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Particulate Matter Air Pollutant Compliance Emissions Test Report

St Marys Cement
Charlevoix Plant
Main Kiln
Charlevoix, Michigan
July 18 and 19, 2023

Report Submittal Date
September 13, 2023

Project No. M232110A

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

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1.0 EXECUTIVE SUMMARY

Mostardi Platt conducted a compliance particulate test program for St Marys Cement at the Charlevoix Plant in Charlevoix, Michigan on the Main Kiln Stack. Main Kiln testing was performed during both "mill on" and "mill off" conditions.

The test locations, test dates, and test parameter are summarized below.

TEST INFORMATION		
Test Locations	**Test Dates**	**Test Parameters**
Main Kiln Stack (Mill On)	July 18, 2023	Filterable Particulate Matter (FPM), Condensable Particulate Matter (CPM), Total Particulate Matter (TPM), Particulate Matter less than 10 microns (PM_{10}), and Particulate Matter less than 2.5 microns ($PM_{2.5}$)
Main Kiln Stack (Mill Off)	July 19, 2023	

The purpose of the test program was to demonstrate compliance with Title 40, *Code of Federal Regulations*, Part 63 (40CFR63), Subpart LLL "*National Emission Standards for Hazardous Air Pollutants (NESHAP) for the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants.*" Specifically, to demonstrate that each of the below listed sources meet their FPM emission limit and to establish a site-specific operating limit (SSOL) for each emission point's continuous parameter monitoring system (CPMS). Additionally, $PM/PM_{10}/PM_{2.5}$ testing was performed in conjunction with the above testing on the Main Kiln Stack in order to demonstrate compliance with Michigan Permit to Install 140-15C and Consent Order AQD No. 2021-09. For reporting purposes, all particulate matter collected (TPM) is considered to be less than $PM_{10}/PM_{2.5}$.

1.1 SSOL Results

Test Location	Parameter	Emission Rate	Filterable Particulate Matter, % of Emissions Limit	Emission Limit	CPMS 3-run Average	CPMS SSOL[1]
Main Kiln Stack (Mill On)	FPM	0.004 lb/ton	5.3	0.07 lb/ton	0.52 mg/m^3	6.91
Main Kiln Stack (Mill Off)	FPM	0.011 lb/ton	15.2	0.07 lb/ton	1.22 mg/m^3	

[1] Main Kiln SSOL is prorated based upon the time weighted average for mill on (87%) and mill off (13%) conditions

1.2 Compliance Results

Test Location	Parameter	Emission Limit	Test Result (Mill On)	Test Result (Mill Off)
Main Kiln Stack	$PM_{10}/PM_{2.5}$	Emission Factor established during test	0.282 lb/ton clinker	1.370 lb/ton clinker
Main Kiln Stack	FPM	0.25 lb/1000lb of stack gas	0.001 lb/1000 lb of stack gas	0.002 lb/1000 lb of stack gas

The identifications of the individuals associated with the test program are summarized below.

TEST PERSONNEL INFORMATION		
Location	**Address**	**Contact**
Test Facility	St Marys Cement Charlevoix Cement Plant 16000 Bells Bay Road Charlevoix, Michigan 49720	Laurie Leaman Environmental Manager (231) 237-1387 laurie.leaman@vcimentos.com
Testing Company Supervisor	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Nicholas C. Colangelo Test Supervisor 630-993-2100 (phone) ncolangelo@mp-mail.com

The test crew consisted of N. Colangelo, A. Diaz, A. Benninghoff.

2.0 TEST METHODOLOGY

Emission testing was conducted following the United States Environmental Protection Agency (USEPA) methods specified in 40CFR60, Appendix A and 40CFR51, Appendix M 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. Laboratory analysis for each test run are included in Appendix D. The computerized reference method test data is included in Appendix E. CPMS data and process data as provided by St Marys Cement are also included in Appendix F.

The following methodologies were used during the test program:

Method 1 Sample and Velocity Traverse Determination

Test measurement points were selected in accordance with USEPA Method 1, 40CFR60, Appendix A. The characteristics of the measurement location are summarized below.

TEST POINT INFORMATION							
Test Location	**Stack Dimensions**	**No. of Ports**	**Port Length (Inches)**	**Upstream Diameters**	**Downstream Diameters**	**Test Parameters**	**Number of Sampling Points**
Main Kiln Stack	10.58'	2	6	7.86	15.72	$PM/PM_{10}/PM_{2.5}$	12

Method 2 Volumetric Flow Rate Determination

Gas velocity was measured following USEPA Method 2, 40CFR60, Appendix A, for purposes of calculating stack gas volumetric flow rate and emission rates on a lb/hr basis. S-type pitot tubes, 0-10" differential pressure gauge, and K-type thermocouple and temperature readout were used to determine gas velocity at each sample point. All of the equipment used was calibrated in accordance with the specifications of the Method. Copies of field data sheets are included in Appendix G. Calibration data are presented in Appendix H. This testing met the performance specifications as outlined in the Method.

Method 3A Oxygen (O_2)/Carbon Dioxide (CO_2) Determination

Flue gas O_2 and CO_2 concentrations for the Main Kiln Stack were determined in accordance with USEPA Method 3A. A Servomex analyzer was used to determine the O_2 and CO_2 concentrations by taking an integrated sample in a tedlar bag for the duration of the test run and analyzing after each test run. The O_2 instrument operates in the nominal range of 0% to 25% with the specific range determined by the high-level calibration gas. The CO_2 instrument operates in the nominal range of 0% to 80% with the specific range determined by the high-level calibration gas. High and mid-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. 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 I.

Method 5 Filterable Particulate Matter (FPM) Determination

FPM runs were performed at the Main Stack during Raw Mill On and Raw Mill Off conditions, in accordance with USEPA Method 5, 40CFR60, Appendix A. Each run was a minimum one hundred twenty (120) minutes in duration and sampled a minimum volume of 2.0 dry standard cubic meters (dscm). Results were reported in lb/hr, lb/ day, lb/1000lb of stack gas, and pounds per ton of clinker produced (lb/ton). Results were used to determine the Site-Specific Operating Limit (SSOL).

The particulate matter sampling train was manufactured by Environmental Supply Corporation and meets all specifications required by Method 5. Velocity pressures were determined simultaneously during sampling with an S-type pitot tube and inclined manometer. All temperatures will be measured using K-type thermocouples with calibrated digital temperature indicators. The probe and filter temperatures were maintained at 248°F +/. 25°F throughout sampling.

The filter media are high purity quartz that meet all requirements of Method 5. All sample contact surfaces of the train were washed with HPLC reagent-grade acetone. These washes were placed in sealed and marked containers for analysis.

All sample recoveries were performed at the test site by the test crew. All final particulate sample analyses were performed by Mostardi Platt personnel at the laboratory in Elmhurst, Illinois.

Laboratory analysis data are found in Appendix D. 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 Method 5 filterable particulate sampling. This method applies to the determination of 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 impingers after filterable particulate material was collected using Method 202. Compared to the December 17, 1991 promulgated Method 202, this Method includes the addition of a condenser, followed by a water dropout impinger immediately after the final heated filter. One modified Greenburg Smith impinger and an ambient temperature filter follow the water dropout impinger.

CPM was collected in the water dropout, modified Greenburg Smith impinger and ambient filter portion of the sampling train as described in this Method. The impinger contents were purged with nitrogen (N_2) immediately after sample collection to remove dissolved sulfur dioxide (SO_2) gases from the impingers. The impinger solution was then extracted with deionized water and hexane. The organic and aqueous fractions were dried and the residues weighed. The total of the aqueous, organic, and ambient filter fractions represents the CPM.

All sample recovery was performed at the test site by the test crew. Mostardi Platt personnel at the laboratory in Elmhurst, Illinois, performed all final particulate sample analyses as provided in Appendix D. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

3.0 TEST RESULT SUMMARIES

Client: St. Marys Cement
Facility: Charlevoix, Michigan
Test Location: Main Kiln Stack
Test Method: 5/202

Source Condition	Mill On	Mill On	Mill On	
Date	7/18/23	7/18/23	7/18/23	
Start Time	8:15	11:20	14:15	
End Time	10:25	13:30	16:23	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	240.5	243.0	245.4	243.0
Flue Gas Moisture, percent by volume	13.9%	13.1%	13.5%	13.5%
Average Flue Pressure, in. Hg	29.34	29.34	29.34	29.34
Gas Sample Volume, dscf	94.513	95.444	94.987	94.981
Average Gas Velocity, ft/sec	92.851	94.418	93.718	93.662
Gas Volumetric Flow Rate, acfm	489,780	498,044	494,352	494,059
Gas Volumetric Flow Rate, dscfm	311,615	318,683	314,084	314,794
Gas Volumetric Flow Rate, scfm	362,039	366,838	362,893	363,923
Average $\%CO_2$ by volume, dry basis	19.6	17.0	20.3	19.0
Average $\%O_2$ by volume, dry basis	9.7	11.1	9.4	10.1
Isokinetic Variance	101.9	100.6	101.6	101.4
Clinker Production Rate, ton/hr	243.4	245.1	250.5	246.4
CPMS Response, mA	0.52	0.53	0.51	0.52
Filterable Particulate Matter (Method 5)				
grams collected	0.00325	0.00192	0.00109	0.00209
mg/dscm	1.214	0.710	0.405	0.7767
grains/dscf	0.0005	0.0003	0.0002	0.0003
lb/hr	1.417	0.848	0.477	0.914
lb/1000 lb of stack gas	0.001	0.001	0.000	0.001
lb/ton of clinker	0.006	0.003	0.002	0.004
Condensable Particulate Matter (Method 202)				
grams collected	0.25291	0.08586	0.12965	0.15614
grains/acf	0.0263	0.0089	0.0134	0.0162
grains/dscf	0.0413	0.0139	0.0211	0.0254
lb/hr	110.284	37.916	56.699	68.300
lb/1000 lb of stack gas	0.072	0.025	0.037	0.045
lb/ton of clinker	0.453	0.155	0.226	0.278
Total Particulate Matter (5/202)				
grams collected	0.25616	0.08778	0.13074	0.15823
grains/acf	0.0266	0.0091	0.0135	0.0164
grains/dscf	0.0418	0.0142	0.0213	0.0258
lb/hr	111.701	38.764	57.176	69.214
lb/1000 lb of stack gas	0.073	0.025	0.037	0.045
lb/ton of clinker	0.459	0.158	0.228	0.282

Client: St. Marys Cement
Facility: Charlevoix, Michigan
Test Location: Main Kiln Stack
Test Method: 5/202

Source Condition	Mill Off	Mill Off	Mill Off	
Date	7/19/23	7/19/23	7/19/23	
Start Time	7:55	10:35	13:15	
End Time	10:03	12:42	15:22	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	392.0	391.4	393.4	392.3
Flue Gas Moisture, percent by volume	11.5%	11.9%	12.5%	12.0%
Average Flue Pressure, in. Hg	29.46	29.46	29.46	29.46
Gas Sample Volume, dscf	85.777	85.632	86.47	85.960
Average Gas Velocity, ft/sec	101.166	100.730	101.903	101.266
Gas Volumetric Flow Rate, acfm	533,639	531,341	537,527	534,169
Gas Volumetric Flow Rate, dscfm	288,121	285,713	286,523	286,786
Gas Volumetric Flow Rate, scfm	325,679	324,482	327,507	325,889
Average %CO_2 by volume, dry basis	20.6	22.1	22.9	21.9
Average %O_2 by volume, dry basis	9.3	8.2	7.8	8.4
Isokinetic Variance	100.0	100.7	101.4	100.7
Clinker Production Rate, ton/hr	245.1	243.4	238.7	242.4
CPMS Response, mA	1.22	1.20	1.23	1.22
Filterable Particulate Matter (Method 5)				
grams collected	0.00483	0.00687	0.00588	0.00586
mg/dscm	1.989	2.833	2.401	2.4077
grains/dscf	0.0009	0.0012	0.0010	0.0010
lb/hr	2.146	3.032	2.577	2.585
lb/1000 lb of stack gas	0.002	0.002	0.002	0.002
lb/ton of clinker	0.009	0.012	0.011	0.011
Condensable Particulate Matter (Method 202)				
grams collected	0.76504	0.74082	0.73354	0.74647
grains/acf	0.0743	0.0718	0.0698	0.0720
grains/dscf	0.1376	0.1335	0.1309	0.1340
lb/hr	339.864	326.909	321.466	329.413
lb/1000 lb of stack gas	0.240	0.231	0.228	0.233
lb/ton of clinker	1.387	1.343	1.347	1.359
Total Particulate Matter (5/202)				
grams collected	0.76987	0.74769	0.73942	0.75233
grains/acf	0.0748	0.0725	0.0704	0.0726
grains/dscf	0.1385	0.1347	0.1319	0.1350
lb/hr	342.010	329.941	324.043	331.998
lb/1000 lb of stack gas	0.242	0.233	0.230	0.235
lb/ton of clinker	1.396	1.356	1.358	1.370

4.0 PARTICULATE MATTER CONTINUOUS PARAMETER MONITORING SYSTEM

Per St Marys Cement a Relative Accuracy Test Audit (RATA) report summarizing the calibration and monitor certification will be submitted under separate cover for EGLE review. In addition to the monitor certification, the PC MACT requires that all data recorded and used to establish parameters for monitoring are to be submitted, including the following, per 1349(b)(1)(vii):

- Make and Model
  - All units are Sick SP100
- Serial Number
  - Main Stack PM Monitor s/n 17398675 Probe 16408330
- Analytical Principal
  - The measuring system works according to the *scattered light measurement* principle (i.e., forward dispersion). A laser diode beams the dust particles in the gas flow with modulated light in the visual range (wavelength approximately 650 nanometers [nm]). A highly sensitive detector registers the light scattered by the particles, amplifies the light electrically, and feeds it to the measuring channel of a microprocessor as a central part of the measuring, control, and evaluation electronics. The measuring volume in the gas duct is defined through the intersection of the sender beam and the receiving aperture.
  - Continuous monitoring of the sender output registers the smallest changes in brightness of the light beam sent, which then serves to determine the measurement signal
- Span of Primary Analytical Range
  - The original system specifications were for a range of 0 to 200 milligrams per dry standard cubic meter (mg/dscm)
- Milliamp Value or Digital Equivalent to the Zero Output
  - The monitor output is in milligrams, with zero equal to zero
- Technique to Determine the Zero Value
  - The sender diode is switched off for *zero-point control* so that no signal is received. This means possible *drifts* or zero-point deviations are reliably detected in the overall system (e.g., due to an electronic defect). An error signal is generated when the *zero value* is outside the specified range.
- Average Milliamp or Digital Equivalent Signals Corresponding to Each PM Compliance Run
  - See Appendix A, raw data recorded by the CPMS monitors is attached.

5.0 CERTIFICATION

Mostardi Platt is pleased to have been of service to St Marys Cement. 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.

MOSTARDI PLATT

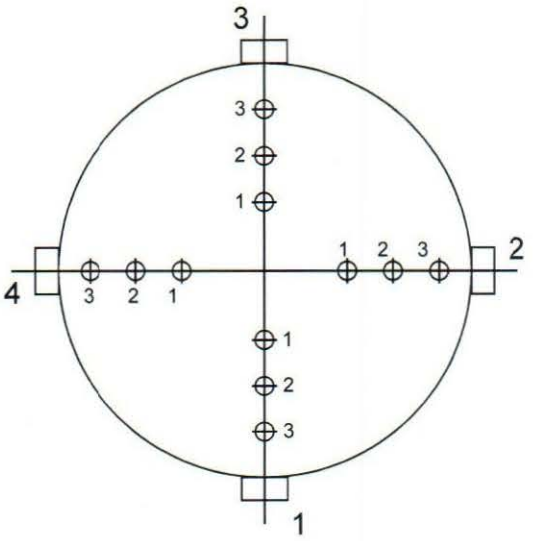
Nicholas C. Colangelo — Project Manager

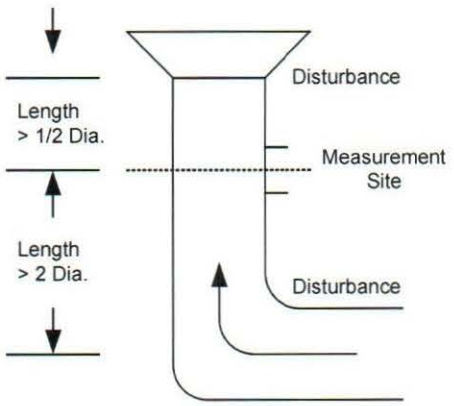
Benjamin W. Hendricks — Quality Assurance

APPENDICES

Appendix A - Test Section Diagrams

EQUAL AREA TRAVERSE FOR ROUND DUCTS

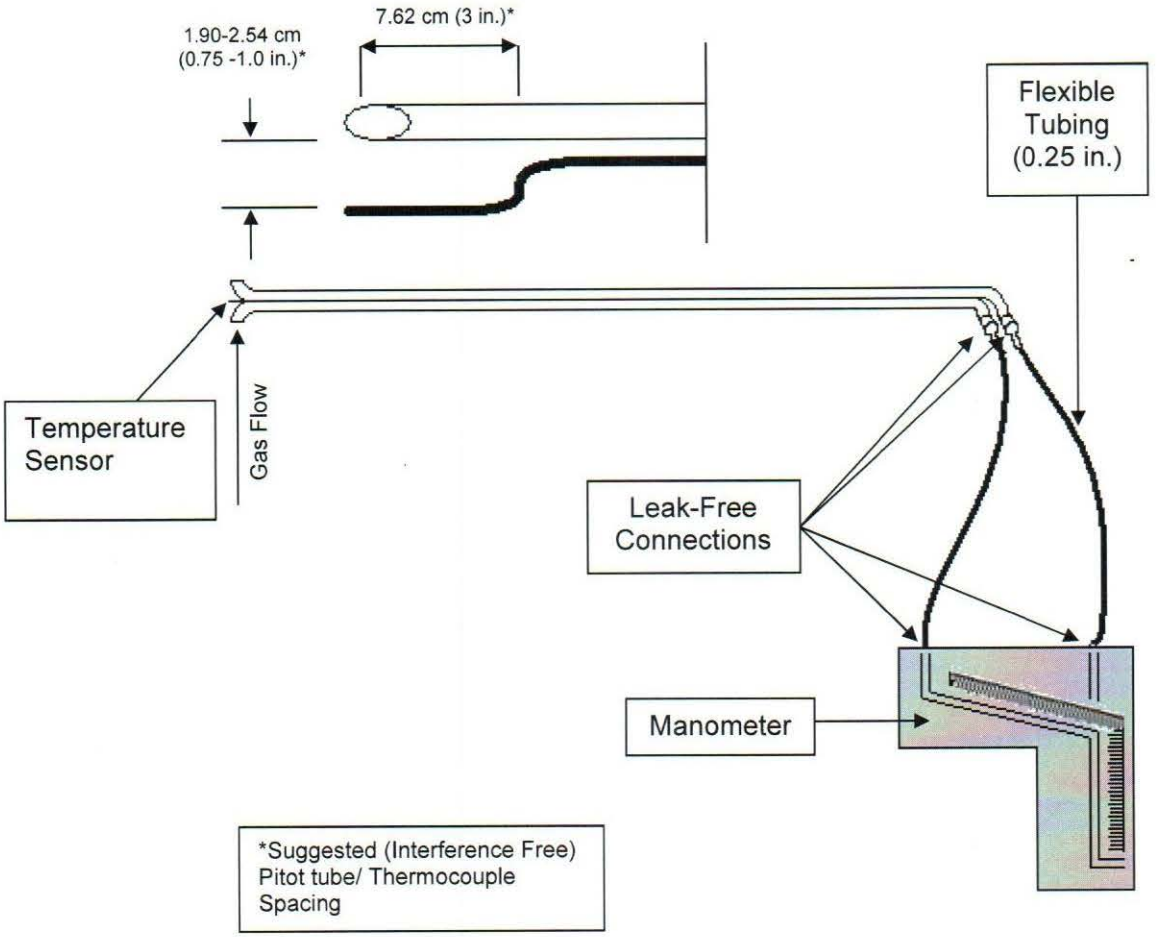




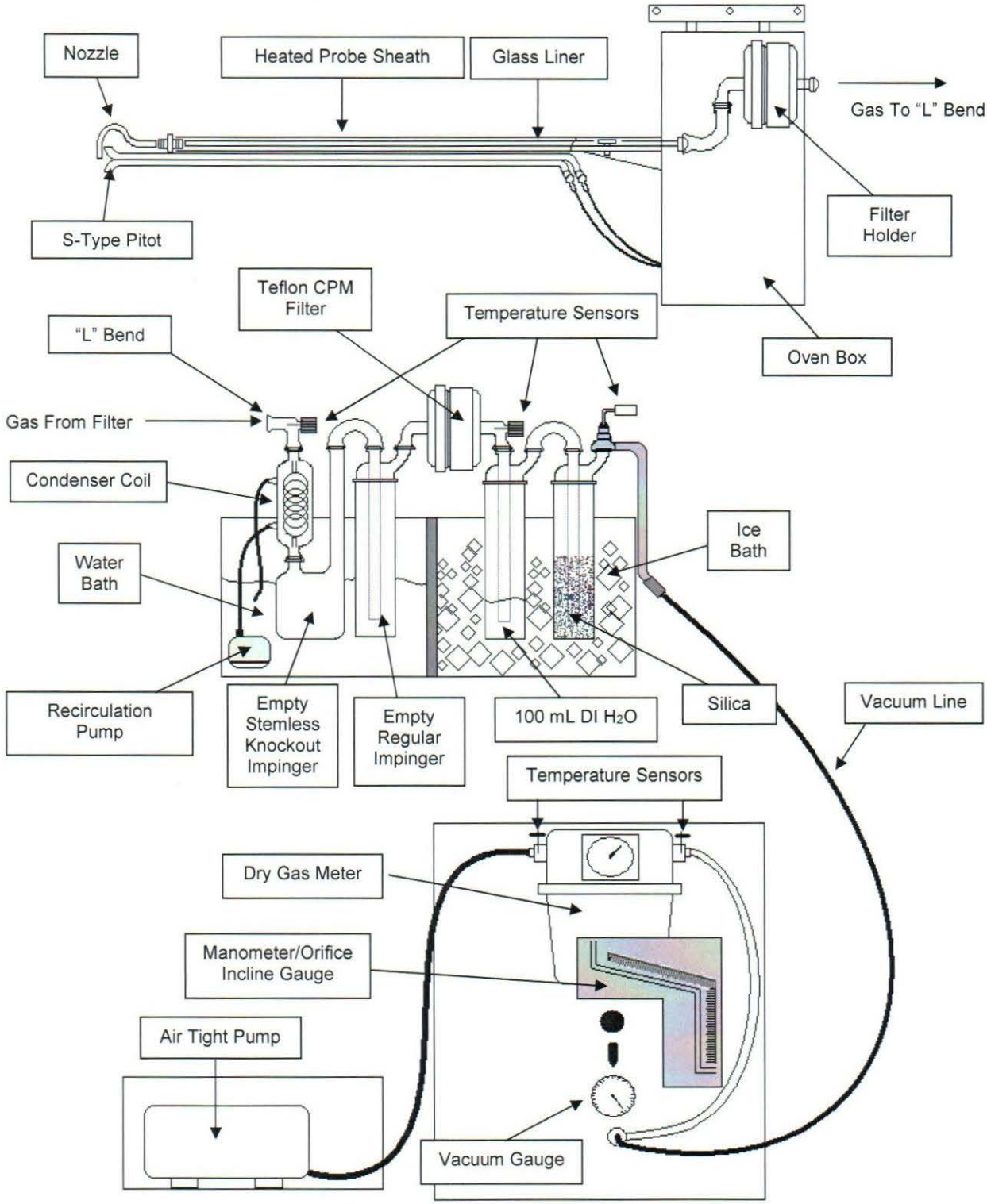
Project:	St Mary's Cement Charlevoix Plant Charlevoix, Michigan
Test Location:	Main Kiln Stack
Test Dates:	July 18 and 19, 2023
No. Sample Points:	12
Diameter:	10.58 Feet
Flue Area:	87.915 Square Feet
Upstream Diameters:	7.9
Downstream Diameters:	15.7

Appendix B - Sample Train Diagrams

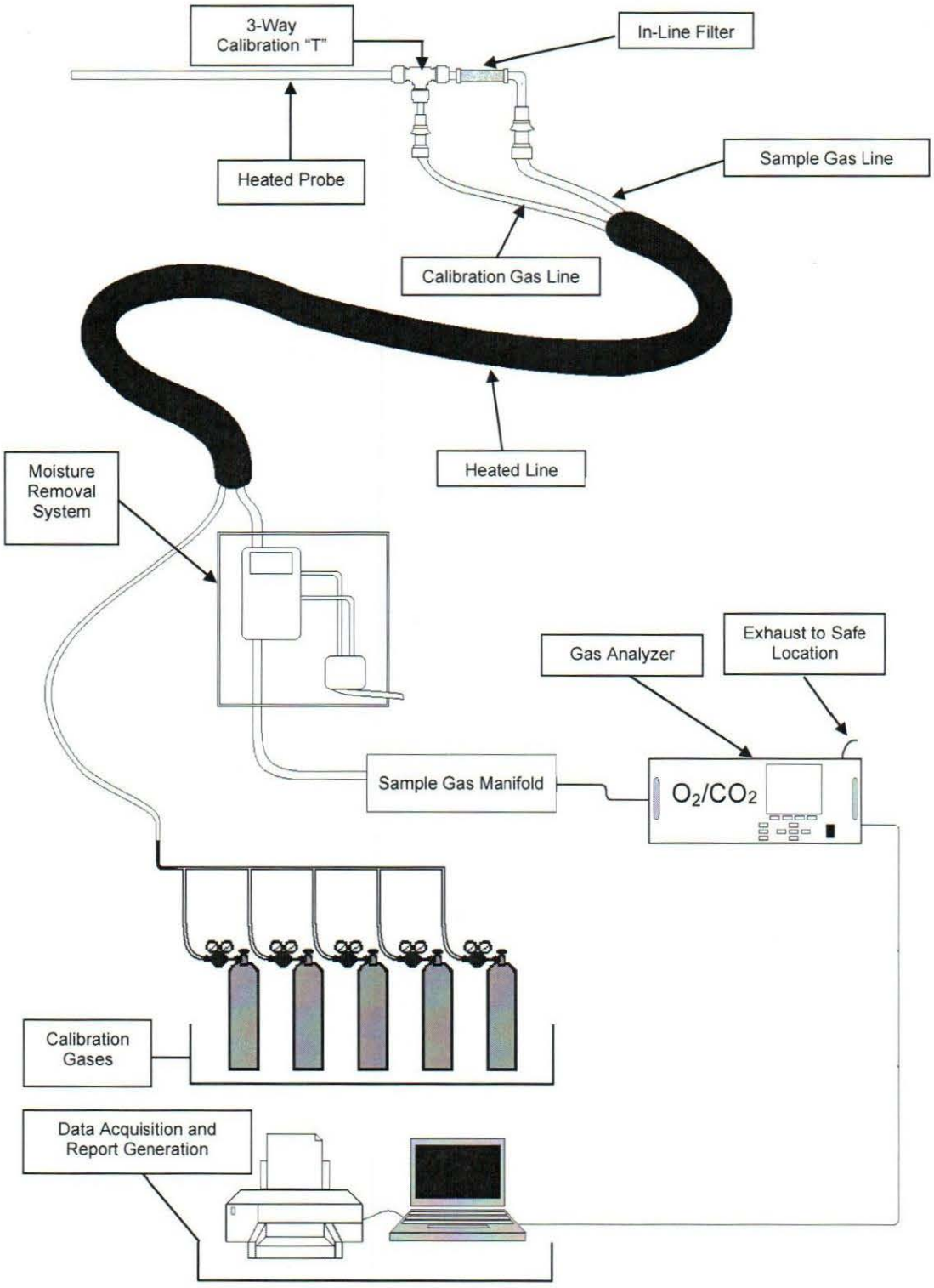
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



USEPA Method 5/202- Filterable/Condensable Particulate Matter



USEPA Method 3A Extractive Gaseous Sampling Diagram



Appendix C - Calculation Nomenclature and Formulas