)	0.47	0.44	–	–	–	–	–
Styrene (ppm@7%O_2)	0.26	0.24	–	–	–	–	–
Napthalene (ppm@7%O_2)	0.21	0.20	–	–	–	–	–
Xylenes (ppm@7%O_2)	0.10	0.09	–	–	–	–	–
Formaldehyde (ppm@7%O_2)	1.12	0.71	–	–	–	–	–
Acetaldehyde (ppm@7%O_2)	6.40	6.04	–	–	–	–	–
Total OHAPs (ppm@7%O_2)	10.89	9.88	12	–	–	–	–
Total PM (mg)	43.11	35.54	–	6.01	–	7.13	–
Total PM (g/dscf)	3.65E-04	3.04E-04	–	9.03E-05	–	6.81E-05	–
Total PM (lb/hr)	12.8	10.8	57.5	0.92	6.24	1.9	5.0
Total PM (lb/ton of production)	0.055	0.044	–	0.009	–	0.008	–
Filterable PM (mg)	43.11	35.54	–	5.06	–	7.11	–
Filterable PM (g/dscf)	3.65E-04	3.04E-04	–	7.60E-05	–	6.80E-05	–
Filterable PM (lb/hr)	12.78	10.80	–	0.78	–	1.91	–
Filterable PM (lb/klb exh)	–	–	–	0.003	0.15	–	–
Filterable PM (lb/ton of production)	0.06	0.04	0.07	0.007	–	0.01	0.02
Condensable PM (mg)	–	–	–	0.95	–	0.02	–
Condensable PM (g/dscf)	–	–	–	1.43E-05	–	1.69E-07	–
Condensable PM (lb/hr)	–	–	–	0.15	–	0.005	–
Condensable PM (lb/ton of production)	–	–	–	0.001	–	0.00002	–
Formaldehyde (ppmvd)	1.01	0.65	–	–	–	–	–
Benzene (ppmvd)	2.09	1.95	–	–	–	–	–
Toluene (ppmvd)	0.42	0.40	–	–	–	–	–
Styrene (ppmvd)	0.24	0.22	–	–	–	–	–
Acetaldehyde (ppmvd)	5.78	5.50	–	–	–	–	–
Napthalene (ppmvd)	0.19	0.18	–	–	–	–	–
Xylenes (ppmvd)	0.09	0.08	–	–	–	–	–
O_2 (%)	8.35	8.26	–	–	–	–	–

The results of all measured pollutant emissions were below the required limits. All testing was performed without any real or apparent errors. All testing was conducted according to the approved testing protocol. However, Method 202 testing, as listed in the protocol, was not conducted on the Kiln Main Stack.

3.0 SOURCE OPERATION

3.1 PROCESS DESCRIPTION

St. Marys Cement (SMC) owns and operates the St. Marys Charlevoix Facility located at 16000 Bell Bay Road in Charlevoix, Michigan. The St. Marys Charlevoix Facility includes an in-line kiln/raw mill equipped with a baghouse, an alkali bypass stack, a finish mill, and a clinker cooler. At this time the alkali bypass stack has been shut down. Should St. Marys Charlevoix need to return the bypass stack to service in the future, St. Marys Charlevoix will notify EGLE and will schedule performance testing.

3.2 SAMPLING LOCATION

The Kiln Main Stack is vertical, circular and measures 10.6 feet (ft) (127.2 inches) in diameter at the test ports which are approximately 173 ft above grade level with an exit elevation of approximately 323 ft above grade

level. The test ports are located approximately 167 ft (2000 inches) downstream and approximately 83 ft (1000 inches) upstream from the nearest disturbances.

The Clinker Cooler Stack is vertical, circular and measures 10.2 feet (ft) (122 inches) in diameter at the test ports which are approximately 74 ft above grade level with an exit elevation of approximately 134 ft above grade level. The test ports are located approximately 82 ft (982 inches) downstream and approximately 21 ft (246 inches) upstream from the nearest disturbances.

The Finish Mill Stack is vertical, circular and measures 7.67 feet (ft) (92 inches) in diameter at the test ports. The test ports are located approximately 26 ft (306 inches) downstream and approximately 84 ft (1005 inches) upstream from the nearest disturbances.

For PM testing, an initial velocity traverse was performed across the stack to confirm the absence of cyclonic flow and profile the stack temperatures and pressure heads. All subsequent PM sampling occurred from the same initial velocity traverse points by leaving the probe at each for an equal amount of time in order to draw at least 2.0 dry standard cubic meters of gas through the sample trains.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 TEST METHODS

The emission test on the Kiln Main Stack, Finish Mill, and Clinker Cooler at the St. Marys Charlevoix was performed following United States Environmental Protection Agency (EPA) methods described by the Code of Federal Regulations (CFR). Table 4.1 outlines the specific methods performed on September 3-6, 2019.

TABLE 4.1
SUMMARY OF SAMPLING METHODS

Pollutant or Parameter	Sampling Method	Analysis Method
Sample Point Location	EPA Method 1	Equal Area Method
Stack Flow Rate	EPA Method 2	S-Type Pitot Tube
Oxygen	EPA Method 3A	Paramagnetic Cell
Carbon Dioxide	EPA Method 3A	Nondispersive Infrared Analyzer
Stack Moisture Content	EPA Method 4	Gravimetric Analysis
Particulate Matter	EPA Method 5	Front Half Filterables
OHAPs [benzene, toluene, styrene, naphthalene, xlyene (m, p, and o)]	EPA Method 18	Gas Chromatography
Particulate Matter [FM and CC only]	EPA Method 202	Back Half Condensables
OHAPs [formaldehyde and acetaldehyde]	EPA Method 320	Fourier Transform Infrared

4.2 INSTRUMENT CONFIGURATION AND OPERATIONS FOR GAS ANALYSIS

The sampling and analysis procedures used during these tests conform with the methods outlined in the Code of Federal Regulations (CFR), Title 40, Part 60, Appendix A, Methods 1, 2, 3A, 4, 5, 18; 40 CFR 51, Appendix M, Method 202; and 40 CFR 63, Appendix A, Method 320.

Figure 4.1 depicts the sample system used for the real-time gas analyzer tests. The gas sample was continuously pulled through the probe and transported, via heat-traced Teflon® tubing, to a heated head pump and into the FTIR then to a stainless-steel minimum-contact condenser designed to dry the sample. Transportation of the sample, through Teflon® tubing, continued into the sample manifold within the mobile laboratory via a stainless steel/Teflon® diaphragm pump. From the manifold, the sample was partitioned to the real-time analyzers through rotameters that controlled the flow rate of the sample. Exhaust samples were routed to the wet based analyzer prior to gas conditioning.

Figure 4.1 shows that the sample system was also equipped with a separate path through which a calibration gas could be delivered to the probe and back through the entire sampling system. This allowed for convenient performance of system bias checks as required by the testing methods.

All instruments were housed in a climate controlled, trailer-mounted mobile laboratory. Gaseous calibration standards were provided in aluminum cylinders with the concentrations certified by the vendor. EPA Protocol No. 1 was used to determine the cylinder concentrations where applicable (i.e. NOx calibration gases).

Table 4.2 provides a description of the analyzers used for the instrument portion of the tests. All data from the continuous monitoring instruments were recorded on a Logic Beach Portable Data Logging System which retrieves calibrated electronic data from each instrument every one second and reports an average of the collected data every 30 seconds. For target compounds measured with the Fourier transform infrared (FTIR) spectrometer, interferograms consisting of 27 co-added scans were recorded continuously during the test periods, and provided approximately 30-second average concentrations. Spectral data was analyzed by the MKS MG2000 software.

Figure 4.2 represents the sample system used for the PM tests. A heated stainless-steel probe with a glass liner and nozzle was inserted into the sample ports of the stack to extract gas measurements from the emission stream through a filter and glass impinger train. Flow rates are monitored with oil filled manometers and total sample volumes are measured with a dry gas meter. Glassware that is used to collect and analyze Method 202 condensable particulate samples, at the FM and CC, is cleaned prior to the test with soap and water, and rinsed using tap water, deionized water, acetone, and finally, hexane. After cleaning, Air Hygiene incorporates a glassware bake at 300°C for six hours rather than the alternative of collecting a field train proof blank.

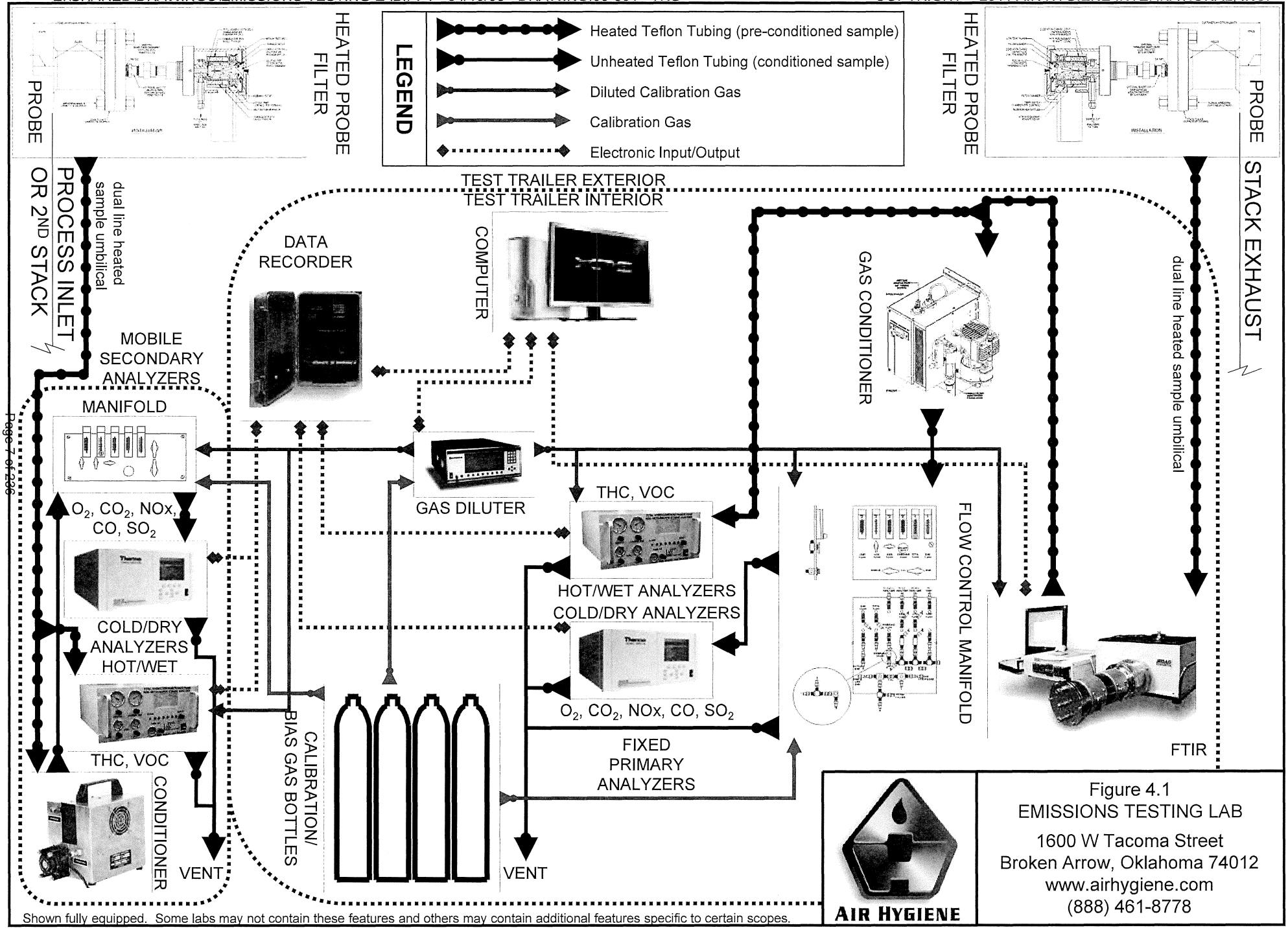
The stack gas analysis for O_2 and CO_2 concentrations was performed in accordance with procedures set forth in EPA Method 3A. The O_2 analyzer uses a paramagnetic cell detector and the CO_2 analyzer uses a continuous nondispersive infrared analyzer.

An MKS Instruments - MultiGas™ Fourier Transform Infrared (FTIR) spectrometer, or equivalent, was used for HAP [formaldehyde and acetaldehyde] analysis per EPA Method 320. The FTIR spectrometer spectral resolution was 0.5 cm^{-1}. The system employed a silicon carbide infrared source at 1200°C, a helium neon reference laser, beam splitters, potassium bromide (KBr) cell window, front-surface optical transfer mirrors, and multi-pass absorption cells. MCT detectors were used and cooled with liquid nitrogen in order to maintain a constant temperature of 77 Kelvin. The approximately 5.11-meter multi-pass path cells incorporated aspheric, aberration-correcting mirrors to increase the optical throughput and the detection sensitivity. Transducers and thermocouples

were connected directly to the insulated sample cells that provide the pressure and temperatures of the sample streams. During testing, the temperature of the absorption cells was set at 191°C. Elevated temperature prevented gas condensation within the cell and minimized compound adhesion to the cell walls and mirrors. The volume of the absorption cell was 0.5 liters, so at a sample gas flow rate of 4.0 liters per minute, the sample gas in the cell is refreshed approximately four times each minute. Interferograms consisting of 28 co-added scans were recorded continuously during the test periods, and provided approximately 30-second average concentrations.

TABLE 4.2
ANALYTICAL INSTRUMENTATION

Parameter	Manufacturer and Model	Range	Sensitivity	Detection Principle
CO_2	SERVOMEX 1440	0-20%	0.1%	Nondispersive infrared
OHAPs	MKS 2030	User may select from multiple ranges	0.1 ppm	Fourier Transform Infrared – FTIR
O_2	SERVOMEX 1440	0-25%	0.1%	Paramagnetic cell, inherently linear.



Shown fully equipped. Some labs may not contain these features and others may contain additional features specific to certain scopes.

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Figure 4.1
EMISSIONS TESTING LAB

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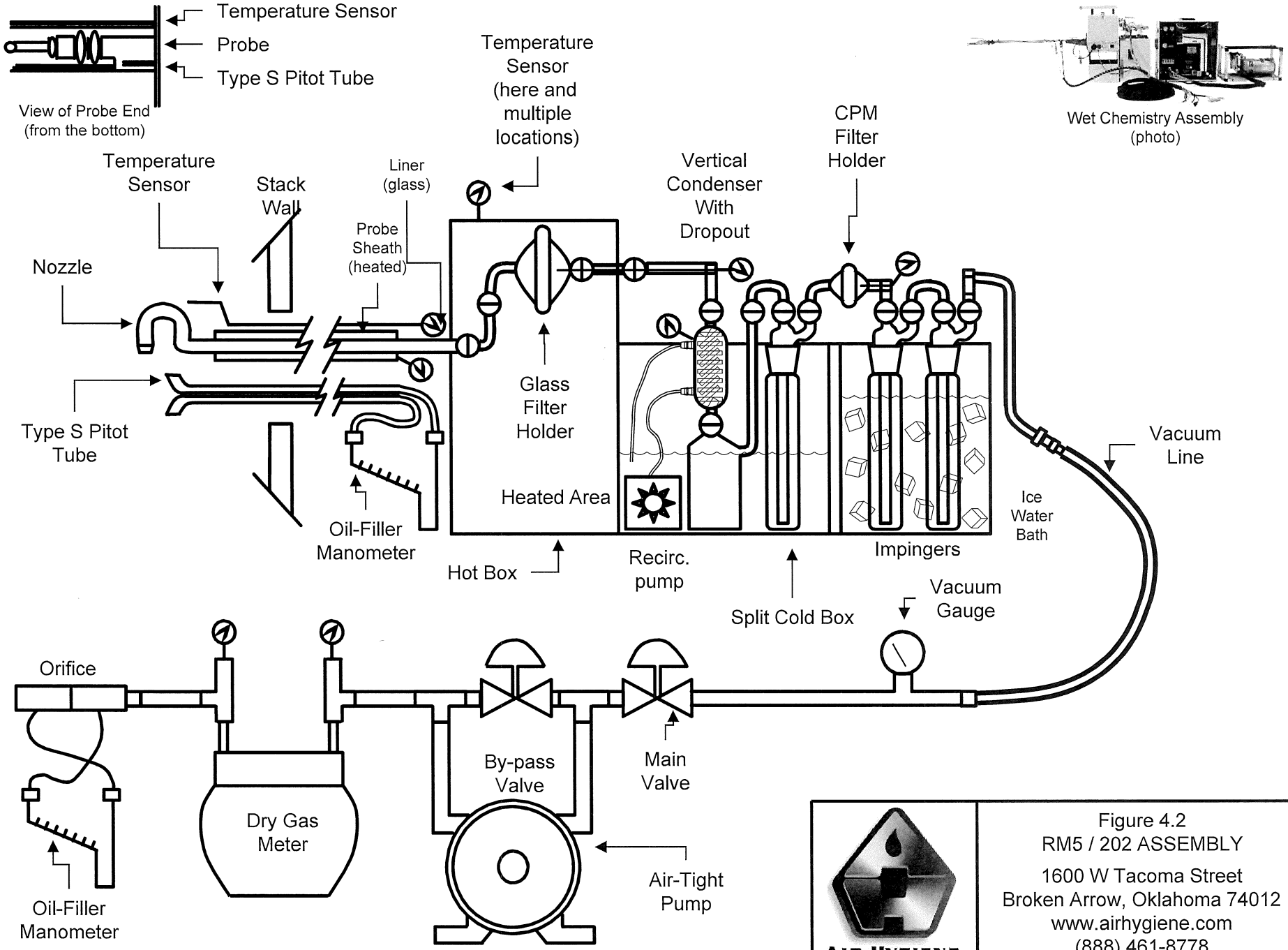

Figure 4.2
RM5 / 202 ASSEMBLY

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APPENDIX A

TEST RESULTS AND CALCULATIONS