Section 114 Information Collection Request Emissions Test Report

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Ash Grove Cement Company
Montana City Cement Plant
EPA Registry ID: 110000595197
100 Highway 518
Clancy, Montana 59634
Report No. M233901B

mostardi platt

Section 114 Information Collection Request
Emissions Test Report

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EPA Registry ID: 110000595197
100 Highway 518
Clancy, Montana 59634

Report Submittal Date:
March 4, 2024

Report No. M233901B

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

Corporate Headquarters
888 Industrial Drive
Elmhurst, Illinois 60126
630-993-2100

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1.0 INTRODUCTION

Mostardi Platt conducted an air emissions test program for Ash Grove Cement Company at the Montana City Cement Plant located in Clancy, Montana. All testing was performed as described in the *Code of Federal Regulations*, Title 40, Part 60, Appendix A (40CFR60), Methods 1, 2, 3A, 4, 26A, and 40CFR63, Appendix A, (40CFR63) Method 320.

The Ash Grove Montana City Cement Plant includes a single Kiln (Main Kiln) ~350,000 TPY long wet kiln system. The kiln system employs a baghouse fabric filtration with DSI.

This test program was completed to satisfy the requirements of the United States Environmental Protection Agency (USEPA) Section 114 Information Collection Request for Portland Cement Manufacturing facilities as described in "Attachment 3 Source Testing Request for Portland Cement: Reporting Requirements".

The identification of individuals associated with the test program is summarized below:

Location	**Address**	**Contact**
Facility Representative	Ash Grove Cement Company 100 Highway 518 Clancy, MT 59634	Mr. Doug Kuenzli Environmental Manager P: 406-444-7128 E: doug.kuenzli@ashgrove.com
Testing Company Representative	Mostardi Platt 7715 Commercial Way Suite 155 Henderson, NV 89011	Mr. Rich Sollars Regional Manager P: (630) 993-2100 (phone) E: rsollars@mp-mail.com

2.0 TEST REQUIREMENTS

Testing was performed at the kiln stack. The following table presents a list of the parameters tested, the applicable methodologies utilized, and average test results:

Source	Parameter Tested	Test Results	Method/Regulation Citation
Kiln Stack	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.13 ppmvd @7% O_2	
		≤ 0.03 lb/hr	
		≤ 0.0007 lb/ton clinker	
	HF[1]	≤ 0.15 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.12 ppmvd @7% O_2	
		≤ 0.02 lb/hr	
		≤ 0.0006 lb/ton clinker	
	Chlorine (Cl_2)[1]	≤ 0.04 ppmvd	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.03 ppmvd @7% O_2	
		≤ 0.02 lb/hr	
		≤ 0.0006 lb/ton clinker	
	Hydrogen Cyanide (HCN)	≤ 0.20 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.26 ppmvd @7% O_2	
		≤ 0.07 lb/hr	
		≤ 0.0018 lb/ton clinker	
	Oxygen (O_2)	3.7 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO_2)	15.2 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H_20)	39.1 %	USEPA Method 320, 40CFR63, Appendix A
	Cyclonic Flow Determination	PASS	USEPA Method 1, 40CFR60, Appendix A, Section 11.4
	Three-point O_2 Stratification Determination	< 5 %	USEPA Method 3A, 40CFR60, Appendix A and Method 7E, Section 8.1.2

During Run 1, the power source for Method 320 FTIR instrumentation failed. A fourth run was conducted to ensure a continuous set of Method 320 data for the full duration of the test run. Test results reported are the average values from Runs 2, 3, and 4.

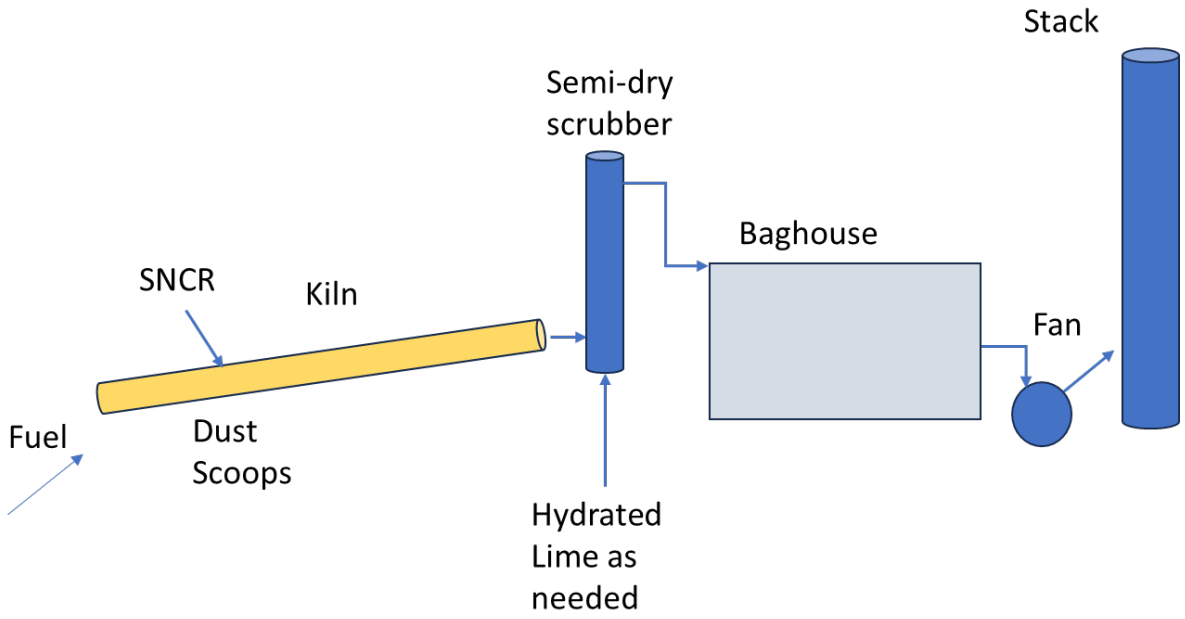
[1] HF and Cl_2 Method 26A results are reported as the average from Train A and Train B.

3.0 QA SPECIFICATIONS AND PROCESS DIAGRAM

3-1 QA/QC Specifications

Parameter	Method	QA/QC Specification	Acceptance Criteria	Actual Result
HCN	320	Method Detection Limit	0.5 ppm	0.2 ppmvw
		SNR	>2500 at 64 scans	6408 (Run 1 Average)
		S Beam	>0.9	1.249 (Run 1 Average)
		Direct HCN Analysis	±5% of tag value	3.6%
		Dynamic Spike Analysis	≤10% of total sample volume	8.4%
			Spike gas ~twice native concentration or 3-4 ppm addition to native concentration	+3.5 ppm
			≤±20% of expected value or ≤±0.5 ppm, whichever is less restrictive	-10.7 %
		Residuals	≤±0.3 ppm, or ≤±5% of measured value, whichever is less restrictive	0.2 ppmvw
Cl_2	26A	Paired Train Agreement	≤10% Relative Deviation or ≤0.2 ppm, whichever is less restrictive.	0.0 ppmvw

3-2 Process Flow Diagram



4.0 TEST PROCEDURES

All testing, sampling, analytical, and calibration procedures used for this test program were performed as described in the Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40CFR60), Methods 1, 2, 3A, 4, 26A, and 40CFR63, Appendix A, Method 320; and the latest revisions thereof. Where applicable, the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III, Stationary Source Specific Methods, United States Environmental Protection Agency (USEPA) 600/R-94/038c, September 1994 was used to supplement procedures in addition to the appended "Draft General Test Plan".

4.1 Method 1 Sample and Velocity Traverse Determination

Sample points for testing are determined using USEPA Test Method 1, 40CFR60, Appendix A. The characteristics of the measurement location is summarized below.

Sample Point Selection

Test Location	Stack Diameter	Port Length	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points
Main Kiln	108 Inches	5.5 Inches	4.6 Diameters	2.0 Diameters	HF/Cl_2 (26A)	24
					O_2 (3A)	3 (stratification)
					$HCN/HF/CO_2$ (320/3A)	1

A cyclonic flow check was performed in accordance with Section 11.4, which demonstrated it meets the criteria of an average value of less than 20° and therefore is considered to be a suitable testing location for flow rate measurements.

4.2 Method 2 Volumetric Flow Rate Determination

The gas velocity and volumetric flowrate were determined using Method 2, 40CFR60, Appendix A, as an integrated part of the HF/Cl_2 sampling system.

Velocity pressures were determined by traversing the duct with wind tunnel calibrated 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 were also determined to permit the calculation of the volumetric flowrate.

4.3 Method 3A Oxygen (O_2) and Carbon Dioxide (CO_2) Determination

O_2 and CO_2 concentrations were determined in accordance with Method 3A, 40CFR60, Appendix A and Method 320, 40CRR63, Appendix A, respectively. A Servomex analyzer was used to determine O_2 concentrations while the MKS 2030 analyzer was used to determine CO_2 concentrations. The O_2 instrument has a paramagnetic detector and operates in a nominal range of 0-25%.

A list of calibration gases used and the results of all calibration and other required quality assurance checks are found in the appendix of this report. Copies of calibration gas certifications are also appended.

4.4 Method 26A Hydrogen Fluoride (HF) and Chlorine (Cl_2) Determination

HF and Cl_2 concentrations and emission rates were determined in accordance with Method 26A, 40CFR60, Appendix A. Paired sampling trains were used to collect the samples. A total of twenty (20) test points were sampled per run on the WGS stack. The sample was extracted isokinetically from the gas stream and passed through dilute sulfuric acid (0.1N H_2SO_4). HF was collected in the dilute acid. Cl_2 was collected in the dilute sodium hydroxide (0.1N NaOH) solution. The sample train consisted of a Teflon coated nozzle, a heated borosilicate glass probe liner, a Teflon® filter placed on the outlet of the glass probe liner, and six impingers. The first two impingers contained the 0.1N H_2SO_4, the third remained empty (and was recovered with the first two impingers), the fourth and fifth impingers contained the 0.1N NaOH, while the sixth impinger contained silica gel to absorb any remaining moisture. A de-ionized water rinse was performed on each set of impingers, and samples were stored in Nalgene sample containers for transport. The 0.1N H_2SO_4 impinger catch samples were analyzed for HF while the 0.1N NaOH impinger catch samples were analyzed for Cl_2. A method detection limit (MDL) of 150 µg was determined for both HF and Cl_2 using the “Definition and Procedure for the Determination of the Method Detection Limit, Revision 2”. All equipment used was calibrated in accordance with the specifications of the method. Calibration data is appended.

Hand recorded field data sheets were reviewed and scans are retained on the Mostardi Platt network. Copies of this data is available upon request.

4.5 Method 320 Speciated Flue Gas Concentration Determinations

The sampling procedures for HCN and HF were performed in accordance with USEPA Method 320, 40CFR63, Appendix A. Data was continuously recorded with a data logging system throughout sampling, with brief interruption to properly label reference spectra.

The average gas effluent concentrations were determined from the average gas concentration displayed by the MKS 2030 analyzer.

All sampling system components were heated to 375^{o}F +/- 25^{o}F, including: stainless steel sample probe, stainless steel calibration tee, in line glass fiber particulate filter, Teflon® sample line, heated head sample pump, and FTIR detector cell. The sample pump distributes the gas sample to the instrument at a steady sample flow rate (+/- 10%). All components of the sampling system are constructed of stainless steel, glass, or Teflon®.

FTIR technology works on the principle that most gases absorb infrared light. This is true for all compounds except for homonuclear diatomic molecules and noble gases such as: N_2, O_2, H_2, He, Ne, and Ar. Vibrations, stretches, bends, and rotations within the bonds of a molecule determine the infrared absorption distinctiveness. The absorption creates a “fingerprint" which is unique for each given compound. The quantity of infrared light absorbed is proportional to the gas concentration. Most compounds have absorbencies at different infrared frequencies, thus allowing the simultaneous analysis of multiple compounds at one time. The FTIR software compares each sample spectrum to a user-selected list of calibration references and concentration data is generated.

FTIR data was collected using an MKS MultiGas 2030 FTIR spectrometer. Data was generated at 0.5 cm^{-1}. Each Spectra was derived from the coaddition of 62-64 scans with a new data point generated approximately every minute. HCN analyte spiking assured the ability of the FTIR to quantify HCN in the presence of effluent gas. All analyte spikes were introduced using an instrument grade stainless steel rotameter. All QA/QC procedures were within the acceptance criteria allowance of the applicable methodology and the “General Test Plan.”

5.0 TEST RESULTS SUMMARIES

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln**
Test Method:	**26A**

Source Condition		**Normal**		**Normal**		**Normal**		**Normal**		
Date		**9/27/23**		**9/27/23**		**9/27/23**		**9/27/23**		
Start Time		**7:30**		**9:57**		**11:20**		**12:45**		
End Time		**8:42**		**11:02**		**12:25**		**13:50**		
		Run 1		**Run 2**		**Run 3**		**Run 4**		**Average**
Stack Conditions										
Average Gas Velocity, ft/sec		38.311		38.190		38.203		38.119		38.211
Gas Volumetric Flow Rate, acfm		146,232		145,773		145,822		145,501		145,851
Gas Volumetric Flow Rate, dscfm		51,768		50,728		52,706		52,057		52,177
Gas Volumetric Flow Rate, scfm		82,304		82,337		82,525		81,772		82,200
Average %CO_2 by volume, dry basis		24.5		24.9		25.0		25.0		24.8
Average %O_2 by volume, dry basis		3.6		3.5		3.7		3.7		3.7
Clinker Production, ton/hr		39.0		39.0		39.4		39.6		39.3
Chloride (Cl2) Emissions										
ppmvd	≤	0.04		0.50	≤	0.04	≤	0.04	≤	0.04
ppmvd @ 7% O_2	≤	0.03		0.40	≤	0.03	≤	0.03	≤	0.03
lb/hr	≤	0.0249		0.2814	≤	0.0247	≤	0.0233	≤	0.0243
lb/ton of clinker	≤	0.0006		0.0072	≤	0.0006	≤	0.0006	≤	0.0006
Hydrogen Fluoride (HF) Emissions										
ppmvd	≤	0.15	≤	0.15	≤	0.15	≤	0.14	≤	0.15
ppmvd @ 7% O_2	≤	0.12	≤	0.12	≤	0.12	≤	0.12	≤	0.12
lb/hr	≤	0.0248	≤	0.0244	≤	0.0246	≤	0.0233	≤	0.0242
lb/ton of clinker	≤	0.0006	≤	0.0006	≤	0.0006	≤	0.0006	≤	0.0006

*Average results include Run 1, 3, and 4 results only as run 2 Cl2 results did not meet the paired train agreement.

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train A)**
Test Method:	**26A**

Source Condition		**Normal**		**Normal**		**Normal**		**Normal**		
Date		**9/27/23**		**9/27/23**		**9/27/23**		**9/27/23**		
Start Time		**7:30**		**9:57**		**11:20**		**12:45**		
End Time		**8:42**		**11:02**		**12:25**		**13:50**		
		Run 1A		**Run 2A**		**Run 3A**		**Run 4A**		**Average**
Stack Conditions										
Average Gas Temperature, °F		345.3		350.5		349.6		358.9		351.3
Flue Gas Moisture, percent by volume		38.2%		37.1%		36.5%		36.1%		36.9%
Average Flue Pressure, in. Hg		25.78		25.78		25.78		25.78		25.78
Gas Sample Volume, dscf		41.092		40.660		42.704		43.919		42.572
Average Gas Velocity, ft/sec		37.983		37.700		37.882		37.888		37.918
Gas Volumetric Flow Rate, acfm		144,981		143,904		144,597		144,621		144,733
Gas Volumetric Flow Rate, dscfm		50,611		50,820		51,590		51,315		51,172
Gas Volumetric Flow Rate, scfm		81,890		80,755		81,240		80,328		81,153
Average %CO_2 by volume, dry basis		24.5		24.9		25.0		25.0		24.8
Average %O_2 by volume, dry basis		3.6		3.5		3.7		3.7		3.7
Isokinetic Variance		103.8		102.3		105.9		109.5		106.4
Chloride (Cl2) Emissions										
ug of sample collected	≤	150.00		188.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.04		0.06	≤	0.04	≤	0.04	≤	0.04
Hydrogen Fluoride (HF) Emissions										
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.16	≤	0.16	≤	0.15	≤	0.15	≤	0.15

*Average results include Run 1, 3, and 4 results only.

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train B)**
Test Method:	**26A**

Source Condition	**Normal**	**Normal**	**Normal**	**Normal**	
Date	**9/27/23**	**9/27/23**	**9/27/23**	**9/27/23**	
Start Time	**7:30**	**9:57**	**11:20**	**12:45**	
End Time	**8:42**	**11:02**	**12:25**	**13:50**	
	Run 1B	**Run 2B**	**Run 3B**	**Run 4B**	**Average**
Stack Conditions					
Average Gas Temperature, °F	354.5	343.7	341.5	343.5	346.5
Flue Gas Moisture, percent by volume	36.0%	39.7%	35.8%	36.6%	36.1%
Average Flue Pressure, in. Hg	25.89	25.89	25.89	25.89	25.89
Gas Sample Volume, dscf	41.466	41.711	42.089	44.884	42.813
Average Gas Velocity, ft/sec	38.638	38.680	38.524	38.349	38.504
Gas Volumetric Flow Rate, acfm	147,482	147,641	147,046	146,381	146,970
Gas Volumetric Flow Rate, dscfm	52,924	50,635	53,822	52,798	53,181
Gas Volumetric Flow Rate, scfm	82,717	83,918	83,810	83,215	83,247
Average %CO_2 by volume, dry basis	24.5	24.9	25.0	25.0	24.8
Average %O_2 by volume, dry basis	3.6	3.5	3.7	3.7	3.7
Isokinetic Variance	100.2	105.3	100.0	108.7	103.0
Chloride (Cl2) Emissions					
ug of sample collected	≤ 150.00	3312.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm	≤ 0.04	0.95	≤ 0.04	≤ 0.04	≤ 0.04
Hydrogen Fluoride (HF) Emissions					
ug of sample collected	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm	≤ 0.15	≤ 0.15	≤ 0.15	≤ 0.14	≤ 0.15

*Average results include Run 1, 3, and 4 results only.

Ash Grove Cement Company
Montana City Cement Plant
Main Kiln
Reference Method Test Data

Test No.	Date	Start Time	End Time	O2 % (dry)	Moisture %	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2
1	9/27/2023	7:30	8:28	3.5	33.1%	≤ 0.30	≤ 0.36	≤ 0.10	≤ 0.12
2	9/27/2023	9:57	10:56	3.5	38.9%	≤ 0.20	≤ 0.26	≤ 0.10	≤ 0.13
3	9/27/2023	11:20	12:19	3.7	39.2%	≤ 0.20	≤ 0.27	≤ 0.10	≤ 0.13
4	9/27/2023	12:45	13:44	3.7	39.4%	≤ 0.20	≤ 0.27	≤ 0.10	≤ 0.13
Average				**3.7**	**39.1%**	**≤ 0.20**	**≤ 0.26**	**≤ 0.10**	**≤ 0.13**

Test No.	Date	Start Time	End Time	Volumetric Flow, DSCFH	Clinker Production, ton/hr	HCN lb/hr	HCN lb/ton	HF lb/hr	HF lb/ton
1	9/27/2023	7:30	8:28	3,106,080	39.0	≤ 0.10	≤ 0.0025	≤ 0.02	≤ 0.0006
2	9/27/2023	9:57	10:56	3,043,680	39.0	≤ 0.07	≤ 0.0018	≤ 0.03	≤ 0.0007
3	9/27/2023	11:20	12:19	3,162,360	39.4	≤ 0.07	≤ 0.0019	≤ 0.03	≤ 0.0007
4	9/27/2023	12:45	13:44	3,123,420	39.6	≤ 0.07	≤ 0.0018	≤ 0.03	≤ 0.0007
Average				**3,109,820**	**39.3**	**≤ 0.07**	**≤ 0.0018**	**≤ 0.03**	**≤ 0.0007**

Note: Due to a power failure in the FTIR sample system during run 1, that run is excluded from the averages and a subsequent fourth run was conducted

6.0 CERTIFICATION

Mostardi Platt is pleased to have been of service to Ash Grove Cement Company If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

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

Richard J. Sollars II — Project Manager

Chet A. Gutwein — Quality Assurance

APPENDICES

Appendix A – Plant Operating Data

Ash Grove Cement - Montana City Plant

RTR Testing
September 27, 2023
Production Data Summary

RUN #1	
Date/Time	Kiln Clinker [TONS/HOUR]
09/27/2023 07:30	39.0
09/27/2023 07:31	38.9
09/27/2023 07:32	39.1
09/27/2023 07:33	39.0
09/27/2023 07:34	39.0
09/27/2023 07:35	39.0
09/27/2023 07:36	39.0
09/27/2023 07:37	39.0
09/27/2023 07:38	39.0
09/27/2023 07:39	39.0
09/27/2023 07:40	39.0
09/27/2023 07:41	39.0
09/27/2023 07:42	39.0
09/27/2023 07:43	39.0
09/27/2023 07:44	39.0
09/27/2023 07:45	39.1
09/27/2023 07:46	39.0
09/27/2023 07:47	39.0
09/27/2023 07:48	39.0
09/27/2023 07:49	38.9
09/27/2023 07:50	39.0
09/27/2023 07:51	39.0
09/27/2023 07:52	39.0
09/27/2023 07:53	39.0
09/27/2023 07:54	39.0
09/27/2023 07:55	39.0
09/27/2023 07:56	39.0
09/27/2023 07:57	39.1
09/27/2023 07:58	39.0
09/27/2023 07:59	39.0
09/27/2023 08:00	39.0
09/27/2023 08:01	39.0
09/27/2023 08:02	39.0
09/27/2023 08:03	39.0
09/27/2023 08:04	39.1
09/27/2023 08:05	39.0
09/27/2023 08:06	39.0
09/27/2023 08:07	39.1
09/27/2023 08:08	39.0
09/27/2023 08:09	38.9
09/27/2023 08:10	39.0
09/27/2023 08:11	39.0
09/27/2023 08:12	39.1
09/27/2023 08:13	39.0
09/27/2023 08:14	39.0
09/27/2023 08:15	39.0
09/27/2023 08:16	39.0
09/27/2023 08:17	39.1
09/27/2023 08:18	39.0
09/27/2023 08:19	39.0
09/27/2023 08:20	39.0
09/27/2023 08:21	39.0
09/27/2023 08:22	38.9
09/27/2023 08:23	39.0
09/27/2023 08:24	39.0
09/27/2023 08:25	39.0
09/27/2023 08:26	39.0
09/27/2023 08:27	39.0
09/27/2023 08:28	39.0
09/27/2023 08:29	39.0
09/27/2023 08:30	39.0
09/27/2023 08:31	39.0
09/27/2023 08:32	39.0
09/27/2023 08:33	39.0
09/27/2023 08:34	39.0
09/27/2023 08:35	39.0
09/27/2023 08:36	39.0
09/27/2023 08:37	39.0
09/27/2023 08:38	39.1
09/27/2023 08:39	39.1
09/27/2023 08:40	38.9
09/27/2023 08:41	39.0
09/27/2023 08:42	38.9

RUN #2	
Date/Time	Kiln Clinker [TONS/HOUR]
09/27/2023 09:57	39.0
09/27/2023 09:58	39.0
09/27/2023 09:59	39.0
09/27/2023 10:00	39.0
09/27/2023 10:01	39.0
09/27/2023 10:02	39.1
09/27/2023 10:03	39.0
09/27/2023 10:04	39.0
09/27/2023 10:05	39.0
09/27/2023 10:06	39.1
09/27/2023 10:07	39.0
09/27/2023 10:08	39.0
09/27/2023 10:09	39.0
09/27/2023 10:10	39.0
09/27/2023 10:11	39.0
09/27/2023 10:12	39.0
09/27/2023 10:13	39.0
09/27/2023 10:14	39.0
09/27/2023 10:15	39.0
09/27/2023 10:16	39.0
09/27/2023 10:17	39.0
09/27/2023 10:18	39.0
09/27/2023 10:19	39.0
09/27/2023 10:20	39.0
09/27/2023 10:21	39.0
09/27/2023 10:22	39.0
09/27/2023 10:23	38.9
09/27/2023 10:24	39.1
09/27/2023 10:25	39.0
09/27/2023 10:26	39.1
09/27/2023 10:27	39.0
09/27/2023 10:28	39.0
09/27/2023 10:29	39.0
09/27/2023 10:30	39.0
09/27/2023 10:31	39.0
09/27/2023 10:32	39.0
09/27/2023 10:33	39.0
09/27/2023 10:34	39.0
09/27/2023 10:35	39.0
09/27/2023 10:36	39.0
09/27/2023 10:37	39.0
09/27/2023 10:38	39.0
09/27/2023 10:39	39.1
09/27/2023 10:40	39.0
09/27/2023 10:41	39.0
09/27/2023 10:42	39.0
09/27/2023 10:43	39.0
09/27/2023 10:44	39.0
09/27/2023 10:45	39.0
09/27/2023 10:46	39.0
09/27/2023 10:47	39.0
09/27/2023 10:48	39.0
09/27/2023 10:49	39.0
09/27/2023 10:50	39.0
09/27/2023 10:51	39.0
09/27/2023 10:52	39.0
09/27/2023 10:53	39.0
09/27/2023 10:54	39.0
09/27/2023 10:55	39.0
09/27/2023 10:56	39.0
09/27/2023 10:57	39.1
09/27/2023 10:58	39.0
09/27/2023 10:59	39.0
09/27/2023 11:00	39.0
09/27/2023 11:01	39.0
09/27/2023 11:02	39.0

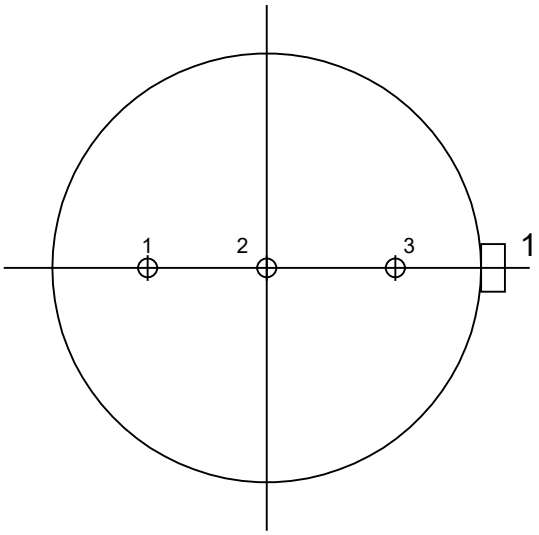
RUN #3	
Date/Time	Kiln Clinker [TONS/HOUR]
09/27/2023 11:20	39.0
09/27/2023 11:21	39.1
09/27/2023 11:22	38.9
09/27/2023 11:23	39.0
09/27/2023 11:24	39.1
09/27/2023 11:25	39.1
09/27/2023 11:26	39.0
09/27/2023 11:27	39.0
09/27/2023 11:28	39.0
09/27/2023 11:29	39.0
09/27/2023 11:30	39.0
09/27/2023 11:31	39.0
09/27/2023 11:32	39.0
09/27/2023 11:33	39.0
09/27/2023 11:34	39.0
09/27/2023 11:35	39.0
09/27/2023 11:36	39.1
09/27/2023 11:37	39.0
09/27/2023 11:38	39.1
09/27/2023 11:39	39.1
09/27/2023 11:40	39.5
09/27/2023 11:41	39.6
09/27/2023 11:42	39.5
09/27/2023 11:43	39.6
09/27/2023 11:44	39.6
09/27/2023 11:45	39.5
09/27/2023 11:46	39.5
09/27/2023 11:47	39.6
09/27/2023 11:48	39.6
09/27/2023 11:49	39.5
09/27/2023 11:50	39.6
09/27/2023 11:51	39.6
09/27/2023 11:52	39.6
09/27/2023 11:53	39.5
09/27/2023 11:54	39.6
09/27/2023 11:55	39.5
09/27/2023 11:56	39.6
09/27/2023 11:57	39.6
09/27/2023 11:58	39.6
09/27/2023 11:59	39.6
09/27/2023 12:00	39.6
09/27/2023 12:01	39.5
09/27/2023 12:02	39.6
09/27/2023 12:03	39.5
09/27/2023 12:04	39.6
09/27/2023 12:05	39.6
09/27/2023 12:06	39.6
09/27/2023 12:07	39.5
09/27/2023 12:08	39.6
09/27/2023 12:09	39.5
09/27/2023 12:10	39.6
09/27/2023 12:11	39.6
09/27/2023 12:12	39.6
09/27/2023 12:13	39.6
09/27/2023 12:14	39.6
09/27/2023 12:15	39.6
09/27/2023 12:16	39.5
09/27/2023 12:17	39.6
09/27/2023 12:18	39.6
09/27/2023 12:19	39.5
09/27/2023 12:20	39.6
09/27/2023 12:21	39.6
09/27/2023 12:22	39.6
09/27/2023 12:23	39.6
09/27/2023 12:24	39.5
09/27/2023 12:25	39.6

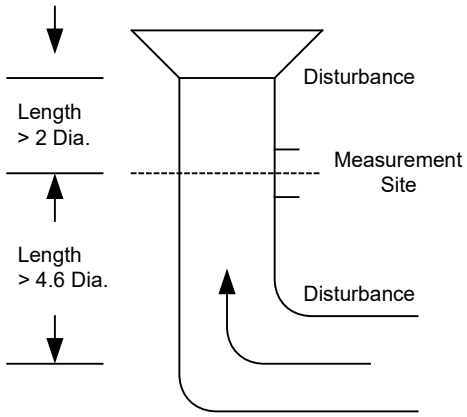
RUN #4	
Date/Time	Kiln Clinker [TONS/HOUR]
09/27/2023 12:45	39.6
09/27/2023 12:46	39.6
09/27/2023 12:47	39.6
09/27/2023 12:48	39.6
09/27/2023 12:49	39.5
09/27/2023 12:50	39.6
09/27/2023 12:51	39.6
09/27/2023 12:52	39.6
09/27/2023 12:53	39.6
09/27/2023 12:54	39.6
09/27/2023 12:55	39.6
09/27/2023 12:56	39.6
09/27/2023 12:57	39.5
09/27/2023 12:58	39.6
09/27/2023 12:59	39.5
09/27/2023 13:00	39.6
09/27/2023 13:01	39.6
09/27/2023 13:02	39.6
09/27/2023 13:03	39.5
09/27/2023 13:04	39.6
09/27/2023 13:05	39.6
09/27/2023 13:06	39.8
09/27/2023 13:07	39.7
09/27/2023 13:08	39.6
09/27/2023 13:09	39.7
09/27/2023 13:10	39.6
09/27/2023 13:11	39.5
09/27/2023 13:12	39.6
09/27/2023 13:13	39.6
09/27/2023 13:14	39.6
09/27/2023 13:15	39.6
09/27/2023 13:16	39.6
09/27/2023 13:17	39.6
09/27/2023 13:18	39.6
09/27/2023 13:19	39.6
09/27/2023 13:20	39.6
09/27/2023 13:21	39.6
09/27/2023 13:22	39.5
09/27/2023 13:23	39.6
09/27/2023 13:24	39.6
09/27/2023 13:25	39.6
09/27/2023 13:26	39.6
09/27/2023 13:27	39.5
09/27/2023 13:28	39.5
09/27/2023 13:29	39.6
09/27/2023 13:30	39.5
09/27/2023 13:31	39.5
09/27/2023 13:32	39.6
09/27/2023 13:33	39.6
09/27/2023 13:34	39.6
09/27/2023 13:35	39.6
09/27/2023 13:36	39.6
09/27/2023 13:37	39.5
09/27/2023 13:38	39.7
09/27/2023 13:39	39.5
09/27/2023 13:40	39.6
09/27/2023 13:41	39.7
09/27/2023 13:42	39.6
09/27/2023 13:43	39.5
09/27/2023 13:44	39.6
09/27/2023 13:45	39.5
09/27/2023 13:46	39.6
09/27/2023 13:47	39.6
09/27/2023 13:48	39.6
09/27/2023 13:49	39.5
09/27/2023 13:50	39.6

Run Averages	
Run #1	39.0 TPH
Run #2	39.0 TPH
Run #3	39.4 TPH
Run #4	39.6 TPH
Combined Ave ▶	**39.3 TPH**

Appendix B – Test Section Diagrams

STRATIFICATION TEST FOR ROUND DUCTS





Job: Ash Grove Cement Company
Montana City Plant
Clancy, Montana

Test Location: Main Kiln

Stack Diameter: 9.0 Feet

Stack Area: 63.62 Square Feet

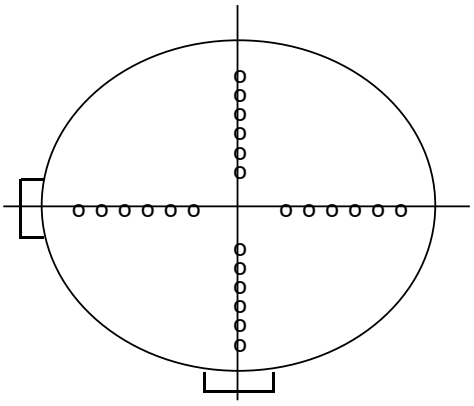
No. Sample Points: 3

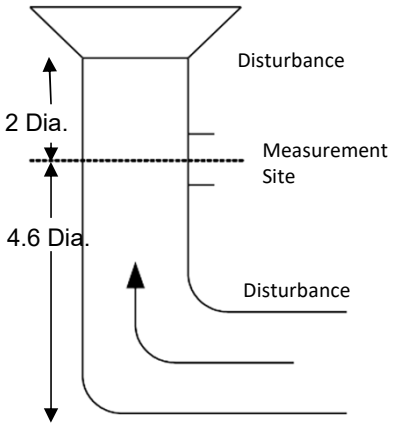
Port Length: 5.5 Inches

Distance from Inside Wall
To Traverse Point:

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

EQUAL AREA TRAVERSE FOR ROUND DUCTS





Client: Ash Grove Cement Company

Facility: Montana City Cement Plant

Test Location: Main Kiln

Diameter (Feet): 9.0

Port Length (In): 5.50

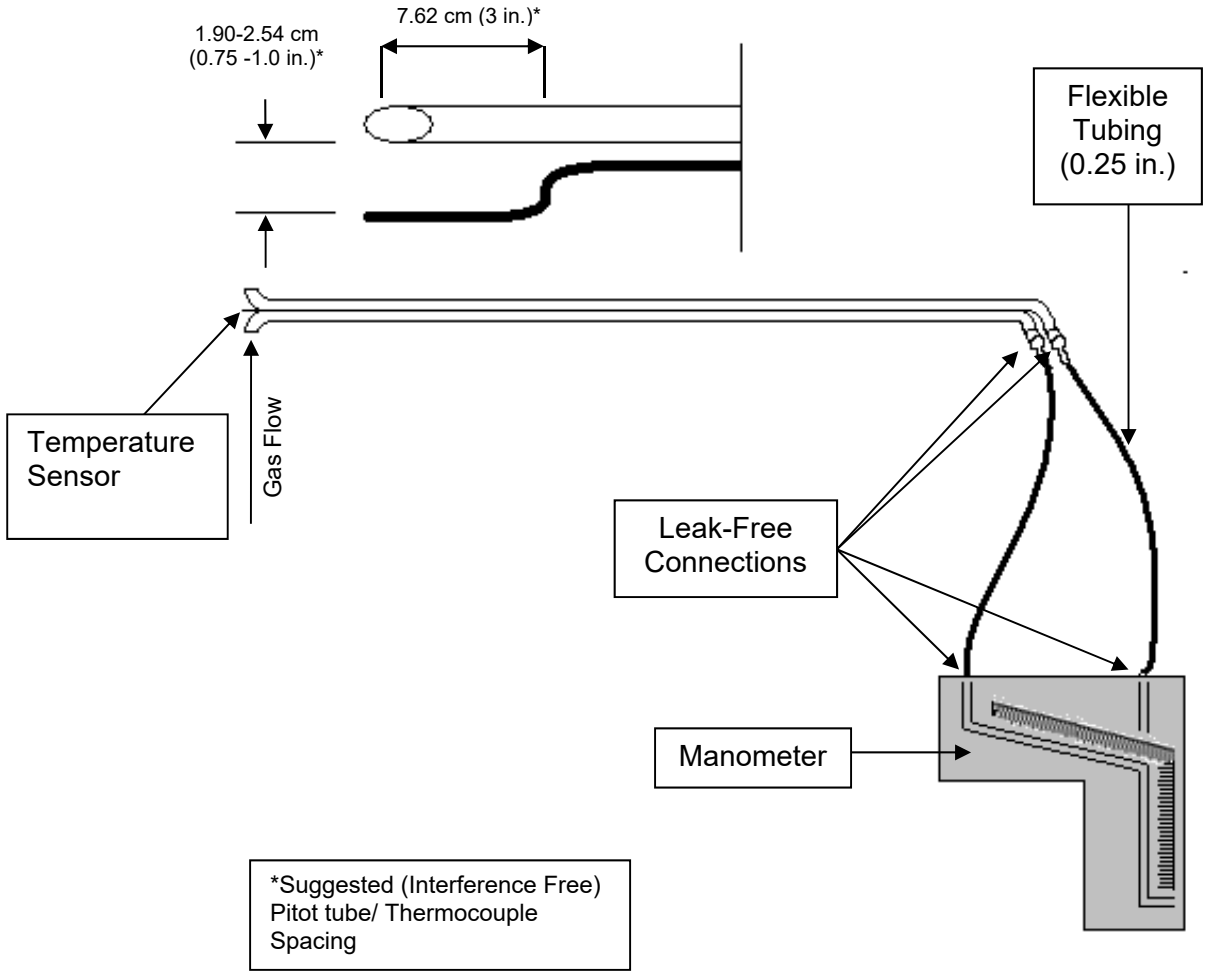
Ports Sampled: 2

Points/Port: 12

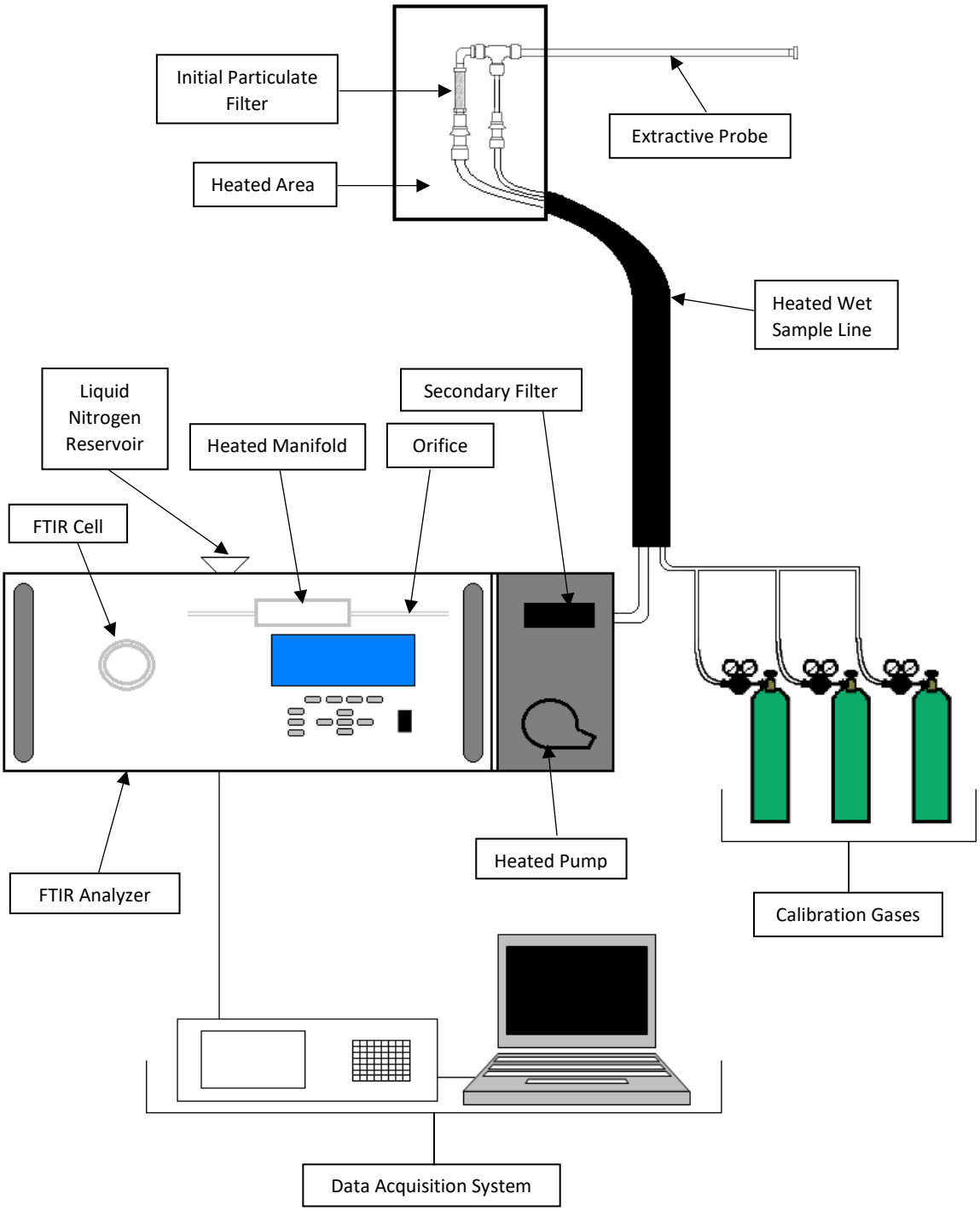
	Point Markings	
	From inside wall (in.)	% of Diameter
1	2.27	2.10
2	7.24	6.70
3	12.74	11.80
4	19.12	17.70
5	27.00	25.00
6	38.45	35.60
7	69.55	64.40
8	81.00	75.00
9	88.88	82.30
10	95.26	88.20
11	100.76	93.30
12	105.73	97.90

Appendix C – Sample Train Diagrams

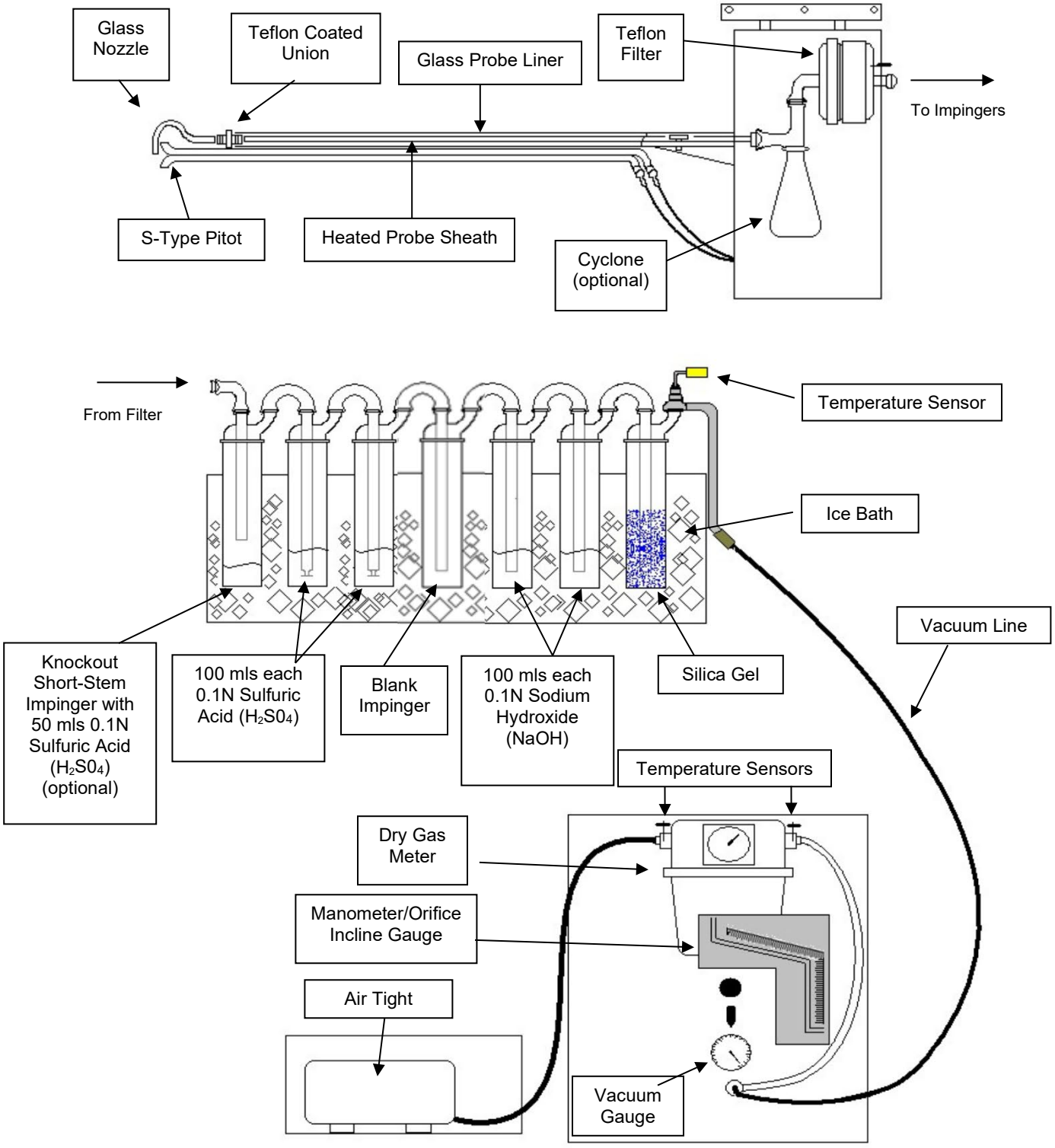
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



USEPA Method 320 – Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy Sample Train Diagram



USEPA Method 26A – HF and Cl_2 Sample Train Diagram



Appendix D – Calculation Nomenclature and Formulas

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train A)**
Run:	**1**
Date:	**9/27/2023**
Method:	**26A**
Source Condition:	**Normal**

Dry Molecular Weight

$$Md = 0.44 \times (\%CO_2) + 0.32 \times (\%O_2) + 0.28 \times \%N_2$$

$\%CO_2$ =	24.5	$\%O_2$ =	3.6	$\%N_2$ =	71.9

Md = 32.064

Wet Molecular Weight

$$Ms = Md \times (1-Bws) + (18.0 \times Bws)$$

Md =	32.064	Bws =	0.382

Ms = 26.692

Meter Volume at Standard Conditions

$$Vm(std) = 17.647 \times Y \times Vm \times \frac{(Pbar + DH/13.6)}{Tm}$$

Y =	1.011	Vm =	45.692	Pbar =	25.8
DH =	1.6	Tm =	53.9		

Vm(std) = 41.092

Volume of Water Vapor Condensed

$$Vw(std) = 0.0471 \times (\text{net } H_2O \text{ gain})$$

Net H_2O = 539.2

Vw(std) = 25.396

Moisture Content

$$Bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

Vw(std) =	25.396	Vm(std) =	41.092

Bws = 0.382

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train A)**
Run:	**1**
Date:	**9/27/2023**
Method:	**26A**
Source Condition:	**Normal**

Average Duct Velocity

$$Vs = 85.49 \times Cp \times \text{Sqrt DP (avg)} \times (Ts\ (avg) + 460 / (Ps \times Ms))^{1/2}$$

Cp =	**0.820**	**Ts (avg) =**	**345.3**	**Sqrt DP (avg):**	**0.501**
Ps =	**25.78**	**Ms =**	**26.692**		

Vs = 37.983

Volumetric Flow Rate (Actual Basis)

$$Q = Vs \times A \times 60$$

Vs =	**37.983**	**A =**	**63.617**

Q = 144,981

Volumetric Flow Rate (Standard Basis)

$$Qstd = 17.647 \times Q \times \frac{Ps}{Ts\ (avg) + 460}$$

Q =	**144,981**	**Ps =**	**25.78**	**Ts (avg) =**	**345.3**

Qstd = 81,890

Volumetric Flow Rate (Standard Dry Basis)

$$Qstd(dry) = Qstd \times (1-Bws)$$

Qstd =	**81,890**	**Bws =**	**0.382**

Qstd(dry) = 50,611

Isokinetic Variation:

$$\%ISO = \frac{0.0945 \times (Ts + 460) \times Vm(std)}{Vs \times \theta \times An \times Ps \times (1-Bws)}$$

Ts =	**345.3**	**Vm(std) =**	**41.092**	**Vs =**	**37.983**
An =	**0.0008296**	**θ =**	**60**	**Ps =**	**25.78**
Bws =	**0.382**				

%ISO = 103.8

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train A)**
Run:	**1**
Date:	**9/27/2023**
Method:	**26A**
Source Condition:	**Normal**

Chloride (Cl2) Concentration:

$$mg/m^3 = \frac{\text{mg of Chloride (Cl2)}}{\text{Vm(std) x 0.02832 } m^3/ft^3}$$

mg= 0.15 **Vm(std) =** 41.092

mg/m^3= 0.13

Chloride (Cl2) Emission Rate:

$$\text{lb of Chloride (Cl2)} = \frac{\mu g \text{ of sample x } 10^{-6} \text{ grams}/\mu g}{453.6 \text{ grams/lb}}$$

$$\text{Emission Rate lb/hr} = \frac{\text{lb of Chloride (Cl2)}}{\text{Vm(std)}} \times \text{dscfm} \times 60 \text{ min/hr}$$

lb of Chloride (Cl2) = 3.31E-10 **dscfm =** 50,611

Emission Rate lb/hr = 0.0244

$$\text{Emission Rate lb/ton} = \frac{\text{lb/hr of Chloride (Cl2)}}{\text{clinker production ton/hr}}$$

lb/hr of Chloride (Cl2) = 0.0244 **clinker ton/hr =** 39.0

Emission Rate lb/ton = 0.0006

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Test Location: Main Kiln
Date: 9/27/23

Sample Calculations

$$(3.58\ \% - 0.04\ \%) \times \frac{\textbf{O2 \% (dry)}\ 11.08\ \%}{11.06\ \% - 0.04\ \%} = 3.56\ \%$$

$$C_{gas} = (C - C_o) \times \frac{C_{ma}}{C_m - C_o}$$

where:
C_{gas} = Effluent gas concentration, dry basis, ppm or %
C = Average gas concentration indicated by gas analyzer, dry basis, ppm or %
C_o = Average of initial and final system calibration bias check responses for the zero gas, ppm or %
C_m = Average of inititial and final system calibration bias check responses for the upscale calibration gas, ppm or %
C_{ma} = Actual concentration of the upscale calibration gas, ppm or %

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Test Location: Main Kiln
Date: 9/27/23

FTIR Sample Calculations

Direct Recovery % of Calibration Transfer Standard

$$DR_{cts} = \frac{D_{cts}}{Cma} \times 100$$

Cma= 101.4 D_{cts} = 101.5

DR_{cts} = 100.1%

Recovery % with Calibration Transfer Standard System Purge

$$R_{cts} = \frac{Sys_{cts}}{D_{cts}} \times 100$$

Sys_{cts} = 101.5 D_{cts} = 101.5

R_{cts} = 100%

Direct Recovery % of Analyte Spike Gas

SF6			HCN		
$DR_{sf6} = \frac{D_{sf6}}{Cma} \times 100$			$DR_{asg} = \frac{D_{asg}}{Cma} \times 100$		
Cma= 5.0	D_{sf6} = 4.9		Cma= 49.6	D_{asg} = 51.3	
DR_{sf6} = 98%			DR_{asg} = 103.6%		

Dilution Factor for Analyte Spiking

$$DF = \frac{Spk_{sf6}}{D_{sf6}}$$

Spk_{sf6} = 0.378 D_{sf6} = 4.903

DF = 0.077

Recovery % for Analyte Spike With HCN

$$R_x = \frac{Spk_x}{(N_x \times (1-DF) + D_{asg} \times DF)}$$

Spk_x = 3.7 N_x = -0.1

DF = 0.077 D_{asg} = 51.3

R_x = 95.9 %

where:

DR_{cts} = Recovery % of the calibration transfer standard directly to the analyzer
Cma = certified concentration of calibration gas, ppm
D_{cts} = Concentration of the calibration transfer standard gas directly to the analyzer, ppm
R_{cts} = Recovery % of the calibration transfer standard through the sampling system
Sys_{cts} = Concentration of the calibration transfer standard gas through the system, ppm
DF = Dilution Factor of analyte spike gas
Spk_{sf6} = SF6 concentration in effluent during spiking
Spk_x = Analyte concentration in effluent during spiking
D_{asg} = Concentration of the analyte spike gas directly to the analyzer, ppm
D_{sf6} = Concentration of the SF6 directly to the analyzer, ppm
R_x = Recovery % of the analyte spike gas
N_x = Native effluent (HCN) concentration prior to analyte spike

MOSTARDI PLATT

Moisture Calculations

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w} = 0.04707(V_f - V_i)$$

$$V_{wsg(std)} = \frac{(W_f - W_i)\rho_w R T_{std}}{P_{std} M_w} = 0.04715(W_f - W_i)$$

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Where:

B_{ws} = Water vapor in gas stream, proportion by volume
M_w = Molecular weight of water, 18.015 lb/lb-mole
P_{bar} = Barometric pressure at the testing site, in. Hg
P_{std} = Standard absolute pressure, 29.92 in. Hg
R = Ideal gas constant, 0.048137 (in. Hg)(ft^3)/(g-mole)(°R) = [21.8348(in. Hg)(ft^3)/(lb-mole)(°R)]/453.592 g-mole/lb-mole
T_m = Absolute average dry gas meter temperature, °R
T_{std} = Standard absolute temperature, 528 °R
V_f = Final volume of condenser water, ml
V_i = Initial volume of condenser water, ml
V_m = Dry gas volume measured by dry gas meter, dcf
$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, scf
$V_{wc(std)}$ = Volume of condensed water vapor, corrected to standard conditions, scf
$V_{wsg(std)}$ = Volume of water vapor collected in silica gel, corrected to standard conditions, scf
W_f = Final weight of silica gel, g
W_i = Initial weight of silica gel, g
Y = Dry gas meter calibration factor
ΔH = Average pressure exerted on dry gas meter outlet by gas sample bag, in. H_2O
ρ_w = Density of water, 0.9982 g/ml
13.6 = Specific gravity of mercury (Hg)
17.64 = T_{std}/P_{std}
0.04707 = ft^3/ml 0.04715 = ft^3/g

MOSTARDI PLATT

Volumetric Flow Nomenclature

A =	Cross-sectional area of stack or duct, ft2
Bws =	Water vapor in gas stream, proportion by volume
Cp =	Pitot tube coefficient, dimensionless
Md =	Dry molecular weight of gas, lb/lb-mole
Ms =	Molecular weight of gas, wet basis, lb/lb-mole
Mw =	Molecular weight of water, 18.0 lb/lb-mole
Pbar =	Barometric pressure at testing site, in. Hg
Pg =	Static pressure of gas, in. Hg (in. H2O/13.6)
DH=	Static pressure of gas, in.H2O
Ps =	Absolute pressure of gas, in. Hg = Pbar + Pg
Pstd =	Standard absolute pressure, 29.92 in. Hg
Acfm =	Actual volumetric gas flow rate
Scfm=	Volumetric gas flow rate, corrected to standard conditions
Dscfm =	Standard volumetric flow rate, corrected to dry conditions
R =	Ideal gas constant, 21.85 in. Hg-ft3/°R-lb-mole
Ts =	Average stack gas temperature, °F
Tm =	Average dry gas meter temperature, oF
Tstd =	Standard absolute temperature, 528°R
vs =	Gas velocity, ft/sec
Vm(std)=	Volume of gas sampled, corrected to standard conditions, scf
Vw(std) =	Volume of water vapor in gas sample, corrected to standard conditions, scf
Vlc=	Volume of liquid collected
Y =	Dry gas meter calibration factor
Δp =	Velocity head of gas, in. H2O
K1 =	17.647 °R/in. Hg
%EA =	Percent excess air
%CO2 =	Percent carbon dioxide by volume, dry basis
%O2 =	Percent oxygen by volume, dry basis
%N2 =	Percent nitrogen by volume, dry basis
0.264 =	Ratio of O2 to N2 in air, v/v
0.28 =	Molecular weight of N2 or CO, divided by 100
0.32 =	Molecular weight of O2 divided by 100
0.44 =	Molecular weight of CO2 divided by 100
13.6 =	Specific gravity of mercury (Hg)

MOSTARDI PLATT

Volumetric Air Flow Calculations

$$Vm\ (std) = 17.647 \times Vm \times \left[\frac{\left(P_{bar} + \left[\frac{DH}{13.6}\right]\right)}{(460 + Tm)}\right] \times Y$$

$$Vw\ (std) = 0.0471 \times Vlc$$

$$Bws = \left[\frac{Vw\ (std)}{Vw\ (std) + Vm\ (std)}\right]$$

$$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + [0.28 \times (100 - \%CO_2 - \%O_2)]$$

$$Ms = Md \times (1 - Bws) + (18 \times Bws)$$

$$Vs = \sqrt{\frac{(Ts + 460)}{Ms \times Ps}} \times \sqrt{DP} \times Cp \times 85.49$$

$$Acfm = Vs \times Area\ (of\ stack\ or\ duct) \times 60$$

$$Scfm = Acfm \times 17.647 \times \left[\frac{Ps}{(460 + Ts)}\right]$$

$$Scfh = Scfm \times 60\frac{min}{hr}$$

$$Dscfm = Scfm \times (1 - Bws)$$

MOSTARDI PLATT

Isokinetic Calculation Formulas

1. $V_{w(std)} = V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right) = K_2 V_{lc}$

2. $V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right)\left(\frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{P_{std}}\right) = K_1\, V_m\, Y \frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{T_m}$

3. $B_{ws} = \frac{V_{w(std)}}{(V_{m(std)} + V_{w(std)})}$

4. $M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$

5. $M_s = M_d(1 - B_{ws}) + 18.0(B_{ws})$

6. $C_a = \frac{m_a}{V_a \rho_a}$

7. $W_a = C_a V_{aw} \rho_a$

8. $C_{acf} = 15.43 K_i\left(\frac{m_n P_s}{V_{w(std)} + V_{m(std)}\, T_s}\right)$

9. $C_S = (15.43\ \text{grains/gram})\,(m_n / V_{m(std)})$

10. $v_s = K_p C_p \sqrt{\frac{\Delta P\, T_s}{P_s M_s}}$

11. $Q_{acfm} = v_s A(60_{sec/min})$

12. $Q_{sd} = (3600_{sec/hr})(1 - B_{ws})\, v_s \left(\frac{T_{std} P_s}{T_s P_{std}}\right) A$

13. $E\,(\text{emission rate, lbs/hr}) = Q_{std}\left(C_s / 7000\ \text{grains/lb}\right)$

14. $IKV = \frac{T_s V_{m(std)} P_{std}}{T_{std} v_s \theta A_n P_s 60(1 - B_{ws})} = K_4 \frac{T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$

15. $\%EA = \left(\frac{\%O_2 - (0.5\,\%CO)}{0.264\,\%N_2 - (\%O_2 - 0.5\,\%CO)}\right) \times 100$

MOSTARDI PLATT

Isokinetic Nomenclature

A = Cross-sectional area of stack or duct, square feet
A_n = Cross-sectional area of nozzle, square feet
B_{ws} = Water vapor in gas stream, by volume
C_a = Acetone blank residue concentration, g/g
C_{acf} = Concentration of particulate matter in gas stream at actual conditions, gr/acf
C_p = Pitot tube coefficient
C_s = Concentration of particulate matter in gas stream, dry basis, corrected to standard conditions, gr/dscf
IKV = Isokinetic sampling variance, must be 90.0 % ≤ IKV ≤ 110.0%
M_d = Dry molecular weight of gas, lb/lb-mole
M_s = Molecular weight of gas, wet basis, lb/lb-mole
M_w = Molecular weight of water, 18.0 lb/lb-mole
m_a = Mass of residue of acetone after evaporation, grams
P_{bar} = Barometric pressure at testing site, inches mercury
P_g = Static pressure of gas, inches mercury (inches water/13.6)
P_s = Absolute pressure of gas, inches mercury = $P_{bar} + P_g$
P_{std} = Standard absolute pressure, 29.92 inches mercury
Q_{acfm} = Actual volumetric gas flow rate, acfm
Q_{sd} = Dry volumetric gas flow rate corrected to standard conditions, dscfh
R = Ideal gas constant, 21.85 inches mercury cubic foot/°R-lb-mole
T_m = Dry gas meter temperature, °R
T_s = Gas temperature, °R
T_{std} = Absolute temperature, 528°R
V_a = Volume of acetone blank, ml
V_{aw} = Volume of acetone used in wash, ml
W_a = Weight of residue in acetone wash, grams
m_n = Total amount of particulate matter collected, grams
V_{1c} = Total volume of liquid collected in impingers and silica gel, ml
V_m = Volume of gas sample as measured by dry gas meter, dcf
$V_{m(std)}$ = Volume of gas sample measured by dry gas meter, corrected to standard conditions, dscf
v_s = Gas velocity, ft/sec
$V_{w(std)}$ = Volume of water vapor in gas sample, corrected to standard conditions, scf
Y = Dry gas meter calibration factor
ΔH = Average pressure differential across the orifice meter, inches water
Δp = Velocity head of gas, inches water
ρ_a = Density of acetone, 0.7855 g/ml (average)
ρ_w = Density of water, 0.002201 lb/ml
θ = Total sampling time, minutes
K_1 = 17.647 °R/in. Hg
K_2 = 0.04707 ft^3/ml
K_4 = 0.09450/100 = 0.000945
K_p = Pitot tube constant, $85.49 \frac{ft}{sec}\left[\frac{(lb/lb-mole)(in.\ Hg)}{(°R)(in.\ H_2O)}\right]^{1/2}$
%EA = Percent excess air
$\%CO_2$ = Percent carbon dioxide by volume, dry basis
$\%O_2$ = Percent oxygen by volume, dry basis
%CO = Percent carbon monoxide by volume, dry basis
$\%N_2$ = Percent nitrogen by volume, dry basis
0.264 = Ratio of O_2 to N_2 in air, v/v
28 = Molecular weight of N_2 or CO
32 = Molecular weight of O_2
44 = Molecular weight of CO_2
13.6 = Specific gravity of mercury (Hg)

MOSTARDI PLATT

Calculations for Hydrogen Fluoride By Method 26 or 26A

Concentration

$$\frac{\text{lbs HF}}{\text{dscf}} = \frac{\mu\text{g HF in sample}}{4.536 \times 10^{8} \times \text{dscf}}$$

where:

$4.536 \times 10^{8} = \mu\text{g/lb}$

dscf = Volume of gas sampled

$$\mu g\text{/lb HF} = \mu\text{g F} \times \frac{20.008}{19.000}$$

Parts Per Million

$$\text{ppm HF} = \frac{\text{lbs HF}}{\text{dscf}} \div \frac{20.008}{385 \times 10^{6}}$$

where:

385 = Volume of 1 lb mole of gas at 68°F and 29.92 in. Hg

106 = Conversion of ppm v/v

Emission Rate

lbs HF /dscf × dscfm × 60 min/hr = lbs/hr HF

MOSTARDI PLATT

Pollutant Concentration Correction 7% for Percent Oxygen

$$C_{adj} = C_d \frac{20.9 - 7\%}{20.9 - \%O_2}$$

where:

C_{adj} = Pollutant concentration corrected to percent O_2

20.9 - 7% = Percent O_2, the defined O_2 correction value, percent

20.9 = Percent O_2 in air

$\%O_2$ = Measured O_2 concentration dry basis, percent

C_d = Pollutant concentration measured, dry basis, ppm.

Appendix E- Laboratory Sample Analysis

mostardi platt

Chain-of-Custody Form

Project Number: M233901	Date Results Required:
Client: Ash Grove Cement Company	TAT Required:
Plant/Test Location: Montana City Kiln Stack	Project Supervisor: R. Sollars

Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
001	9/27/23	#1A KILN M26A H2SO4	1		HF	
002	9/27/23	#1A KILN M26A NaOH	1		Cl_2	
003	9/27/23	#1B KILN M26A H2SO4	1		HF	
004	9/27/23	#1B KILN M26A NaOH	1		Cl_2	
005	9/27/23	#2A KILN M26A H2SO4	1		HF	
006	9/27/23	#2A KILN M26A NaOH	1		Cl_2	
007	9/27/23	#2B KILN M26A H2SO4	1		HF	
008	9/27/23	#2B KILN M26A NaOH	1		Cl_2	
009	9/27/23	#3A KILN M26A H2SO4	1		HF	
010	9/27/23	#3A KILN M26A NaOH	1		Cl_2	
011	9/27/23	#3B KILN M26A H2SO4	1		HF	
012	9/27/23	#3B KILN M26A NaOH	1		Cl_2	
013	9/27/23	#4A KILN M26A H2SO4	1		HF	
014	9/27/23	#4A KILN M26A NaOH	1		Cl_2	
015	9/27/23	#4B KILN M26A H2SO4	1		HF	
016	9/27/23	#4B KILN M26A NaOH	1		Cl_2	
017	9/27/23	A Train Blank H2SO4	1		HF	
018	9/27/23	A Train Blank NaOH	1		Cl_2	
019	9/27/23	DI Reagent Blank	1		HF/ Cl_2	
020	9/27/23	H2SO4 Reagent Blank	1		HF/ Cl_2	
021	9/27/23	NaOH Reagent Blank	1		HF/ Cl_2	

Delivered to Lab by: Date/Time:	Received by: Date/Time:	Processed by: Date/Time:

Laboratory Notes:

Client:	Ash Grove Cement	**Analysis Date:**	10/11/2023								
Facility:	Montana City	**Analysis Location:**	Elmhurst								
Test Location:	Kiln Stack	**Analyst:**	JMG								
Project Number:	M233901										
Method:	26A										
Date Samples Received:	10/6/2023										
Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**							
1	0.2098	0.2098	**0.94**	**0.2233**							
2	0.4184	0.2092	**1.87**								
5	1.1349	0.2270	**5.08**	**Response Factor Ave**							
8	1.8685	0.2336	**8.37**	**0.2233**							
10	2.3686	0.2369	**10.60**								
Lot Number	Ricca 8209004										
	R^2	**0.9997**									
COC Number	**Sample Date**	**Sample ID**	**Sample Area**	**PPM F**	**PPM X Dilution Factor**	**Dilution Factor**	**Total ml**	**mg F in soln**	**mg HF in soln**	**mg HF in soln avg**	**ug HF in soln**
019	9/27/2023	DI Reagent Blank	0.0000	0.0000	0.0000	1	120	0.0000	0.0000		
019	9/27/2023	DI Reagent Blank	0.0001	0.0004	0.0004	1	120	0.0001	0.0001	**0.0000**	**0.028294733**
020	9/27/2023	H2SO4 Reagent Blank	0.0023	0.0103	0.0103	1	247	0.0025	0.0027		
020	9/27/2023	H2SO4 Reagent Blank	0.0032	0.0143	0.0143	1	247	0.0035	0.0037	**0.0032**	**3.203199519**
001	9/27/2023	Test 1A H2SO4 Imp	0.0037	0.0166	0.0166	1	560	0.0093	0.0098		
001	9/27/2023	Test 1A H2SO4 Imp	0.0030	0.0134	0.0134	1	560	0.0075	0.0079	**0.0088**	**8.846819725**
001	9/27/2023	Test 1A H2SO4 Imp	0.0026	0.0116	0.0116	1	560	0.0065	0.0069		
001	9/27/2023	Test 1A H2SO4 Imp	0.0027	0.0121	0.0121	1	560	0.0068	0.0071	**0.0070**	**6.998230529**
005	9/27/2023	Test 2A H2SO4 Imp	0.0014	0.0063	0.0063	1	519	0.0033	0.0034		
005	9/27/2023	Test 2A H2SO4 Imp	0.0010	0.0045	0.0045	1	519	0.0023	0.0024	**0.0029**	**2.936993244**
009	9/27/2023	Test 3A H2SO4 Imp	0.0035	0.0157	0.0157	1	561	0.0088	0.0093		
009	9/27/2023	Test 3A H2SO4 Imp	0.0042	0.0188	0.0188	1	561	0.0105	0.0111	**0.0102**	**10.18539637**
013	9/27/2023	Test 4A H2SO4 Imp	0.0058	0.0260	0.0260	1	583	0.0151	0.0159		
013	9/27/2023	Test 4A H2SO4 Imp	0.0049	0.0219	0.0219	1	583	0.0128	0.0135	**0.0147**	**14.70878095**
017	9/27/2023	Train Blank	0.0010	0.0045	0.0045	1	386	0.0017	0.0018		
017	9/27/2023	Train Blank	0.0012	0.0054	0.0054	1	386	0.0021	0.0021	**0.0020**	**1.954683384**
					Expected Value	**% Difference**					
		Run 1 H2SO4 Spike W/ 2ppm	0.2138	0.9572	0.9441						
Lot Number: Thermo 21-191JKS		Run 1 H2SO4 Spike W/ 2ppm	0.2130	0.9537	0.9441	1.20%					
CCV ppm Cl	**Area**	**PPM Cl**									
1 ppm ICV	0.2284	1.0226									
5 ppm CCV	1.1155	4.9944									
5 ppm CCV	1.118	5.0056									
5 ppm CCV	1.0282	4.6035									
5 ppm CCV	1.0436	4.6725									
Standard ppm Cl	**Area**	**Difference**									
1	0.2059	0.95%									
2	0.4150	0.41%									
5	1.1136	0.96%									
8	1.8529	0.42%									
10	2.3509	0.38%									

Client:	Ash Grove Cement	**Analysis Date:**	10/11/2023								
Facility:	Montana City	**Analysis Location:**	Elmhurst								
Test Location:	Kiln Stack	**Analyst:**	JMG								
Project Number:	M233901										
Method:	26A										
Date Samples Received:	10/6/2023										
Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**							
1	0.2098	0.2098	**0.94**	**0.2233**							
2	0.4184	0.2092	**1.87**								
5	1.1349	0.2270	**5.08**	**Response Factor Ave**							
8	1.8685	0.2336	**8.37**	**0.2233**							
10	2.3686	0.2369	**10.60**								
Lot Number	Ricca 8209004										
	R^2	**0.9997**									
COC Number	**Sample Date**	**Sample ID**	**Sample Area**	**PPM F**	**PPM X Dilution Factor**	**Dilution Factor**	**Total ml**	**mg F in soln**	**mg HF in soln**	**mg HF in soln avg**	**ug HF in soln**
019	9/27/2023	DI Reagent Blank	0.0000	0.0000	0.0000	1	120	0.0000	0.0000		
019	9/27/2023	DI Reagent Blank	0.0001	0.0004	0.0004	1	120	0.0001	0.0001	**0.0000**	**0.028294733**
020	9/27/2023	H2SO4 Reagent Blank	0.0023	0.0103	0.0103	1	247	0.0025	0.0027		
020	9/27/2023	H2SO4 Reagent Blank	0.0032	0.0143	0.0143	1	247	0.0035	0.0037	**0.0032**	**3.203199519**
003	9/27/2023	Test 1B H2SO4 Imp	0.0072	0.0322	0.0322	1	503	0.0162	0.0171		
003	9/27/2023	Test 1B H2SO4 Imp	0.0071	0.0318	0.0318	1	503	0.0160	0.0168	**0.0170**	**16.96009851**
003	9/27/2023	Test 1B H2SO4 Imp	0.0080	0.0358	0.0358	1	503	0.0180	0.0190		
003	9/27/2023	Test 1B H2SO4 Imp	0.0079	0.0354	0.0354	1	503	0.0178	0.0187	**0.0189**	**18.85773191**
007	9/27/2023	Test 2B H2SO4 Imp	0.0079	0.0354	0.0354	1	460	0.0163	0.0171		
007	9/27/2023	Test 2B H2SO4 Imp	0.0068	0.0304	0.0304	1	460	0.0140	0.0148	**0.0159**	**15.94408182**
011	9/27/2023	Test 3B H2SO4 Imp	0.0070	0.0313	0.0313	1	552	0.0173	0.0182		
011	9/27/2023	Test 3B H2SO4 Imp	0.0069	0.0309	0.0309	1	552	0.0171	0.0180	**0.0181**	**18.09165202**
015	9/27/2023	Test 4B H2SO4 Imp	0.0056	0.0251	0.0251	1	549	0.0138	0.0145		
015	9/27/2023	Test 4B H2SO4 Imp	0.0055	0.0246	0.0246	1	549	0.0135	0.0142	**0.0144**	**14.36877258**
CCV ppm F	**Area**	**PPM CI**									
1 ppm ICV	0.2284	1.0226									
5 ppm CCV	1.1155	4.9944									
5 ppm CCV	1.118	5.0056									
5 ppm CCV	1.0282	4.6035									
5 ppm CCV	1.0436	4.6725									
Standard ppm CI	**Area**	**Difference**									
1	0.2059	0.95%									
2	0.4150	0.41%									
5	1.1136	0.96%									
8	1.8529	0.42%									
10	2.3509	0.38%									

Kiln Stack

Client:	Ash Grove Cement	Analysis Date:	10/11/2023
Facility:	Montana City	Analysis Location:	Elmhurst
Test Location:	Kiln Stack	Analyst:	JMG
Project Number:	M233901		
Method:	26A		
Date Samples Received:	10/6/2023		

Train A

Sampling Date		9/20/2023	9/20/2023	9/20/2023	9/20/2023		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	120	247	560	560		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		9/20/2023	9/20/2023	9/27/2023			
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**	**M26A- H2SO4 R4**		**RDL**	**MDL**
Sulfuric Acid Volume	ml	519	561	583			
Hydrofluoric Acid	ug	<150	<150	<150		150	15

Train B

Sampling Date		9/27/2023	9/27/2023	9/27/2023	9/27/2023		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	120	247	503	503		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		9/27/2023	9/27/2023	9/27/2023			
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**	**M26A- H2SO4 R4**		**RDL**	**MDL**
Sulfuric Acid Volume	ml	519	561	549			
Hydrofluoric Acid	ug	<150	<150	<150		150	15

Client:	Ash Grove Cement	**Analysis Date:**	10/11/2023							
Facility:	Montana City	**Analysis Location:**	Elmhurst Lab							
Test Location:	Kiln Stack	**Analyst:**	JMG							
Project Number:	M233901									
Method:	26A									
Date Samples Received:	10/6/2023									
Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**						
1	0.1366	0.1366	**0.98**	**0.1389**						
2	0.2552	0.1276	**1.84**							
5	0.7086	0.1417	**5.10**	**Response Factor Ave**						
8	1.1443	0.1430	**8.24**	**0.1388**						
10	1.4511	0.1451	**10.45**							
Lot Number	Ricca 8209004									
	R^2	**0.9996**								
COC Number	**Sample Date**	**Sample ID**	**Sample Area**	**PPM Cl**	**PPM X Dilution Factor**	**Dilution Factor**	**Total ml**	**mg HCl in soln**	**mg HCl in soln avg**	**ug HCl in soln**
019	9/27/2023	DI Reagent Blank	0.0011	0.0079	0.0079	1	120	0.0010		
019	9/27/2023	DI Reagent Blank	0.0006	0.0043	0.0043	1	120	0.0005	**0.0008**	**0.755236896**
020	9/27/2023	H2SO4 Reagent Blank	0.0239	0.1721	0.1721	1	186	0.0329		
020	9/27/2023	H2SO4 Reagent Blank	0.0248	0.1786	0.1786	1	186	0.0342	**0.0335**	**33.53473946**
002	9/27/2023	Test 1A NaOH Imp	0.0199	0.1433	0.1433	1	323	0.0476		
002	9/27/2023	Test 1A NaOH Imp	0.0218	0.1570	0.1570	1	323	0.0521	**0.0499**	**49.86451605**
002	9/27/2023	Test 1A NaOH Imp	0.0220	0.1584	0.1584	1	323	0.0526		
002	9/27/2023	Test 1A NaOH Imp	0.0219	0.1577	0.1577	1	323	0.0524	**0.0525**	**52.4952579**
006	9/27/2023	Test 2A NaOH Imp	0.0790	0.5689	0.5689	1	321	0.1878		
006	9/27/2023	Test 2A NaOH Imp	0.0789	0.5682	0.5682	1	321	0.1875	**0.1876**	**187.6463813**
010	9/27/2023	Test 3A NaOH Imp	0.0164	0.1181	0.1181	1	269	0.0327		
010	9/27/2023	Test 3A NaOH Imp	0.0170	0.1224	0.1224	1	269	0.0339	**0.0333**	**33.26226183**
014	9/27/2023	Test 4A NaOH Imp	0.0435	0.3132	0.3132	1	268	0.0863		
014	9/27/2023	Test 4A NaOH Imp	0.0461	0.3320	0.3320	1	268	0.0915	**0.0889**	**88.89878692**
018	9/27/2023	Train Blank	0.0227	0.1635	0.1635	1	300	0.0504		
018	9/27/2023	Train Blank	0.0225	0.1620	0.1620	1	300	0.0500	**0.0502**	**50.20104072**
					Expected Value	**% Difference**				
		Run 1 H2SO4 Spike W/ 2ppm	0.1314	0.9462	0.9939					
		Run 1 H2SO4 Spike W/ 2ppm	0.1410	1.0154	0.9939	1.32%				
CCV ppm Cl	**Area**	**PPM Cl**								
5 ppm ICV	0.7081	5.0991								
5 ppm CCV	0.7164	5.1589								
5 ppm CCV	0.7125	5.1308								
5 ppm CCV	0.7265	5.2316								
Standard ppm Cl	**Area**	**Difference**								
1	0.1360	0.22%								
2	0.2413	2.88%								
5	0.6911	1.27%								
8	1.1246	0.88%								
10	1.4154	1.26%								

Client:	Ash Grove Cement	**Analysis Date:**	10/11/2023						
Facility:	Montana City	**Analysis Location:**	Elmhurst Lab						
Test Location:	Kiln Stack	**Analyst:**	JMG						
Project Number:	M233901								
Method:	26A								
Date Samples Received:	10/6/2023								

Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**
1	0.1366	0.1366	**0.98**	**0.1389**
2	0.2552	0.1276	**1.84**	
5	0.7086	0.1417	**5.10**	**Response Factor Ave**
8	1.1443	0.1430	**8.24**	**0.1388**
10	1.4511	0.1451	**10.45**	
Lot Number	Ricca 8209004			
	R²	**0.9996**		

COC Number	**Sample Date**	**Sample ID**	**Sample Area**	**PPM Cl**	**PPM X Dilution Factor**	**Dilution Factor**	**Total ml**	**mg Cl2 in soln avg**	**ug Cl2 in soln**
019	9/27/2023	DI Reagent Blank	0.0011	0.0079	0.0079	1	120		
019	9/27/2023	DI Reagent Blank	0.0006	0.0043	0.0043	1	120	**0.0007**	**0.734517091**
021	9/27/2023	NaOH Reagent Blank	0.0239	0.1721	0.1721	1	186		
021	9/27/2023	NaOH Reagent Blank	0.0248	0.1786	0.1786	1	186	**0.0326**	**32.61471917**
004	9/27/2023	Test 1B NaOH Imp	0.0094	0.0677	0.0677	1	330		
004	9/27/2023	Test 1B NaOH Imp	0.0076	0.0547	0.0547	1	330	**0.0202**	**20.19921999**
004	9/27/2023	Test 1B NaOH Imp	0.0104	0.0749	0.0749	1	330		
004	9/27/2023	Test 1B NaOH Imp	0.0098	0.0706	0.0706	1	330	**0.0240**	**24.00142611**
008	9/27/2023	Test 2B NaOH Imp	1.1608	8.3593	8.3593	1	398		
008	9/27/2023	Test 2B NaOH Imp	1.1501	8.2820	8.2820	1	398	**3.3116**	**3311.628417**
012	9/27/2023	Test 3B NaOH Imp	0.0105	0.0756	0.0756	1	256		
012	9/27/2023	Test 3B NaOH Imp	0.0050	0.0360	0.0360	1	256	**0.0143**	**14.28707753**
014	9/27/2023	Test 4B NaOH Imp	0.0277	0.1995	0.1995	1	255		
014	9/27/2023	Test 4B NaOH Imp	0.0291	0.2096	0.2096	1	255	**0.0522**	**52.15071344**

CCV ppm Cl	**Area**	**PPM Cl**
5 ppm ICV	0.7081	5.0991
5 ppm CCV	0.7164	5.1589
5 ppm CCV	0.7125	5.1308
5 ppm CCV	0.7265	5.2316

Standard ppm Cl	**Area**	**Difference**
1	0.1360	0.22%
2	0.2413	2.88%
5	0.6911	1.27%
8	1.1246	0.88%
10	1.4154	1.26%

Kiln Stack

Client:	Ash Grove Cement	Analysis Date:	10/11/2023
Facility:	Montana City	Analysis Location:	Elmhurst
Test Location:	Kiln Stack	Analyst:	JMG
Project Number:	M233901		
Method:	26A		
Date Samples Received:	10/6/2023		

Train A

Sampling Date		9/27/2023	9/27/2023	9/27/2023	9/27/2023		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	120	186	323	323		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		9/27/2023	9/27/2023	9/27/2023			
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**	**M26A- NaOH R4**		**RDL**	**MDL**
Sodium Hydroxide Volume	ml	321	269	268			
Chlorine	ug	188	<150	<150		150	15

Train B

Sampling Date		9/27/2023	9/27/2023	9/27/2023	9/27/2023		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	120	186	330	330		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		9/27/2023	9/27/2023	9/27/2023			
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**	**M26A- NaOH R4**		**RDL**	**MDL**
Sodium Hydroxide Volume	ml	398	256	255			
Chlorine	ug	3312	<150	<150		150	15

Appendix F - Reference Method Test Data

Client:	Ash Grove Cement Company			
Facility:	Montana City Cement Plant			
Test Location:	Main Kiln (Train A)			
Project #:	M233901			
Test Method:	26A			
Test Engineer:	NJC			
Test Technician:	EROD			
	Run 1A	**Run 2A**	**Run 3A**	**Run 4A**
Temp ID:	CM41	CM41	CM41	CM41
Meter ID:	CM41	CM41	CM41	CM41
Pitot ID:	S8-031A	S8-031A	S8-031A	S8-031A
Nozzle Diameter (Inches):	0.390	0.390	0.390	0.390
Meter Calibration Date:	8/25/2023	8/25/2023	8/25/2023	8/25/2023
Meter Calibration Factor (Y):	1.011	1.011	1.011	1.011
Meter Orifice Setting (Delta H):	1.708	1.708	1.708	1.708
Nozzle Kit ID Number and Material:	Glass # 9	Glass # 9	Glass # 9	Glass # 9
Pitot Tube Coefficient:	0.820			
Probe Length (Feet):	10.0			
Probe Liner Material:	Glass			
Sample Plane:	Horizontal			
Port Length (Inches):	5.50			
Port Size (Diameter, Inches):	6.00			
Port Type:	Flange			
Duct Shape:	Circular			
Diameter (Feet):	9			
Duct Area (Square Feet):	63.617			
Upstream Diameters:	2.0			
Downstream Diameters:	4.6			
Number of Ports Sampled:	2			
Number of Points per Port:	12			
Minutes per Point:	2.5			
Minutes per Reading:	2.5			
Total Number of Traverse Points:	24			
Test Length (Minutes):	60			
Train Type:	Anderson Box			
Source Condition:	Normal			
Diluent Model/Serial Number:	CAI 700 and MKS 2030			
Moisture Balance ID:	LV4			
# of Runs	4			

Method 1 and 2 Cyclonic Flow Check Data

Project Number	M233901	**Source Condition:**	Normal
Client:	Ash Grove Cement Company	**Run No.:**	1
Facility:	Montana City Cement Plant	**Date:**	9/26/2023
Location:	Main Kiln (Train A)	**Start Time:**	14:07
Pitot ID:	S8-031A	**End Time:**	14:22
Pitot Coefficient:	0.820	**RM Testers:**	NJC
Probe Length:	10	**Port Length:**	5.50

Port	Point	DP (in. H_2O)	Sqrt. DP	Temp (^oF)	Yaw (o)		Velocity (V)	Port	Point	DP (in. H_2O)	Sqrt. DP	Temp (^oF)	Yaw (o)		Velocity (V)
A	1	0.23	0.4796	345.0	6.0	6.0	33.24	B	1	0.28	0.5292	350.0	7.0	7.0	36.79
A	2	0.25	0.5000	348.0	6.0	6.0	34.72	B	2	0.29	0.5385	351.0	7.0	7.0	37.46
A	3	0.26	0.5099	351.0	5.0	5.0	35.47	B	3	0.29	0.5385	353.0	6.0	6.0	37.51
A	4	0.28	0.5292	354.0	5.0	5.0	36.88	B	4	0.30	0.5477	354.0	7.0	7.0	38.17
A	5	0.29	0.5385	355.0	5.0	5.0	37.55	B	5	0.29	0.5385	356.0	5.0	5.0	37.58
A	6	0.28	0.5292	356.0	4.0	4.0	36.92	B	6	0.28	0.5292	356.0	5.0	5.0	36.92
A	7	0.25	0.5000	357.0	4.0	4.0	34.91	B	7	0.26	0.5099	357.0	5.0	5.0	35.60
A	8	0.24	0.4899	357.0	3.0	3.0	34.21	B	8	0.23	0.4796	357.0	3.0	3.0	33.49
A	9	0.23	0.4796	357.0	2.0	2.0	33.49	B	9	0.22	0.4690	356.0	2.0	2.0	32.73
A	10	0.20	0.4472	356.0	1.0	1.0	31.21	B	10	0.20	0.4472	354.0	2.0	2.0	31.17
A	11	0.20	0.4472	356.0	1.0	1.0	31.21	B	11	0.16	0.4000	354.0	1.0	1.0	27.88
A	12	0.16	0.4000	354.0	2.0	2.0	27.88	B	12	0.14	0.3742	354.0	1.0	1.0	26.08

Average Yaw Angle 4.0 °

Run 1A - Method 26A

Client: Ash Grove Cement Company | **Date: 9/27/23**

Facility: Montana City Cement Plant | **Start Time: 7:30**

Test Location: Main Kiln (Train A) | **End Time: 8:42**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.57	in. H_2O	Static Pressure	-0.20	in. H_2O
Meter Temperature, Tm:	53.9	°F	Flue Pressure (Ps):	25.78	in. Hg. abs.
Sqrt ΔP:	0.501	in. H_2O	Carbon Dioxide:	24.50	%
Stack Temperature, Ts:	345.3	°F	Oxygen:	3.60	%
Meter Volume, Vm:	45.692	ft^3	Nitrogen:	71.90	%
Meter Volume, Vmstd:	41.092	dscf	Gas Weight dry, Md:	32.064	lb/lb mole
Meter Volume, Vwstd:	25.396	wscf	Gas Weight wet, Ms:	26.692	lb/lb mole
Isokinetic Variance:	103.8	%I	Excess Air:	23.405	%
			Gas Velocity, Vs:	37.983	fps
Test Length:	60.00	in mins.	Volumetric Flow:	144,981	acfm
Nozzle Diameter:	0.390	in inches	Volumetric Flow:	50,611	dscfm
Barometric Pressure:	25.79	in Hg	Volumetric Flow:	81,890	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3641.9	ml	Silica Initial Wt.	840.0	grams
Final Impinger Content:	4166.5	ml	Silica Final Wt.	854.6	grams
Impinger Difference:	524.6	ml	Silica Difference:	14.6	grams
Total Water Gain:	539.2		Moisture, Bws:	0.382	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	7:30:00	0.26	1.60	246.502	339	50	50	255	251	47
1-2	7:32:30	0.26	1.60	248.440	340	51	51	256	252	50
1-3	7:35:00	0.28	1.70	250.370	340	51	51	254	250	48
1-4	7:37:30	0.28	1.70	252.380	339	51	51	254	251	45
1-5	7:40:00	0.29	1.80	254.380	339	51	51	256	252	45
1-6	7:42:30	0.30	1.90	256.430	342	51	51	255	253	46
1-7	7:45:00	0.27	1.70	258.520	340	51	51	254	251	46
1-8	7:47:30	0.24	1.50	260.470	340	51	51	254	252	48
1-9	7:50:00	0.22	1.40	262.330	341	52	52	253	252	50
1-10	7:52:30	0.20	1.20	264.120	340	52	52	254	251	52
1-11	7:55:00	0.18	1.10	265.810	340	52	52	252	252	53
1-12	7:57:30	0.16	1.00	267.430	339	52	52	255	253	55
	8:00:00			268.944						
2-1	8:12:00	0.29	1.80	268.944	346	55	55	251	252	60
2-2	8:14:30	0.29	1.80	270.980	350	55	55	252	251	57
2-3	8:17:00	0.30	1.90	273.040	352	55	55	255	254	57
2-4	8:19:30	0.30	1.90	275.120	351	56	56	255	253	58
2-5	8:22:00	0.31	1.90	277.210	352	56	56	256	254	59
2-6	8:24:30	0.29	1.80	279.320	352	56	56	254	255	59
2-7	8:27:00	0.28	1.70	281.370	351	57	57	253	255	56
2-8	8:29:30	0.26	1.60	283.380	350	57	57	254	256	55
2-9	8:32:00	0.22	1.40	285.330	351	57	57	254	255	54
2-10	8:34:30	0.22	1.40	287.120	352	58	58	253	251	53
2-11	8:37:00	0.19	1.20	288.910	351	58	58	252	250	53
2-12	8:39:30	0.18	1.10	290.560	350	59	59	251	252	52
	8:42:00			292.194						
Total	1:00:00			45.692		53.9	53.9			
Average			1.57		345.3	53.9				
Min			1.00		339.0	50.0				
Max			1.90		352.0	59.0				

Impinger Weight Sheet - Run 1A

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M233901**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**NJC**
Balance ID:	**LV4**

Scale Calibration Check Date: **9/27/2023**

Scale Calibration Check (see QS-6.05C for procedure)
must be within ± 0.5g of certified mass

Certified Weight, grams	Result, grams
250	250.0
500	500.0
750	750.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	903.9	750.6	153.3
0.1N H2SO4	912.9	738.0	174.9
Empty	736.0	607.2	128.8
0.1N NaOH	809.1	758.6	50.5
0.1N NaOH	804.6	787.5	17.1
Silica Gel	854.6	840.0	14.6
	4,166.5	3,641.9	524.6
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	854.6	840.0	14.6
	Silica Final	**Silica Initial**	**Silica Gain**

Run 2A - Method 26A

Client: Ash Grove Cement Company | **Date: 9/27/23**

Facility: Montana City Cement Plant | **Start Time: 9:57**

Test Location: Main Kiln (Train A) | **End Time: 11:02**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.58	In. H_2O	Static Pressure	-0.20	in. H_2O
Meter Temperature, Tm:	66.6	°F	Flue Pressure (Ps):	25.78	in. Hg. abs.
Sqrt ΔP:	0.497	In. H_2O	Carbon Dioxide:	24.90	%
Stack Temperature, Ts:	350.5	°F	Oxygen:	3.50	%
Meter Volume, Vm:	46.324	ft^3	Nitrogen:	71.6	%
Meter Volume, Vmstd:	40.660	dscf	Gas Weight dry, Md:	32.124	lb/lb mole
Meter Volume, Vwstd:	23.950	wscf	Gas Weight wet, Ms:	26.888	lb/lb mole
Isokinetic Variance:	102.3	%I	Excess Air:	22.724	%
			Gas Velocity, Vs:	37.700	fps
Test Length:	60.00	in mins.	Volumetric Flow:	143,904	acfm
Nozzle Diameter:	0.390	in inches	Volumetric Flow:	50,820	dscfm
Barometric Pressure:	25.79	in Hg	Volumetric Flow:	80,755	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3586.9	ml	Silica Initial Wt.	870.8	grams
Final Impinger Content:	4070.4	ml	Silica Final Wt.	895.8	grams
Impinger Difference:	483.5	ml	Silica Difference:	25.0	grams
Total Water Gain:	508.5		Moisture, Bws:	0.371	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	9:57:00	0.28	1.80	292.944	346	61	61	256	255	62
1-2	9:59:30	0.29	1.80	294.980	352	61	61	254	256	61
1-3	10:02:00	0.30	1.90	297.050	352	61	61	255	252	60
1-4	10:04:30	0.31	1.90	299.150	351	61	61	252	253	60
1-5	10:07:00	0.31	1.90	301.290	352	61	61	251	252	60
1-6	10:09:30	0.30	1.90	303.430	351	62	62	252	255	59
1-7	10:12:00	0.28	1.80	305.540	350	64	64	251	254	58
1-8	10:14:30	0.26	1.60	307.590	350	64	64	256	255	58
1-9	10:17:00	0.23	1.50	309.540	349	64	64	255	256	56
1-10	10:19:30	0.21	1.30	311.410	349	65	65	256	254	55
1-11	10:22:00	0.19	1.20	313.180	351	65	65	254	255	56
1-12	10:24:30	0.17	1.10	314.870	352	65	65	254	252	58
	10:27:00			316.464						
2-1	10:32:00	0.25	1.60	316.464	351	67	67	252	251	65
2-2	10:34:30	0.25	1.60	318.410	351	67	67	255	256	63
2-3	10:37:00	0.27	1.70	320.350	351	67	67	253	252	60
2-4	10:39:30	0.28	1.80	322.360	350	68	68	252	251	61
2-5	10:42:00	0.29	1.80	324.430	349	69	69	257	256	62
2-6	10:44:30	0.29	1.90	326.540	349	70	70	256	255	61
2-7	10:47:00	0.26	1.70	328.640	351	72	72	255	253	60
2-8	10:49:30	0.24	1.50	330.640	351	72	72	256	254	59
2-9	10:52:00	0.20	1.30	332.560	350	72	72	253	252	56
2-10	10:54:30	0.19	1.20	334.320	352	73	73	251	252	53
2-11	10:57:00	0.17	1.10	336.030	352	73	73	252	254	53
2-12	10:59:30	0.17	1.10	337.650	351	74	74	250	251	52
	11:02:00			339.268						
Total	1:00:00			46.324		66.6	66.6			
Average			1.58		350.5	66.6				
Min			1.10		346.0	61.0				
Max			1.90		352.0	74.0				

Impinger Weight Sheet - Run 2A

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M233901**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**NJC**
Balance ID:	**LV4**

Scale Calibration Check Date: **9/27/2023**

Scale Calibration Check (see QS-6.05C for procedure)
must be within ± 0.5g of certified mass

Certified Weight, grams	Result, grams
250	250.0
500	500.0
750	750.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	821.0	720.0	101.0
0.1N H2SO4	896.9	711.8	185.1
Empty	736.1	646.1	90.0
0.1N NaOH	808.7	740.0	68.7
0.1N NaOH	807.7	769.0	38.7
Silica Gel	895.8	870.8	25.0

Liquid Final	Liquid Initial	Liquid Gain
4,070.4	3,586.9	483.5

Silica Final	Silica Initial	Silica Gain
895.8	870.8	25.0

Run 3A - Method 26A

Client: Ash Grove Cement Company | **Date: 9/27/23**

Facility: Montana City Cement Plant | **Start Time: 11:20**

Test Location: Main Kiln (Train A) | **End Time: 12:25**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.74	In. H_2O	Static Pressure	-0.20	in. H_2O
Meter Temperature, Tm:	70.3	°F	Flue Pressure (Ps):	25.78	in. Hg. abs.
Sqrt ΔP:	0.501	In. H_2O	Carbon Dioxide:	25.00	%
Stack Temperature, Ts:	349.6	°F	Oxygen:	3.70	%
Meter Volume, Vm:	48.978	ft^3	Nitrogen:	71.3	%
Meter Volume, Vmstd:	42.704	dscf	Gas Weight dry, Md:	32.148	lb/lb mole
Meter Volume, Vwstd:	24.544	wscf	Gas Weight wet, Ms:	26.984	lb/lb mole
Isokinetic Variance:	105.9	%I	Excess Air:	24.466	%
			Gas Velocity, Vs:	37.882	fps
Test Length:	60.00	in mins.	Volumetric Flow:	144,597	acfm
Nozzle Diameter:	0.390	in inches	Volumetric Flow:	51,590	dscfm
Barometric Pressure:	25.79	in Hg	Volumetric Flow:	81,240	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3576.5	ml	Silica Initial Wt.	872.4	grams
Final Impinger Content:	4081.7	ml	Silica Final Wt.	888.3	grams
Impinger Difference:	505.2	ml	Silica Difference:	15.9	grams
Total Water Gain:	521.1		Moisture, Bws:	0.365	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	11:20:00	0.26	1.70	341.394	349	71	71	256	255	60
1-2	11:22:30	0.25	1.60	343.390	349	71	71	254	256	59
1-3	11:25:00	0.27	1.70	345.360	350	69	69	255	253	52
1-4	11:27:30	0.28	1.80	347.370	348	68	68	252	251	50
1-5	11:30:00	0.30	1.90	349.450	350	67	67	252	250	53
1-6	11:32:30	0.31	2.00	351.560	351	67	67	255	254	53
1-7	11:35:00	0.27	1.70	353.740	349	67	67	254	256	54
1-8	11:37:30	0.25	1.60	355.750	349	67	67	252	255	54
1-9	11:40:00	0.21	1.30	357.720	348	68	68	251	254	55
1-10	11:42:30	0.20	1.30	359.480	348	68	68	257	256	55
1-11	11:45:00	0.19	1.20	361.230	349	67	67	255	256	56
1-12	11:47:30	0.18	1.10	362.930	348	68	68	257	258	60
	11:50:00			364.582						
2-1	11:55:00	0.29	1.90	364.582	349	70	70	256	255	64
2-2	11:57:30	0.28	1.80	366.680	348	70	70	254	252	62
2-3	12:00:00	0.31	2.30	368.760	350	71	71	252	253	63
2-4	12:02:30	0.30	2.30	371.460	350	71	71	256	255	61
2-5	12:05:00	0.30	2.30	373.790	348	72	72	254	253	60
2-6	12:07:30	0.29	2.20	376.120	351	72	72	251	252	58
2-7	12:10:00	0.28	2.10	378.380	352	73	73	254	256	58
2-8	12:12:30	0.25	1.90	380.650	352	73	73	256	255	57
2-9	12:15:00	0.23	1.70	382.760	351	74	74	253	251	56
2-10	12:17:30	0.21	1.60	384.810	351	74	74	252	250	57
2-11	12:20:00	0.20	1.50	386.760	350	75	75	254	252	58
2-12	12:22:30	0.16	1.20	388.670	350	75	75	252	254	60
	12:25:00			390.372						
Total	1:00:00			48.978		70.3	70.3			
Average			1.74		349.6	70.3				
Min			1.10		348.0	67.0				
Max			2.30		352.0	75.0				

Impinger Weight Sheet - Run 3A

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M233901**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**NJC**
Balance ID:	**LV4**

Scale Calibration Check Date: **9/27/2023**

Scale Calibration Check (see QS-6.05C for procedure)
must be within ± 0.5g of certified mass

Certified Weight, grams	Result, grams
250	250.0
500	500.0
750	750.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	903.8	724.0	179.8
0.1N H2SO4	889.7	697.1	192.6
Empty	712.2	612.3	99.9
0.1N NaOH	792.5	765.0	27.5
0.1N NaOH	783.5	778.1	5.4
Silica Gel	888.3	872.4	15.9
	4,081.7 **Liquid Final**	3,576.5 **Liquid Initial**	505.2 **Liquid Gain**
	888.3 **Silica Final**	872.4 **Silica Initial**	15.9 **Silica Gain**

Run 4A -Method 26A

Client: Ash Grove Cement Company | **Date: 9/27/23**

Facility: Montana City Cement Plant | **Start Time: 12:45**

Test Location: Main Kiln (Train A) | **End Time: 13:50**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.90	In. H_2O	Static Pressure	-0.20	in. H_2O
Meter Temperature, Tm:	82.3	°F	Flue Pressure (Ps):	25.78	in. Hg. abs.
Sqrt ΔP:	0.499	In. H_2O	Carbon Dioxide:	25.00	%
Stack Temperature, Ts:	358.9	°F	Oxygen:	3.70	%
Meter Volume, Vm:	51.479	ft^3	Nitrogen:	71.3	%
Meter Volume, Vmstd:	43.919	dscf	Gas Weight dry, Md:	32.148	lb/lb mole
Meter Volume, Vwstd:	24.831	wscf	Gas Weight wet, Ms:	27.038	lb/lb mole
Isokinetic Variance:	109.5	%I	Excess Air:	24.466	%
			Gas Velocity, Vs:	37.888	fps
Test Length:	60.00	in mins.	Volumetric Flow:	144,621	acfm
Nozzle Diameter:	0.390	in inches	Volumetric Flow:	51,315	dscfm
Barometric Pressure:	25.79	in Hg	Volumetric Flow:	80,328	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3627.9	ml	Silica Initial Wt.	867.3	grams
Final Impinger Content:	4137.1	ml	Silica Final Wt.	885.3	grams
Impinger Difference:	509.2	ml	Silica Difference:	18.0	grams
Total Water Gain:	527.2		Moisture, Bws:	0.361	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	12:45:00	0.30	2.30	390.933	359	80	80	254	252	65
1-2	12:47:30	0.29	2.20	393.290	358	80	80	253	257	59
1-3	12:50:00	0.30	2.30	395.570	359	79	79	258	260	55
1-4	12:52:30	0.31	2.30	397.930	358	79	79	254	252	52
1-5	12:55:00	0.30	2.30	400.320	360	80	80	255	258	50
1-6	12:57:30	0.30	2.30	402.650	360	80	80	253	253	51
1-7	13:00:00	0.27	2.00	405.020	359	81	81	257	255	52
1-8	13:02:30	0.25	1.90	407.240	359	81	81	256	254	53
1-9	13:05:00	0.24	1.80	409.380	358	81	81	254	251	55
1-10	13:07:30	0.20	1.50	411.490	359	82	82	253	252	57
1-11	13:10:00	0.19	1.40	413.410	359	82	82	251	255	60
1-12	13:12:30	0.17	1.30	415.280	358	82	82	256	258	62
	13:15:00			417.058						
2-1	13:20:00	0.24	1.80	417.058	360	83	83	255	254	65
2-2	13:22:30	0.24	1.80	419.170	361	83	83	257	258	63
2-3	13:25:00	0.26	2.00	421.270	361	83	83	254	256	61
2-4	13:27:30	0.28	2.10	423.470	360	84	84	252	251	60
2-5	13:30:00	0.29	2.20	425.760	359	84	84	253	254	59
2-6	13:32:30	0.30	2.30	428.060	359	84	84	258	259	57
2-7	13:35:00	0.27	2.10	430.450	358	85	85	260	258	58
2-8	13:37:30	0.26	2.00	432.680	359	85	85	257	255	59
2-9	13:40:00	0.22	1.70	434.880	359	85	85	254	252	61
2-10	13:42:30	0.20	1.50	436.910	358	84	84	253	251	63
2-11	13:45:00	0.18	1.40	438.850	357	84	84	255	253	61
2-12	13:47:30	0.16	1.20	440.690	357	83	83	254	252	60
	13:50:00			442.412						
Total	1:00:00			51.479		82.3	82.3			
Average			1.90		358.9	82.3				
Min			1.20		357.0	79.0				
Max			2.30		361.0	85.0				

Impinger Weight Sheet - Run 4A

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M233901**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**NJC**
Balance ID:	**LV4**

Scale Calibration Check Date: **9/27/2023**

Scale Calibration Check (see QS-6.05C for procedure)

must be within ± 0.5g of certified mass

Certified Weight, grams	Result, grams
250	250.0
500	500.0
750	750.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	905.4	735.8	169.6
0.1N H2SO4	904.3	705.6	198.7
Empty	774.7	652.9	121.8
0.1N NaOH	773.0	755.3	17.7
0.1N NaOH	779.7	778.3	1.4
Silica Gel	885.3	867.3	18.0
	4,137.1	3,627.9	509.2
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	885.3	867.3	18.0
	Silica Final	**Silica Initial**	**Silica Gain**

Client:	Ash Grove Cement Company			
Facility:	Montana City Cement Plant			
Test Location:	Main Kiln (Train B)			
Project #:	M233901			
Test Method:	26A			
Test Engineer:	RB			
Test Technician:	ER			
	Run 1B	**Run 2B**	**Run 3B**	**Run 4B**
Temp ID:	CM44	CM44	CM44	CM44
Meter ID:	CM44	CM44	CM44	CM44
Pitot ID:	S8-032A	S8-032A	S8-032A	S8-032A
Nozzle Diameter (Inches):	0.390	0.390	0.390	0.390
Meter Calibration Date:	8/17/2023	8/17/2023	8/17/2023	8/17/2023
Meter Calibration Factor (Y):	1.016	1.016	1.016	1.016
Meter Orifice Setting (Delta H):	1.801	1.801	1.801	1.801
Nozzle Kit ID Number and Material:	Glass # 21	Glass # 21	Glass # 21	Glass # 21
Pitot Tube Coefficient:	0.822			
Probe Length (Feet):	10.0			
Probe Liner Material:	Glass			
Sample Plane:	Horizontal			
Port Length (Inches):	5.50			
Port Size (Diameter, Inches):	6.00			
Port Type:	Flange			
Duct Shape:	Circular			
Diameter (Feet):	9			
Duct Area (Square Feet):	63.617			
Upstream Diameters:	2.0			
Downstream Diameters:	4.6			
Number of Ports Sampled:	2			
Number of Points per Port:	12			
Minutes per Point:	2.5			
Minutes per Reading:	2.5			
Total Number of Traverse Points:	24			
Test Length (Minutes):	60			
Train Type:	Anderson Box			
Source Condition:	Normal			
Diluent Model/Serial Number:	CAI 700 and MKS 2030			
Moisture Balance ID:	LV4			
# of Runs	4			

Run 1B - Method 26A

Client: Ash Grove Cement Company | **Date: 9/27/23**

Facility: Montana City Cement Plant | **Start Time: 7:30**

Test Location: Main Kiln (Train B) | **End Time: 8:42**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.70	in. H_2O	Static Pressure	-0.20	in. H_2O
Meter Temperature, Tm:	65.0	°F	Flue Pressure (Ps):	25.89	in. Hg. abs.
Sqrt ΔP:	0.509	in. H_2O	Carbon Dioxide:	24.50	%
Stack Temperature, Ts:	354.5	°F	Oxygen:	3.60	%
Meter Volume, Vm:	46.651	ft^3	Nitrogen:	71.90	%
Meter Volume, Vmstd:	41.466	dscf	Gas Weight dry, Md:	32.064	lb/lb mole
Meter Volume, Vwstd:	23.343	wscf	Gas Weight wet, Ms:	26.998	lb/lb mole
Isokinetic Variance:	100.2	%I	Excess Air:	23.405	%
			Gas Velocity, Vs:	38.638	fps
Test Length:	60.00	in mins.	Volumetric Flow:	147,482	acfm
Nozzle Diameter:	0.390	in inches	Volumetric Flow:	52,924	dscfm
Barometric Pressure:	25.90	in Hg	Volumetric Flow:	82,717	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3556.6	ml	Silica Initial Wt.	867.6	grams
Final Impinger Content:	4026.8	ml	Silica Final Wt.	893.0	grams
Impinger Difference:	470.2	ml	Silica Difference:	25.4	grams
Total Water Gain:	495.6		Moisture, Bws:	0.360	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	7:30:00	0.30	1.95	36.417	350	62	62	250	252	52
1-2	7:32:30	0.28	1.82	38.490	350	62	62	253	252	53
1-3	7:35:00	0.32	2.08	40.510	354	63	63	255	252	52
1-4	7:37:30	0.32	2.08	42.660	354	63	63	255	251	52
1-5	7:40:00	0.33	2.14	44.810	356	63	63	250	250	52
1-6	7:42:30	0.31	2.01	47.020	356	63	63	250	250	50
1-7	7:45:00	0.28	1.82	49.110	356	63	63	250	252	52
1-8	7:47:30	0.25	1.62	51.120	356	63	63	253	252	53
1-9	7:50:00	0.23	1.49	53.020	357	64	64	255	252	52
1-10	7:52:30	0.22	1.43	54.840	357	64	64	255	251	52
1-11	7:55:00	0.20	1.30	56.630	357	64	64	250	250	52
1-12	7:57:30	0.17	1.10	58.330	357	64	64	250	250	50
	8:00:00			59.902						
2-1	8:12:00	0.25	1.62	59.902	353	66	66	255	252	52
2-2	8:14:30	0.26	1.69	61.800	353	66	66	255	252	53
2-3	8:17:00	0.26	1.69	63.760	353	66	66	259	252	52
2-4	8:19:30	0.28	1.82	65.710	353	66	66	255	251	52
2-5	8:22:00	0.29	1.88	67.730	354	66	66	254	250	52
2-6	8:24:30	0.29	1.88	69.800	354	66	66	254	250	50
2-7	8:27:00	0.30	1.95	71.860	354	67	67	260	255	52
2-8	8:29:30	0.25	1.62	73.960	354	67	67	260	255	53
2-9	8:32:00	0.24	1.56	75.870	354	67	67	259	259	52
2-10	8:34:30	0.24	1.56	77.750	355	68	68	259	255	52
2-11	8:37:00	0.22	1.43	79.630	355	68	68	255	254	52
2-12	8:39:30	0.18	1.17	81.430	355	68	68	255	254	50
	8:42:00			83.068						
Total	1:00:00			46.651		65.0	65.0			
Average			1.70		354.5	65.0				
Min			1.10		350.0	62.0				
Max			2.14		357.0	68.0				

Impinger Weight Sheet - Run 1B

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M233901**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**NJC**
Balance ID:	**LV4**

Scale Calibration Check Date: **9/27/2023**

Scale Calibration Check (see QS-6.05C for procedure)
must be within ± 0.5g of certified mass

Certified Weight, grams	Result, grams
250	250.0
500	500.0
750	750.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	803.7	697.2	106.5
0.1N H2SO4	897.7	739.2	158.5
Empty	697.2	588.0	109.2
0.1N NaOH	809.5	747.4	62.1
0.1N NaOH	818.7	784.8	33.9
Silica Gel	893.0	867.6	25.4
	4,026.8	3,556.6	470.2
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	893.0	867.6	25.4
	Silica Final	**Silica Initial**	**Silica Gain**

Run 2B - Method 26A

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Test Location: Main Kiln (Train B)
Source Condition: Normal

Date: 9/27/23
Start Time: 9:57
End Time: 11:02

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.69	In. H_2O	Static Pressure	-0.20	in. H_2O
Meter Temperature, Tm:	71.3	°F	Flue Pressure (Ps):	25.89	in. Hg. abs.
Sqrt ΔP:	0.509	In. H_2O	Carbon Dioxide:	24.90	%
Stack Temperature, Ts:	343.7	°F	Oxygen:	3.50	%
Meter Volume, Vm:	47.497	ft^3	Nitrogen:	71.6	%
Meter Volume, Vmstd:	41.711	dscf	Gas Weight dry, Md:	32.124	lb/lb mole
Meter Volume, Vwstd:	27.417	wscf	Gas Weight wet, Ms:	26.522	lb/lb mole
Isokinetic Variance:	105.3	%I	Excess Air:	22.724	%
			Gas Velocity, Vs:	38.680	fps
Test Length:	60.00	in mins.	Volumetric Flow:	147,641	acfm
Nozzle Diameter:	0.390	in inches	Volumetric Flow:	50,635	dscfm
Barometric Pressure:	25.90	in Hg	Volumetric Flow:	83,918	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3564.0	ml	Silica Initial Wt.	884.7	grams
Final Impinger Content:	4113.2	ml	Silica Final Wt.	917.6	grams
Impinger Difference:	549.2	ml	Silica Difference:	32.9	grams
Total Water Gain:	582.1		Moisture, Bws:	0.397	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	9:57:00	0.26	1.69	84.490	343	69	69	260	261	55
1-2	9:59:30	0.25	1.62	86.450	343	69	69	261	265	55
1-3	10:02:00	0.25	1.62	88.390	343	69	69	262	261	55
1-4	10:04:30	0.28	1.82	90.330	343	69	69	262	259	54
1-5	10:07:00	0.29	1.88	92.380	343	69	69	260	259	54
1-6	10:09:30	0.28	1.82	94.470	344	70	70	265	260	53
1-7	10:12:00	0.30	1.95	96.520	344	70	70	265	265	53
1-8	10:14:30	0.29	1.88	98.650	344	70	70	261	260	54
1-9	10:17:00	0.26	1.69	100.740	345	70	70	259	261	54
1-10	10:19:30	0.24	1.56	102.720	345	70	70	259	262	56
1-11	10:22:00	0.20	1.30	104.620	345	71	71	260	262	56
1-12	10:24:30	0.17	1.10	106.350	345	71	71	265	260	56
	10:27:00			107.961						
2-1	10:32:00	0.29	1.88	107.961	343	72	72	265	262	53
2-2	10:34:30	0.28	1.82	110.050	343	72	72	265	261	54
2-3	10:37:00	0.29	1.88	112.110	343	72	72	265	260	54
2-4	10:39:30	0.31	2.01	114.210	343	72	72	261	259	56
2-5	10:42:00	0.33	2.14	116.380	343	72	72	261	259	56
2-6	10:44:30	0.31	2.01	118.620	344	73	73	262	259	56
2-7	10:47:00	0.29	1.88	120.790	344	73	73	261	260	55
2-8	10:49:30	0.27	1.75	122.890	344	73	73	260	265	55
2-9	10:52:00	0.25	1.62	124.920	344	74	74	259	265	55
2-10	10:54:30	0.22	1.43	126.880	344	74	74	259	261	54
2-11	10:57:00	0.19	1.23	128.710	343	74	74	259	261	54
2-12	10:59:30	0.16	1.04	130.420	343	74	74	260	262	53
	11:02:00			131.987						
Total	1:00:00			47.497		71.3	71.3			
Average			1.69		343.7	71.3				
Min			1.04		343.0	69.0				
Max			2.14		345.0	74.0				

Impinger Weight Sheet - Run 2B

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M233901**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**NJC**
Balance ID:	**LV4**

Scale Calibration Check Date: **9/27/2023**

Scale Calibration Check (see QS-6.05C for procedure)

must be within ± 0.5g of certified mass

Certified Weight, grams	Result, grams
250	250.0
500	500.0
750	750.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	782.3	672.2	110.1
0.1N H2SO4	872.1	757.5	114.6
Empty	785.4	624.4	161.0
0.1N NaOH	848.7	742.8	105.9
0.1N NaOH	824.7	767.1	57.6
Silica Gel	917.6	884.7	32.9
	4,113.2 Liquid Final	3,564.0 Liquid Initial	549.2 Liquid Gain
	917.6 Silica Final	884.7 Silica Initial	32.9 Silica Gain

Run 3B - Method 26A

Client: Ash Grove Cement Company | **Date: 9/27/23**

Facility: Montana City Cement Plant | **Start Time: 11:20**

Test Location: Main Kiln (Train B) | **End Time: 12:25**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.72	In. H_2O	Static Pressure	-0.20	in. H_2O
Meter Temperature, Tm:	70.6	°F	Flue Pressure (Ps):	25.89	in. Hg. abs.
Sqrt ΔP:	0.513	In. H_2O	Carbon Dioxide:	25.00	%
Stack Temperature, Ts:	341.5	°F	Oxygen:	3.70	%
Meter Volume, Vm:	47.861	ft^3	Nitrogen:	71.3	%
Meter Volume, Vmstd:	42.089	dscf	Gas Weight dry, Md:	32.148	lb/lb mole
Meter Volume, Vwstd:	23.451	wscf	Gas Weight wet, Ms:	27.086	lb/lb mole
Isokinetic Variance:	100.0	%I	Excess Air:	24.466	%
			Gas Velocity, Vs:	38.524	fps
Test Length:	60.00	in mins.	Volumetric Flow:	147,046	acfm
Nozzle Diameter:	0.390	in inches	Volumetric Flow:	53,822	dscfm
Barometric Pressure:	25.90	in Hg	Volumetric Flow:	83,810	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3455.2	ml	Silica Initial Wt.	882.3	grams
Final Impinger Content:	3934.1	ml	Silica Final Wt.	901.3	grams
Impinger Difference:	478.9	ml	Silica Difference:	19.0	grams
Total Water Gain:	497.9		Moisture, Bws:	0.358	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	11:20:00	0.28	1.82	40.553	341	70	70	265	262	53
1-2	11:22:30	0.30	1.95	43.600	341	70	70	265	261	54
1-3	11:25:00	0.31	2.01	44.720	341	70	70	265	260	54
1-4	11:27:30	0.33	2.14	46.890	341	70	70	261	259	56
1-5	11:30:00	0.31	2.01	49.120	341	71	71	261	259	56
1-6	11:32:30	0.29	1.88	51.290	342	71	71	262	259	56
1-7	11:35:00	0.29	1.88	53.390	342	71	71	260	261	55
1-8	11:37:30	0.26	1.69	55.480	342	71	71	261	265	55
1-9	11:40:00	0.26	1.69	57.470	342	71	71	262	261	55
1-10	11:42:30	0.24	1.56	59.450	342	71	71	262	259	54
1-11	11:45:00	0.21	1.36	61.360	343	72	72	260	259	54
1-12	11:47:30	0.18	1.17	63.150	343	72	72	265	260	53
	11:50:00			64.804						
2-1	11:55:00	0.25	1.62	64.804	342	71	71	262	265	56
2-2	11:57:30	0.26	1.69	66.740	342	71	71	261	265	55
2-3	12:00:00	0.26	1.69	68.720	342	71	71	260	265	55
2-4	12:02:30	0.28	1.82	70.710	342	71	71	259	261	55
2-5	12:05:00	0.29	1.88	72.770	341	71	71	259	261	54
2-6	12:07:30	0.29	1.88	74.860	341	70	70	261	262	54
2-7	12:10:00	0.30	1.95	76.960	341	70	70	265	260	53
2-8	12:12:30	0.29	1.88	79.090	341	70	70	261	261	53
2-9	12:15:00	0.26	1.69	81.180	341	70	70	259	262	54
2-10	12:17:30	0.24	1.56	83.160	341	70	70	259	262	54
2-11	12:20:00	0.20	1.30	85.070	340	70	70	259	260	56
2-12	12:22:30	0.17	1.10	86.810	340	70	70	260	265	56
	12:25:00			88.414						
Total	1:00:00			47.861		70.6	70.6			
Average			1.72		341.5	70.6				
Min			1.10		340.0	70.0				
Max			2.14		343.0	72.0				

Impinger Weight Sheet - Run 3B

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M233901**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**NJC**
Balance ID:	**LV4**

Scale Calibration Check Date: **9/27/2023**

Scale Calibration Check (see QS-6.05C for procedure)

must be within ± 0.5g of certified mass

Certified Weight, grams	Result, grams
250	250.0
500	500.0
750	750.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	867.7	676.6	191.1
0.1N H2SO4	891.3	694.2	197.1
Empty	640.3	590.6	49.7
0.1N NaOH	737.5	707.4	30.1
0.1N NaOH	797.3	786.4	10.9
Silica Gel	901.3	882.3	19.0
	3,934.1	3,455.2	478.9
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	901.3	882.3	19.0
	Silica Final	**Silica Initial**	**Silica Gain**

Run 4B -Method 26A

Client: Ash Grove Cement Company | **Date: 9/27/23**

Facility: Montana City Cement Plant | **Start Time: 12:45**

Test Location: Main Kiln (Train B) | **End Time: 13:50**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.69	In. H_2O	Static Pressure	-0.20	in. H_2O
Meter Temperature, Tm:	68.2	°F	Flue Pressure (Ps):	25.89	in. Hg. abs.
Sqrt ΔP:	0.509	In. H_2O	Carbon Dioxide:	25.00	%
Stack Temperature, Ts:	343.5	°F	Oxygen:	3.70	%
Meter Volume, Vm:	50.810	ft^3	Nitrogen:	71.3	%
Meter Volume, Vmstd:	44.884	dscf	Gas Weight dry, Md:	32.148	lb/lb mole
Meter Volume, Vwstd:	25.858	wscf	Gas Weight wet, Ms:	26.977	lb/lb mole
Isokinetic Variance:	108.7	%I	Excess Air:	24.466	%
			Gas Velocity, Vs:	38.349	fps
Test Length:	60.00	in mins.	Volumetric Flow:	146,381	acfm
Nozzle Diameter:	0.390	in inches	Volumetric Flow:	52,798	dscfm
Barometric Pressure:	25.90	in Hg	Volumetric Flow:	83,215	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3613.8	ml	Silica Initial Wt.	858.8	grams
Final Impinger Content:	4143.2	ml	Silica Final Wt.	878.4	grams
Impinger Difference:	529.4	ml	Silica Difference:	19.6	grams
Total Water Gain:	549.0		Moisture, Bws:	0.366	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	12:45:00	0.26	1.69	88.856	343	68	68	252	250	56
1-2	12:47:30	0.25	1.62	90.968	343	68	68	252	253	55
1-3	12:50:00	0.25	1.62	93.069	343	68	68	252	255	56
1-4	12:52:30	0.28	1.82	95.130	343	68	68	251	255	55
1-5	12:55:00	0.29	1.88	97.332	344	68	68	250	250	55
1-6	12:57:30	0.28	1.82	99.571	344	67	67	250	250	53
1-7	13:00:00	0.30	1.95	101.768	344	67	67	252	250	53
1-8	13:02:30	0.29	1.88	104.041	344	67	67	252	253	54
1-9	13:05:00	0.26	1.69	106.297	344	67	67	252	255	54
1-10	13:07:30	0.24	1.56	108.390	344	67	67	251	255	56
1-11	13:10:00	0.20	1.30	110.420	345	67	67	250	250	56
1-12	13:12:30	0.17	1.10	112.280	345	68	68	250	250	57
	13:15:00			114.016						
2-1	13:20:00	0.29	1.88	114.016	344	68	68	252	255	55
2-2	13:22:30	0.28	1.82	116.240	344	68	68	252	255	55
2-3	13:25:00	0.29	1.88	118.440	344	68	68	252	259	55
2-4	13:27:30	0.31	2.01	120.680	344	68	68	251	255	54
2-5	13:30:00	0.33	2.14	123.020	344	69	69	250	254	54
2-6	13:32:30	0.31	2.01	125.390	344	69	69	250	254	53
2-7	13:35:00	0.29	1.88	127.710	343	69	69	255	260	53
2-8	13:37:30	0.27	1.75	129.960	343	69	69	255	260	54
2-9	13:40:00	0.25	1.62	132.120	343	69	69	259	259	54
2-10	13:42:30	0.22	1.43	134.210	342	70	70	255	259	56
2-11	13:45:00	0.19	1.23	136.170	342	70	70	254	255	56
2-12	13:47:30	0.16	1.04	138.020	342	70	70	254	255	56
	13:50:00			139.666						
Total	1:00:00			50.810		68.2	68.2			
Average			1.69		343.5	68.2				
Min			1.04		342.0	67.0				
Max			2.14		345.0	70.0				

Impinger Weight Sheet - Run 4B

Client:	**Ash Grove Cement Company**
Facility:	**Montana City Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M233901**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**NJC**
Balance ID:	**LV4**

Scale Calibration Check Date: **9/27/2023**

Scale Calibration Check (see QS-6.05C for procedure)
must be within ± 0.5g of certified mass

Certified Weight, grams	Result, grams
250	250.0
500	500.0
750	750.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	869.0	706.4	162.6
0.1N H2SO4	892.1	747.8	144.3
Empty	765.9	627.0	138.9
0.1N NaOH	837.8	770.9	66.9
0.1N NaOH	778.4	761.7	16.7
Silica Gel	878.4	858.8	19.6
	4,143.2	3,613.8	529.4
	Liquid Final	Liquid Initial	Liquid Gain
	878.4	858.8	19.6
	Silica Final	Silica Initial	Silica Gain

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Test Location: Main Kiln
Date: 9/27/23

Run 1

		FTIR Data						Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN1_000237.LAB	7:30	27.87	17.65	0.46	≤ 0.10	191.17	0.88	3.74
RUN1_000238.LAB	7:31	28.94	17.15	0.33	≤ 0.10	191.10	0.88	3.67
RUN1_000239.LAB	7:32	28.74	17.25	0.39	≤ 0.10	191.04	0.88	3.60
RUN1_000240.LAB	7:33	29.03	17.09	0.26	≤ 0.10	191.08	0.88	3.46
RUN1_000241.LAB	7:34	28.31	17.34	0.39	≤ 0.10	191.03	0.88	3.41
RUN1_000242.LAB	7:35	28.63	17.48	0.34	≤ 0.10	191.03	0.88	3.50
RUN1_000243.LAB	7:36	28.71	17.40	0.30	≤ 0.10	191.04	0.88	3.51
RUN1_000244.LAB	7:37	28.98	17.09	0.33	≤ 0.10	191.04	0.88	3.55
RUN1_000245.LAB	7:38	28.78	16.98	0.24	≤ 0.10	191.04	0.88	3.56
RUN1_000246.LAB	7:39	28.05	17.31	0.41	≤ 0.10	191.04	0.88	3.47
RUN1_000247.LAB	7:40	28.77	17.25	0.30	≤ 0.10	191.19	0.88	3.41
RUN1_000248.LAB	7:41	28.70	17.12	0.31	≤ 0.10	191.52	0.88	3.33
RUN1_000249.LAB	7:42	28.61	17.28	0.40	≤ 0.10	191.47	0.88	3.39
RUN1_000250.LAB	7:43	28.78	17.42	0.27	≤ 0.10	191.29	0.88	3.33
RUN1_000251.LAB	7:44	29.19	17.18	0.24	≤ 0.10	191.14	0.88	3.38
RUN1_000252.LAB	7:45	29.60	17.11	0.24	≤ 0.10	191.07	0.88	3.45
RUN1_000253.LAB	7:46	28.78	17.67	≤ 0.20	≤ 0.10	191.03	0.88	3.45
RUN1_000254.LAB	7:47	28.77	17.57	0.31	≤ 0.10	191.02	0.88	3.43
RUN1_000255.LAB	7:48	29.36	17.76	0.30	≤ 0.10	191.02	0.88	3.37
RUN1_000256.LAB	7:49	29.41	17.61	≤ 0.20	≤ 0.10	191.04	0.88	3.42
RUN1_000257.LAB	7:50	29.43	17.61	≤ 0.20	≤ 0.10	191.01	0.88	3.48
RUN1_000258.LAB	7:51	29.22	17.88	≤ 0.20	≤ 0.10	190.96	0.88	3.60
RUN1_000259.LAB	7:52	29.71	17.58	≤ 0.20	≤ 0.10	190.99	0.88	3.64
RUN1_000260.LAB	7:53	29.14	17.54	≤ 0.20	≤ 0.10	190.95	0.88	3.70
RUN1_000261.LAB	7:54	29.29	17.60	0.26	≤ 0.10	191.02	0.88	3.67
RUN1_000262.LAB	7:55	29.29	17.52	0.32	≤ 0.10	191.13	0.88	3.65
RUN1_000263.LAB	7:56	28.24	17.53	0.42	≤ 0.10	191.17	0.88	3.69
RUN1_000264.LAB	7:57	28.04	17.51	0.42	≤ 0.10	191.08	0.88	3.63
RUN1_000265.LAB	7:58	28.04	17.64	0.41	≤ 0.10	191.05	0.88	3.62
RUN1_000266.LAB	7:59	27.89	17.69	0.44	≤ 0.10	191.14	0.88	3.56
RUN1_000267.LAB	8:00	28.33	17.18	0.36	≤ 0.10	191.17	0.88	3.59
RUN1_000268.LAB	8:01	27.75	17.47	0.41	≤ 0.10	191.20	0.88	3.55
RUN1_000269.LAB	8:02	27.70	17.58	0.45	≤ 0.10	191.19	0.88	3.55
RUN1_000270.LAB	8:03	28.48	16.98	0.34	≤ 0.10	191.10	0.88	3.56
RUN1_000271.LAB	8:04	27.96	17.35	0.43	≤ 0.10	191.05	0.88	3.58
RUN1_000272.LAB	8:05	28.94	17.26	0.29	≤ 0.10	191.04	0.88	3.56
RUN1_000273.LAB	8:06	27.94	17.57	0.44	≤ 0.10	191.04	0.88	3.52
RUN1_000274.LAB	8:07	28.20	17.55	0.44	≤ 0.10	191.03	0.88	3.54
RUN1_000275.LAB	8:08	28.62	17.67	0.43	≤ 0.10	191.09	0.88	3.52
RUN1_000276.LAB	8:09	28.36	17.33	0.43	≤ 0.10	191.33	0.88	3.64
RUN1_000277.LAB	8:10	28.14	17.56	0.49	≤ 0.10	191.38	0.88	3.72
RUN1_000278.LAB	8:11	28.45	17.40	0.44	≤ 0.10	191.40	0.88	3.76
RUN1_000279.LAB	8:12	28.16	17.65	0.50	≤ 0.10	191.39	0.88	3.68
RUN1_000280.LAB	8:13	32.55	16.81	≤ 0.20	≤ 0.10	191.28	0.88	3.63
RUN1_000281.LAB	8:14	34.91	16.33	≤ 0.20	≤ 0.10	191.17	0.88	3.71
RUN1_000282.LAB	8:15	35.52	16.19	≤ 0.20	≤ 0.10	191.18	0.88	3.68
RUN1_000283.LAB	8:16	35.52	16.27	≤ 0.20	≤ 0.10	191.15	0.88	3.64
RUN1_000284.LAB	8:17	35.21	16.54	≤ 0.20	≤ 0.10	191.13	0.88	3.54
RUN1_000285.LAB	8:18	35.36	16.34	≤ 0.20	≤ 0.10	191.04	0.88	3.52
RUN1_000286.LAB	8:19	35.88	16.08	≤ 0.20	≤ 0.10	191.05	0.88	3.52
RUN1_000287.LAB	8:20	44.46	13.83	≤ 0.20	≤ 0.10	191.08	0.88	3.55
RUN1_000288.LAB	8:21	51.33	12.46	≤ 0.20	≤ 0.10	191.21	0.88	3.64
RUN1_000289.LAB	8:22	51.33	12.47	≤ 0.20	≤ 0.10	191.23	0.88	3.65
RUN1_000290.LAB	8:23	52.83	11.78	≤ 0.20	≤ 0.10	191.18	0.88	3.65
RUN1_000291.LAB	8:24	52.09	12.00	≤ 0.20	≤ 0.10	191.15	0.88	3.61
RUN1_000292.LAB	8:25	51.86	12.18	≤ 0.20	≤ 0.10	191.16	0.88	3.63
RUN1_000293.LAB	8:26	51.49	12.23	≤ 0.20	≤ 0.10	191.07	0.88	3.55
RUN1_000294.LAB	8:27	52.29	11.90	≤ 0.20	≤ 0.10	191.05	0.88	3.51
RUN1_000295.LAB	8:28	51.75	11.87	≤ 0.20	≤ 0.10	191.07	0.88	3.49
RUN1_000296.LAB	8:29	51.68	12.00	≤ 0.20	≤ 0.10	191.26	0.88	3.52
Average		**33.12**	**16.44**	**≤ 0.30**	**≤ 0.10**	**191.13**	**0.88**	**3.56**

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Test Location: Main Kiln
Date: 9/27/23

Run 2

		FTIR Data						Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN2_000442.LAB	9:57	39.37	15.4	≤ 0.20	≤ 0.10	191.2	0.88	3.81
RUN2_000443.LAB	9:58	39.35	15.4	≤ 0.20	≤ 0.10	191.3	0.88	3.75
RUN2_000444.LAB	9:59	39.30	15.3	≤ 0.20	≤ 0.10	191.4	0.88	3.82
RUN2_000445.LAB	10:00	39.48	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.73
RUN2_000446.LAB	10:01	39.38	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.75
RUN2_000447.LAB	10:02	38.94	15.3	≤ 0.20	≤ 0.10	191.4	0.88	3.65
RUN2_000448.LAB	10:03	39.05	15.2	≤ 0.20	≤ 0.10	191.4	0.88	3.57
RUN2_000449.LAB	10:04	39.01	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.66
RUN2_000450.LAB	10:05	39.01	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.54
RUN2_000451.LAB	10:06	39.30	15.5	≤ 0.20	≤ 0.10	191.4	0.88	3.54
RUN2_000452.LAB	10:07	39.12	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.58
RUN2_000453.LAB	10:08	38.83	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.56
RUN2_000454.LAB	10:09	38.93	15.3	≤ 0.20	≤ 0.10	191.4	0.88	3.58
RUN2_000455.LAB	10:10	38.59	15.2	≤ 0.20	≤ 0.10	191.4	0.88	3.59
RUN2_000456.LAB	10:11	38.93	15.4	≤ 0.20	≤ 0.10	191.2	0.88	3.57
RUN2_000457.LAB	10:12	39.04	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.78
RUN2_000458.LAB	10:13	39.00	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.50
RUN2_000459.LAB	10:14	38.84	15.4	≤ 0.20	≤ 0.10	191.5	0.88	3.45
RUN2_000460.LAB	10:15	38.57	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.45
RUN2_000461.LAB	10:16	38.46	15.3	≤ 0.20	≤ 0.10	191.4	0.88	3.53
RUN2_000462.LAB	10:17	38.77	15.5	≤ 0.20	≤ 0.10	191.4	0.88	3.47
RUN2_000463.LAB	10:18	38.74	15.5	≤ 0.20	≤ 0.10	191.4	0.88	3.49
RUN2_000464.LAB	10:19	38.71	15.6	≤ 0.20	≤ 0.10	191.3	0.88	3.49
RUN2_000465.LAB	10:20	39.38	15.4	≤ 0.20	≤ 0.10	191.5	0.88	3.44
RUN2_000466.LAB	10:21	38.93	15.4	≤ 0.20	≤ 0.10	191.5	0.88	3.43
RUN2_000467.LAB	10:22	38.93	15.4	≤ 0.20	≤ 0.10	191.4	0.88	3.69
RUN2_000468.LAB	10:23	38.80	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.58
RUN2_000469.LAB	10:24	38.70	15.0	≤ 0.20	≤ 0.10	191.4	0.88	3.37
RUN2_000470.LAB	10:25	38.74	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.30
RUN2_000471.LAB	10:26	38.66	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.22
RUN2_000472.LAB	10:27	38.77	14.9	≤ 0.20	≤ 0.10	191.4	0.88	3.30
RUN2_000473.LAB	10:28	38.87	15.0	≤ 0.20	≤ 0.10	191.3	0.88	3.34
RUN2_000474.LAB	10:29	38.65	15.0	≤ 0.20	≤ 0.10	191.2	0.88	3.34
RUN2_000475.LAB	10:30	38.77	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.37
RUN2_000476.LAB	10:31	38.80	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.38
RUN2_000477.LAB	10:32	38.73	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.33
RUN2_000478.LAB	10:33	38.98	15.0	≤ 0.20	≤ 0.10	191.2	0.88	3.29
RUN2_000479.LAB	10:34	39.14	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.60
RUN2_000480.LAB	10:35	39.08	15.4	≤ 0.20	≤ 0.10	191.3	0.88	3.52
RUN2_000481.LAB	10:36	39.09	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.42
RUN2_000482.LAB	10:37	39.01	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.37
RUN2_000483.LAB	10:38	39.08	15.4	≤ 0.20	≤ 0.10	191.4	0.88	3.44
RUN2_000484.LAB	10:39	38.76	15.4	≤ 0.20	≤ 0.10	191.3	0.88	3.42
RUN2_000485.LAB	10:40	38.82	15.4	≤ 0.20	≤ 0.10	191.3	0.88	3.42
RUN2_000486.LAB	10:41	38.80	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.43
RUN2_000487.LAB	10:42	38.83	15.0	≤ 0.20	≤ 0.10	191.4	0.88	3.39
RUN2_000488.LAB	10:43	38.65	15.0	≤ 0.20	≤ 0.10	191.3	0.88	3.42
RUN2_000489.LAB	10:44	38.86	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.42
RUN2_000490.LAB	10:45	38.87	14.9	≤ 0.20	≤ 0.10	191.4	0.88	3.43
RUN2_000491.LAB	10:46	38.73	15.0	≤ 0.20	≤ 0.10	191.3	0.88	3.38
RUN2_000492.LAB	10:47	38.89	15.2	≤ 0.20	≤ 0.10	191.2	0.88	3.42
RUN2_000493.LAB	10:48	38.98	15.0	≤ 0.20	≤ 0.10	191.3	0.88	3.45
RUN2_000494.LAB	10:49	39.17	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.42
RUN2_000495.LAB	10:50	39.21	14.9	≤ 0.20	≤ 0.10	191.3	0.88	3.38
RUN2_000496.LAB	10:51	38.91	15.1	≤ 0.20	≤ 0.10	191.2	0.88	3.47
RUN2_000497.LAB	10:52	38.85	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.43
RUN2_000498.LAB	10:53	38.73	14.9	≤ 0.20	≤ 0.10	191.4	0.88	3.25
RUN2_000499.LAB	10:54	38.63	15.0	≤ 0.20	≤ 0.10	191.3	0.88	3.73
RUN2_000500.LAB	10:55	38.65	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.74
RUN2_000501.LAB	10:56	38.73	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.61
Average		**38.92**	**15.20**	**≤ 0.20**	**≤ 0.10**	**191.33**	**0.88**	**3.49**

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Test Location: Main Kiln
Date: 9/27/23

Run 3

		FTIR Data						Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 3_000586.LAB	11:20	38.18	14.7	≤ 0.20	≤ 0.10	191.2	0.88	3.62
RUN 3_000587.LAB	11:21	38.30	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.56
RUN 3_000588.LAB	11:22	38.70	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.62
RUN 3_000589.LAB	11:23	38.60	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.60
RUN 3_000590.LAB	11:24	38.93	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.61
RUN 3_000591.LAB	11:25	39.22	15.3	≤ 0.20	≤ 0.10	191.4	0.88	3.63
RUN 3_000592.LAB	11:26	39.04	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.66
RUN 3_000593.LAB	11:27	38.95	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.73
RUN 3_000594.LAB	11:28	39.14	15.0	≤ 0.20	≤ 0.10	191.3	0.88	3.45
RUN 3_000595.LAB	11:29	39.12	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.46
RUN 3_000596.LAB	11:30	39.01	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.45
RUN 3_000597.LAB	11:31	39.25	15.3	≤ 0.20	≤ 0.10	191.2	0.88	3.58
RUN 3_000598.LAB	11:32	39.40	15.4	≤ 0.20	≤ 0.10	191.4	0.88	3.51
RUN 3_000599.LAB	11:33	39.73	15.4	≤ 0.20	≤ 0.10	191.3	0.88	3.58
RUN 3_000600.LAB	11:34	39.30	15.4	≤ 0.20	≤ 0.10	191.2	0.88	3.72
RUN 3_000601.LAB	11:36	39.11	15.4	≤ 0.20	≤ 0.10	191.3	0.88	3.68
RUN 3_000602.LAB	11:37	39.07	15.4	≤ 0.20	≤ 0.10	191.4	0.88	3.75
RUN 3_000603.LAB	11:38	39.05	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.75
RUN 3_000604.LAB	11:39	39.11	14.9	≤ 0.20	≤ 0.10	191.2	0.88	3.82
RUN 3_000605.LAB	11:40	39.14	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.69
RUN 3_000606.LAB	11:41	39.11	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.64
RUN 3_000607.LAB	11:42	39.11	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.65
RUN 3_000608.LAB	11:43	38.98	15.0	≤ 0.20	≤ 0.10	191.3	0.88	3.74
RUN 3_000609.LAB	11:44	38.99	14.9	≤ 0.20	≤ 0.10	191.4	0.88	3.71
RUN 3_000610.LAB	11:45	39.07	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.80
RUN 3_000611.LAB	11:46	39.44	15.0	≤ 0.20	≤ 0.10	191.2	0.88	3.99
RUN 3_000612.LAB	11:47	39.45	15.0	≤ 0.20	≤ 0.10	191.4	0.88	3.86
RUN 3_000613.LAB	11:48	39.46	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.90
RUN 3_000614.LAB	11:49	39.26	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.90
RUN 3_000615.LAB	11:50	39.23	14.9	≤ 0.20	≤ 0.10	191.3	0.88	4.11
RUN 3_000616.LAB	11:51	39.23	14.9	≤ 0.20	≤ 0.10	191.4	0.88	4.13
RUN 3_000617.LAB	11:52	39.14	14.8	≤ 0.20	≤ 0.10	191.3	0.88	4.16
RUN 3_000618.LAB	11:53	39.16	15.2	≤ 0.20	≤ 0.10	191.2	0.88	3.99
RUN 3_000619.LAB	11:54	39.46	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.93
RUN 3_000620.LAB	11:55	39.30	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.86
RUN 3_000621.LAB	11:56	39.23	15.0	≤ 0.20	≤ 0.10	191.2	0.88	3.85
RUN 3_000622.LAB	11:58	39.21	15.3	≤ 0.20	≤ 0.10	191.2	0.88	3.80
RUN 3_000623.LAB	11:59	39.40	15.3	≤ 0.20	≤ 0.10	191.4	0.88	3.74
RUN 3_000624.LAB	12:00	39.43	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.91
RUN 3_000625.LAB	12:01	39.27	15.1	≤ 0.20	≤ 0.10	191.2	0.88	3.84
RUN 3_000626.LAB	12:02	39.06	15.0	≤ 0.20	≤ 0.10	191.4	0.88	3.97
RUN 3_000627.LAB	12:03	39.19	15.1	≤ 0.20	≤ 0.10	191.4	0.88	4.03
RUN 3_000628.LAB	12:04	38.75	15.0	≤ 0.20	≤ 0.10	191.3	0.88	3.78
RUN 3_000629.LAB	12:05	38.85	14.9	≤ 0.20	≤ 0.10	191.3	0.88	3.67
RUN 3_000630.LAB	12:06	38.99	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.55
RUN 3_000631.LAB	12:07	39.17	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.62
RUN 3_000632.LAB	12:08	38.96	15.3	≤ 0.20	≤ 0.10	191.2	0.88	3.64
RUN 3_000633.LAB	12:09	39.23	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.70
RUN 3_000634.LAB	12:10	39.44	15.4	≤ 0.20	≤ 0.10	191.4	0.88	3.69
RUN 3_000635.LAB	12:11	39.49	15.7	≤ 0.20	≤ 0.10	191.2	0.88	3.76
RUN 3_000636.LAB	12:12	39.56	15.3	≤ 0.20	≤ 0.10	191.2	0.88	3.69
RUN 3_000637.LAB	12:13	39.32	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.70
RUN 3_000638.LAB	12:14	39.53	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.79
RUN 3_000639.LAB	12:15	39.41	15.4	≤ 0.20	≤ 0.10	191.2	0.88	3.77
RUN 3_000640.LAB	12:16	39.42	15.5	≤ 0.20	≤ 0.10	191.3	0.88	3.74
RUN 3_000641.LAB	12:17	39.29	15.1	≤ 0.20	≤ 0.10	191.4	0.88	3.76
RUN 3_000642.LAB	12:18	39.25	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.83
RUN 3_000643.LAB	12:20	39.20	15.4	≤ 0.20	≤ 0.10	191.2	0.88	3.59
RUN 3_000644.LAB	12:21	39.40	15.5	≤ 0.20	≤ 0.10	191.3	0.88	3.53
RUN 3_000645.LAB	12:22	39.30	15.5	≤ 0.20	≤ 0.10	191.3	0.88	3.60
Average		**39.17**	**15.19**	**≤ 0.20**	**≤ 0.10**	**191.30**	**0.88**	**3.74**

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Test Location: Main Kiln
Date: 9/27/23

Run 4

		FTIR Data						Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN4_000732.LAB	12:45	39.15	15.2	≤ 0.20	≤ 0.10	191.2	0.88	3.37
RUN4_000733.LAB	12:46	39.08	15.4	≤ 0.20	≤ 0.10	191.3	0.88	3.50
RUN4_000734.LAB	12:47	39.15	15.3	≤ 0.20	≤ 0.10	191.3	0.88	3.60
RUN4_000735.LAB	12:48	39.06	15.2	≤ 0.20	≤ 0.10	191.3	0.88	3.94
RUN4_000736.LAB	12:49	39.18	15.1	≤ 0.20	≤ 0.10	191.2	0.88	3.60
RUN4_000737.LAB	12:50	39.36	15.5	≤ 0.20	≤ 0.10	191.3	0.88	3.53
RUN4_000738.LAB	12:51	39.06	15.2	≤ 0.20	≤ 0.10	191.4	0.88	3.40
RUN4_000739.LAB	12:52	38.99	15.2	≤ 0.20	≤ 0.10	191.2	0.88	3.64
RUN4_000740.LAB	12:53	39.18	15.3	≤ 0.20	≤ 0.10	191.2	0.87	3.61
RUN4_000741.LAB	12:54	39.29	15.4	≤ 0.20	≤ 0.10	191.3	0.88	3.42
RUN4_000742.LAB	12:55	38.99	15.4	≤ 0.20	≤ 0.10	191.3	0.88	3.72
RUN4_000743.LAB	12:56	39.23	15.3	≤ 0.20	≤ 0.10	191.2	0.87	3.58
RUN4_000744.LAB	12:57	39.31	15.3	≤ 0.20	≤ 0.10	191.3	0.87	3.89
RUN4_000745.LAB	12:58	39.59	15.3	≤ 0.20	≤ 0.10	191.3	0.87	3.42
RUN4_000746.LAB	12:59	39.88	15.3	≤ 0.20	≤ 0.10	191.2	0.87	3.43
RUN4_000747.LAB	13:00	39.28	15.2	≤ 0.20	≤ 0.10	191.2	0.87	3.70
RUN4_000748.LAB	13:01	39.37	15.1	≤ 0.20	≤ 0.10	191.3	0.88	3.78
RUN4_000749.LAB	13:02	39.14	15.2	≤ 0.20	≤ 0.10	191.4	0.87	3.99
RUN4_000750.LAB	13:03	39.14	15.2	≤ 0.20	≤ 0.10	191.2	0.87	4.07
RUN4_000751.LAB	13:04	39.23	15.1	≤ 0.20	≤ 0.10	191.3	0.87	3.49
RUN4_000752.LAB	13:05	39.49	15.1	≤ 0.20	≤ 0.10	191.4	0.87	3.26
RUN4_000753.LAB	13:06	39.88	15.2	≤ 0.20	≤ 0.10	191.4	0.87	3.83
RUN4_000754.LAB	13:07	39.93	15.2	≤ 0.20	≤ 0.10	191.2	0.88	4.46
RUN4_000755.LAB	13:08	39.69	15.3	≤ 0.20	≤ 0.10	191.2	0.87	4.47
RUN4_000756.LAB	13:09	39.42	15.2	≤ 0.20	≤ 0.10	191.3	0.87	3.45
RUN4_000757.LAB	13:10	39.54	15.3	≤ 0.20	≤ 0.10	191.2	0.87	3.54
RUN4_000758.LAB	13:11	39.45	15.2	≤ 0.20	≤ 0.10	191.1	0.87	3.53
RUN4_000759.LAB	13:12	39.28	15.3	≤ 0.20	≤ 0.10	191.3	0.87	3.50
RUN4_000760.LAB	13:13	39.68	15.1	≤ 0.20	≤ 0.10	191.3	0.87	3.88
RUN4_000761.LAB	13:14	39.36	15.2	≤ 0.20	≤ 0.10	191.2	0.87	3.64
RUN4_000762.LAB	13:15	39.48	15.1	≤ 0.20	≤ 0.10	191.1	0.87	3.89
RUN4_000763.LAB	13:16	39.57	15.0	≤ 0.20	≤ 0.10	191.3	0.87	3.86
RUN4_000764.LAB	13:17	39.36	15.2	≤ 0.20	≤ 0.10	191.3	0.87	3.70
RUN4_000765.LAB	13:18	39.63	15.1	≤ 0.20	≤ 0.10	191.2	0.87	3.57
RUN4_000766.LAB	13:19	39.33	15.2	≤ 0.20	≤ 0.10	191.2	0.87	3.38
RUN4_000767.LAB	13:20	39.44	14.9	≤ 0.20	≤ 0.10	191.3	0.87	3.55
RUN4_000768.LAB	13:21	39.40	15.2	≤ 0.20	≤ 0.10	191.2	0.87	3.82
RUN4_000769.LAB	13:22	39.93	15.0	≤ 0.20	≤ 0.10	191.1	0.87	3.91
RUN4_000770.LAB	13:23	39.78	15.2	≤ 0.20	≤ 0.10	191.3	0.87	3.88
RUN4_000771.LAB	13:24	39.18	15.1	≤ 0.20	≤ 0.10	191.4	0.87	3.87
RUN4_000772.LAB	13:25	39.43	15.3	≤ 0.20	≤ 0.10	191.3	0.87	3.91
RUN4_000773.LAB	13:26	39.29	15.1	≤ 0.20	≤ 0.10	191.2	0.87	3.91
RUN4_000774.LAB	13:27	39.29	15.0	≤ 0.20	≤ 0.10	191.3	0.87	3.92
RUN4_000775.LAB	13:28	39.01	15.0	≤ 0.20	≤ 0.10	191.3	0.87	3.98
RUN4_000776.LAB	13:29	39.36	15.1	≤ 0.20	≤ 0.10	191.2	0.87	3.92
RUN4_000777.LAB	13:30	39.51	14.9	≤ 0.20	≤ 0.10	191.0	0.87	3.72
RUN4_000778.LAB	13:31	39.26	15.2	≤ 0.20	≤ 0.10	190.9	0.87	3.21
RUN4_000779.LAB	13:32	39.20	15.2	≤ 0.20	≤ 0.10	191.0	0.87	3.10
RUN4_000780.LAB	13:33	39.37	15.2	≤ 0.20	≤ 0.10	191.0	0.87	3.27
RUN4_000781.LAB	13:34	39.20	15.0	≤ 0.20	≤ 0.10	191.1	0.87	3.49
RUN4_000782.LAB	13:35	39.38	15.1	≤ 0.20	≤ 0.10	191.2	0.87	3.81
RUN4_000783.LAB	13:36	39.24	15.3	≤ 0.20	≤ 0.10	191.3	0.87	4.01
RUN4_000784.LAB	13:37	39.62	15.4	≤ 0.20	≤ 0.10	191.3	0.87	4.02
RUN4_000785.LAB	13:38	39.39	15.5	≤ 0.20	≤ 0.10	191.3	0.87	3.97
RUN4_000786.LAB	13:39	39.71	15.1	≤ 0.20	≤ 0.10	191.3	0.87	3.93
RUN4_000787.LAB	13:40	39.11	15.0	≤ 0.20	≤ 0.10	191.1	0.87	4.00
RUN4_000788.LAB	13:41	39.71	15.1	≤ 0.20	≤ 0.10	191.0	0.87	3.89
RUN4_000789.LAB	13:42	39.29	15.3	≤ 0.20	≤ 0.10	191.0	0.87	3.67
RUN4_000790.LAB	13:43	39.14	15.0	≤ 0.20	≤ 0.10	191.0	0.87	3.52
RUN4_000791.LAB	13:44	38.81	15.2	≤ 0.20	≤ 0.10	190.9	0.87	3.91
Average		**39.36**	**15.19**	**≤ 0.20**	**≤ 0.10**	**191.2**	**0.87**	**3.75**

Stratification Test Results Summary
Ash Grove Cement Company
Montana City Cement Plant
Main Kiln
September 27, 2023

Number of Ports Sampled:	1
Number of Points per Port:	3
Total Number of Traverse Points:	3

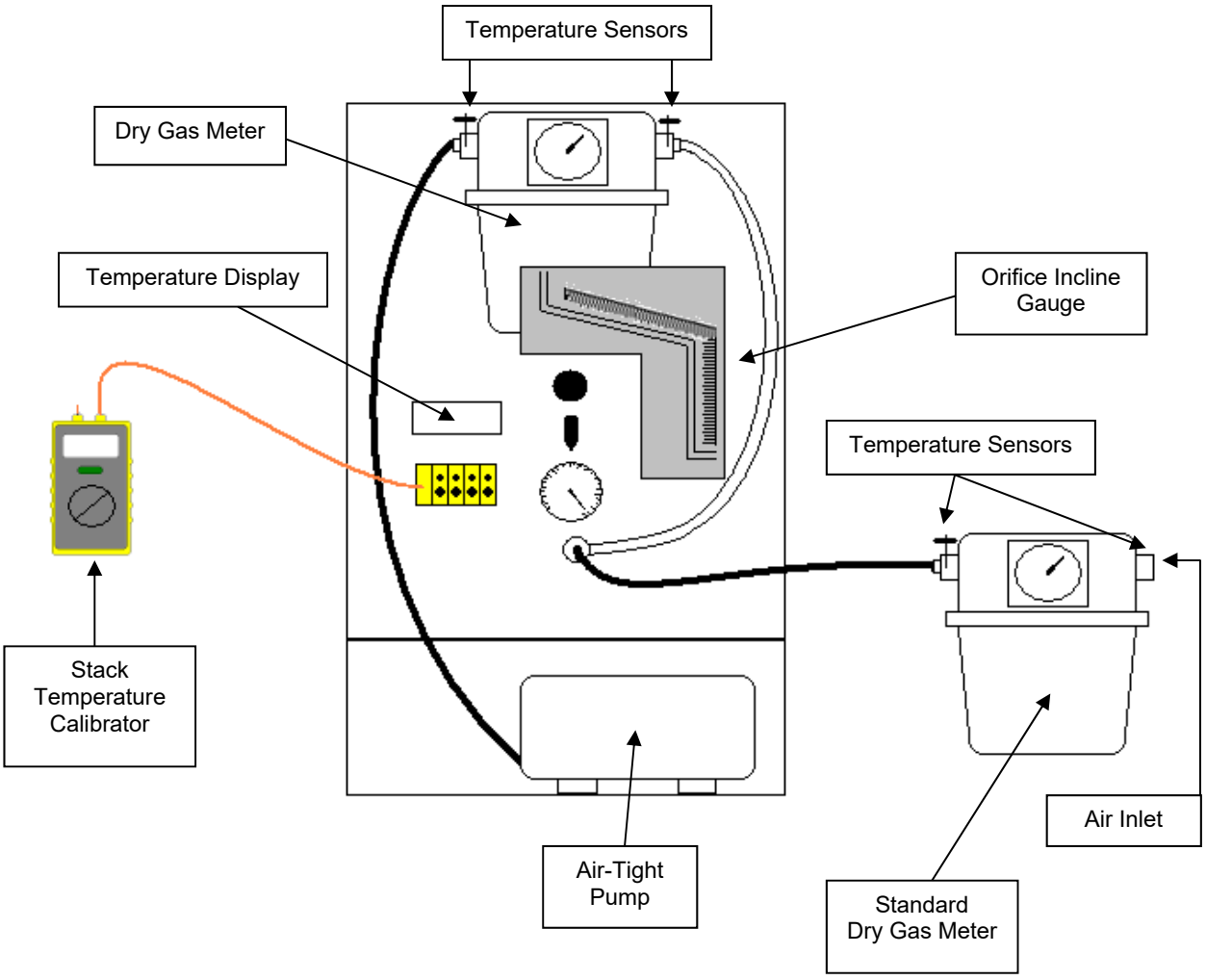
Port No.	Point No.	Time	O_2%	Actual % Difference O_2%	Mean Difference O_2%
1	1	7:05	3.56	0.19	0.01
	2	7:08	3.54	0.38	0.01
	3	7:11	3.56	0.19	0.01
Average			**3.55**		

One point traverse (<5% difference)
Three point traverse (0.4, 1.2, and 2.0 meters), <10% difference
Twelve point traverse (Method 1 points) >10% difference

One point traverse (<0.3% mean difference)
Three point traverse (0.4, 1.2, and 2.0 meters), < 0.5% mean difference for O_2
Twelve point traverse (Method 1 points) >0.5% mean difference for O_2

Appendix G - Calibration Data

Dry Gas Meter/Control Module Calibration Diagram



Dry Gas Meter Calibration Data

Dry Gas Meter No.	*CM41*	*Date:*	*August 25, 2023*
Standard Meter No.	*18654513*	*Calibrated By:*	*SWK*
Standard Meter (Y)	*1.00630*	*Barometric Pressure:*	*25.08*

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			*46.873*	*223.824*	*75*	*75*	*75*					
Initial			*41.807*	*218.770*	*76*	*73*	*73*					
Difference	*1*	*0.20*	*5.066*	*5.054*	*76*	*74*	*74*	*74*	*18*	*0*	*1.005*	*1.701*
Final			*52.241*	*229.184*	*75*	*75*	*75*					
Initial			*46.873*	*223.824*	*75*	*75*	*75*					
Difference	*2*	*0.50*	*5.368*	*5.360*	*75*	*75*	*75*	*75*	*12*	*0*	*1.006*	*1.677*
Final			*57.427*	*234.334*	*75*	*77*	*77*					
Initial			*52.241*	*229.184*	*75*	*75*	*75*					
Difference	*3*	*0.70*	*5.186*	*5.150*	*75*	*76*	*76*	*76*	*10*	*0*	*1.013*	*1.743*
Final			*62.959*	*239.858*	*74*	*77*	*77*					
Initial			*57.427*	*234.334*	*75*	*76*	*76*					
Difference	*4*	*0.90*	*5.532*	*5.524*	*75*	*77*	*77*	*77*	*9*	*30*	*1.009*	*1.773*
Final			*68.687*	*245.557*	*74*	*77*	*77*					
Initial			*62.959*	*239.858*	*74*	*77*	*77*					
Difference	*5*	*1.20*	*5.728*	*5.699*	*74*	*77*	*77*	*77*	*8*	*0*	*1.014*	*1.559*
Final			*41.807*	*218.770*	*76*	*73*	*73*					
Initial			*36.455*	*213.536*	*76*	*73*	*73*					
Difference	*6*	*2.00*	*5.352*	*5.234*	*76*	*73*	*73*	*73*	*6*	*10*	*1.017*	*1.795*

Average ***1.011*** ***1.708***

Stack Temperature Sensor Calibration			
Temperature ID :	CM41	Name :	SWK
Ambient Temperature, °F :	78.9	Date :	August 25, 2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	November 8, 2022
Serial # :	T-314718	Expiration Date:	November 8, 2023

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	0	0.0
250	251	0.1
600	601	0.1
1200	1205	0.3

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Dry Gas Meter Calibration Data

Dry Gas Meter No.	*CM41*	*Date:*	*October 4, 2023*
Standard Meter No.	*18654513*	*Calibrated By:*	*PJC1*
Standard Meter (Y)	*1.00630*	*Barometric Pressure:*	*24.90*

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F^o tr	Dry Gas Meter Inlet Temp. F^o tdi	Dry Gas Meter Outlet Temp. F^o tdo	Dry Gas Meter Avg. Temp. F^o td	Time Min	Time Sec	Y	Chg (H)
Final			*679.643*	*665.714*	*69*	*71*	*71*					
Initial			*674.622*	*660.680*	*69*	*71*	*71*					
Difference	*1*	*0.20*	*5.021*	*5.034*	*69*	*71*	*71*	*71*	*18*	*0*	*1.007*	*1.711*
Final			*684.960*	*671.049*	*69*	*70*	*70*					
Initial			*679.643*	*665.714*	*69*	*71*	*71*					
Difference	*2*	*0.50*	*5.317*	*5.335*	*69*	*71*	*71*	*71*	*12*	*0*	*1.004*	*1.697*
Final			*690.141*	*676.220*	*69*	*71*	*71*					
Initial			*684.960*	*671.049*	*69*	*70*	*70*					
Difference	*3*	*0.70*	*5.181*	*5.171*	*69*	*71*	*71*	*71*	*10*	*0*	*1.009*	*1.738*
Final			*695.482*	*681.560*	*69*	*71*	*71*					
Initial			*690.141*	*676.200*	*69*	*71*	*71*					
Difference	*4*	*0.90*	*5.341*	*5.360*	*69*	*71*	*71*	*71*	*9*	*0*	*1.004*	*1.701*
Final			*701.088*	*687.142*	*70*	*72*	*72*					
Initial			*695.482*	*681.560*	*69*	*71*	*71*					
Difference	*5*	*1.20*	*5.606*	*5.582*	*70*	*72*	*72*	*72*	*8*	*0*	*1.011*	*1.629*
Final			*674.622*	*660.680*	*69*	*71*	*71*					
Initial			*669.370*	*655.483*	*70*	*71*	*71*					
Difference	*6*	*2.00*	*5.252*	*5.197*	*70*	*71*	*71*	*71*	*6*	*0*	*1.014*	*1.741*

Average	***1.008***	***1.703***

Stack Temperature Sensor Calibration			
Temperature ID :	CM41	Name :	PJC1
Ambient Temperature, °F :	71.4	Date :	October 4, 2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	November 8, 2022
Serial # :	T-314718	Expiration Date:	November 8, 2023

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	0	0.0
250	251	0.1
600	601	0.1
1200	1205	0.3

$$\frac{(\text{Ref. Temp., }^{o}\text{F} + 460) - (\text{Test Therm. Temp., }^{o}\text{F} + 460)}{\text{Ref. Temp., }^{o}\text{F} + 460} * 100 <= 1.5\ \%$$

Dry Gas Meter Calibration Data

Dry Gas Meter No.	*CM44*	*Date:*	*September 14, 2023*
Standard Meter No.	*18654513*	*Calibrated By:*	*PJC*
Standard Meter (Y)	*1.00630*	*Barometric Pressure:*	*24.94*

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			*330.730*	*733.167*	*74*	*75*	*75*					
Initial			*325.262*	*727.720*	*73*	*75*	*75*					
Difference	*1*	*0.20*	*5.468*	*5.447*	*74*	*75*	*75*	*75*	*20*	*0*	*1.012*	*1.795*
Final			*301.124*	*703.295*	*72*	*73*	*73*					
Initial			*295.364*	*697.458*	*72*	*72*	*72*					
Difference	*2*	*0.50*	*5.760*	*5.837*	*72*	*73*	*73*	*73*	*12*	*0*	*0.992*	*1.455*
Final			*306.709*	*708.932*	*72*	*73*	*73*					
Initial			*301.124*	*703.295*	*72*	*73*	*73*					
Difference	*3*	*0.70*	*5.585*	*5.637*	*72*	*73*	*73*	*73*	*10*	*0*	*0.997*	*1.503*
Final			*312.215*	*714.525*	*73*	*73*	*73*					
Initial			*306.709*	*708.932*	*72*	*73*	*73*					
Difference	*4*	*0.90*	*5.506*	*5.593*	*73*	*73*	*73*	*73*	*9*	*0*	*0.989*	*1.614*
Final			*317.920*	*720.282*	*72*	*74*	*74*					
Initial			*312.215*	*714.525*	*73*	*73*	*73*					
Difference	*5*	*1.20*	*5.705*	*5.757*	*73*	*74*	*74*	*74*	*8*	*0*	*0.996*	*1.582*
Final			*288.913*	*690.916*	*72*	*72*	*72*					
Initial			*283.564*	*685.544*	*72*	*71*	*71*					
Difference	*6*	*2.00*	*5.349*	*5.372*	*72*	*72*	*72*	*72*	*6*	*0*	*0.995*	*1.690*
										Average	***0.997***	***1.607***

Stack Temperature Sensor Calibration			
Temperature ID :	CM44	Name :	PJC
Ambient Temperature, °F :	73.5	Date :	September 14, 2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	November 8, 2022
Serial # :	T-314718	Expiration Date:	November 8, 2023

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	0	0.0
250	249	0.1
600	597	0.3
1200	1197	0.2

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Dry Gas Meter Calibration Data

Dry Gas Meter No.	*CM44*	*Date:*	*September 29, 2023*
Standard Meter No.	*18654513*	*Calibrated By:*	*PJC1*
Standard Meter (Y)	*1.00630*	*Barometric Pressure:*	*24.80*

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F^o tr	Dry Gas Meter Inlet Temp. F^o tdi	Dry Gas Meter Outlet Temp. F^o tdo	Dry Gas Meter Avg. Temp. F^o td	Time Min	Time Sec	Y	Chg (H)
Final			*422.779*	*955.971*	*76*	*75*	*75*					
Initial			*417.342*	*950.492*	*76*	*74*	*74*					
Difference	*1*	*0.20*	*5.437*	*5.479*	*76*	*75*	*75*	*75*	*18*	*0*	*0.995*	*1.495*
Final			*428.287*	*961.541*	*77*	*76*	*76*					
Initial			*422.779*	*955.971*	*76*	*75*	*75*					
Difference	*2*	*0.50*	*5.508*	*5.570*	*77*	*76*	*76*	*76*	*12*	*0*	*0.992*	*1.618*
Final			*433.574*	*966.888*	*77*	*77*	*77*					
Initial			*428.287*	*961.541*	*77*	*76*	*76*					
Difference	*3*	*0.70*	*5.287*	*5.347*	*77*	*77*	*77*	*77*	*10*	*0*	*0.992*	*1.707*
Final			*438.975*	*972.372*	*78*	*78*	*78*					
Initial			*433.574*	*966.888*	*77*	*77*	*77*					
Difference	*4*	*0.90*	*5.401*	*5.484*	*78*	*78*	*78*	*78*	*9*	*0*	*0.988*	*1.704*
Final			*444.485*	*977.937*	*79*	*78*	*78*					
Initial			*438.975*	*972.372*	*78*	*78*	*78*					
Difference	*5*	*1.20*	*5.510*	*5.565*	*79*	*78*	*78*	*78*	*8*	*0*	*0.992*	*1.730*
Final			*417.342*	*950.492*	*76*	*74*	*74*					
Initial			*412.117*	*945.272*	*76*	*74*	*74*					
Difference	*6*	*2.00*	*5.225*	*5.220*	*76*	*74*	*74*	*74*	*6*	*0*	*0.998*	*1.800*

Average	***0.993***	***1.676***

Stack Temperature Sensor Calibration			
Temperature ID :	CM44	Name :	PJC1
Ambient Temperature, °F :	78.5	Date :	September 29, 2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	November 8, 2022
Serial # :	T-314718	Expiration Date:	November 8, 2023

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	0	0.0
250	249	0.1
600	596	0.4
1200	1197	0.2

$$\frac{(\text{Ref. Temp., }^{o}\text{F} + 460) - (\text{Test Therm. Temp., }^{o}\text{F} + 460)}{\text{Ref. Temp., }^{o}\text{F} + 460} * 100 <= 1.5\ \%$$

Airflow Sciences Corporation
Probe Calibration for Method 2

Wind Tunnel Facility: Airflow Sciences Corporation
Wind Tunnel Location: Livonia, MI
Probe Type: S-Type Pitot
Probe ID: S8-031-A
Probe Calibration Date: 07/10/17
Test Point Location: center
Ambient Temperature (°F): 77.8
Barometric Pressure ("Hg): 29.23

Repitition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (°F)	DP ("H_2O)	Yaw Angle (°)	
1	60	0.81	77.8	1.18	0	0.82
2	60	0.80	77.8	1.18	0	0.82
3	60	0.81	77.8	1.18	0	0.82
					Average ($C_{p(avg-low)}$)	0.82

Repitition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (°F)	DP ("H_2O)	Yaw Angle (deg)	
1	90	1.81	77.8	2.63	0	0.82
2	90	1.81	77.8	2.62	0	0.82
3	90	1.81	77.8	2.63	0	0.82
					Average ($C_{p(avg-high)}$)	0.82

$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.49\%}$$ Pass

Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
(2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

C_p = 0.820

Airflow Sciences Corporation

Probe Calibration for Method 2

Wind Tunnel Facility:	Airflow Sciences Corporation
Wind Tunnel Location:	Livonia, MI
Probe Type:	S-Type Pitot
Probe ID:	S8-031-B
Probe Calibration Date:	07/10/17
Test Point Location:	center
Ambient Temperature (°F):	77.5
Barometric Pressure ("Hg):	29.23

Repitition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (°F)	DP ("H_2O)	Yaw Angle (°)	
1	60	0.81	77.5	1.19	0	0.82
2	60	0.81	77.5	1.19	0	0.82
3	60	0.81	77.5	1.19	0	0.82
					Average ($C_{p(avg-low)}$)	0.82

Repitition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (°F)	DP ("H_2O)	Yaw Angle (deg)	
1	90	1.81	77.5	2.65	0	0.82
2	90	1.81	77.5	2.64	0	0.82
3	90	1.81	77.5	2.64	0	0.82
					Average ($C_{p(avg-high)}$)	0.82

$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.55\%}$$ Pass

Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
(2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

C_p = 0.818

Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date:	6/8/2017
Temperature (°F):	72.2
Pressure ("Hg):	29.33
Personnel:	wgj
Probe:	S8-031-A

Wind Tunnel Target DP [I.W.C]	Wind Tunnel Actual DP [I.W.C]	S-Probe DP [I.W.C.]	C_p	$C_{p(avg)}$	C_p-$C_{p(avg)}$	σ max	
0.81	0.81	1.19	0.818	0.818	0.000	0.001	Pass
0.81	0.81	1.19	0.818		0.000		
0.81	0.81	1.19	0.817		-0.001		
1.81	1.82	2.63	0.823	0.822	0.001	0.001	Pass
1.81	1.82	2.64	0.822		0.000		
1.81	1.81	2.64	0.820		-0.001		

Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date:	6/8/2017
Temperature (°F):	72.0
Pressure ("Hg):	29.33
Personnel:	wgj
Probe:	S8-031-B

Wind Tunnel Target DP [I.W.C]	Wind Tunnel Actual DP [I.W.C]	S-Probe DP [I.W.C.]	C_p	$C_{p(avg)}$	C_p-$C_{p(avg)}$	σ max	
0.81	0.81	1.19	0.817	0.816	0.000	0.001	Pass
0.81	0.81	1.19	0.817		0.000		
0.81	0.81	1.19	0.816		-0.001		
1.81	1.82	2.65	0.820	0.820	0.000	0.000	Pass
1.81	1.82	2.65	0.820		0.000		
1.81	1.82	2.64	0.820		0.000		

Airflow Sciences Corporation

Probe Calibration for Method 2

Wind Tunnel Facility:	Airflow Sciences Corporation
Wind Tunnel Location:	Livonia, MI
Probe Type:	S-Type Pitot
Probe ID:	S8-031-A
Probe Calibration Date:	06/08/17
Test Point Location:	center
Ambient Temperature (°F):	72.2
Barometric Pressure ("Hg):	29.33

Repitition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (°F)	DP ("H_2O)	Yaw Angle (°)	
1	60	0.81	72.2	1.19	0	0.82
2	60	0.81	72.2	1.19	0	0.82
3	60	0.81	72.2	1.19	0	0.82
					Average ($C_{p(avg-low)}$)	0.82

Repitition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (°F)	DP ("H_2O)	Yaw Angle (deg)	
1	90	1.82	72.2	2.63	0	0.82
2	90	1.82	72.2	2.64	0	0.82
3	90	1.81	72.2	2.64	0	0.82
					Average ($C_{p(avg-high)}$)	0.82

$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.51\%}$$ Pass

Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
(2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

C_p = 0.820

Airflow Sciences Corporation
Probe Calibration for Method 2

Wind Tunnel Facility:	Airflow Sciences Corporation
Wind Tunnel Location:	Livonia, MI
Probe Type:	S-Type Pitot
Probe ID:	S8-031-B
Probe Calibration Date:	06/08/17
Test Point Location:	center
Ambient Temperature (°F):	72.0
Barometric Pressure ("Hg):	29.33

Repitition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (°F)	DP ("H_2O)	Yaw Angle (°)	
1	60	0.81	72.0	1.19	0	0.82
2	60	0.81	72.0	1.19	0	0.82
3	60	0.81	72.0	1.19	0	0.82
					Average ($C_{p(avg-low)}$)	0.82

Repitition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (°F)	DP ("H_2O)	Yaw Angle (deg)	
1	90	1.82	72.0	2.65	0	0.82
2	90	1.82	72.0	2.65	0	0.82
3	90	1.82	72.0	2.64	0	0.82
					Average ($C_{p(avg-high)}$)	0.82

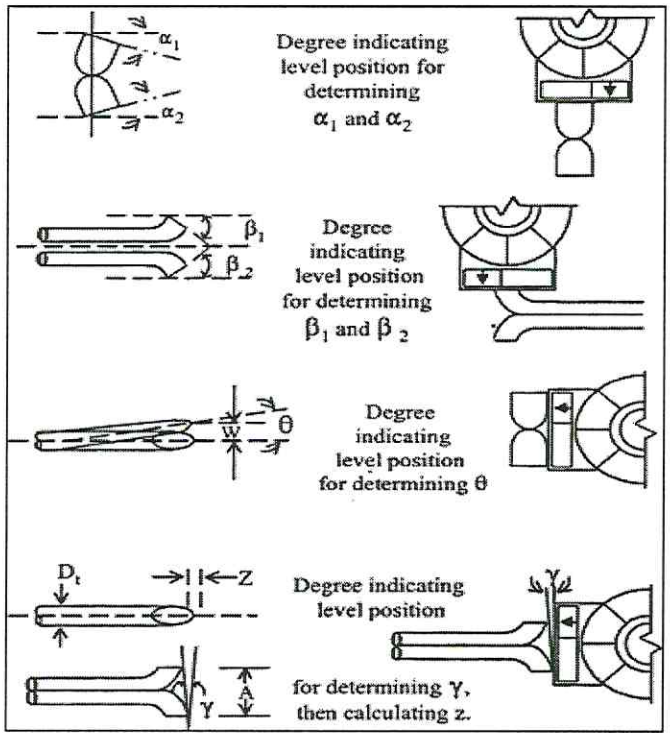
$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.45\%}$$ Pass

Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
(2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

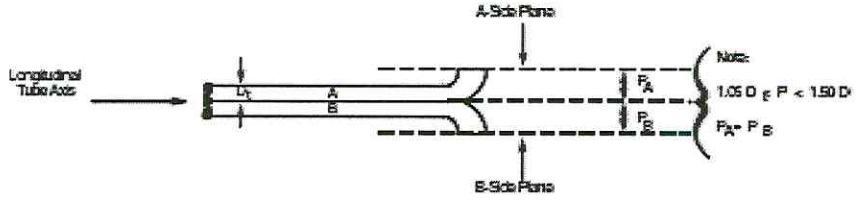
C_p = 0.818

Airflow Sciences Corporation

Probe Inspection for Method 2



α_1	0.8 (°)	Pass
α_2	0.3 (°)	Pass
β_1	0.3 (°)	Pass
β_2	1.1 (°)	Pass
D_t	0.375 (")	Pass
P_a	0.459 (")	Pass
P_b	0.459 (")	Pass
z	<0.02 (")	Pass
w	0.005 (")	Pass



Certification

I certify that Type S probe ID **S8-031** meets or exceeds all specifications, criteria, and applicable design features.

Certified by: Craig Rood Date: 6/8/2017

Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date:	8/31/2017
Temperature (^{o}F):	73.7
Pressure ("Hg):	29.43
Personnel:	wgj
Probe:	S8-032-A

Wind Tunnel Target DP [I.W.C]	Wind Tunnel Actual DP [I.W.C]	S-Probe DP [I.W.C.]	C_p	$C_{p(avg)}$	C_p-$C_{p(avg)}$	σ max	
0.81	0.81	1.18	0.820	0.821	0.000	0.000	Pass
0.81	0.81	1.18	0.821		0.000		
0.81	0.81	1.18	0.821		0.000		
1.81	1.82	2.62	0.825	0.824	0.000	0.000	Pass
1.81	1.82	2.63	0.824		0.000		
1.81	1.82	2.63	0.824		0.000		

Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date:	8/31/2017
Temperature (^{o}F):	74.5
Pressure ("Hg):	29.43
Personnel:	wgj
Probe:	S8-032-B

Wind Tunnel Target DP [I.W.C]	Wind Tunnel Actual DP [I.W.C]	S-Probe DP [I.W.C.]	C_p	$C_{p(avg)}$	C_p-$C_{p(avg)}$	σ max	
0.81	0.81	1.19	0.819	0.819	0.000	0.000	Pass
0.81	0.81	1.19	0.819		0.000		
0.81	0.81	1.19	0.820		0.000		
1.81	1.81	2.63	0.823	0.823	0.000	0.000	Pass
1.81	1.82	2.63	0.823		0.000		
1.81	1.82	2.63	0.823		0.000		

Airflow Sciences Corporation

Probe Calibration for Method 2

Wind Tunnel Facility:	Airflow Sciences Corporation
Wind Tunnel Location:	Livonia, MI
Probe Type:	S-Type Pitot
Probe ID:	S8-032-A
Probe Calibration Date:	08/31/17
Test Point Location:	center
Ambient Temperature (^oF):	73.7
Barometric Pressure ("Hg):	29.43

Repitition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (^oF)	DP ("H_2O)	Yaw Angle (^{o})	
1	60	0.81	73.7	1.18	0	0.82
2	60	0.81	73.7	1.18	0	0.82
3	60	0.81	73.7	1.18	0	0.82
					Average ($C_{p(avg-low)}$)	0.82

Repitition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (^oF)	DP ("H_2O)	Yaw Angle (deg)	
1	90	1.82	73.7	2.62	0	0.82
2	90	1.82	73.7	2.63	0	0.82
3	90	1.82	73.7	2.63	0	0.82
					Average ($C_{p(avg-high)}$)	0.82

$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.46\%}$$ **Pass**

Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
(2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0^o.

C_p = 0.822

Airflow Sciences Corporation

Probe Calibration for Method 2

Wind Tunnel Facility:	Airflow Sciences Corporation
Wind Tunnel Location:	Livonia, MI
Probe Type:	S-Type Pitot
Probe ID:	S8-032-B
Probe Calibration Date:	08/31/17
Test Point Location:	center
Ambient Temperature (^oF):	74.5
Barometric Pressure ("Hg):	29.43

Repitition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (^oF)	DP ("H_2O)	Yaw Angle (^{o})	
1	60	0.81	74.5	1.19	0	0.82
2	60	0.81	74.5	1.19	0	0.82
3	60	0.81	74.5	1.19	0	0.82
					Average ($C_{p(avg-low)}$)	0.82

Repitition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP_{std} ("H_2O)	Temperature (^oF)	DP ("H_2O)	Yaw Angle (deg)	
1	90	1.81	74.5	2.63	0	0.82
2	90	1.82	74.5	2.63	0	0.82
3	90	1.82	74.5	2.63	0	0.82
					Average ($C_{p(avg-high)}$)	0.82

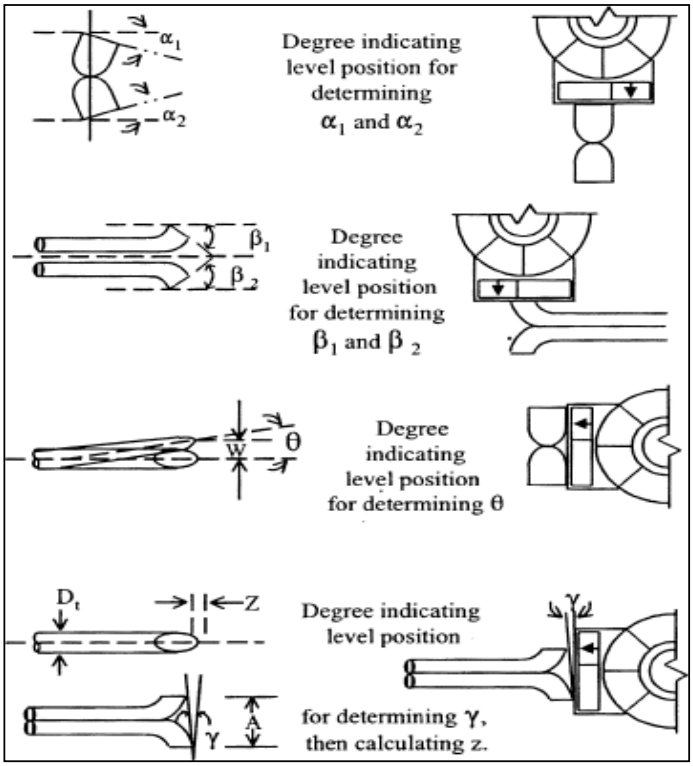
$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.43\%}$$ **Pass**

Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
(2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0^o.

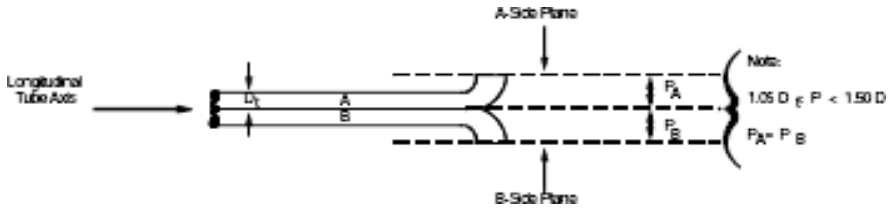
C_p = 0.821

Airflow Sciences Corporation

Probe Inspection for Method 2



α_1	1.1 (°)	Pass
α_2	1.8 (°)	Pass
β_1	1.0 (°)	Pass
β_2	1.5 (°)	Pass
D_t	0.375 (")	Pass
P_a	0.481 (")	Pass
P_b	0.481 (")	Pass
z	<0.02 (")	Pass
w	0.008 (")	Pass



Certification

I certify that Type S probe ID **S8-032** meets or exceeds all specifications, criteria, and applicable design features.

Certified by: wgj Date: 8/31/2017

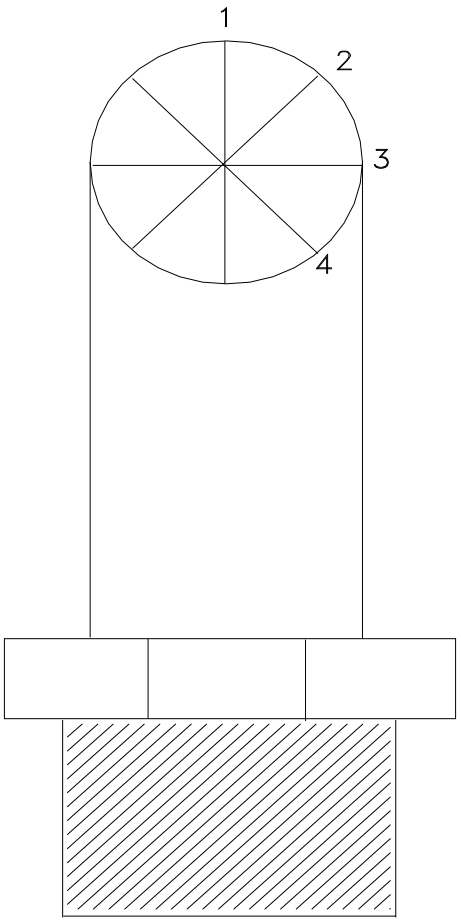
Nozzle Calibration

Date: 11/22/2021

Nozzle ID No.: 996

Analyst: RNS

Material/Type: Glass



0.390	1
0.391	2
0.390	3
0.390	4

Valid Data

Average
0.390

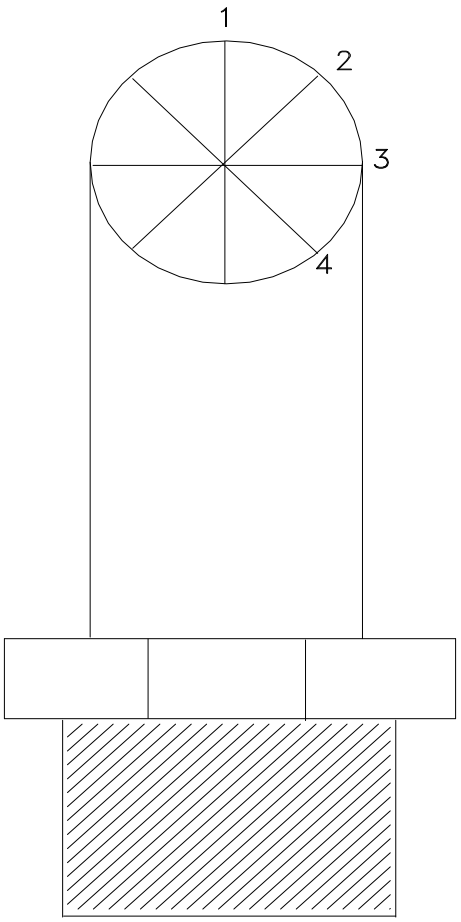
Nozzle Calibration

Date: 10/26/2021

Nozzle ID No.: 993

Analyst: KLJ

Material/Type: Glass



0.390	1
0.391	2
0.390	3
0.390	4

Valid Data

Average
0.390

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Test Location: Main Kiln
Date: 9/27/2023
Operator: R. Sollars
Operating Condition Normal

Sample System:	FTIR				
Probe Length:	8.0	**ft**			
Probe Type:	FTIR				
Sample Plane:	Vertical				
Port Length:	5.5	**in.**			
Port Size (diameter):	6	**in.**			
Port Type:	Flange				
Duct Shape:	Circular				
Diameter:	9	**ft**			
Duct Area:	63.62	**Sq. Ft.**			
Upstream Diameters:	2.00		Minimum Upstream Distance	4.5	Feet
Downstream Diameters:	4.60		Minimum Downstream Distance	18.0	Feet
Number of Ports Sampled:	1		Ideal Upstream Distance	18.0	Feet
Number of Points per Port:	1		Ideal Downstream Distance	72.0	Feet
Total Number of Traverse Points:	1				

Calibration Gases

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder		Final Bottle Pressure, PSI
O2 % (dry)	Zero	Zero Nitrogen	0.0	0.01	-0.05%	N/A			1500
	Mid	EB0065754	11.08	11.04	0.18%	5/11/2031	50.27%		1800
	High	CC189827	22.04	22.09	-0.23%	5/24/2031			1950

Type	Compound	Cylinder ID	Cylinder Value	Expiration Date	Final Bottle Pressure, PSI
Zero Gas	Nitrogen	Zero Nitrogen	0.0	N/A	1700
Calibration Transfer Standard	Ethylene	CC1570	101.4	5/30/2031	650
Analyte Spike Gas	HCN	CC768241	49.55	3/11/2024	1900
	SF6		5.001		

Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
O2 % (dry)	CAI 700	2211018	25	22.04
HF ppmvw	MKS 2030	110161896	10	N/A
HCN ppmvw	MKS 2030	110161896	100	N/A

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Diluent: O2 %

Test Location: Main Kiln
Date: 9/27/23
Operator: R. Sollars
O2 % Correction: 7

O2 % (dry) Correction Data

Run #	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
1	11.08	11.08	11.03	0.04	0.04	0.04	11.06	3.58	3.6	0.05	-0.23	-0.14	0.00
2	11.08	11.03	11.12	0.04	-0.06	-0.01	11.08	3.53	3.5	-0.36	0.41	0.32	-0.45
3	11.08	11.12	11.05	-0.06	0.06	0.00	11.09	3.74	3.7	-0.05	-0.32	-0.23	0.54
4	11.08	11.05	11.06	0.06	0.02	0.04	11.06	3.75	3.7	-0.09	0.05	-0.05	-0.18

Concentration of Cal Gas C = Average value of test Co=Average Pre and Post Zero
erage Pre and Post Span Cgas = Corrected gas value of test

Calibration Corrected and Calculated Data

Run #	Run Date	Start Time	End Time	Moisture %	O2 % (dry)	CO2 % (wet)	CO2 % (dry)	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2
1	9/27/23	7:29	8:28	35.82%	3.56	15.72	24.49	0.27	0.34	0.10	0.12
2	9/27/23	9:57	10:56	38.91%	3.54	15.20	24.89	0.20	0.26	0.10	0.13
3	9/27/23	11:20	12:19	39.18%	3.74	15.22	25.03	0.20	0.27	0.10	0.13
4	9/27/23	12:45	13:44	39.34%	3.73	15.19	25.04	0.20	0.27	0.10	0.13

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Test Location: Main Kiln
Date: 9/27/23
Project #: M233901

Linearity Cal/Pre 1 Cal

Time	O2 % (dry)	
6:31	0.02	
6:32	0.01	iz
6:33	7.10	
6:34	10.19	
6:35	6.82	
6:36	1.28	
6:37	0.06	
6:38	0.02	
6:39	10.41	
6:40	18.54	
6:41	22.09	
6:42	22.09	ih
6:43	18.61	
6:44	13.39	
6:45	11.07	
6:46	11.04	im
6:47	9.75	
6:48	1.17	
6:49	2.89	
6:50	6.88	
6:51	1.58	
6:52	5.47	
6:53	7.75	
6:54	1.25	
6:55	0.72	
6:56	0.06	
6:57	0.04	z
6:58	0.03	
6:59	7.38	
7:00	11.06	
7:01	11.09	
7:02	11.08	m

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Test Location: Main Kiln
Date: 9/27/23

Post 1/Pre 2			Post 2/Pre 3		
Time	**O2 % (dry)**		**Time**	**O2 % (dry)**	
9:45	11.17		11:04	1.38	
9:46	0.11		11:05	-0.05	
9:47	0.05		11:06	-0.06	**z**
9:48	0.04	**z**	11:07	5.94	
9:49	3.46		11:08	10.93	
9:50	11.01		11:09	11.09	
9:51	11.03	**m**	11:10	11.11	
			11:11	11.12	**m**

Post 3/Pre 4			Post 4/Pre 5		
Time	**O2 % (dry)**		**Time**	**O2 % (dry)**	
12:28	3.55		13:54	3.69	
12:29	1.35		13:55	1.06	
12:30	0.07		13:56	0.03	
12:31	0.06	**z**	13:57	0.02	**z**
12:32	7.34		13:58	4.61	
12:33	11.04		13:59	11.05	
12:34	11.05	**m**	14:00	11.06	
			14:01	11.06	**m**

Appendix H - FTIR QA/QC

Method 320 FTIR Detector Multi-Gas Determination QA/QC

FTIR data was collected using an MKS MultiGas 2030 FTIR spectrometer.

The FTIR was equipped with a temperature-controlled, 5.11 meter multi-pass gas cell maintained at 191°C. Gas flows and sampling system pressures were monitored using a rotameter and pressure transducer. All data was collected at 0.5 cm^{-1} resolution. Each spectrum was derived from the coaddition of 64 scans, with a new data point generated approximately every one minute. Analyzer data for each run is presented in the Reference Method Test Data appendix.

SAMPLING SYSTEM PARAMETERS				
MKS Serial #	**Sampling Line**	**Probe Assembly**	**Particulate Filter Media**	**Operating Temperatures**
110161896	100' 3/8" dia., heated Teflon	Heated 12', 3/8" dia. SS	0.01µ heated borosilicate glass fiber	191°C

QA/QC procedures followed US EPA Method 320 guidelines. See below for QA/QC procedure details and list of calibration gas standards. All calibration gases were introduced to the analyzer and the sampling system using an instrument grade stainless steel rotameter. All QA/QC procedures were within the acceptance criteria allowance of the applicable EPA methodology. Detailed FTIR QA/QC data follow the narrative portion of this appendix.

FTIR QA/QC Procedures						
QA/QC Specification	**Purpose**	**Calibration Gas Analyte**	**Delivery**	**Frequency**	**Acceptance Criteria**	**Result**
M320: Zero	Verify that the FTIR is free of contaminants & zero the FTIR	Nitrogen (zero)	Direct to FTIR	pre/post test	< MDL or Noise	**Pass**
M320: Calibration Transfer Standard (CTS) Direct	Verify FTIR stability, confirm optical path length	Ethylene	Direct to FTIR	pretest	+/- 5% cert. value	**Pass**
M320: Analyte Direct	Verify FTIR calibration	HCN, SF_6	Direct to FTIR	Pretest	+/- 5% cert. value	**Pass**
M320: CTS Response	Verify system stability, recovery, response time	Ethylene	Sampling System	Daily, pre/post test	+/- 5% of Direct Measurement	**Pass**
M320: Zero Response	Verify system is free of contaminants, system bias	Nitrogen (zero)	Sampling System	pretest	Bias correct data	**Pass**
M320: Analyte Spike	Verify system ability to deliver and quantify analyte of interest in the presence of other effluent gases	HCN, SF_6	Dynamic Addition to Sampling System, 1:10 effluent	Throughout testing – daily	+/- 20% theoretical recovery	**Pass**

Note: The determined concentrations from direct analyses were used in all system/spike recovery calculations.

CALIBRATION GAS STANDARDS				
Components	**Concentration (ppm)**	**Vendor**	**Cylinder #**	**Standard Type**
Ethylene	101.4	Airgas	CC1570	Primary +/- 1%
HCN/SF_6	49.60/5.000	Airgas	CC768241	Certified Standard-Spec +/- 5%
Nitrogen	Zero Gas	Airgas	Zero Nitrogen	UHP Grade

Analyte Spiking

HCN spiking was performed prior to testing to verify the ability of the sampling system to quantitatively deliver a sample containing HCN from the base of the probe to the FTIR. Analyte spiking assures the ability of the FTIR sampling system to recover acid gases in the presence of effluent gas.

As part of the spiking procedure, samples were measured to determine native HCN concentrations to be used in the spike recovery calculations. The analyte spiking gases contained a low concentration of sulfur hexafluoride (SF_6). The determined SF_6 concentration in the spiked sample was used to calculate the dilution factor of the spike and thus used to calculate the concentration of the spiked HCN. The spike target dilution ratio was 1:10 or less.

The following equation illustrates the percent recovery calculation.

$$DF = \frac{SF6(spk)}{SF6(direct)}$$ (Sec. 9.2.3 (3) USEPA Method 320)

$$CS = DF * Spike(dir) + Unspike(1 - DF)$$ (Sec. 9.2.3 (4) USEPA Method 320)

DF = Dilution factor of the spike gas
$SF_{6(dir)}$ = SF_6 concentration measured directly in undiluted spike gas
$SF_{6(spk)}$ = Diluted SF_6 concentration measured in a spiked sample
$Spike_{dir}$ = Concentration of the analyte in the spike standard measure by the FTIR directly
CS = Expected concentration of the spiked samples
Unspike = Native concentration of analytes in unspiked samples

Post Collection Data Validation

As part of the data validation procedure, reference spectra are manually fit to that of the sample spectra and a concentration is determined. The reference spectra are scaled to match the peak amplitude of the sample, thus providing a scale factor. The scale factor multiplied by the reference spectra concentration is used to determine the concentration value for the sample spectra. Sample pressure and temperature corrections are then applied to compute the final sample concentration. The manually calculated results are then compared with the software-generated results. The data is then validated if the two concentrations are within ± 20% agreement. If there is a difference greater than ± 20% the spectra are reviewed for possible spectra interferences or any other possible causes leading to incorrectly quantified data.

Detection Limit

The detection limit of each analyte was calculated following Annex A2 of ASTM D6348-12 procedure using spectra that contained similar amounts of moisture.

FTIR DETECTION LIMITS			
Analyte	**Detection Limit (ppmv wet)**	**Detection Limit (%v)**	**Detection Limit (%v wet)**
Hydrogen Cyanide	0.2	—	—
Hydrogen Fluoride	0.1		
Water	—	**0.1**	**N/A**
Carbon Dioxide	—	**N/A**	**0.1**

Copies of gas cylinder certifications are appended. All concentration data were recorded on a wet, volume basis. HCN spiking was performed prior to testing to confirm the measurement system's ability to deliver and quantify HCN. The sample and data collection followed the procedures outlined in Methods 320.

Zero Gas and In-Stack Detection Limit Study
Ash Grove Cement Company
Louisville Cement Plant
Kiln 2 (HW) Breaching Duct
9/26/2023

	DL summary - zero gas		Time	DL summary - in stack	
Time	HF ppm (10) 191C	HCN (100) 191C		HF ppm (10) 191C	HCN (100) 191C
5:22:15 AM	0.03	0.03	6:42:23 AM	-0.04	2.94
5:22:23 AM	-0.06	-0.07	6:43:27 AM	-0.04	2.88
5:22:31 AM	-0.03	0.00	6:44:31 AM	-0.05	3.00
5:22:39 AM	-0.01	-0.05	6:45:35 AM	-0.02	2.99
5:22:48 AM	-0.01	-0.01	6:46:39 AM	-0.04	2.97
5:22:56 AM	-0.01	-0.03	6:47:42 AM	-0.03	3.05
5:23:04 AM	0.01	-0.08	6:48:46 AM	-0.03	2.92
Standard Deviation	**0.03**	**0.04**	**Standard Deviation**	**0.01**	**0.05**
3x = DL	**0.08**	**0.11**	**3x = DL**	**0.03**	**0.15**

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Operating Condition: Normal

Test Location: Main Kiln
Date: 9/27/2023
Operator: R. Sollars
FTIR s/n: 110161896

System Leak Check: 0.0 mL/min

Nitrogen (Zero) Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
N2_DIR_000001.LAB	9/27/23	6:31:20	0.0	0.0	0.0	191.1	0.87	0.5	0.0	0.007
N2_DIR_000002.LAB	9/27/23	6:31:28	0.0	0.0	0.0	191.0	0.87	0.4	0.2	0.006
N2_DIR_000003BKG.LAB	9/27/23	6:33:42	0.0	0.0	0.0	191.1	0.87	0.0	0.0	0.000
N2_DIR_000004.LAB	9/27/23	6:33:56	0.0	0.0	0.0	191.1	0.87	-0.2	-0.1	0.005
N2_DIR_000005.LAB	9/27/23	6:34:03	0.0	0.0	0.0	191.1	0.87	0.1	0.1	-0.002
N2_DIR_000006.LAB	9/27/23	6:34:11	0.0	0.0	0.1	191.1	0.87	0.0	0.0	0.006
N2_DIR_000007.LAB	9/27/23	6:34:19	0.0	0.0	0.0	191.1	0.87	-0.1	0.1	0.009
N2_DIR_000008.LAB	9/27/23	6:34:27	0.0	0.0	0.0	191.1	0.87	0.0	-0.1	0.006
N2_DIR_000009.LAB	9/27/23	6:34:35	0.0	0.0	0.0	191.1	0.87	0.1	0.0	0.003

Calibration Transfer Standard (CTS), Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS_DIR_000019.LAB	9/27/23	6:36:43	0.0	0.0	0.0	191.1	0.87	101.4	-0.2	-0.017	**100.0%**
CTS_DIR_000020.LAB	9/27/23	6:36:51	0.0	0.0	0.0	191.1	0.87	101.7	-0.2	-0.019	**100.3%**
CTS_DIR_000021.LAB	9/27/23	6:36:59	0.0	0.0	0.0	191.1	0.87	101.4	0.0	-0.010	**100.0%**
CTS_DIR_000022.LAB	9/27/23	6:37:06	0.0	0.0	0.0	191.1	0.87	101.4	-0.1	-0.021	**100.0%**
CTS_DIR_000023.LAB	9/27/23	6:37:14	0.0	0.0	0.0	191.1	0.87	101.6	-0.1	-0.012	**100.1%**
CTS_DIR_000024.LAB	9/27/23	6:37:22	0.0	0.0	0.0	191.1	0.87	101.5	-0.1	-0.013	**100.1%**
CTS_DIR_000025.LAB	9/27/23	6:37:30	0.0	0.0	0.0	191.1	0.87	101.6	0.0	-0.016	**100.2%**
	Average							**101.5**			**100.1%**

Analyte Spike Gas (HCN) Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % HCN
49.6 HCN_DIR_000031.LAB	9/27/23	6:39:10	0.0	0.0	0.0	191.1	0.87	-0.5	50.9	4.900	**102.8%**
49.6 HCN_DIR_000032.LAB	9/27/23	6:39:18	0.0	0.0	0.0	191.1	0.87	-0.3	51.0	4.899	**102.9%**
49.6 HCN_DIR_000033.LAB	9/27/23	6:39:26	0.0	0.0	0.0	191.1	0.87	-0.3	51.3	4.901	**103.5%**
49.6 HCN_DIR_000034.LAB	9/27/23	6:39:34	0.0	0.0	0.0	191.2	0.87	-0.2	51.3	4.895	**103.5%**
49.6 HCN_DIR_000035.LAB	9/27/23	6:39:41	0.0	0.0	0.0	191.1	0.87	-0.5	51.4	4.902	**103.7%**
49.6 HCN_DIR_000036.LAB	9/27/23	6:39:49	0.0	0.0	0.1	191.1	0.87	-0.2	51.5	4.900	**103.9%**
49.6 HCN_DIR_000037.LAB	9/27/23	6:39:57	0.0	0.0	0.0	191.1	0.87	-0.2	51.7	4.914	**104.4%**
49.6 HCN_DIR_000038.LAB	9/27/23	6:40:05	0.0	0.0	0.0	191.1	0.87	-0.3	51.6	4.913	**104.2%**
	Average								**51.3**	**4.903**	**103.6%**

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
PRE1_CTS_000358.LAB	9/27/23	9:40:19	0.7	0.0	0.0	191.4	0.88	101.1	0.2	-0.009	**99.7%**
PRE1_CTS_000359.LAB	9/27/23	9:40:27	0.4	0.0	0.0	191.3	0.88	101.5	0.2	-0.013	**100.1%**
PRE1_CTS_000360.LAB	9/27/23	9:40:35	0.4	0.0	0.0	191.3	0.88	101.5	0.1	-0.021	**100.0%**
PRE1_CTS_000361.LAB	9/27/23	9:40:43	0.3	0.0	0.0	191.4	0.88	101.7	0.3	-0.015	**100.1%**
PRE1_CTS_000362.LAB	9/27/23	9:40:50	0.3	0.0	0.0	191.3	0.88	101.6	0.2	-0.018	**100.1%**
PRE1_CTS_000363.LAB	9/27/23	9:40:58	0.3	0.0	0.0	191.3	0.88	101.2	0.3	-0.024	**99.7%**
PRE1_CTS_000364.LAB	9/27/23	9:41:06	0.3	0.0	0.0	191.3	0.88	101.3	-0.1	-0.018	**99.8%**
PRE1_CTS_000365.LAB	9/27/23	9:41:14	0.3	0.0	0.0	191.3	0.88	101.8	0.2	-0.010	**100.3%**

Response Time Test

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Response Time (sec)
CTS_RT2_000062.LAB	9/27/23	6:49:26	39.9	13.9	-0.1	191.0	0.88	1.0	-0.5	-0.030	-
CTS_RT2_000063.LAB	9/27/23	6:49:34	38.4	12.6	-0.1	191.0	0.88	1.4	10.3	-0.011	**15.797**
CTS_RT2_000064.LAB	9/27/23	6:49:41	15.6	0.5	-0.1	191.0	0.88	70.6	15.0	0.193	**23.797**
CTS_RT2_000065.LAB	9/27/23	6:49:49	10.7	0.1	-0.1	191.0	0.88	90.8	1.2	-0.012	
CTS_RT2_000066.LAB	9/27/23	6:49:57	8.6	0.1	-0.1	191.0	0.88	93.6	0.9	-0.007	
CTS_RT2_000067.LAB	9/27/23	6:50:05	7.2	0.1	0.0	191.0	0.88	94.4	0.7	-0.028	
CTS_RT2_000068.LAB	9/27/23	6:50:13	6.0	0.1	0.0	191.0	0.88	96.1	0.7	-0.010	
CTS_RT2_000069.LAB	9/27/23	6:50:21	5.2	0.1	-0.1	191.0	0.88	96.9	0.5	-0.007	
CTS_RT2_000070.LAB	9/27/23	6:50:29	4.6	0.1	0.0	191.0	0.88	97.4	0.4	-0.008	

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Operating Condition: Normal

Test Location: Main Kiln
Date: 9/27/2023
Operator: R. Sollars
FTIR s/n: 110161896

Pre 1 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
PRE1_NATIVE_000194.LAB	9/27/23	7:10:34	33.4	16.8	-0.2	191.0	0.88	1.4	-0.2	-0.004
PRE1_NATIVE_000195.LAB	9/27/23	7:10:42	33.4	16.8	-0.1	191.0	0.88	1.1	-0.1	-0.015
PRE1_NATIVE_000196.LAB	9/27/23	7:10:50	33.3	16.5	-0.2	191.0	0.88	1.1	-0.2	-0.014
									-0.1	**-0.011**

Pre 1 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
PRE1_SPIKE_000201.LAB	9/27/23	7:16:31	30.1	15.5	-0.3	191.1	0.88	1.0	3.7	0.378	**0.077**	**95.9%**
PRE1_SPIKE_000202.LAB	9/27/23	7:16:39	31.2	15.4	-0.3	191.1	0.88	0.9	3.4	0.383	**0.078**	**86.6%**
PRE1_SPIKE_000203.LAB	9/27/23	7:16:47	31.1	15.5	-0.4	191.1	0.88	0.9	3.6	0.390	**0.080**	**91.2%**
PRE1_SPIKE_000204.LAB	9/27/23	7:16:55	31.0	15.3	-0.3	191.1	0.88	0.9	3.5	0.384	**0.078**	**88.9%**
PRE1_SPIKE_000205.LAB	9/27/23	7:17:03	31.4	15.2	-0.3	191.1	0.88	0.9	3.5	0.377	**0.077**	**91.9%**
PRE1_SPIKE_000206.LAB	9/27/23	7:17:10	31.1	15.1	-0.3	191.1	0.88	0.9	3.4	0.378	**0.077**	**90.0%**
PRE1_SPIKE_000207.LAB	9/27/23	7:17:19	31.2	15.3	-0.3	191.1	0.88	0.9	3.6	0.377	**0.077**	**95.6%**
PRE1_SPIKE_000208.LAB	9/27/23	7:17:26	31.3	15.5	-0.3	191.1	0.88	1.2	3.6	0.388	**0.079**	**92.3%**

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
PRE1_NATIVE_000385.LAB	9/27/23	9:44:25	39.1	14.6	-0.2	191.3	0.88	1.2	-0.3	-0.001
PRE1_NATIVE_000386.LAB	9/27/23	9:44:33	38.8	14.9	-0.2	191.3	0.88	1.4	-0.5	0.005
PRE1_NATIVE_000387.LAB	9/27/23	9:44:41	38.4	15.0	-0.2	191.3	0.88	1.4	-0.2	0.005
									-0.3	**0.003**

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
PRE1_SPK_000409.LAB	9/27/23	9:49:15	35.7	13.9	-0.2	191.3	0.88	1.2	3.7	0.430	**0.088**	**88.7%**
PRE1_SPK_000410.LAB	9/27/23	9:49:23	35.3	13.9	-0.2	191.2	0.88	1.2	3.8	0.439	**0.090**	**89.5%**
PRE1_SPK_000411.LAB	9/27/23	9:49:31	36.3	13.6	-0.2	191.2	0.88	1.0	3.4	0.429	**0.088**	**81.3%**
PRE1_SPK_000412.LAB	9/27/23	9:49:39	35.4	13.8	-0.2	191.2	0.88	1.3	3.5	0.439	**0.089**	**81.3%**
PRE1_SPK_000413.LAB	9/27/23	9:49:46	35.4	14.1	-0.2	191.2	0.88	1.2	3.7	0.426	**0.087**	**89.1%**
PRE1_SPK_000414.LAB	9/27/23	9:49:54	35.4	14.1	-0.2	191.3	0.88	1.2	3.6	0.424	**0.086**	**87.5%**
PRE1_SPK_000415.LAB	9/27/23	9:50:02	35.1	14.1	-0.3	191.2	0.88	1.2	3.9	0.432	**0.088**	**92.0%**
PRE1_SPK_000416.LAB	9/27/23	9:50:10	35.1	14.0	-0.2	191.2	0.88	1.4	3.7	0.433	**0.088**	**86.4%**

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
POST2_CTS_000523.LAB	9/27/23	11:07:24	1.6	0.1	0.0	191.3	0.88	99.8	0.5	-0.020	**98.3%**
POST2_CTS_000524.LAB	9/27/23	11:07:32	1.2	0.1	0.0	191.3	0.88	100.5	0.2	-0.014	**99.0%**
POST2_CTS_000525.LAB	9/27/23	11:07:40	1.0	0.0	0.0	191.2	0.88	100.5	0.3	-0.017	**99.0%**
POST2_CTS_000526.LAB	9/27/23	11:07:47	0.9	0.0	0.0	191.2	0.88	101.0	0.2	-0.026	**99.5%**
POST2_CTS_000527.LAB	9/27/23	11:07:55	0.8	0.0	0.0	191.2	0.88	100.8	0.3	-0.022	**99.3%**
POST2_CTS_000528.LAB	9/27/23	11:08:03	0.8	0.0	0.0	191.2	0.88	101.0	0.2	-0.022	**99.5%**
POST2_CTS_000529.LAB	9/27/23	11:08:11	0.7	0.0	0.0	191.2	0.88	100.7	0.2	-0.031	**99.2%**
POST2_CTS_000530.LAB	9/27/23	11:08:19	0.7	0.0	0.0	191.2	0.88	101.0	0.3	-0.020	**99.5%**

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Operating Condition: Normal

Test Location: Main Kiln
Date: 9/27/2023
Operator: R. Sollars
FTIR s/n: 110161896

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN2_000501.LAB	9/27/23	10:59:03	38.7	15.1	-0.2	191.4	0.88	1.0	-0.3	-0.011
RUN2_000502.LAB	9/27/23	11:00:05	38.6	15.0	-0.2	191.3	0.88	1.0	-0.2	-0.012
RUN2_000503.LAB	9/27/23	11:01:08	38.4	15.1	-0.2	191.2	0.88	1.0	-0.2	-0.008
									-0.3	**-0.010**

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
POST2_SPK_000505.LAB	9/27/23	11:04:20	35.3	14.3	-0.2	191.2	0.88	0.8	3.5	0.402	**0.082**	**87.0%**
POST2_SPK_000506.LAB	9/27/23	11:04:28	35.2	14.2	-0.2	191.2	0.88	1.0	3.5	0.408	**0.083**	**85.7%**
POST2_SPK_000507.LAB	9/27/23	11:04:35	35.1	14.1	-0.2	191.2	0.88	0.7	3.3	0.400	**0.082**	**82.7%**
POST2_SPK_000508.LAB	9/27/23	11:04:43	35.2	13.9	-0.2	191.2	0.88	0.6	3.4	0.402	**0.082**	**85.6%**
POST2_SPK_000509.LAB	9/27/23	11:04:51	35.5	13.7	-0.1	191.2	0.88	0.9	3.6	0.410	**0.084**	**87.5%**
POST2_SPK_000510.LAB	9/27/23	11:04:59	35.6	13.9	-0.2	191.2	0.88	0.9	3.4	0.402	**0.082**	**84.4%**
POST2_SPK_000511.LAB	9/27/23	11:05:07	35.5	14.1	-0.2	191.3	0.88	0.7	3.3	0.403	**0.082**	**83.3%**
POST2_SPK_000512.LAB	9/27/23	11:05:15	35.3	14.0	-0.2	191.3	0.88	0.7	3.5	0.405	**0.083**	**88.1%**

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
POST3_CTS_000682.LAB	9/27/23	12:33:39	0.8	0.0	0.0	191.2	0.88	100.5	0.4	-0.022	**99.0%**
POST3_CTS_000683.LAB	9/27/23	12:33:47	0.8	0.0	0.0	191.2	0.88	100.8	0.3	-0.025	**99.3%**
POST3_CTS_000684.LAB	9/27/23	12:33:55	0.8	0.0	0.0	191.2	0.88	100.4	0.2	-0.024	**98.9%**
POST3_CTS_000685.LAB	9/27/23	12:34:02	0.8	0.0	0.0	191.2	0.88	100.8	0.2	-0.025	**99.3%**
POST3_CTS_000686.LAB	9/27/23	12:34:10	0.7	0.0	0.0	191.2	0.88	100.7	0.2	-0.025	**99.2%**
POST3_CTS_000687.LAB	9/27/23	12:34:18	0.4	0.0	0.0	191.2	0.88	101.4	0.2	-0.031	**99.9%**
POST3_CTS_000688.LAB	9/27/23	12:34:26	0.3	0.0	0.0	191.3	0.88	101.1	0.3	-0.029	**99.6%**
POST3_CTS_000689.LAB	9/27/23	12:34:34	0.3	0.0	0.0	191.3	0.87	101.3	0.2	-0.037	**99.8%**

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 3_000644.LAB	9/27/23	12:21:03	39.4	15.5	-0.2	191.3	0.88	0.8	-0.2	-0.014
RUN 3_000645.LAB	9/27/23	12:22:06	39.3	15.5	-0.2	191.3	0.88	0.9	-0.2	-0.018
RUN 3_000646.LAB	9/27/23	12:23:09	39.4	15.5	-0.2	191.2	0.88	0.8	-0.3	-0.019
									-0.2	**-0.017**

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
POST3_SPK_000671.LAB	9/27/23	12:30:39	35.7	13.8	-0.2	191.2	0.88	0.5	3.4	0.395	**0.081**	**86.0%**
POST3_SPK_000672.LAB	9/27/23	12:30:47	35.4	14.0	-0.2	191.3	0.88	0.7	3.3	0.395	**0.081**	**84.2%**
POST3_SPK_000673.LAB	9/27/23	12:30:55	35.5	14.1	-0.2	191.3	0.88	0.7	3.3	0.403	**0.082**	**82.8%**
POST3_SPK_000674.LAB	9/27/23	12:31:03	35.6	14.1	-0.2	191.3	0.88	0.8	3.4	0.393	**0.080**	**86.5%**
POST3_SPK_000675.LAB	9/27/23	12:31:10	35.3	14.1	-0.2	191.3	0.88	0.7	3.4	0.395	**0.081**	**86.4%**
POST3_SPK_000676.LAB	9/27/23	12:31:18	35.7	13.9	-0.2	191.3	0.88	0.5	3.5	0.397	**0.081**	**88.2%**
POST3_SPK_000677.LAB	9/27/23	12:31:26	35.6	13.9	-0.2	191.3	0.88	0.8	3.6	0.390	**0.080**	**91.8%**
POST3_SPK_000678.LAB	9/27/23	12:31:34	35.6	14.1	-0.2	191.4	0.88	0.7	3.5	0.396	**0.081**	**87.5%**

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
POST4_CTS_000818.LAB	9/27/23	13:58:21	0.5	0.0	0.0	191.2	0.87	100.5	0.2	-0.016	**99.0%**
POST4_CTS_000819.LAB	9/27/23	13:58:29	0.3	0.0	0.0	191.2	0.87	101.3	0.2	-0.029	**99.8%**
POST4_CTS_000820.LAB	9/27/23	13:58:37	0.2	0.0	0.0	191.2	0.87	101.1	0.3	-0.019	**99.6%**
POST4_CTS_000821.LAB	9/27/23	13:58:44	0.2	0.0	0.0	191.2	0.87	101.2	0.2	-0.024	**99.7%**
POST4_CTS_000822.LAB	9/27/23	13:58:52	0.1	0.0	0.0	191.2	0.87	101.5	0.3	-0.021	**100.0%**
POST4_CTS_000823.LAB	9/27/23	13:59:00	0.2	0.0	0.0	191.2	0.87	101.9	0.2	-0.029	**100.4%**
POST4_CTS_000824.LAB	9/27/23	13:59:08	0.1	0.0	0.0	191.2	0.87	101.6	0.3	-0.038	**100.1%**
POST4_CTS_000825.LAB	9/27/23	13:59:16	0.1	0.0	0.0	191.2	0.87	101.3	0.3	-0.030	**99.7%**

Client: Ash Grove Cement Company
Facility: Montana City Cement Plant
Project #: M233901
Operating Condition: Normal

Test Location: Main Kiln
Date: 9/27/2023
Operator: R. Sollars
FTIR s/n: 110161896

Post Test CTS, Direct Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
POST4_CTS_DIR_000888.LAB	9/27/23	14:14:39	0.0	0.0	0.0	191.0	0.87	102.4	0.2	-0.019	**100.8%**
POST4_CTS_DIR_000889.LAB	9/27/23	14:14:47	0.0	0.0	0.0	191.0	0.87	102.6	0.3	-0.026	**101.0%**
POST4_CTS_DIR_000890.LAB	9/27/23	14:14:55	0.0	0.0	0.0	191.0	0.87	102.3	0.2	-0.016	**100.7%**
POST4_CTS_DIR_000891.LAB	9/27/23	14:15:02	0.0	0.0	0.0	191.0	0.87	102.2	0.3	-0.013	**100.6%**
POST4_CTS_DIR_000892.LAB	9/27/23	14:15:10	0.0	0.0	0.0	191.1	0.87	102.3	0.2	-0.025	**100.8%**
POST4_CTS_DIR_000893.LAB	9/27/23	14:15:18	0.0	0.0	0.0	191.1	0.87	102.4	0.1	-0.020	**100.9%**
POST4_CTS_DIR_000894.LAB	9/27/23	14:15:26	0.0	0.0	0.0	191.0	0.87	102.3	0.3	-0.017	**100.8%**
POST4_CTS_DIR_000895.LAB	9/27/23	14:15:34	0.0	0.0	0.0	191.0	0.87	101.4	0.1	-0.024	**99.9%**
	Average							**102.2**			

Post Test N2, Direct Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
POST4_N2_DIR_000922.LAB	9/27/23	14:21:48	0.0	0.0	0.0	191.2	0.87	0.0	0.2	-0.008
POST4_N2_DIR_000923.LAB	9/27/23	14:23:54	0.0	0.0	0.0	191.2	0.87	0.0	0.3	-0.007
POST4_N2_DIR_000924.LAB	9/27/23	14:25:59	0.0	0.0	0.0	191.1	0.87	0.0	0.2	-0.009

Appendix I - Gas Cylinder Certifications

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
11711 S. Alameda Street
Los Angeles, CA 90059
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI78E15A0225	Reference Number:	48-402737254-1
Cylinder Number:	EB0065754	Cylinder Volume:	152.0 CF
Laboratory:	124 - Los Angeles (SAP) - CA	Cylinder Pressure:	2015 PSIG
PGVP Number:	B32023	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	May 11, 2023

Expiration Date: May 11, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	11.00 %	11.18 %	G1	+/- 0.6% NIST Traceable	05/11/2023
OXYGEN	11.00 %	11.08 %	G1	+/- 0.8% NIST Traceable	05/11/2023
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08010611	K005428	13.94 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 30, 2024
NTRM	98051002	SG9150866BAL	12.05 % OXYGEN/NITROGEN	+/- 0.7%	Dec 14, 2023

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS 6E CO2	NDIR	Apr 26, 2023
SIEMENS OXYMAT 6	PARAMAGNETIC	Apr 21, 2023

Triad Data Available Upon Request

Signature on file
Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
11711 S. Alameda Street
Los Angeles, CA 90059
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI56E15A1055	Reference Number:	48-402750152-1
Cylinder Number:	CC189827	Cylinder Volume:	162.0 CF
Laboratory:	124 - Los Angeles (SAP) - CA	Cylinder Pressure:	2015 PSIG
PGVP Number:	B32023	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	May 24, 2023

Expiration Date: May 24, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	22.00 %	22.69 %	G1	+/- 0.7% NIST Traceable	05/24/2023
OXYGEN	22.00 %	22.04 %	G1	+/- 0.7% NIST Traceable	05/24/2023
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12061520	CC354777	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024
NTRM	08010228	K016648	23.20 % OXYGEN/NITROGEN	+/- 0.2%	Jun 01, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS 6E CO2	NDIR	Apr 26, 2023
SIEMENS OXYMAT 6	PARAMAGNETIC	May 22, 2023

Triad Data Available Upon Request

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
11711 S. Alameda Street
Los Angeles, CA 90059
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Part Number:	X02NI99C15A1268	Reference Number:	48-402750148-1
Cylinder Number:	CC1570	Cylinder Volume:	144.0 CF
Laboratory:	124 - Los Angeles (SAP) - CA	Cylinder Pressure:	2015 PSIG
Analysis Date:	May 30, 2023	Valve Outlet:	350
Lot Number:	48-402750148-1		

Expiration Date: May 30, 2031

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	101.4 PPM	+/- 2%
NITROGEN	Balance		

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
6141 Easton Road
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Customer:	MOSTARDI PLATT		
Part Number:	X03NI99C15AC0W8	Reference Number:	160-402841635-1
Cylinder Number:	CC768241	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
Analysis Date:	Sep 11, 2023	Valve Outlet:	350SS
Lot Number:	160-402841635-1		

Expiration Date: Mar 11, 2024

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
SULFUR HEXAFLUORIDE	5.000 PPM	5.001 PPM	+/- 1.3%
HYDROGEN CYANIDE	50.00 PPM	49.55 PPM	+/- 5%
NITROGEN	Balance		

Signature on file
Approved for Release

END OF THE REPORT