Section 114 Information Collection Request Emissions Test Report

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Ash Grove Cement Company
Durkee Cement Plant
EPA Registry ID: 110070834904
33060 Shirttail Creek Road
Durkee, Oregon
Report No. M234105

mostardi platt

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Emissions Test Report

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33060 Shirttail Creek Road
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Report Submittal Date:
March 4, 2024

Report No. M234105

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 Durkee Cement Plant located in Durkee, Oregon. 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 Durkee Cement Plant includes a single Kiln (K1) ~1,000,000 TPY preheater/pre-calciner having an in-line raw mill. There are two calciners; an incline and a separate line calciner. The kiln system employs a SNCR for NO_x control and has a baghouse fabric filtration, and a separate polishing baghouse with activated carbon injection for mercury control.

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.

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

Location	**Address**	**Contact**
Facility Representative	Ash Grove Cement Company Durkee Cement Plant 33060 Shirttail Creek Road Durkee, OR 97905	Ms. Norma Job Environmental Manager 541-877-2640 norma.job@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 Mill On	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.16 ppmvd @7% O_2	
		≤ 0.05 lb/hr	
		≤ 0.0005 lb/ton clinker	
	HF[1]	≤ 0.15 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.19 ppmvd @7% O_2	
		≤ 0.06 lb/hr	
		≤ 0.0005 lb/ton clinker	
	Chlorine (Cl_2)[1]	≤ 0.04 ppmvd	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.05 ppmvd @7% O_2	
		≤ 0.06 lb/hr	
		≤ 0.0005 lb/ton clinker	
	Hydrogen Cyanide (HCN)	1.89 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		3.02 ppmvd @7% O_2	
		1.35 lb/hr	
		0.0115 lb/ton clinker	
	Oxygen (O_2)	10.4 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO_2)	16.8 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H_20)	17.3 %	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

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

Source	Parameter Tested	Test Results	Method/Regulation Citation
Kiln Stack Mill Off	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.14 ppmvd @7% O_2	
		≤ 0.05 lb/hr	
		≤ 0.0004 lb/ton clinker	
	HF[2]	≤ 0.14 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.16 ppmvd @7% O_2	
		≤ 0.05 lb/hr	
		≤ 0.0004 lb/ton clinker	
	Chlorine (Cl_2)[2]	≤ 0.04 ppmvd	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.05 ppmvd @7% O_2	
		≤ 0.05 lb/hr	
		≤ 0.0005 lb/ton clinker	
	Hydrogen Cyanide (HCN)	2.04 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		2.91 ppmvd @7% O_2	
		1.28 lb/hr	
		0.0109 lb/ton clinker	
	Oxygen (O_2)	8.8 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO_2)	19.1 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H_20)	19.4 %	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

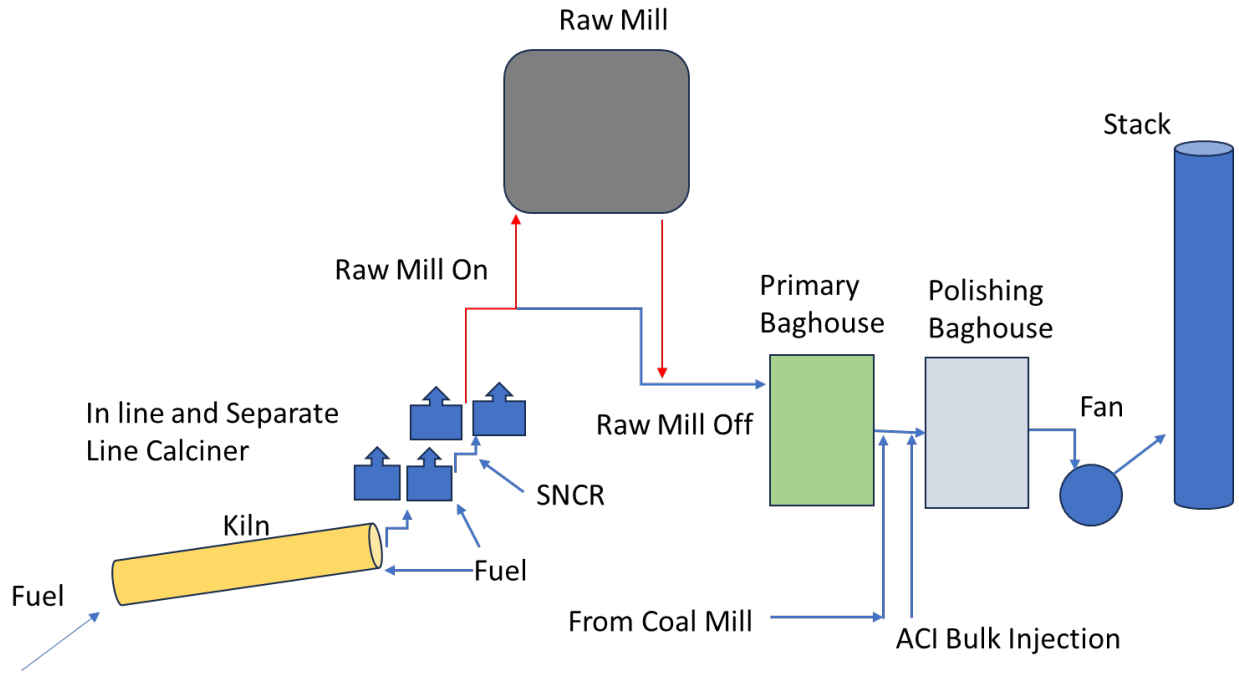
[2] HF and Cl_2 Method 26A results are reported as the average from Train A and Train B.

3.0 QA SPECIFICATIONS AND PROCESS DIAGRAM

Table 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	6244 (Run 1 Average)
		S Beam	>0.9	1.161 (Run 1 Average)
		Direct HCN Analysis	±5% of tag value	4.3%
		Dynamic Spike Analysis	≤10% of total sample volume	8.1%
			Spike gas ~twice native concentration or 3-4 ppm addition to native concentration	+4.1 ppm
			≤±20% of expected value or ≤±0.5 ppm, whichever is less restrictive	+1.5 %
		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.	0.01 ppmvd

Table 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	10.9 Feet	8.5 Inches	4.1 Diameters	16.5 Diameters	HF/Cl_2 (26A)	12
					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°F +/- 25°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: Durkee Cement Plant
Test Location: Main Kiln
Test Method: 26A - Combined Results

Source Condition	Mill On	Mill On	Mill On	
Date	10/11/23	10/11/23	10/11/23	
Start Time	8:30	10:10	11:45	
End Time	9:39	11:21	12:54	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Velocity, ft/sec	44.297	43.771	43.505	43.858
Gas Volumetric Flow Rate, acfm	248,007	245,066	243,572	245,548
Gas Volumetric Flow Rate, dscfm	141,476	139,427	140,381	140,428
Gas Volumetric Flow Rate, scfm	171,083	169,908	169,160	170,050
Average %CO_2 by volume, dry basis	16.8	16.8	16.7	16.8
Average %O_2 by volume, dry basis	10.4	10.4	10.4	10.4
Clinker Production, ton/hr	117.0	117.0	118.0	117.3
Chlorine (Cl2) Emissions				
ppm	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.04
ppmvd@7%O2	≤ 0.05	≤ 0.05	≤ 0.05	≤ 0.05
lb/hr	≤ 0.0625	≤ 0.0616	≤ 0.0620	≤ 0.0620
lb/ton of clinker	≤ 0.0005	≤ 0.0005	≤ 0.0005	≤ 0.0005
Hydrogen Fluoride (HF) Emissions				
ppm	≤ 0.15	≤ 0.15	≤ 0.15	≤ 0.15
ppmvd@7%O2	≤ 0.19	≤ 0.19	≤ 0.19	≤ 0.19
lb/hr	≤ 0.0639	≤ 0.0639	≤ 0.0643	≤ 0.0640
lb/ton of clinker	≤ 0.0005	≤ 0.0005	≤ 0.0005	≤ 0.0005

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

Source Condition	Mill On	Mill On	Mill On	
Date	10/11/23	10/11/23	10/11/23	
Start Time	8:30	10:10	11:45	
End Time	9:39	11:21	12:54	
	Run 1A	Run 2A	Run 3A	Average
Stack Conditions				
Average Gas Temperature, °F	227.2	223.5	222.9	224.5
Flue Gas Moisture, percent by volume	17.0%	17.6%	17.0%	17.2%
Average Flue Pressure, in. Hg	26.83	26.83	26.83	26.83
Gas Sample Volume, dscf	51.292	51.056	51.117	51.155
Average Gas Velocity, ft/sec	44.219	43.966	43.876	44.020
Gas Volumetric Flow Rate, acfm	247,575	246,159	245,651	246,462
Gas Volumetric Flow Rate, dscfm	141,517	140,438	141,295	141,083
Gas Volumetric Flow Rate, scfm	170,587	170,521	170,314	170,474
Average $\%CO_2$ by volume, dry basis	16.8	16.8	16.7	16.8
Average $\%O_2$ by volume, dry basis	10.4	10.4	10.4	10.4
Isokinetic Variance	101.6	101.9	101.4	101.6
Chlorine (Cl2) Emissions				
ug of sample collected	≤ 150	≤ 150	≤ 150	≤ 150
ppm	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.04
Hydrogen Fluoride (HF) Emissions				
ug of sample collected	≤ 150	≤ 150	≤ 150	≤ 150
ppm	≤ 0.12	≤ 0.13	≤ 0.12	≤ 0.12

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

Source Condition	Mill On	Mill On	Mill On	
Date	10/11/23	10/11/23	10/11/23	
Start Time	8:30	10:10	11:45	
End Time	9:39	11:21	12:54	
	Run 1B	Run 2B	Run 3B	Average
Stack Conditions				
Average Gas Temperature, °F	225.6	222.3	220.6	222.8
Flue Gas Moisture, percent by volume	17.6%	18.2%	17.0%	17.6%
Average Flue Pressure, in. Hg	26.83	26.83	26.83	26.83
Gas Sample Volume, dscf	38.277	37.621	37.451	37.783
Average Gas Velocity, ft/sec	44.374	43.576	43.133	43.694
Gas Volumetric Flow Rate, acfm	248,439	243,972	241,492	244,634
Gas Volumetric Flow Rate, dscfm	141,434	138,415	139,467	139,772
Gas Volumetric Flow Rate, scfm	171,578	169,295	168,005	169,626
Average $\%CO_2$ by volume, dry basis	16.8	16.8	16.7	16.8
Average $\%O_2$ by volume, dry basis	10.4	10.4	10.5	10.4
Isokinetic Variance	101.4	101.8	100.6	101.3
Chlorine (Cl2) Emissions				
ug of sample collected	≤ 150	≤ 150	≤ 150	≤ 150
ppm	≤ 0.05	≤ 0.05	≤ 0.05	≤ 0.05
Hydrogen Fluoride (HF) Emissions				
ug of sample collected	≤ 150	≤ 150	≤ 150	≤ 150
ppm	≤ 0.17	≤ 0.17	≤ 0.17	≤ 0.17

Ash Grove Cement Company
Durkee Cement Plant
Main Kiln
Mill On
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	10/11/2023	8:30	9:29	10.4	17.2%	2.19	3.50	≤ 0.10	≤ 0.16
2	10/11/2023	10:10	11:09	10.4	17.4%	1.81	2.89	≤ 0.10	≤ 0.16
3	10/11/2023	11:45	12:44	10.4	17.2%	1.66	2.67	≤ 0.10	≤ 0.16
Average				**10.4**	**17.3%**	**1.89**	**3.02**	**≤ 0.10**	**≤ 0.16**

Test No.	Date	Start Time	End Time	Volumetric Flow, DSCFM	Clinker Production, ton/hr	HCN lb/hr	HCN lb/ton	HF lb/hr	HF lb/ton
1	10/11/2023	8:30	9:29	141,476	117.0	1.58	0.0135	≤ 0.05	≤ 0.0005
2	10/11/2023	10:10	11:09	139,427	117.0	1.28	0.0110	≤ 0.05	≤ 0.0004
3	10/11/2023	11:45	12:44	140,381	118.0	1.19	0.0101	≤ 0.05	≤ 0.0004
Average				**140,428**	**117.3**	**1.35**	**0.0115**	**≤ 0.05**	**≤ 0.0005**

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln**
Test Method:	**26A - Combined Results**

Source Condition		**Mill Off**		**Mill Off**		**Mill Off**		
Date		**10/12/23**		**10/12/23**		**10/12/23**		
Start Time		**10:45**		**12:15**		**13:50**		
End Time		**11:54**		**13:24**		**14:59**		
		Run 1		**Run 2**		**Run 3**		**Average**
Stack Conditions								
Average Gas Velocity, ft/sec		41.469		41.378		41.284		41.377
Gas Volumetric Flow Rate, acfm		232,176		231,663		231,139		231,659
Gas Volumetric Flow Rate, dscfm		121,046		121,513		121,155		121,238
Gas Volumetric Flow Rate, scfm		150,633		149,915		149,357		149,968
Average %CO_2 by volume, dry basis		18.8		19.3		19.1		19.1
Average %O_2 by volume, dry basis		8.9		8.8		8.8		8.8
Clinker Production, ton/hr		117.0		120.0		118.0		118.3
Chlorine (Cl2) Emissions								
ppm	≤	0.04	≤	0.04	≤	0.04	≤	0.04
ppmvd@7%O2	≤	0.05	≤	0.05	≤	0.05	≤	0.05
lb/hr	≤	0.0535	≤	0.0537	≤	0.0535	≤	0.0535
lb/ton of clinker	≤	0.0005	≤	0.0004	≤	0.0005	≤	0.0005
Hydrogen Fluoride (HF) Emissions								
ppm	≤	0.14	≤	0.14	≤	0.14	≤	0.14
ppmvd@7%O2	≤	0.16	≤	0.16	≤	0.16	≤	0.16
lb/hr	≤	0.0520	≤	0.0522	≤	0.0521	≤	0.0521
lb/ton of clinker	≤	0.0004	≤	0.0004	≤	0.0004	≤	0.0004

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

Source Condition	Mill Off	Mill Off	Mill Off	
Date	10/12/23	10/12/23	10/12/23	
Start Time	10:45	12:15	13:50	
End Time	11:54	13:24	14:59	
	Run 1A	Run 2A	Run 3A	Average
Stack Conditions				
Average Gas Temperature, °F	277.8	281.0	282.2	280.3
Flue Gas Moisture, percent by volume	19.3%	18.7%	19.0%	19.0%
Average Flue Pressure, in. Hg	27.10	27.10	27.10	27.10
Gas Sample Volume, dscf	45.595	45.455	45.363	45.471
Average Gas Velocity, ft/sec	42.037	42.033	41.987	42.019
Gas Volumetric Flow Rate, acfm	235,358	235,334	235,074	235,255
Gas Volumetric Flow Rate, dscfm	123,167	123,491	122,762	123,140
Gas Volumetric Flow Rate, scfm	152,570	151,885	151,479	151,978
Average $\%CO_2$ by volume, dry basis	18.8	19.3	19.1	19.1
Average $\%O_2$ by volume, dry basis	8.9	8.8	8.8	8.8
Isokinetic Variance	103.8	103.2	103.6	103.5
Chlorine (Cl2) Emissions				
ug of sample collected	≤ 150	≤ 150	≤ 150	≤ 150
ppm	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.04
Hydrogen Fluoride (HF) Emissions				
ug of sample collected	≤ 150	≤ 150	≤ 150	≤ 150
ppm	≤ 0.14	≤ 0.14	≤ 0.14	≤ 0.14

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

Source Condition	Mill Off	Mill Off	Mill Off	
Date	10/12/23	10/12/23	10/11/23	
Start Time	10:45	12:15	13:50	
End Time	11:54	13:24	14:59	
	Run 1B	Run 2B	Run 3B	Average
Stack Conditions				
Average Gas Temperature, °F	276.5	277.0	278.0	277.2
Flue Gas Moisture, percent by volume	20.0%	19.2%	18.8%	19.3%
Average Flue Pressure, in. Hg	27.10	27.10	27.10	27.10
Gas Sample Volume, dscf	47.017	46.924	46.836	46.926
Average Gas Velocity, ft/sec	40.901	40.722	40.581	40.735
Gas Volumetric Flow Rate, acfm	228,994	227,991	227,204	228,063
Gas Volumetric Flow Rate, dscfm	118,925	119,534	119,548	119,336
Gas Volumetric Flow Rate, scfm	148,696	147,945	147,235	147,959
Average $\%CO_2$ by volume, dry basis	18.8	19.3	19.1	19.1
Average $\%O_2$ by volume, dry basis	8.9	8.8	8.8	8.8
Isokinetic Variance	104.2	103.5	103.3	103.7
Chlorine (Cl2) Emissions				
ug of sample collected	≤ 150	≤ 150	≤ 150	≤ 150
ppm	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.04
Hydrogen Fluoride (HF) Emissions				
ug of sample collected	≤ 150	≤ 150	≤ 150	≤ 150
ppm	≤ 0.14	≤ 0.14	≤ 0.14	≤ 0.14

Ash Grove Cement Company
Durkee Cement Plant
Main Kiln
Mill Off
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	10/12/2023	10:45	11:44	8.9	19.9%	2.08	3.01	≤ 0.10	≤ 0.14
2	10/12/2023	12:15	13:14	8.8	19.3%	2.03	2.88	≤ 0.10	≤ 0.14
3	10/12/2023	13:50	14:49	8.8	19.2%	2.00	2.83	≤ 0.10	≤ 0.14
Average				**8.8**	**19.4%**	**2.04**	**2.91**	**≤ 0.10**	**≤ 0.14**

Test No.	Date	Start Time	End Time	Volumetric Flow, DSCFM	Clinker Production, ton/hr	HCN lb/hr	HCN lb/ton	HF lb/hr	HF lb/ton
1	10/12/2023	10:45	11:44	121,046	117.0	1.32	0.0113	≤ 0.05	≤ 0.0004
2	10/12/2023	12:15	13:14	121,513	120.0	1.28	0.0107	≤ 0.05	≤ 0.0004
3	10/12/2023	13:50	14:49	121,155	118.0	1.26	0.0107	≤ 0.05	≤ 0.0004
Average				**121,238**	**118.3**	**1.29**	**0.0109**	**≤ 0.05**	**≤ 0.0004**

6.0 CERTIFICATION

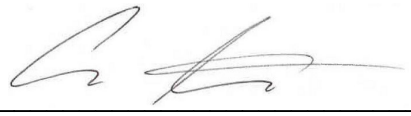
Mostardi Platt is pleased to have been of service to Ash Grove Cement Company If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

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

Project Manager

Richard J. Sollars II



Quality Assurance

Chet A. Gutwein

APPENDICES

Appendix A – Plant Operating Data

HCN Production Data for October 11 & 12, 2023

Fuel Usage - 0% Coal, 97% Natural Gas and 3% Tires

Timestamp	Total Kiln Feed Rate	Total Clinker
	stph	stph
10/11/2023 7:30	197	117
10/11/2023 7:31	199	118
10/11/2023 7:32	199	118
10/11/2023 7:33	200	118
10/11/2023 7:34	198	118
10/11/2023 7:35	198	118
10/11/2023 7:36	198	118
10/11/2023 7:37	198	118
10/11/2023 7:38	197	118
10/11/2023 7:39	199	118
10/11/2023 7:40	198	118
10/11/2023 7:41	199	118
10/11/2023 7:42	198	117
10/11/2023 7:43	198	118
10/11/2023 7:44	198	117
10/11/2023 7:45	198	117
10/11/2023 7:46	199	117
10/11/2023 7:47	197	117
10/11/2023 7:48	196	117
10/11/2023 7:49	200	118
10/11/2023 7:50	198	118
10/11/2023 7:51	198	118
10/11/2023 7:52	199	117
10/11/2023 7:53	197	117
10/11/2023 7:54	196	117
10/11/2023 7:55	195	116
10/11/2023 7:56	195	116
10/11/2023 7:57	196	116
10/11/2023 7:58	196	116
10/11/2023 7:59	196	116
10/11/2023 8:00	196	116
10/11/2023 8:01	196	117
10/11/2023 8:02	198	117
10/11/2023 8:03	196	117
10/11/2023 8:04	196	116
10/11/2023 8:05	195	116
10/11/2023 8:06	197	117
10/11/2023 8:07	196	116
10/11/2023 8:08	196	117
10/11/2023 8:09	196	116
10/11/2023 8:10	195	116
10/11/2023 8:11	196	117
10/11/2023 8:12	195	116
10/11/2023 8:13	196	116
10/11/2023 8:14	195	116
10/11/2023 8:15	197	117
10/11/2023 8:16	198	117
10/11/2023 8:17	196	117
10/11/2023 8:18	195	116
10/11/2023 8:19	196	116
10/11/2023 8:20	196	116
10/11/2023 8:21	195	116
10/11/2023 8:22	195	116
10/11/2023 8:23	197	116
10/11/2023 8:24	196	116
10/11/2023 8:25	197	116
10/11/2023 8:26	197	116
10/11/2023 8:27	197	116
10/11/2023 8:28	198	117
10/11/2023 8:29	197	116

10/11/2023 8:30	195	116
10/11/2023 8:31	196	116
10/11/2023 8:32	197	116
10/11/2023 8:33	197	117
10/11/2023 8:34	196	116
10/11/2023 8:35	196	116
10/11/2023 8:36	194	116
10/11/2023 8:37	195	116
10/11/2023 8:38	197	116
10/11/2023 8:39	198	117
Run 1 Average	197	117
10/11/2023 9:10	196	116
10/11/2023 9:11	196	117
10/11/2023 9:12	196	116
10/11/2023 9:13	193	116
10/11/2023 9:14	196	116
10/11/2023 9:15	196	116
10/11/2023 9:16	195	116
10/11/2023 9:17	196	116
10/11/2023 9:18	196	117
10/11/2023 9:19	194	116
10/11/2023 9:20	196	117
10/11/2023 9:21	197	117
10/11/2023 9:22	195	116
10/11/2023 9:23	196	116
10/11/2023 9:24	197	117
10/11/2023 9:25	195	116
10/11/2023 9:26	196	116
10/11/2023 9:27	197	117
10/11/2023 9:28	196	117
10/11/2023 9:29	195	117
10/11/2023 9:30	195	116
10/11/2023 9:31	195	116
10/11/2023 9:32	196	116
10/11/2023 9:33	196	116
10/11/2023 9:34	196	117
10/11/2023 9:35	197	117
10/11/2023 9:36	194	116
10/11/2023 9:37	197	116
10/11/2023 9:38	196	116
10/11/2023 9:39	196	116
10/11/2023 9:40	195	116
10/11/2023 9:41	197	117
10/11/2023 9:42	194	116
10/11/2023 9:43	193	116
10/11/2023 9:44	195	116
10/11/2023 9:45	196	117
10/11/2023 9:46	195	116
10/11/2023 9:47	196	116
10/11/2023 9:48	196	117
10/11/2023 9:49	196	116
10/11/2023 9:50	195	116
10/11/2023 9:51	196	117
10/11/2023 9:52	198	117
10/11/2023 9:53	198	117
10/11/2023 9:54	198	117
10/11/2023 9:55	197	117
10/11/2023 9:56	196	117
10/11/2023 9:57	197	117
10/11/2023 9:58	198	118
10/11/2023 9:59	196	117
10/11/2023 10:00	198	117
10/11/2023 10:01	197	117
10/11/2023 10:02	196	117
10/11/2023 10:03	196	117
10/11/2023 10:04	196	117
10/11/2023 10:05	198	117
10/11/2023 10:06	197	117

10/11/2023 10:07	196	117
10/11/2023 10:08	197	117
10/11/2023 10:09	198	117
10/11/2023 10:10	197	117
10/11/2023 10:11	198	117
10/11/2023 10:12	195	117
10/11/2023 10:13	198	117
10/11/2023 10:14	198	117
10/11/2023 10:15	198	117
10/11/2023 10:16	195	117
10/11/2023 10:17	197	117
10/11/2023 10:18	195	116
10/11/2023 10:19	198	117
10/11/2023 10:20	198	117
10/11/2023 10:21	196	117
Run 2 Average	196	117
10/11/2023 10:45	199	118
10/11/2023 10:46	198	118
10/11/2023 10:47	198	118
10/11/2023 10:48	197	117
10/11/2023 10:49	198	118
10/11/2023 10:50	198	118
10/11/2023 10:51	198	118
10/11/2023 10:52	199	118
10/11/2023 10:53	196	117
10/11/2023 10:54	198	117
10/11/2023 10:55	197	117
10/11/2023 10:56	197	118
10/11/2023 10:57	198	118
10/11/2023 10:58	198	118
10/11/2023 10:59	197	118
10/11/2023 11:00	198	118
10/11/2023 11:01	197	118
10/11/2023 11:02	197	117
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10/11/2023 11:04	198	117
10/11/2023 11:05	198	118
10/11/2023 11:06	199	118
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10/11/2023 11:09	199	118
10/11/2023 11:10	198	118
10/11/2023 11:11	199	118
10/11/2023 11:12	200	118
10/11/2023 11:13	199	118
10/11/2023 11:14	198	118
10/11/2023 11:15	198	118
10/11/2023 11:16	197	118
10/11/2023 11:17	199	118
10/11/2023 11:18	200	118
10/11/2023 11:19	198	118
10/11/2023 11:20	198	118
10/11/2023 11:21	199	118
10/11/2023 11:22	199	118
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10/11/2023 11:29	198	119
10/11/2023 11:30	199	118
10/11/2023 11:31	199	118
10/11/2023 11:32	200	118
10/11/2023 11:33	198	118
10/11/2023 11:34	199	118
10/11/2023 11:35	201	118
10/11/2023 11:36	200	118
10/11/2023 11:37	199	117

10/11/2023 11:38	198	118
10/11/2023 11:39	200	118
10/11/2023 11:40	199	118
10/11/2023 11:41	199	118
10/11/2023 11:42	198	118
10/11/2023 11:43	200	118
10/11/2023 11:44	199	118
10/11/2023 11:45	198	118
10/11/2023 11:46	199	118
10/11/2023 11:47	198	117
10/11/2023 11:48	198	118
10/11/2023 11:49	199	118
10/11/2023 11:50	199	118
10/11/2023 11:51	199	118
10/11/2023 11:52	199	118
10/11/2023 11:53	200	119
10/11/2023 11:54	199	118
Run 3 Average	199	118
10/12/2023 9:45	193	114
10/12/2023 9:46	195	115
10/12/2023 9:47	193	115
10/12/2023 9:48	193	114
10/12/2023 9:49	192	114
10/12/2023 9:50	193	115
10/12/2023 9:51	194	115
10/12/2023 9:52	193	115
10/12/2023 9:53	193	114
10/12/2023 9:54	192	114
10/12/2023 9:55	194	116
10/12/2023 9:56	195	116
10/12/2023 9:57	196	116
10/12/2023 9:58	196	117
10/12/2023 9:59	196	116
10/12/2023 10:00	197	116
10/12/2023 10:01	195	117
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10/12/2023 10:03	193	116
10/12/2023 10:04	194	116
10/12/2023 10:05	194	115
10/12/2023 10:06	195	115
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10/12/2023 10:08	195	115
10/12/2023 10:09	195	116
10/12/2023 10:10	194	115
10/12/2023 10:11	194	115
10/12/2023 10:12	194	115
10/12/2023 10:13	195	116
10/12/2023 10:14	193	116
10/12/2023 10:15	195	116
10/12/2023 10:16	197	116
10/12/2023 10:17	195	116
10/12/2023 10:18	194	116
10/12/2023 10:19	197	117
10/12/2023 10:20	197	118
10/12/2023 10:21	197	117
10/12/2023 10:22	196	117
10/12/2023 10:23	197	117
10/12/2023 10:24	198	118
10/12/2023 10:25	198	117
10/12/2023 10:26	200	118
10/12/2023 10:27	199	118
10/12/2023 10:28	196	117
10/12/2023 10:29	200	118
10/12/2023 10:30	198	118
10/12/2023 10:31	198	118
10/12/2023 10:32	200	119
10/12/2023 10:33	199	119
10/12/2023 10:34	199	119
10/12/2023 10:35	199	119

10/12/2023 10:36	199	118
10/12/2023 10:37	197	118
10/12/2023 10:38	197	117
10/12/2023 10:39	198	117
10/12/2023 10:40	197	117
10/12/2023 10:41	198	117
10/12/2023 10:42	199	118
10/12/2023 10:43	197	117
10/12/2023 10:44	198	117
10/12/2023 10:45	198	118
10/12/2023 10:46	199	118
10/12/2023 10:47	197	118
10/12/2023 10:48	197	117
10/12/2023 10:49	197	117
10/12/2023 10:50	199	118
10/12/2023 10:51	200	119
10/12/2023 10:52	202	120
10/12/2023 10:53	201	119
10/12/2023 10:54	199	119
Run 4 Average	196	117
10/12/2023 11:15	199	119
10/12/2023 11:16	201	119
10/12/2023 11:17	201	119
10/12/2023 11:18	201	119
10/12/2023 11:19	199	118
10/12/2023 11:20	199	118
10/12/2023 11:21	199	119
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10/12/2023 11:23	201	119
10/12/2023 11:24	199	119
10/12/2023 11:25	199	118
10/12/2023 11:26	200	119
10/12/2023 11:27	200	119
10/12/2023 11:28	201	119
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10/12/2023 11:31	202	120
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10/12/2023 11:33	202	120
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10/12/2023 11:39	203	121
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10/12/2023 11:42	204	121
10/12/2023 11:43	203	121
10/12/2023 11:44	205	121
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10/12/2023 11:46	202	120
10/12/2023 11:47	205	122
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10/12/2023 11:49	204	121
10/12/2023 11:50	205	121
10/12/2023 11:51	203	121
10/12/2023 11:52	204	121
10/12/2023 11:53	205	121
10/12/2023 11:54	204	122
10/12/2023 11:55	205	122
10/12/2023 11:56	206	122
10/12/2023 11:57	204	122
10/12/2023 11:58	203	121
10/12/2023 11:59	204	121
10/12/2023 12:00	204	121
10/12/2023 12:01	203	121
10/12/2023 12:02	201	120
10/12/2023 12:03	201	120

10/12/2023 12:04	203	119
10/12/2023 12:05	205	120
10/12/2023 12:06	202	121
10/12/2023 12:07	205	121
10/12/2023 12:08	204	121
10/12/2023 12:09	203	121
10/12/2023 12:10	205	121
10/12/2023 12:11	200	120
10/12/2023 12:12	200	119
10/12/2023 12:13	199	120
10/12/2023 12:14	202	120
10/12/2023 12:15	200	120
10/12/2023 12:16	201	120
10/12/2023 12:17	203	120
10/12/2023 12:18	202	121
10/12/2023 12:19	203	120
10/12/2023 12:20	202	121
10/12/2023 12:21	205	120
10/12/2023 12:22	202	120
10/12/2023 12:23	202	120
10/12/2023 12:24	206	122
Run 5 Average	202	120
10/12/2023 12:50	201	119
10/12/2023 12:51	201	120
10/12/2023 12:52	200	119
10/12/2023 12:53	201	119
10/12/2023 12:54	200	119
10/12/2023 12:55	201	119
10/12/2023 12:56	201	119
10/12/2023 12:57	199	119
10/12/2023 12:58	200	119
10/12/2023 12:59	200	119
10/12/2023 13:00	201	119
10/12/2023 13:01	200	119
10/12/2023 13:02	200	119
10/12/2023 13:03	200	119
10/12/2023 13:04	199	119
10/12/2023 13:05	200	119
10/12/2023 13:06	200	119
10/12/2023 13:07	200	118
10/12/2023 13:08	200	119
10/12/2023 13:09	199	119
10/12/2023 13:10	201	119
10/12/2023 13:11	198	118
10/12/2023 13:12	201	119
10/12/2023 13:13	203	120
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10/12/2023 13:15	199	118
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10/12/2023 13:19	200	119
10/12/2023 13:20	201	119
10/12/2023 13:21	199	119
10/12/2023 13:22	202	119
10/12/2023 13:23	200	119
10/12/2023 13:24	201	119
10/12/2023 13:25	203	119
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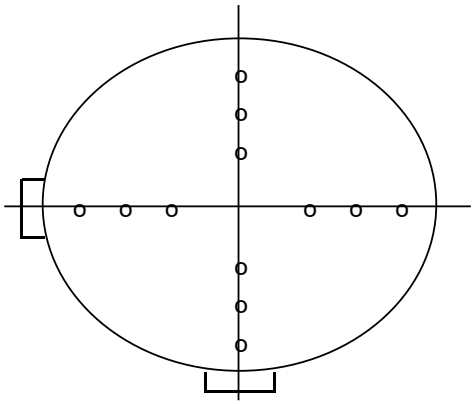
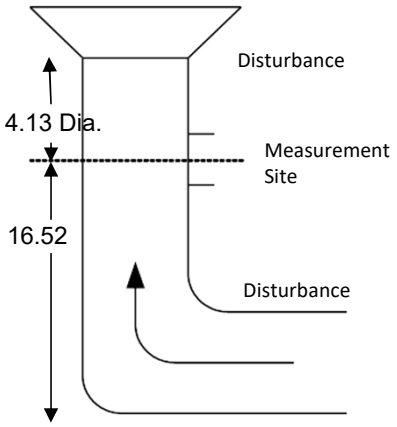
10/12/2023 13:30	200	119
10/12/2023 13:31	199	118
10/12/2023 13:32	201	119
10/12/2023 13:33	202	119
10/12/2023 13:34	198	117
10/12/2023 13:35	194	116
10/12/2023 13:36	196	116

10/12/2023 13:37	197	117
10/12/2023 13:38	197	117
10/12/2023 13:39	197	117
10/12/2023 13:40	196	117
10/12/2023 13:41	195	116
10/12/2023 13:42	196	116
10/12/2023 13:43	197	117
10/12/2023 13:44	194	115
10/12/2023 13:45	196	117
10/12/2023 13:46	194	116
10/12/2023 13:47	196	117
10/12/2023 13:48	196	117
10/12/2023 13:49	196	116
10/12/2023 13:50	194	117
10/12/2023 13:51	197	117
10/12/2023 13:52	198	118
10/12/2023 13:53	197	117
10/12/2023 13:54	197	117
10/12/2023 13:55	196	117
10/12/2023 13:56	195	117
10/12/2023 13:57	195	116
10/12/2023 13:58	196	117
10/12/2023 13:59	197	117
Run 6 Average	199	118

Appendix B – Test Section Diagrams

EQUAL AREA TRAVERSE FOR ROUND DUCTS





Client: Ash Grove Cement Company

Facility: Durkee Cement Plant

Test Location: Main Kiln

Date: 10/11/2023 & 10/12/2023

Diameter (Feet): 10.900

Port Length (In): 8.50

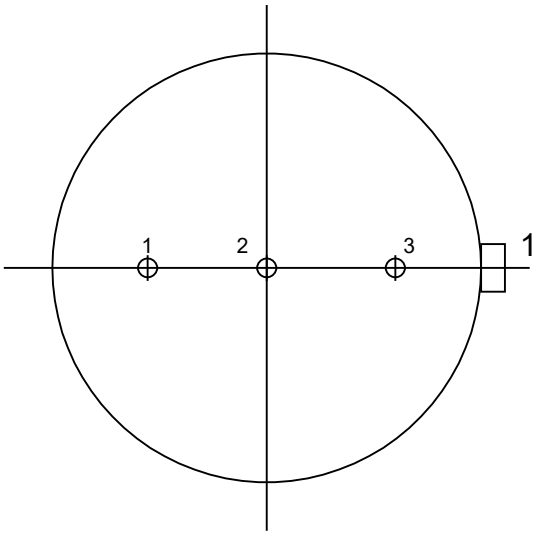
Ports Sampled: 4

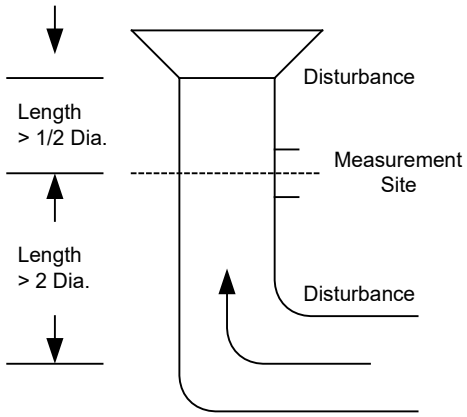
Points/Port: 3

Point Markings

	From inside wall (in.)	% of Diameter
1	5.76	4.40
2	19.10	14.60
3	38.72	29.60

STRATIFICATION TEST FOR ROUND DUCTS





Job: Ash Grove Cement Company
Durkee Cement Plant
Durkee, Oregon

Test Location: Main Kiln Inlet

Stack Diameter: 10.9 Feet

Stack Area: 93.313 Square Feet

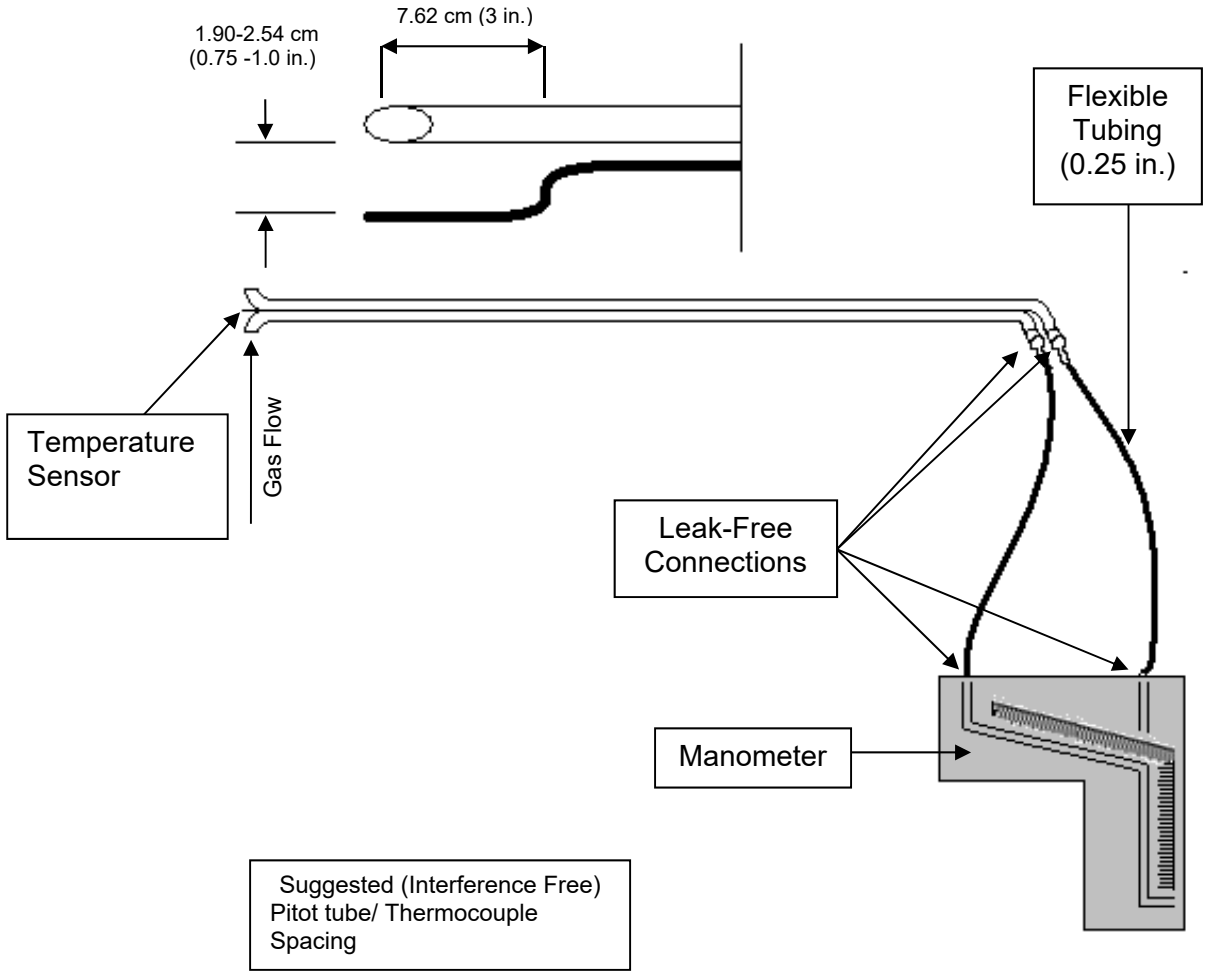
No. Sample Points: 3

Distance from Inside Wall
To Traverse Point:

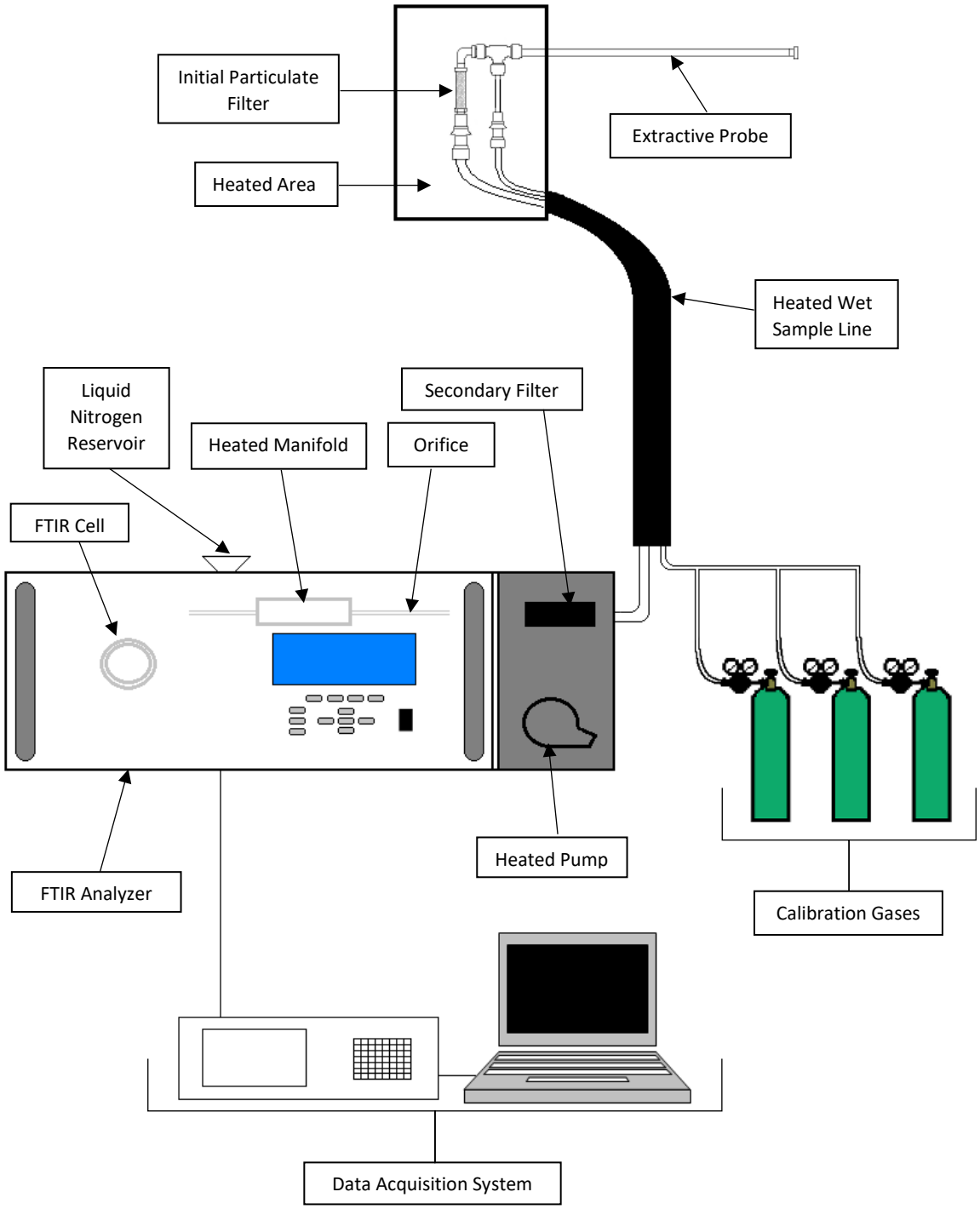
1. 83.3 % of diameter
2. 50.0 % of diameter
3. 16.7 % of diameter

Appendix C – Sample Train Diagrams

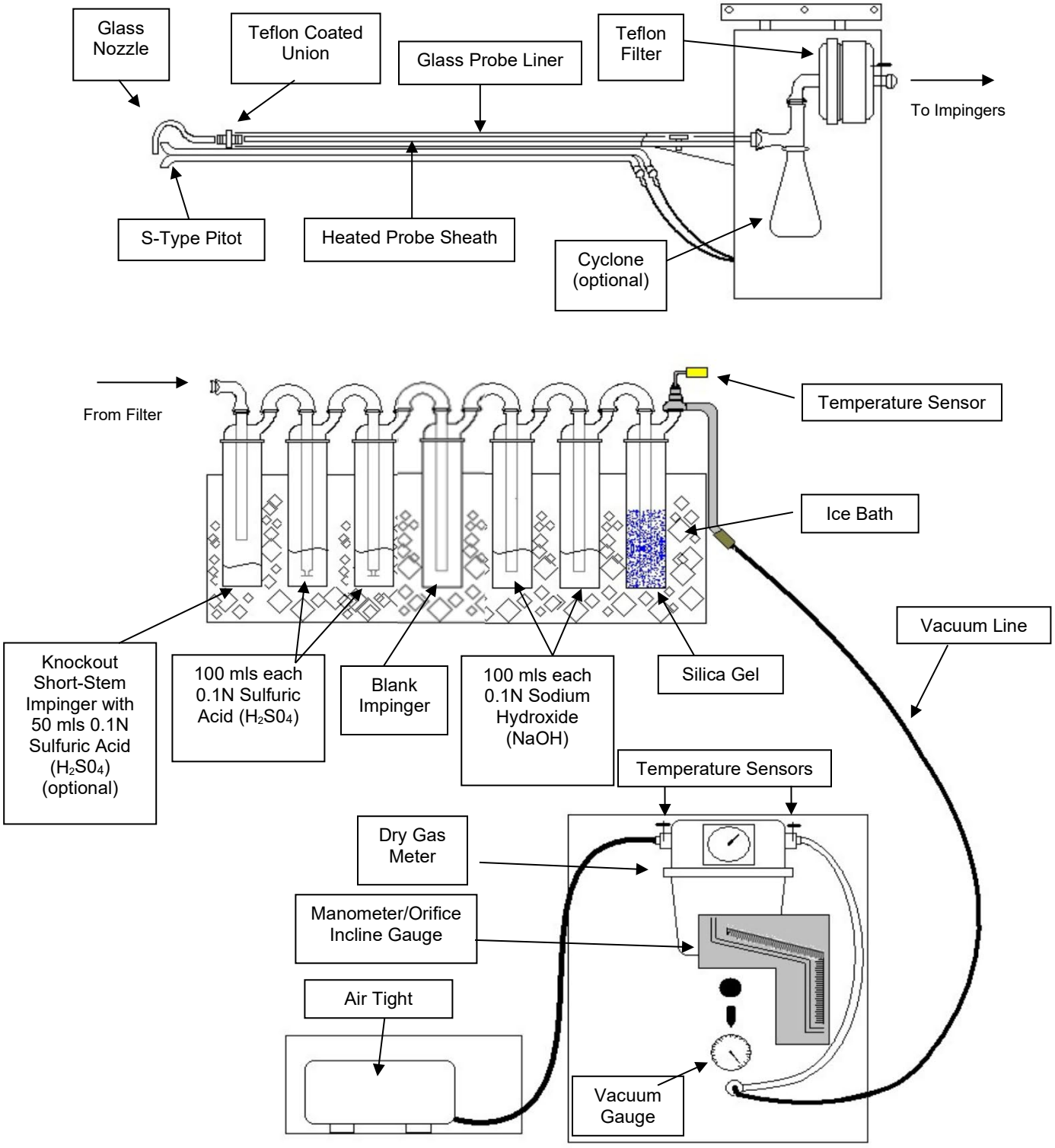
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



USEPA Method 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:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train A)**
Run:	**1**
Date:	**10/11/2023**
Method:	**26A**
Source Condition:	**Mill On**

Dry Molecular Weight

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

$\%CO_2$ =	16.8	$\%O_2$ =	10.4	$\%N_2$ =	72.8

Md = 31.104

Wet Molecular Weight

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

Md =	31.104	Bws =	0.170

Ms = 28.871

Meter Volume at Standard Conditions

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

Y =	1.004	Vm =	56.432	Pbar =	26.9
DH =	2.6	Tm =	67.3		

Vm(std) = 51.292

Volume of Water Vapor Condensed

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

Net H_2O = 223.7

Vw(std) = 10.536

Moisture Content

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

Vw(std) =	10.536	Vm(std) =	51.292

Bws = 0.170

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train A)**
Run:	**1**
Date:	**10/11/2023**
Method:	**26A**
Source Condition:	**Mill On**

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) =**	**227.2**	**Sqrt DP (avg):**	**0.670**
Ps =	**26.83**	**Ms =**	**28.871**		

Vs = 44.219

Volumetric Flow Rate (Actual Basis)

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

Vs =	**44.219**	**A =**	**93.313**

Q = 247,575

Volumetric Flow Rate (Standard Basis)

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

Q =	**247,575**	**Ps =**	**26.83**	**Ts (avg) =**	**227.2**

Qstd = 170,587

Volumetric Flow Rate (Standard Dry Basis)

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

Qstd =	**170,587**	**Bws =**	**0.170**

Qstd(dry) = 141,517

Isokinetic Variation:

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

Ts =	**227.2**	**Vm(std) =**	**51.292**	**Vs =**	**44.219**
An =	**0.0005550**	**θ =**	**60**	**Ps =**	**26.83**
Bws =	**0.170**				

%ISO = 101.6

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train A)**
Run:	**1**
Date:	**10/11/2023**
Method:	**26A**
Source Condition:	**Mill On**

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) =** 51.292

mg/m^3= 0.10

Chloride (Cl2) Emission Rate:

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

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

lb of Chloride (Cl2) = 3.31E-10 **dscfm =** 141,517

Emission Rate lb/hr = 0.0547

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

lb/hr of Chloride (Cl2) = 0.0547 **clinker ton/hr =** 117.0

Emission Rate lb/ton = 0.0005

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/11/23

Sample Calculations

$$(\ 10.37\ \%\ -\ -0.06\ \%)\ \times\ \frac{\textbf{O2 \% (dry)}\ \ 11.96\ \%}{11.96\ \%\ -\ -0.06\ \%} = 10.38\ \%$$

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

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: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/11/23

FTIR Sample Calculations

Direct Recovery % of Calibration Transfer Standard

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

Cma= 100.7 D_{cts} = 99.8

DR_{cts} = 99.1%

Recovery % with Calibration Transfer Standard System Purge

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

Sys_{cts} = 99.7 D_{cts} = 99.8

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= 49.3	D_{asg} = 51.4	
DR_{sf6} = 98%			DR_{asg} = 104.3%		

Dilution Factor for Analyte Spiking

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

Spk_{sf6} = 0.395 D_{sf6} = 4.905

DF = 0.081

Recovery % for Analyte Spike With HCN

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

Spk_x = 6.2 N_x = 2.2

DF = 0.081 D_{asg} = 51.4

R_x = 101.9 %

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

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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: M234105				Date Results Required:		
Client: Ash Grove Cement – Durkee, OR				TAT Required:		
Plant/Test Location: Kiln				Project Supervisor: Rich S		
Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
001	10/12/23	#1A 26A Mill off 0.1N H2SO4	1		M26A (HF)	
002	10/12/23	#1A 26A Mill off 0.1N NaOH	1		M26A (Cl_2)	
003	10/12/23	#2A 26A Mill off 0.1N H2SO4	1		M26A (HF)	
004	10/12/23	#2A 26A Mill off 0.1N NaOH	1		M26A (Cl_2)	
005	10/12/23	#3A 26A Mill off 0.1N H2SO4	1		M26A (HF)	
006	10/12/23	#3A 26A Mill off 0.1N NaOH	1		M26A (Cl_2)	
007	10/12/23	#1B 26A Mill off 0.1N H2SO4	1		M26A (HF)	
008	10/12/23	#1B 26A Mill off 0.1N NaOH	1		M26A (Cl_2)	
009	10/12/23	#2B 26A Mill off 0.1N H2SO4	1		M26A (HF)	
010	10/12/23	#2B 26A Mill off 0.1N NaOH	1		M26A (Cl_2)	
011	10/12/23	#3B 26A Mill off 0.1N H2SO4	1		M26A (HF)	
012	10/12/23	#3B 26A Mill off 0.1N NaOH	1		M26A (Cl_2)	
013	10/11/23	#1A 26A Mill on 0.1N H2SO4	1		M26A (HF)	
014	10/11/23	#1A 26A Mill on 0.1N NaOH	1		M26A (Cl_2)	
015	10/11/23	#2A 26A Mill on 0.1N H2SO4	1		M26A (HF)	
016	10/11/23	#2A 26A Mill on 0.1N NaOH	1		M26A (Cl_2)	
017	10/11/23	#3A 26A Mill on 0.1N H2SO4	1		M26A (HF)	
018	10/11/23	#3A 26A Mill on 0.1N NaOH	1		M26A (Cl_2)	
019	10/11/23	#1B 26A Mill on 0.1N H2SO4	1		M26A (HF)	
020	10/11/23	#1B 26A Mill on 0.1N NaOH	1		M26A (Cl_2)	
021	10/11/23	#2B 26A Mill on 0.1N H2SO4	1		M26A (HF)	
022	10/11/23	#2B 26A Mill on 0.1N NaOH	1		M26A (Cl_2)	
023	10/11/23	#3B 26A Mill on 0.1N H2SO4	1		M26A (HF)	
024	10/11/23	#3B 26A Mill on 0.1N NaOH	1		M26A (Cl_2)	

025	10/11/23	A Train Field Blank 0.1N H2SO4	1		M26A (HF)	
026	10/11/23	A Train Field Blank 0.1N NaOH	1		M26A (Cl_2)	
027	10/11/23	B Train Field Blank 0.1N H2SO4	1		M26A (HF)	
028	10/11/23	B Train Field Blank 0.1N NaOH	1		M26A (Cl_2)	
029	10/11/23	0.1N H2SO4 Reagent Blank	1		M26A (HF)	
030	10/11/23	0.1N NaOH Reagent Blank	1		M26A (Cl_2)	
031	10/11/23	DI Water Reagent Blank	1		M26A (HF and Cl_2)	

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

Laboratory Notes:

Kiln

Client:	Ash Grove	Analysis Date:	11/2/2023
Facility:	Durkee	Analysis Location:	Elmhurst
Test Location:	Kiln	Analyst:	JMG
Project Number:	M234105		
Method:	26A		
Date Samples Received:	10/20/2023		

Train A

Sampling Date		10/12/2023	10/12/2023	10/12/2023	10/12/2023		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	200	200	445	445		
Hydrofluoric Acid	ug	150	150	150	150	150	15

Sampling Date		10/12/2023	10/12/2023	10/12/2023			
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**	**M26A Train Blank**		**RDL**	**MDL**
Sulfuric Acid Volume	ml	420	490	265			
Hydrofluoric Acid	ug	150	150	150		150	15

Train B

Sampling Date		10/12/2023	10/12/2023	10/12/2023	10/12/2023		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	200	200	387	387		
Hydrofluoric Acid	ug	150	150	150	150	150	15

Sampling Date		10/12/2023	10/12/2023				
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**			**RDL**	**MDL**
Sulfuric Acid Volume	ml	378	428				
Hydrofluoric Acid	ug	150	150			150	15

Client:	Ash Grove	**Analysis Date:**	11/2/2023								
Facility:	Durkee	**Analysis Location:**	Elmhurst								
Test Location:	Kiln	**Analyst:**	JMG								
Project Number:	M234105										
Method:	26A										
Date Samples Received:	10/20/2023										

Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**
1	0.2338	0.2338	**0.94**	**0.2474**
2	0.4867	0.2434	**1.97**	
5	1.2557	0.2511	**5.07**	**Response Factor Ave**
8	1.9964	0.2496	**8.07**	**0.2473**
10	2.5855	0.2586	**10.45**	
Lot Number	Ricca 8209004			
	R²	**0.9993**		

Sample 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**
031	10/12/2023	DI Reagent Blank	0.0050	0.0202	0.0202	1	200	0.0040	0.0043		
031	10/12/2023	DI Reagent Blank	0.0022	0.0089	0.0089	1	200	0.0018	0.0019	**0.0031**	**3.064702009**
029	10/12/2023	H2SO4 Reagent Blank	0.0055	0.0222	0.0222	1	200	0.0044	0.0047		
029	10/12/2023	H2SO4 Reagent Blank	0.0061	0.0247	0.0247	1	200	0.0049	0.0052	**0.0049**	**4.937575459**
013	10/12/2023	Test 1A H2SO4 Imp	0.0433	0.1750	0.1750	1	445	0.0779	0.0820		
013	10/12/2023	Test 1A H2SO4 Imp	0.0424	0.1713	0.1713	1	445	0.0763	0.0803	**0.0812**	**81.164589**
013	10/12/2023	Test 1A H2SO4 Imp	0.0407	0.1645	0.1645	1	445	0.0732	0.0771		
013	10/12/2023	Test 1A H2SO4 Imp	0.0436	0.1762	0.1762	1	445	0.0784	0.0826	**0.0798**	**79.83867973**
015	10/12/2023	Test 2A H2SO4 Imp	0.0407	0.1645	0.1645	1	420	0.0691	0.0728		
015	10/12/2023	Test 2A H2SO4 Imp	0.0463	0.1871	0.1871	1	420	0.0786	0.0828	**0.0778**	**77.76681348**
017	10/12/2023	Test 3A H2SO4 Imp	0.0479	0.1936	0.1936	1	490	0.0949	0.0999		
017	10/12/2023	Test 3A H2SO4 Imp	0.0451	0.1823	0.1823	1	490	0.0893	0.0941	**0.0970**	**96.98504899**
027	10/12/2023	Train Blank	0.0315	0.1273	0.1273	1	265	0.0337	0.0347		
027	10/12/2023	Train Blank	0.0372	0.1503	0.1503	1	265	0.0398	0.0410	**0.0378**	**37.82426171**
					Expected Value	**% Difference**					
		Run 1 H2SO4 Spike W/ 2ppm	0.2681	1.0835	1.0700						
Lot Number: Thermo 21-191JKS		Run 1 H2SO4 Spike W/ 2ppm	0.2629	1.0624	1.0700	0.27%					

CCV ppm F	**Area**	**PPM F**
1 ppm ICV	0.2585	1.0447
5 ppm CCV	1.1864	4.7945
5 ppm CCV	1.1759	4.7521
5 ppm CCV	1.1783	4.7618

Client:	Ash Grove	**Analysis Date:**	11/2/2023								
Facility:	Durkee	**Analysis Location:**	Elmhurst								
Test Location:	Kiln	**Analyst:**	JMG								
Project Number:	M234105										
Method:	26A										
Date Samples Received:	10/20/2023										

Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**
1	0.2338	0.2338	**0.94**	**0.2474**
2	0.4867	0.2434	**1.97**	
5	1.2557	0.2511	**5.07**	**Response Factor Ave**
8	1.9964	0.2496	**8.07**	**0.2473**
10	2.5855	0.2586	**10.45**	
Lot Number	Ricca 8209004			
	R^2	**0.9993**		

Sample 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**
031	10/12/2023	DI Reagent Blank	0.0050	0.0202	0.0202	1	200	0.0040	0.0043		
031	10/12/2023	DI Reagent Blank	0.0022	0.0089	0.0089	1	200	0.0018	0.0019	**0.0031**	**3.064702009**
029	10/12/2023	H2SO4 Reagent Blank	0.0055	0.0222	0.0222	1	200	0.0044	0.0047		
029	10/12/2023	H2SO4 Reagent Blank	0.0061	0.0247	0.0247	1	200	0.0049	0.0052	**0.0049**	**4.937575459**
019	10/12/2023	Test 1B H2SO4 Imp	0.0191	0.0772	0.0772	1	387	0.0299	0.0315		
019	10/12/2023	Test 1B H2SO4 Imp	0.0112	0.0453	0.0453	1	387	0.0175	0.0184	**0.0250**	**24.95625155**
019	10/12/2023	Test 1B H2SO4 Imp	0.0148	0.0598	0.0598	1	387	0.0231	0.0244		
019	10/12/2023	Test 1B H2SO4 Imp	0.0186	0.0752	0.0752	1	387	0.0291	0.0306	**0.0275**	**27.50953141**
021	10/12/2023	Test 2B H2SO4 Imp	0.0217	0.0877	0.0877	1	378	0.0331	0.0349		
021	10/12/2023	Test 2B H2SO4 Imp	0.0287	0.1160	0.1160	1	378	0.0438	0.0462	**0.0405**	**40.54600758**
023	10/12/2023	Test 3B H2SO4 Imp	0.0403	0.1629	0.1629	1	428	0.0697	0.0734		
023	10/12/2023	Test 3B H2SO4 Imp	0.0466	0.1883	0.1883	1	428	0.0806	0.0849	**0.0792**	**79.15699636**

CCV ppm F	**Area**	**PPM F**
1 ppm ICV	0.2585	1.0447
5 ppm CCV	1.1864	4.7945
5 ppm CCV	1.1759	4.7521
5 ppm CCV	1.1783	4.7618
5 ppm CCV	0	0.0000

Kiln

Client:	Ash Grove	Analysis Date:	11/2/2023
Facility:	Durkee	Analysis Location:	Elmhurst
Test Location:	Kiln	Analyst:	JMG
Project Number:	M234105		
Method:	26A		
Date Samples Received:	10/20/2023		

Train A

Sampling Date		10/12/2023	10/12/2023	10/12/2023	10/12/2023		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	200	200	220	220		
Chlorine	ug	150	150	150	150	150	15

Sampling Date		10/12/2023	10/12/2023	10/12/2023			
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**	**M26A- Train Blank**		**RDL**	**MDL**
Sodium Hydroxide Volume	ml	233	241	247			
Chlorine	ug	150	150	150		150	15

Train B

Sampling Date		10/12/2023	10/12/2023	10/12/2023	10/12/2023		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	200	200	237	237		
Chlorine	ug	150	150	150	150	150	15

Sampling Date		10/12/2023	10/12/2023				
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**			**RDL**	**MDL**
Sodium Hydroxide Volume	ml	211	250				
Chlorine	ug	150	150			150	15

Client:	Ash Grove	**Analysis Date:**	11/2/2023							
Facility:	Durkee	**Analysis Location:**	Elmhurst Lab							
Test Location:	Kiln	**Analyst:**	JMG							
Project Number:	M234105									
Method:	26A									
Date Samples Received:	10/20/2023									
Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**						
1	0.1443	0.1443	**0.97**	**0.1493**						
2	0.2936	0.1468	**1.97**							
5	0.7479	0.1496	**5.01**	**Response Factor Ave**						
8	1.2139	0.1517	**8.13**	**0.1493**						
10	1.5385	0.1539	**10.31**							
Lot Number	Ricca 8209004									
	R^2	**0.9998**								
Sample Number	**Sample Date**	**Sample ID**	**Sample Area**	**PPM Cl**	**PPM X Dilution Factor**	**Dilution Factor**	**Total ml**	**mg Cl in soln**	**ug Cl2 in soln**	**ug Cl2 in soln**
031	10/12/2023	DI Reagent Blank	0.0007	0.0047	0.0047	1	200	0.0009		
031	10/12/2023	DI Reagent Blank	0.0003	0.0020	0.0020	1	200	0.0004	**0.0007**	**0.669889041**
030	10/12/2023	NaOH Reagent Blank	0.0134	0.0898	0.0898	1	200	0.0180		
030	10/12/2023	NaOH Reagent Blank	0.0187	0.1253	0.1253	1	200	0.0251	**0.0215**	**21.50343821**
014	10/12/2023	Test 1A NaOH Imp	0.0007	0.0047	0.0047	1	220	0.0010		
014	10/12/2023	Test 1A NaOH Imp	0.0008	0.0054	0.0054	1	220	0.0012	**0.0011**	**1.105316917**
014	10/12/2023	Test 1A NaOH Imp	0.0007	0.0047	0.0047	1	220	0.0010		
014	10/12/2023	Test 1A NaOH Imp	0.0005	0.0033	0.0033	1	220	0.0007	**0.0009**	**0.884253534**
016	10/12/2023	Test 2A NaOH Imp	0.0020	0.0134	0.0134	1	233	0.0031		
016	10/12/2023	Test 2A NaOH Imp	0.0035	0.0234	0.0234	1	233	0.0055	**0.0043**	**4.292314029**
018	10/12/2023	Test 3A NaOH Imp	0.0037	0.0248	0.0248	1	241	0.0060		
018	10/12/2023	Test 3A NaOH Imp	0.0040	0.0268	0.0268	1	241	0.0065	**0.0062**	**6.215565466**
028	1/0/1900	Train Blank	0.0120	0.0804	0.0804	1	247	0.0199		
028	1/0/1900	Train Blank	0.0097	0.0650	0.0650	1	247	0.0160	**0.0180**	**17.95269135**
					Expected Value	**% Difference**				
		Run 1 H2SO4 Spike W/ 2ppm	0.1344	0.9003	0.9859					
		Run 1 H2SO4 Spike W/ 2ppm	0.1326	0.8883	0.9859	9.29%				
CCV ppm Cl	**Area**	**PPM Cl**								
5 ppm ICV	0.7485	5.0141								
5 ppm CCV	0.7127	4.7743								
5 ppm CCV	0.7169	4.8024								

Client:	Ash Grove	**Analysis Date:**	11/2/2023							
Facility:	Durkee	**Analysis Location:**	Elmhurst Lab							
Test Location:	Kiln	**Analyst:**	JMG							
Project Number:	M234105									
Method:	26A									
Date Samples Received:	10/20/2023									
Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**						
1	0.1443	0.1443	**0.97**	**0.1493**						
2	0.2936	0.1468	**1.97**							
5	0.7479	0.1496	**5.01**	**Response Factor Ave**						
8	1.2139	0.1517	**8.13**	**0.1493**						
10	1.5385	0.1539	**10.31**							
Lot Number	Ricca 8209004									
	R^2	**0.9998**								
Sample Number	**Sample Date**	**Sample ID**	**Sample Area**	**PPM Cl**	**PPM X Dilution Factor**	**Dilution Factor**	**Total ml**	**mg Cl in soln**	**mg Cl2 in soln avg**	**ug Cl2 in soln**
031	10/12/2023	DI Reagent Blank	0.0007	0.0047	0.0047	1	200	0.0009		
031	10/12/2023	DI Reagent Blank	0.0003	0.0020	0.0020	1	200	0.0004	**0.0007**	**0.669889041**
030	10/12/2023	NaOH Reagent Blank	0.0134	0.0898	0.0898	1	200	0.0180		
030	10/12/2023	NaOH Reagent Blank	0.0187	0.1253	0.1253	1	200	0.0251	**0.0215**	**21.50343821**
020	10/12/2023	Test 1B NaOH Imp	0.0050	0.0335	0.0335	1	237	0.0079		
020	10/12/2023	Test 1B NaOH Imp	0.0040	0.0268	0.0268	1	237	0.0064	**0.0071**	**7.144366621**
020	10/12/2023	Test 1B NaOH Imp	0.0029	0.0194	0.0194	1	237	0.0046		
020	10/12/2023	Test 1B NaOH Imp	0.0055	0.0368	0.0368	1	237	0.0087	**0.0067**	**6.668075513**
021	10/12/2023	Test 2B NaOH Imp	0.0015	0.0100	0.0100	1	211	0.0021		
021	10/12/2023	Test 2B NaOH Imp	0.0011	0.0074	0.0074	1	211	0.0016	**0.0018**	**1.837505639**
022	10/12/2023	Test 3B NaOH Imp	0.0060	0.0402	0.0402	1	250	0.0100		
022	10/12/2023	Test 3B NaOH Imp	0.0038	0.0255	0.0255	1	250	0.0064	**0.0082**	**8.20614075**
CCV ppm Cl	**Area**	**PPM Cl**								
5 ppm ICV	0.7485	5.0141								
5 ppm CCV	0.7127	4.7743								
5 ppm CCV	0.7169	4.8024								

Kiln

Client:	Ash Grove	Analysis Date:	11/2/2023
Facility:	Durkee	Analysis Location:	Elmhurst
Test Location:	Kiln	Analyst:	JMG
Project Number:	M234105		
Method:	26A		
Date Samples Received:	10/20/2023		

Train A

Sampling Date		10/12/2023	10/12/2023	10/12/2023	10/12/2023		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	200	200	559	559		
Hydrofluoric Acid	ug	150	150	150	150	150	15

Sampling Date		10/12/2023	10/12/2023				
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**	**M26A- H2SO4 R4**		**RDL**	**MDL**
Sulfuric Acid Volume	ml	444	424				
Hydrofluoric Acid	ug	150	150			150	15

Train B

Sampling Date		10/12/2023	10/12/2023	10/12/2023	10/12/2023		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	200	200	499	499		
Hydrofluoric Acid	ug	150	150	150	150	150	15

Sampling Date		10/12/2023	10/12/2023				
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**			**RDL**	**MDL**
Sulfuric Acid Volume	ml	466	434				
Hydrofluoric Acid	ug	150	150			150	15

Client:	Ash Grove	**Analysis Date:**	11/2/2023								
Facility:	Durkee	**Analysis Location:**	Elmhurst								
Test Location:	Kiln	**Analyst:**	JMG								
Project Number:	M234105										
Method:	26A										
Date Samples Received:	10/20/2023										

Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**
1	0.2338	0.2338	**0.94**	**0.2474**
2	0.4867	0.2434	**1.97**	
5	1.2557	0.2511	**5.07**	**Response Factor Ave**
8	1.9964	0.2496	**8.07**	**0.2473**
10	2.5855	0.2586	**10.45**	
Lot Number	Ricca 8209004			
	R²	**0.9993**		

Sample 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**
031	10/12/2023	DI Reagent Blank	0.0050	0.0202	0.0202	1	200	0.0040	0.0043		
031	10/12/2023	DI Reagent Blank	0.0022	0.0089	0.0089	1	200	0.0018	0.0019	**0.0031**	**3.064702009**
029	10/12/2023	H2SO4 Reagent Blank	0.0055	0.0222	0.0222	1	200	0.0044	0.0047		
029	10/12/2023	H2SO4 Reagent Blank	0.0061	0.0247	0.0247	1	200	0.0049	0.0052	**0.0049**	**4.937575459**
001	10/12/2023	Test 1A H2SO4 Imp	0.0101	0.0408	0.0408	1	559	0.0228	0.0240		
001	10/12/2023	Test 1A H2SO4 Imp	0.0068	0.0275	0.0275	1	559	0.0154	0.0162	**0.0201**	**20.10593496**
001	10/12/2023	Test 1A H2SO4 Imp	0.0071	0.0288	0.0288	1	559	0.0161	0.0170		
001	10/12/2023	Test 1A H2SO4 Imp	0.0083	0.0335	0.0335	1	559	0.0188	0.0197	**0.0184**	**18.35707553**
003	10/12/2023	Test 2A H2SO4 Imp	0.0145	0.0586	0.0586	1	444	0.0260	0.0274		
003	10/12/2023	Test 2A H2SO4 Imp	0.0157	0.0634	0.0634	1	444	0.0282	0.0297	**0.0285**	**28.53748354**
004	10/12/2023	Test 3A H2SO4 Imp	0.0183	0.0740	0.0740	1	424	0.0314	0.0330		
004	10/12/2023	Test 3A H2SO4 Imp	0.0167	0.0675	0.0675	1	424	0.0286	0.0301	**0.0316**	**31.58345681**
025	10/12/2023	Train Blank	0.0315	0.1273	0.1273	1	265	0.0337	0.0347		
025	10/12/2023	Train Blank	0.0372	0.1503	0.1503	1	265	0.0398	0.0410	**0.0378**	**37.82426171**
					Expected Value	**% Difference**					
		Run 1 H2SO4 Spike W/ 2ppm	0.2447	0.9889	1.0005						
Lot Number: Thermo 21-191JKS		Run 1 H2SO4 Spike W/ 2ppm	0.2442	0.9869	1.0005	1.26%					

CCV ppm F	**Area**	**PPM F**
1 ppm ICV	0.2585	1.0447
5 ppm CCV	1.1864	4.7945
5 ppm CCV	1.1759	4.7521
5 ppm CCV	1.1783	4.7618
5 ppm CCV	1.1809	4.7723

Standard ppm F	**Area**	**Difference**
1	0.2275	1.38%
2	0.4590	3.02%
5	1.1879	2.85%
8	1.9331	1.64%
10	2.4707	2.32%

Client:	Ash Grove	**Analysis Date:**	11/2/2023								
Facility:	Durkee	**Analysis Location:**	Elmhurst								
Test Location:	Kiln	**Analyst:**	JMG								
Project Number:	M234105										
Method:	26A										
Date Samples Received:	10/20/2023										

Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**
1	0.2338	0.2338	**0.94**	**0.2474**
2	0.4867	0.2434	**1.97**	
5	1.2557	0.2511	**5.07**	**Response Factor Ave**
8	1.9964	0.2496	**8.07**	**0.2473**
10	2.5855	0.2586	**10.45**	
Lot Number	Ricca 8209004			
	R^2	**0.9993**		

Sample 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**
031	10/12/2023	DI Reagent Blank	0.0050	0.0202	0.0202	1	200	0.0040	0.0043		
031	10/12/2023	DI Reagent Blank	0.0022	0.0089	0.0089	1	200	0.0018	0.0019	**0.0031**	**3.064702009**
029	10/12/2023	H2SO4 Reagent Blank	0.0055	0.0222	0.0222	1	200	0.0044	0.0047		
029	10/12/2023	H2SO4 Reagent Blank	0.0061	0.0247	0.0247	1	200	0.0049	0.0052	**0.0049**	**4.937575459**
007	10/12/2023	Test 1B H2SO4 Imp	0.0146	0.0590	0.0590	1	499	0.0294	0.0310		
007	10/12/2023	Test 1B H2SO4 Imp	0.0079	0.0319	0.0319	1	499	0.0159	0.0168	**0.0239**	**23.89509848**
007	10/12/2023	Test 1B H2SO4 Imp	0.0079	0.0319	0.0319	1	499	0.0159	0.0168		
007	10/12/2023	Test 1B H2SO4 Imp	0.0166	0.0671	0.0671	1	499	0.0335	0.0353	**0.0260**	**26.01910723**
009	10/12/2023	Test 2B H2SO4 Imp	0.0126	0.0509	0.0509	1	466	0.0237	0.0250		
009	10/12/2023	Test 2B H2SO4 Imp	0.0074	0.0299	0.0299	1	466	0.0139	0.0147	**0.0198**	**19.83543245**
011	10/12/2023	Test 3B H2SO4 Imp	0.0122	0.0493	0.0493	1	434	0.0214	0.0225		
011	10/12/2023	Test 3B H2SO4 Imp	0.0108	0.0436	0.0436	1	434	0.0189	0.0200	**0.0212**	**21.24434407**

CCV ppm F	**Area**	**PPM F**
1 ppm ICV	0.2585	1.0447
5 ppm CCV	1.1864	4.7945
5 ppm CCV	1.1759	4.7521
5 ppm CCV	1.1783	4.7618
5 ppm CCV	1.1809	4.7723

Kiln

Client:	Ash Grove	Analysis Date:	11/2/2023
Facility:	Durkee	Analysis Location:	Elmhurst
Test Location:	Kiln	Analyst:	JMG
Project Number:	M234105		
Method:	26A		
Date Samples Received:	10/20/2023		

Train A

Sampling Date		10/12/2023	10/12/2023	10/12/2023	10/12/2023		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	200	200	159	159		
Chlorine	ug	150	150	150	150	150	15

Sampling Date		10/12/2023	10/12/2023				
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**			**RDL**	**MDL**
Sodium Hydroxide Volume	ml	250	242				
Chlorine	ug	150	150			150	15

Train B

Sampling Date		10/12/2023	10/12/2023	10/12/2023	10/12/2023		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	200	200	247	247		
Chlorine	ug	150	150	150	150	150	15

Sampling Date		10/12/2023	10/12/2023				
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**			**RDL**	**MDL**
Sodium Hydroxide Volume	ml	247	232				
Chlorine	ug	150	150			150	15

Client:	Ash Grove	**Analysis Date:**	11/2/2023							
Facility:	Durkee	**Analysis Location:**	Elmhurst Lab							
Test Location:	Kiln	**Analyst:**	JMG							
Project Number:	M234105									
Method:	26A									
Date Samples Received:	10/20/2023									
Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**						
1	0.1443	0.1443	**0.97**	**0.1493**						
2	0.2936	0.1468	**1.97**							
5	0.7479	0.1496	**5.01**	**Response Factor Ave**						
8	1.2139	0.1517	**8.13**	**0.1493**						
10	1.5385	0.1539	**10.31**							
Lot Number	Ricca 8209004									
	R^2	**0.9998**								
Sample Number	**Sample Date**	**Sample ID**	**Sample Area**	**PPM Cl**	**PPM X Dilution Factor**	**Dilution Factor**	**Total ml**	**mg Cl in soln**	**ug Cl2 in soln**	**ug Cl2 in soln**
031	10/12/2023	DI Reagent Blank	0.0007	0.0047	0.0047	1	200	0.0009		
031	10/12/2023	DI Reagent Blank	0.0003	0.0020	0.0020	1	200	0.0004	**0.0007**	**0.669889041**
030	10/12/2023	NaOH Reagent Blank	0.0134	0.0898	0.0898	1	200	0.0180		
030	10/12/2023	NaOH Reagent Blank	0.0187	0.1253	0.1253	1	200	0.0251	**0.0215**	**21.50343821**
002	10/12/2023	Test 1A NaOH Imp	0.0021	0.0141	0.0141	1	159	0.0022		
002	10/12/2023	Test 1A NaOH Imp	0.0015	0.0100	0.0100	1	159	0.0016	**0.0019**	**1.917222435**
002	10/12/2023	Test 1A NaOH Imp	0.0025	0.0167	0.0167	1	159	0.0027		
002	10/12/2023	Test 1A NaOH Imp	0.0019	0.0127	0.0127	1	159	0.0020	**0.0023**	**2.343271865**
004	10/12/2023	Test 2A NaOH Imp	0.0035	0.0234	0.0234	1	250	0.0059		
004	10/12/2023	Test 2A NaOH Imp	0.0016	0.0107	0.0107	1	250	0.0027	**0.0043**	**4.270542635**
006	10/12/2023	Test 3A NaOH Imp	0.0011	0.0074	0.0074	1	242	0.0018		
006	10/12/2023	Test 3A NaOH Imp	0.0004	0.0027	0.0027	1	242	0.0006	**0.0012**	**1.215848609**
026	10/12/2023	Train Blank	0.0120	0.0804	0.0804	1	247	0.0199		
026	10/12/2023	Train Blank	0.0097	0.0650	0.0650	1	247	0.0160	**0.0180**	**17.95269135**
					Expected Value	**% Difference**				
		Run 1 H2SO4 Spike W/ 2ppm	0.1319	0.8836	0.9894					
		Run 1 H2SO4 Spike W/ 2ppm	0.1348	0.9030	0.9894	9.72%				
CCV ppm Cl	**Area**	**PPM Cl**								
5 ppm ICV	0.7485	5.0141								
5 ppm CCV	0.7127	4.7743								
5 ppm CCV	0.7169	4.8024								
5 ppm CCV		0.0000								
Standard ppm Cl	**Area**	**Difference**								
1	0.1452	0.31%								
2	0.2843	1.64%								
5	0.7229	1.73%								
8	1.1735	1.72%								
10	1.4938	1.50%								

Client:	Ash Grove	**Analysis Date:**	11/2/2023						
Facility:	Durkee	**Analysis Location:**	Elmhurst Lab						
Test Location:	Kiln	**Analyst:**	JMG						
Project Number:	M234105								
Method:	26A								
Date Samples Received:	10/20/2023								

Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**
1	0.1443	0.1443	**0.97**	**0.1493**
2	0.2936	0.1468	**1.97**	
5	0.7479	0.1496	**5.01**	**Response Factor Ave**
8	1.2139	0.1517	**8.13**	**0.1493**
10	1.5385	0.1539	**10.31**	
Lot Number	Ricca 8209004			
	R^2	**0.9998**		

Sample Number	**Sample Date**	**Sample ID**	**Sample Area**	**PPM Cl**	**PPM X Dilution Factor**	**Dilution Factor**	**Total ml**	**mg Cl in soln**	**mg Cl2 in soln avg**	**ug Cl2 in soln**
031	10/12/2023	DI Reagent Blank	0.0007	0.0047	0.0047	1	200	0.0009		
031	10/12/2023	DI Reagent Blank	0.0003	0.0020	0.0020	1	200	0.0004	**0.0007**	**0.669889041**
030	10/12/2023	NaOH Reagent Blank	0.0134	0.0898	0.0898	1	200	0.0180		
030	10/12/2023	NaOH Reagent Blank	0.0187	0.1253	0.1253	1	200	0.0251	**0.0215**	**21.50343821**
008	10/12/2023	Test 1B NaOH Imp	0.0011	0.0074	0.0074	1	247	0.0018		
008	10/12/2023	Test 1B NaOH Imp	0.0008	0.0054	0.0054	1	247	0.0013	**0.0016**	**1.571894634**
008	10/12/2023	Test 1B NaOH Imp	0.0013	0.0087	0.0087	1	247	0.0022		
008	10/12/2023	Test 1B NaOH Imp	0.0017	0.0114	0.0114	1	247	0.0028	**0.0025**	**2.481938896**
010	10/12/2023	Test 2B NaOH Imp	0.0037	0.0248	0.0248	1	247	0.0061		
010	10/12/2023	Test 2B NaOH Imp	0.0035	0.0234	0.0234	1	247	0.0058	**0.0060**	**5.956653351**
012	10/12/2023	Test 3B NaOH Imp	0.0032	0.0214	0.0214	1	232	0.0050		
012	10/12/2023	Test 3B NaOH Imp	0.0014	0.0094	0.0094	1	232	0.0022	**0.0036**	**3.574527922**

CCV ppm Cl	**Area**	**PPM Cl**
5 ppm ICV	0.7485	5.0141
5 ppm CCV	0.7127	4.7743
5 ppm CCV	0.7169	4.8024
5 ppm CCV	0.7166	4.8004

Standard ppm Cl	**Area**	**Difference**
1	0.1452	0.31%
2	0.2843	1.64%
5	0.7229	1.73%
8	1.1735	1.72%
10	1.4938	1.50%

Appendix F - Reference Method Test Data

Client:	Ash Grove Cement Company		
Facility:	Durkee Cement Plant		
Test Location:	Main Kiln (Train A)		
Project #:	M234105		
Test Method:	26A		
Test Engineer:	CPD		
Test Technician:	ER		
	Run 1A	**Run 2A**	**Run 3A**
Temp ID:	CM46	CM46	CM46
Meter ID:	CM46	CM46	CM46
Pitot ID:	S8-031A	S8-031A	S8-031A
Nozzle Diameter (Inches):	0.319	0.319	0.319
Meter Calibration Date:	9/5/2023	9/5/2023	9/5/2023
Meter Calibration Factor (Y):	1.004	1.004	1.004
Meter Orifice Setting (Delta H):	1.744	1.744	1.744
Nozzle Kit ID Number and Material:	Glass #39	Glass #39	Glass #39
Pitot Tube Coefficient:	0.820		
Probe Length (Feet):	4.0		
Probe Liner Material:	Glass		
Sample Plane:	Horizontal		
Port Length (Inches):	8.50		
Port Size (Diameter, Inches):	6.00		
Port Type:	Nipple		
Duct Shape:	Circular		
Diameter (Feet):	10.9		
Duct Area (Square Feet):	93.313		
Upstream Diameters:	4.13		
Downstream Diameters:	16.52		
Number of Ports Sampled:	4		
Number of Points per Port:	3		
Minutes per Point:	5.0		
Minutes per Reading:	5.0		
Total Number of Traverse Points:	12		
Test Length (Minutes):	60		
Train Type:	Anderson Box		
Source Condition:	Mill On		
Diluent Model/Serial Number:	CAI 700 and MKS 2030		
Moisture Balance ID:	LV3		
# of Runs	3		

Run 1A - Method 26A

Client: Ash Grove Cement Company | **Date: 10/11/23**

Facility: Durkee Cement Plant | **Start Time: 8:30**

Test Location: Main Kiln (Train A) | **End Time: 9:39**

Source Condition: Mill On

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	2.56	in. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	67.3	F	Flue Pressure (Ps):	26.83	in. Hg. abs.
Sqrt P:	0.670	in. H_2O	Carbon Dioxide:	16.8	%
Stack Temperature, Ts:	227.2	F	Oxygen:	10.4	%
Meter Volume, Vm:	56.432	ft^3	Nitrogen:	72.80	%
Meter Volume, Vmstd:	51.292	dscf	Gas Weight dry, Md:	31.104	lb/lb mole
Meter Volume, Vwstd:	10.536	wscf	Gas Weight wet, Ms:	28.871	lb/lb mole
Isokinetic Variance:	101.6	%I	Excess Air:	---	%
			Gas Velocity, Vs:	44.219	fps
Test Length:	60.00	in mins.	Volumetric Flow:	247,575	acfm
Nozzle Diameter:	0.319	in inches	Volumetric Flow:	141,517	dscfm
Barometric Pressure:	26.86	in Hg	Volumetric Flow:	170,587	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3533.6	ml	Silica Initial Wt.	856.3	grams
Final Impinger Content:	3744.1	ml	Silica Final Wt.	869.5	grams
Impinger Difference:	210.5	ml	Silica Difference:	13.2	grams
Total Water Gain:	223.7		Moisture, Bws:	0.170	

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	8:30:00	0.53	3.00	360.819	225	65	65	259	263	58
1-2	8:35:00	0.52	2.90	365.820	227	65	65	259	258	47
1-3	8:40:00	0.35	2.00	370.930	227	65	65	261	260	53
	8:45:00			375.090						
2-1	8:48:00	0.54	3.10	375.090	226	66	66	260	260	55
2-2	8:53:00	0.50	2.80	380.260	228	66	66	263	260	55
2-3	8:58:00	0.36	2.00	385.220	228	67	67	260	259	53
	9:03:00			389.370						
3-1	9:06:00	0.51	2.90	389.370	224	68	68	260	260	56
3-2	9:11:00	0.45	2.60	394.420	229	68	68	264	261	59
3-3	9:16:00	0.36	2.00	399.710	229	68	68	262	260	60
	9:21:00			403.320						
4-1	9:24:00	0.51	2.90	403.320	228	69	69	263	261	55
4-2	9:29:00	0.44	2.50	408.260	228	70	70	258	260	54
4-3	9:34:00	0.35	2.00	412.810	227	70	70	261	260	57
	9:39:00			417.251						
Total	1:00:00			56.432		67.3	67.3			
Average			2.56		227.2	67.3				
Min			2.00		224.0	65.0				
Max			3.10		229.0	70.0				

Impinger Weight Sheet - Run 1A

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M234105**
Date:	**10/11/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV3**

Scale Calibration Check Date: **10/11/2023**

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	832.7	736.6	96.1
0.1N H2SO4	756.4	683.5	72.9
Empty	663.3	640.4	22.9
0.1N NaOH	789.3	776.1	13.2
0.1N NaOH	702.4	697.0	5.4
Silica Gel	869.5	856.3	13.2

Liquid Final	Liquid Initial	Liquid Gain
3,744.1	3,533.6	210.5

Silica Final	Silica Initial	Silica Gain
869.5	856.3	13.2

Run 2A - Method 26A

Client: Ash Grove Cement Company | **Date: 10/11/23**

Facility: Durkee Cement Plant | **Start Time: 10:10**

Test Location: Main Kiln (Train A) | **End Time: 11:21**

Source Condition: Mill On

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	2.60	In. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	74.8	F	Flue Pressure (Ps):	26.83	in. Hg. abs.
Sqrt P:	0.667	In. H_2O	Carbon Dioxide:	16.8	%
Stack Temperature, Ts:	223.5	F	Oxygen:	10.4	%
Meter Volume, Vm:	56.974	ft^3	Nitrogen:	72.8	%
Meter Volume, Vmstd:	51.056	dscf	Gas Weight dry, Md:	31.104	lb/lb mole
Meter Volume, Vwstd:	10.937	wscf	Gas Weight wet, Ms:	28.792	lb/lb mole
Isokinetic Variance:	101.9	%I	Excess Air:	---	%
			Gas Velocity, Vs:	43.966	fps
Test Length:	60.00	in mins.	Volumetric Flow:	246,159	acfm
Nozzle Diameter:	0.319	in inches	Volumetric Flow:	140,438	dscfm
Barometric Pressure:	26.86	in Hg	Volumetric Flow:	170,521	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3642.1	ml	Silica Initial Wt.	882.5	grams
Final Impinger Content:	3857.2	ml	Silica Final Wt.	899.6	grams
Impinger Difference:	215.1	ml	Silica Difference:	17.1	grams
Total Water Gain:	232.2		Moisture, Bws:	0.176	

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	10:10:00	0.53	3.10	417.721	224	73	73	260	257	56
1-2	10:15:00	0.49	2.80	422.820	225	73	73	263	262	54
1-3	10:20:00	0.36	2.10	427.850	224	73	73	265	260	55
	10:25:00			432.120						
2-1	10:28:00	0.51	3.00	432.120	223	73	73	258	260	59
2-2	10:33:00	0.50	2.90	437.250	224	74	74	260	260	59
2-3	10:38:00	0.34	1.97	442.240	224	74	74	260	260	58
	10:43:00			446.310						
3-1	10:48:00	0.52	3.00	446.310	224	75	75	260	260	58
3-2	10:53:00	0.46	2.70	451.380	224	75	75	260	259	56
3-3	10:58:00	0.35	2.00	456.310	223	77	77	264	260	57
	11:03:00			460.510						
4-1	11:06:00	0.50	2.90	460.510	222	77	77	259	260	55
4-2	11:11:00	0.45	2.60	465.630	223	77	77	261	261	54
4-3	11:16:00	0.36	2.10	470.420	222	77	77	258	260	53
	11:21:00			474.695						
Total	1:00:00			56.974		74.8	74.8			
Average			2.60		223.5	74.8				
Min			1.97		222.0	73.0				
Max			3.10		225.0	77.0				

Impinger Weight Sheet - Run 2A

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M234105**
Date:	**10/11/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV3**

Scale Calibration Check Date: **10/11/2023**

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	852.3	752.0	100.3
0.1N H2SO4	859.5	790.5	69.0
Empty	654.9	630.0	24.9
0.1N NaOH	745.8	729.1	16.7
0.1N NaOH	744.7	740.5	4.2
Silica Gel	899.6	882.5	17.1

Liquid Final	Liquid Initial	Liquid Gain
3,857.2	3,642.1	215.1

Silica Final	Silica Initial	Silica Gain
899.6	882.5	17.1

Run 3A - Method 26A

Client: Ash Grove Cement Company | **Date: 10/11/23**

Facility: Durkee Cement Plant | **Start Time: 11:45**

Test Location: Main Kiln (Train A) | **End Time: 12:54**

Source Condition: Mill On

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	2.60	In. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	78.2	F	Flue Pressure (Ps):	26.83	in. Hg. abs.
Sqrt P:	0.666	In. H_2O	Carbon Dioxide:	16.7	%
Stack Temperature, Ts:	222.9	F	Oxygen:	10.4	%
Meter Volume, Vm:	57.397	ft^3	Nitrogen:	72.9	%
Meter Volume, Vmstd:	51.117	dscf	Gas Weight dry, Md:	31.088	lb/lb mole
Meter Volume, Vwstd:	10.499	wscf	Gas Weight wet, Ms:	28.858	lb/lb mole
Isokinetic Variance:	101.4	%I	Excess Air:	---	%
			Gas Velocity, Vs:	43.876	fps
Test Length:	60.00	in mins.	Volumetric Flow:	245,651	acfm
Nozzle Diameter:	0.319	in inches	Volumetric Flow:	141,295	dscfm
Barometric Pressure:	26.86	in Hg	Volumetric Flow:	170,314	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3546.8	ml	Silica Initial Wt.	765.6	grams
Final Impinger Content:	3759.6	ml	Silica Final Wt.	775.7	grams
Impinger Difference:	212.8	ml	Silica Difference:	10.1	grams
Total Water Gain:	222.9		Moisture, Bws:	0.170	

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	11:45:00	0.54	3.10	476.019	224	78	78	258	260	57
1-2	11:50:00	0.50	2.90	481.370	224	78	78	260	260	55
1-3	11:55:00	0.36	2.10	486.290	224	78	78	258	261	54
	12:00:00			490.620						
2-1	12:03:00	0.51	3.00	490.620	221	78	78	259	259	53
2-2	12:08:00	0.49	2.90	495.850	220	78	78	263	260	54
2-3	12:13:00	0.36	2.10	500.680	221	78	78	257	258	52
	12:18:00			505.090						
3-1	12:21:00	0.49	2.80	505.090	222	78	78	264	258	53
3-2	12:26:00	0.45	2.60	510.210	222	78	78	260	260	54
3-3	12:31:00	0.37	2.20	514.810	223	78	78	263	260	55
	12:36:00			519.330						
4-1	12:39:00	0.50	2.90	519.330	224	78	78	262	259	57
4-2	12:44:00	0.44	2.60	524.330	225	79	79	264	260	59
4-3	12:49:00	0.35	2.00	529.160	225	79	79	261	260	61
	12:54:00			533.416						
Total	1:00:00			57.397		78.2	78.2			
Average			2.60		222.9	78.2				
Min			2.00		220.0	78.0				
Max			3.10		225.0	79.0				

Impinger Weight Sheet - Run 3A

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M234105**
Date:	**10/11/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV3**

Scale Calibration Check Date: **10/11/2023**

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	893.1	745.1	148.0
0.1N H2SO4	735.1	685.1	50.0
Empty	653.3	645.3	8.0
0.1N NaOH	788.0	783.1	4.9
0.1N NaOH	690.1	688.2	1.9
Silica Gel	775.7	765.6	10.1

Liquid Final	Liquid Initial	Liquid Gain
3,759.6	3,546.8	212.8

Silica Final	Silica Initial	Silica Gain
775.7	765.6	10.1

Client:	Ash Grove Cement Company		
Facility:	Durkee Cement Plant		
Test Location:	Main Kiln (Train B)		
Project #:	M234105		
Test Method:	26A		
Test Engineer:	KAW		
Test Technician:	EROD		
	Run 1B	**Run 2B**	**Run 3B**
Meter ID:	CM54	CM54	CM54
Pitot ID:	S8-032A	S8-032A	S8-032A
Nozzle Diameter (Inches):	0.276	0.276	0.276
Meter Calibration Date:	9/20/2023	9/20/2023	9/20/2023
Meter Calibration Factor (Y):	0.986	0.986	0.986
Meter Orifice Setting (Delta H):	1.914	1.914	1.914
Nozzle Kit ID Number and Material:	uartz	uartz	uartz
Pitot Tube Coefficient:	0.822		
Probe Length (Feet):	4.0		
Probe Liner Material:	Glass		
Sample Plane:	Horizontal		
Port Length (Inches):	8.50		
Port Size (Diameter, Inches):	6.00		
Port Type:	Nipple		
Duct Shape:	Circular		
Diameter (Feet):	10.9		
Duct Area (Square Feet):	93.313		
Upstream Diameters:	4.13		
Downstream Diameters:	16.52		
Number of Ports Sampled:	4		
Number of Points per Port:	3		
Minutes per Point:	5.0		
Minutes per Reading:	5.0		
Total Number of Traverse Points:	12		
Test Length (Minutes):	60		
Train Type:	Anderson Box		
Source Condition:	Mill On		
Diluent Model/Serial Number:	CAI 700 and MKS 2030		
Moisture Balance ID:	LV4		
# of Runs	3		

Run 1B - Method 26A

Client: Ash Grove Cement Company | **Date: 10/11/23**

Facility: Durkee Cement Plant | **Start Time: 8:30**

Test Location: Main Kiln (Train B) | **End Time: 9:39**

Source Condition: Mill On

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	1.53	in. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	66.4	F	Flue Pressure (Ps):	26.83	in. Hg. abs.
Sqrt P:	0.670	in. H_2O	Carbon Dioxide:	16.8	%
Stack Temperature, Ts:	225.6	F	Oxygen:	10.4	%
Meter Volume, Vm:	42.933	ft^3	Nitrogen:	72.80	%
Meter Volume, Vmstd:	38.277	dscf	Gas Weight dry, Md:	31.104	lb/lb mole
Meter Volume, Vwstd:	8.158	wscf	Gas Weight wet, Ms:	28.802	lb/lb mole
Isokinetic Variance:	101.4	%I	Excess Air:	---	%
			Gas Velocity, Vs:	44.374	fps
Test Length:	60.00	in mins.	Volumetric Flow:	248,439	acfm
Nozzle Diameter:	0.276	in inches	Volumetric Flow:	141,434	dscfm
Barometric Pressure:	26.86	in Hg	Volumetric Flow:	171,578	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3408.9	ml	Silica Initial Wt.	823.5	grams
Final Impinger Content:	3572.9	ml	Silica Final Wt.	832.7	grams
Impinger Difference:	164.0	ml	Silica Difference:	9.2	grams
Total Water Gain:	173.2		Moisture, Bws:	0.176	

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	8:30:00	0.51	1.73	78.632	223	64	64	255	261	55
1-2	8:35:00	0.46	1.56	82.490	225	64	64	258	260	55
1-3	8:40:00	0.35	1.18	85.970	225	64	64	255	261	59
	8:45:00			89.150						
2-1	8:48:00	0.51	1.73	89.150	225	65	65	268	260	62
2-2	8:53:00	0.45	1.52	92.910	226	65	65	251	260	62
2-3	8:58:00	0.36	1.22	96.440	226	66	66	254	260	62
	9:03:00			99.700						
3-1	9:06:00	0.53	1.80	99.700	226	67	67	264	260	62
3-2	9:11:00	0.52	1.77	103.640	227	67	67	256	258	62
3-3	9:16:00	0.35	1.19	107.250	227	68	68	262	260	62
	9:21:00			110.560						
4-1	9:24:00	0.53	1.80	110.560	226	69	69	260	261	57
4-2	9:29:00	0.50	1.70	114.580	226	69	69	261	258	58
4-3	9:34:00	0.36	1.20	118.340	225	69	69	263	260	59
	9:39:00			121.565						
Total	1:00:00			42.933		66.4	66.4			
Average			1.53		225.6	66.4				
Min			1.18		223.0	64.0				
Max			1.80		227.0	69.0				

Impinger Weight Sheet - Run 1B

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M234105**
Date:	**10/11/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV4**

Scale Calibration Check Date: **10/11/2023**

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	832.1	743.3	88.8
0.1N H2SO4	738.6	685.2	53.4
Empty	654.1	640.0	14.1
0.1N NaOH	740.4	735.1	5.3
0.1N NaOH	607.7	605.3	2.4
Silica Gel	832.7	823.5	9.2

3,572.9	3,408.9	164.0
Liquid Final	**Liquid Initial**	**Liquid Gain**
832.7	823.5	9.2
Silica Final	**Silica Initial**	**Silica Gain**

Run 2B - Method 26A

Client: Ash Grove Cement Company | **Date: 10/11/23**

Facility: Durkee Cement Plant | **Start Time: 10:10**

Test Location: Main Kiln (Train B) | **End Time: 11:21**

Source Condition: Mill On

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	1.50	In. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	71.0	F	Flue Pressure (Ps):	26.83	in. Hg. abs.
Sqrt P:	0.659	In. H_2O	Carbon Dioxide:	16.8	%
Stack Temperature, Ts:	222.3	F	Oxygen:	10.4	%
Meter Volume, Vm:	42.572	ft^3	Nitrogen:	72.8	%
Meter Volume, Vmstd:	37.621	dscf	Gas Weight dry, Md:	31.104	lb/lb mole
Meter Volume, Vwstd:	8.393	wscf	Gas Weight wet, Ms:	28.714	lb/lb mole
Isokinetic Variance:	101.8	%I	Excess Air:	---	%
			Gas Velocity, Vs:	43.576	fps
Test Length:	60.00	in mins.	Volumetric Flow:	243,972	acfm
Nozzle Diameter:	0.276	in inches	Volumetric Flow:	138,415	dscfm
Barometric Pressure:	26.86	in Hg	Volumetric Flow:	169,295	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3474.1	ml	Silica Initial Wt.	828.6	grams
Final Impinger Content:	3641.0	ml	Silica Final Wt.	839.9	grams
Impinger Difference:	166.9	ml	Silica Difference:	11.3	grams
Total Water Gain:	178.2		Moisture, Bws:	0.182	

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	10:10:00	0.50	1.72	122.056	223	71	71	262	262	55
1-2	10:15:00	0.46	1.59	125.910	222	72	72	250	260	57
1-3	10:20:00	0.37	1.28	129.570	222	72	72	253	260	55
	10:25:00			132.800						
2-1	10:28:00	0.51	1.76	132.800	223	72	72	259	261	59
2-2	10:33:00	0.45	1.55	136.600	223	72	72	251	262	56
2-3	10:38:00	0.34	1.17	140.210	223	72	72	252	261	55
	10:43:00			143.410						
3-1	10:48:00	0.52	1.79	143.410	223	72	72	261	260	61
3-2	10:53:00	0.47	1.62	147.240	223	72	72	256	259	59
3-3	10:58:00	0.37	1.27	150.960	222	71	71	263	259	58
	11:03:00			154.270						
4-1	11:06:00	0.49	1.69	154.270	222	70	70	257	260	60
4-2	11:11:00	0.43	1.48	157.960	221	68	69	255	261	59
4-3	11:16:00	0.33	1.13	161.470	221	68	68	255	260	60
	11:21:00			164.628						
Total	1:00:00			42.572		71.0	71.1			
Average			1.50		222.3	71.0				
Min			1.13		221.0	68.0				
Max			1.79		223.0	72.0				

Impinger Weight Sheet - Run 2B

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M234105**
Date:	**10/11/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV4**

Scale Calibration Check Date: **10/11/2023**

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	875.3	751.3	124.0
0.1N H2SO4	734.1	700.0	34.1
Empty	584.5	580.0	4.5
0.1N NaOH	756.6	754.7	1.9
0.1N NaOH	690.5	688.1	2.4
Silica Gel	839.9	828.6	11.3

Liquid Final	Liquid Initial	Liquid Gain
3,641.0	3,474.1	166.9

Silica Final	Silica Initial	Silica Gain
839.9	828.6	11.3

Run 3B - Method 26A

Client: Ash Grove Cement Company | **Date: 10/11/23**

Facility: Durkee Cement Plant | **Start Time: 11:45**

Test Location: Main Kiln (Train B) | **End Time: 12:54**

Source Condition: Mill On

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	1.47	In. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	63.3	F	Flue Pressure (Ps):	26.83	in. Hg. abs.
Sqrt P:	0.655	In. H_2O	Carbon Dioxide:	16.7	%
Stack Temperature, Ts:	220.6	F	Oxygen:	10.5	%
Meter Volume, Vm:	41.768	ft^3	Nitrogen:	72.8	%
Meter Volume, Vmstd:	37.451	dscf	Gas Weight dry, Md:	31.092	lb/lb mole
Meter Volume, Vwstd:	7.663	wscf	Gas Weight wet, Ms:	28.868	lb/lb mole
Isokinetic Variance:	100.6	%I	Excess Air:	---	%
			Gas Velocity, Vs:	43.133	fps
Test Length:	60.00	in mins.	Volumetric Flow:	241,492	acfm
Nozzle Diameter:	0.276	in inches	Volumetric Flow:	139,467	dscfm
Barometric Pressure:	26.86	in Hg	Volumetric Flow:	168,005	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3441.2	ml	Silica Initial Wt.	832.5	grams
Final Impinger Content:	3595.9	ml	Silica Final Wt.	840.5	grams
Impinger Difference:	154.7	ml	Silica Difference:	8.0	grams
Total Water Gain:	162.7		Moisture, Bws:	0.170	

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	11:45:00	0.49	1.68	165.137	220	66	66	258	261	55
1-2	11:50:00	0.45	1.54	168.920	221	65	65	255	260	58
1-3	11:55:00	0.35	1.19	172.380	221	63	63	260	261	60
	12:00:00			175.580						
2-1	12:03:00	0.51	1.73	175.580	220	62	62	266	260	60
2-2	12:08:00	0.45	1.53	179.370	220	63	63	262	261	60
2-3	12:13:00	0.38	1.29	183.010	220	63	63	261	263	60
	12:18:00			186.210						
3-1	12:21:00	0.48	1.63	186.210	221	63	63	260	260	62
3-2	12:26:00	0.43	1.46	189.880	221	63	63	260	261	62
3-3	12:31:00	0.35	1.19	193.340	221	63	63	261	261	62
	12:36:00			196.530						
4-1	12:39:00	0.50	1.70	196.530	221	63	63	260	261	62
4-2	12:44:00	0.44	1.50	200.230	221	63	63	261	261	62
4-3	12:49:00	0.34	1.16	203.820	220	63	63	257	260	62
	12:54:00			206.905						
Total	1:00:00			41.768		63.3	63.3			
Average			1.47		220.6	63.3				
Min			1.16		220.0	62.0				
Max			1.73		221.0	66.0				

Impinger Weight Sheet - Run 3B

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M234105**
Date:	**10/11/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV4**

Scale Calibration Check Date: **10/11/2023**

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	864.8	747.5	117.3
0.1N H2SO4	723.1	694.1	29.0
Empty	650.0	644.5	5.5
0.1N NaOH	769.4	766.8	2.6
0.1N NaOH	588.6	588.3	0.3
Silica Gel	840.5	832.5	8.0

3,595.9	3,441.2	154.7
Liquid Final	**Liquid Initial**	**Liquid Gain**
840.5	832.5	8.0
Silica Final	**Silica Initial**	**Silica Gain**

Client:	Ash Grove Cement Company		
Facility:	Durkee Cement Plant		
Test Location:	Main Kiln (Train A)		
Project #:	M234105		
Test Method:	26A		
Test Engineer:	CPD		
Test Technician:	EROD		
	Run 1A	**Run 2A**	**Run 3A**
Temp ID:	CM46	CM46	CM46
Meter ID:	CM46	CM46	CM46
Pitot ID:	S8-031A	S8-031A	S8-031A
Nozzle Diameter (Inches):	0.319	0.319	0.319
Meter Calibration Date:	9/5/2023	9/5/2023	9/5/2023
Meter Calibration Factor (Y):	1.004	1.004	1.004
Meter Orifice Setting (Delta H):	1.744	1.744	1.744
Nozzle Kit ID Number and Material:	Glass #39	Glass #39	Glass #39
Pitot Tube Coefficient:	0.820		
Probe Length (Feet):	4.0		
Probe Liner Material:	Glass		
Sample Plane:	Horizontal		
Port Length (Inches):	8.50		
Port Size (Diameter, Inches):	6.00		
Port Type:	Nipple		
Duct Shape:	Circular		
Diameter (Feet):	10.9		
Duct Area (Square Feet):	93.313		
Upstream Diameters:	4.13		
Downstream Diameters:	16.52		
Number of Ports Sampled:	4		
Number of Points per Port:	3		
Minutes per Point:	5.0		
Minutes per Reading:	5.0		
Total Number of Traverse Points:	12		
Test Length (Minutes):	60		
Train Type:	Anderson Box		
Source Condition:	Mill Off		
Diluent Model/Serial Number:	CAI 700 and MKS 2030		
Moisture Balance ID:	LV3		
# of Runs	3		

Run 1A - Method 26A

Client: Ash Grove Cement Company | **Date: 10/12/23**

Facility: Durkee Cement Plant | **Start Time: 10:45**

Test Location: Main Kiln (Train A) | **End Time: 11:54**

Source Condition: Mill Off

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	2.05	in. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	74.2	F	Flue Pressure (Ps):	27.10	in. Hg. abs.
Sqrt P:	0.617	in. H_2O	Carbon Dioxide:	18.8	%
Stack Temperature, Ts:	277.8	F	Oxygen:	8.9	%
Meter Volume, Vm:	50.389	ft^3	Nitrogen:	72.30	%
Meter Volume, Vmstd:	45.595	dscf	Gas Weight dry, Md:	31.364	lb/lb mole
Meter Volume, Vwstd:	10.885	wscf	Gas Weight wet, Ms:	28.788	lb/lb mole
Isokinetic Variance:	103.8	%I	Excess Air:	87.365	%
			Gas Velocity, Vs:	42.037	fps
Test Length:	60.00	in mins.	Volumetric Flow:	235,358	acfm
Nozzle Diameter:	0.319	in inches	Volumetric Flow:	123,167	dscfm
Barometric Pressure:	27.13	in Hg	Volumetric Flow:	152,570	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3679.6	ml	Silica Initial Wt.	854.4	grams
Final Impinger Content:	3894.8	ml	Silica Final Wt.	870.3	grams
Impinger Difference:	215.2	ml	Silica Difference:	15.9	grams
Total Water Gain:	231.1		Moisture, Bws:	0.193	

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	10:45:00	0.48	2.60	533.907	278	70	70	262	260	53
1-2	10:50:00	0.40	2.10	538.640	276	72	72	261	260	54
1-3	10:55:00	0.33	1.80	542.770	276	74	74	261	259	54
	11:00:00			546.830						
2-1	11:03:00	0.47	2.50	546.830	275	74	74	260	260	56
2-2	11:08:00	0.41	2.20	551.590	277	74	74	257	260	57
2-3	11:13:00	0.33	1.80	555.870	278	74	74	262	259	57
	11:18:00			559.820						
3-1	11:21:00	0.42	2.20	559.820	279	74	74	260	260	55
3-2	11:26:00	0.35	1.90	564.340	279	74	74	264	259	55
3-3	11:31:00	0.30	1.60	568.370	278	75	75	261	260	56
	11:36:00			571.880						
4-1	11:39:00	0.43	2.30	571.880	279	76	76	263	260	57
4-2	11:44:00	0.36	1.90	576.410	279	76	76	262	260	58
4-3	11:49:00	0.31	1.70	580.340	279	77	77	260	260	60
	11:54:00			584.296						
Total	1:00:00			50.389		74.2	74.2			
Average			2.05		277.8	74.2				
Min			1.60		275.0	70.0				
Max			2.60		279.0	77.0				

Impinger Weight Sheet - Run 1A

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M234105**
Date:	**10/12/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV3**

Scale Calibration Check Date: **10/12/2023**

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	915.2	760.5	154.7
0.1N H2SO4	850.4	798.8	51.6
Empty	727.2	635.1	92.1
0.1N NaOH	692.0	714.7	-22.7
0.1N NaOH	710.0	770.5	-60.5
Silica Gel	870.3	854.4	15.9

3,894.8	3,679.6	215.2
Liquid Final	**Liquid Initial**	**Liquid Gain**
870.3	854.4	15.9
Silica Final	**Silica Initial**	**Silica Gain**

Run 2A - Method 26A

Client: Ash Grove Cement Company | **Date: 10/12/23**

Facility: Durkee Cement Plant | **Start Time: 12:15**

Test Location: Main Kiln (Train A) | **End Time: 13:24**

Source Condition: Mill Off

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	2.06	In. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	76.6	F	Flue Pressure (Ps):	27.10	in. Hg. abs.
Sqrt P:	0.617	In. H_2O	Carbon Dioxide:	19.3	%
Stack Temperature, Ts:	281.0	F	Oxygen:	8.8	%
Meter Volume, Vm:	50.460	ft^3	Nitrogen:	71.9	%
Meter Volume, Vmstd:	45.455	dscf	Gas Weight dry, Md:	31.440	lb/lb mole
Meter Volume, Vwstd:	10.451	wscf	Gas Weight wet, Ms:	28.927	lb/lb mole
Isokinetic Variance:	103.2	%I	Excess Air:	86.430	%
			Gas Velocity, Vs:	42.033	fps
Test Length:	60.00	in mins.	Volumetric Flow:	235,334	acfm
Nozzle Diameter:	0.319	in inches	Volumetric Flow:	123,491	dscfm
Barometric Pressure:	27.13	in Hg	Volumetric Flow:	151,885	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3560.7	ml	Silica Initial Wt.	775.2	grams
Final Impinger Content:	3776.3	ml	Silica Final Wt.	781.5	grams
Impinger Difference:	215.6	ml	Silica Difference:	6.3	grams
Total Water Gain:	221.9		Moisture, Bws:	0.187	

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	12:15:00	0.46	2.50	585.051	278	77	77	262	259	56
1-2	12:20:00	0.39	2.10	589.740	279	77	77	260	263	55
1-3	12:25:00	0.32	1.70	593.850	278	77	77	261	262	56
	12:30:00			597.710						
2-1	12:33:00	0.48	2.60	597.710	278	76	76	262	260	56
2-2	12:38:00	0.40	2.20	602.460	278	76	76	261	260	57
2-3	12:43:00	0.34	1.80	606.760	277	76	76	260	260	58
	12:48:00			610.770						
3-1	12:51:00	0.43	2.30	610.770	279	76	76	260	260	59
3-2	12:56:00	0.37	2.00	615.380	280	76	76	264	259	60
3-3	13:01:00	0.31	1.70	619.320	282	77	77	261	260	60
	13:06:00			623.240						
4-1	13:09:00	0.44	2.30	623.240	287	77	77	261	261	55
4-2	13:14:00	0.34	1.80	627.810	288	77	77	261	261	56
4-3	13:19:00	0.31	1.70	631.750	288	77	77	264	259	58
	13:24:00			635.511						
Total	1:00:00			50.460		76.6	76.6			
Average			2.06		281.0	76.6				
Min			1.70		277.0	76.0				
Max			2.60		288.0	77.0				

Impinger Weight Sheet - Run 2A

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M234105**
Date:	**10/12/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV3**

Scale Calibration Check Date: **10/12/2023**

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	890.6	749.3	141.3
0.1N H2SO4	740.6	683.6	57.0
Empty	650.1	641.7	8.4
0.1N NaOH	791.3	786.1	5.2
0.1N NaOH	703.7	700.0	3.7
Silica Gel	781.5	775.2	6.3

Final	Initial	Gain
3,776.3	3,560.7	215.6
Liquid Final	**Liquid Initial**	**Liquid Gain**
781.5	775.2	6.3
Silica Final	**Silica Initial**	**Silica Gain**

Run 3A - Method 26A

Client: Ash Grove Cement Company | **Date: 10/12/23**

Facility: Durkee Cement Plant | **Start Time: 13:50**

Test Location: Main Kiln (Train A) | **End Time: 14:59**

Source Condition: Mill Off

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	2.05	In. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	76.9	F	Flue Pressure (Ps):	27.10	in. Hg. abs.
Sqrt P:	0.615	In. H_2O	Carbon Dioxide:	19.1	%
Stack Temperature, Ts:	282.2	F	Oxygen:	8.8	%
Meter Volume, Vm:	50.390	ft^3	Nitrogen:	72.1	%
Meter Volume, Vmstd:	45.363	dscf	Gas Weight dry, Md:	31.408	lb/lb mole
Meter Volume, Vwstd:	10.612	wscf	Gas Weight wet, Ms:	28.866	lb/lb mole
Isokinetic Variance:	103.6	%I	Excess Air:	85.985	%
			Gas Velocity, Vs:	41.987	fps
Test Length:	60.00	in mins.	Volumetric Flow:	235,074	acfm
Nozzle Diameter:	0.319	in inches	Volumetric Flow:	122,762	dscfm
Barometric Pressure:	27.13	in Hg	Volumetric Flow:	151,479	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3681.3	ml	Silica Initial Wt.	869.5	grams
Final Impinger Content:	3892.6	ml	Silica Final Wt.	883.5	grams
Impinger Difference:	211.3	ml	Silica Difference:	14.0	grams
Total Water Gain:	225.3		Moisture, Bws:	0.190	

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	13:50:00	0.48	2.60	636.038	284	77	77	263	258	57
1-2	13:55:00	0.41	2.20	640.710	283	77	77	261	262	55
1-3	14:00:00	0.34	1.80	645.170	282	77	77	264	261	53
	14:05:00			649.110						
2-1	14:08:00	0.46	2.50	649.110	282	76	76	261	261	55
2-2	14:13:00	0.39	2.10	653.750	282	76	76	263	260	55
2-3	14:18:00	0.33	1.80	657.970	282	77	77	261	260	56
	14:23:00			661.920						
3-1	14:26:00	0.41	2.20	661.920	281	77	77	258	260	58
3-2	14:31:00	0.34	1.80	666.320	281	77	77	262	260	57
3-3	14:36:00	0.31	1.70	670.140	281	77	77	258	261	58
	14:41:00			674.080						
4-1	14:44:00	0.42	2.30	674.080	282	77	77	259	260	59
4-2	14:49:00	0.35	1.90	678.410	283	77	77	261	260	60
4-3	14:54:00	0.32	1.70	682.480	283	78	78	261	260	62
	14:59:00			686.428						
Total	1:00:00			50.390		76.9	76.9			
Average			2.05		282.2	76.9				
Min			1.70		281.0	76.0				
Max			2.60		284.0	78.0				

Impinger Weight Sheet - Run 3A

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train A)**
Project #:	**M234105**
Date:	**10/12/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV3**

Scale Calibration Check Date: **10/12/2023**

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	863.7	760.7	103.0
0.1N H2SO4	867.7	798.1	69.6
Empty	657.3	635.9	21.4
0.1N NaOH	747.5	735.4	12.1
0.1N NaOH	756.4	751.2	5.2
Silica Gel	883.5	869.5	14.0
	3,892.6	3,681.3	211.3
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	883.5	869.5	14.0
	Silica Final	**Silica Initial**	**Silica Gain**

Client:	Ash Grove Cement Company		
Facility:	Durkee Cement Plant		
Test Location:	Main Kiln (Train B)		
Project #:	M234105		
Test Method:	26A		
Test Engineer:	KAW		
Test Technician:	EROD		
	Run 1B	**Run 2B**	**Run 3B**
Meter ID:	CM54	CM54	CM54
Pitot ID:	S8-032A	S8-032A	S8-032A
Nozzle Diameter (Inches):	0.329	0.329	0.329
Meter Calibration Date:	9/20/2023	9/20/2023	9/20/2023
Meter Calibration Factor (Y):	0.986	0.986	0.986
Meter Orifice Setting (Delta H):	1.914	1.914	1.914
Nozzle Kit ID Number and Material:	uartz	uartz	uartz
Pitot Tube Coefficient:	0.822		
Probe Length (Feet):	4.0		
Probe Liner Material:	Glass		
Sample Plane:	Horizontal		
Port Length (Inches):	8.50		
Port Size (Diameter, Inches):	6.00		
Port Type:	Nipple		
Duct Shape:	Circular		
Diameter (Feet):	10.9		
Duct Area (Square Feet):	93.313		
Upstream Diameters:	4.13		
Downstream Diameters:	16.52		
Number of Ports Sampled:	4		
Number of Points per Port:	3		
Minutes per Point:	5.0		
Minutes per Reading:	5.0		
Total Number of Traverse Points:	12		
Test Length (Minutes):	60		
Train Type:	Anderson Box		
Source Condition:	Mill Off		
Diluent Model/Serial Number:	CAI 700 and MKS 2030		
Moisture Balance ID:	LV4		
# of Runs	3		

Run 1B - Method 26A

Client: Ash Grove Cement Company | **Date: 10/12/23**

Facility: Durkee Cement Plant | **Start Time: 10:45**

Test Location: Main Kiln (Train B) | **End Time: 11:54**

Source Condition: Mill Off

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	2.29	in. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	66.8	F	Flue Pressure (Ps):	27.10	in. Hg. abs.
Sqrt P:	0.598	in. H_2O	Carbon Dioxide:	18.8	%
Stack Temperature, Ts:	276.5	F	Oxygen:	8.9	%
Meter Volume, Vm:	52.140	ft^3	Nitrogen:	72.30	%
Meter Volume, Vmstd:	47.017	dscf	Gas Weight dry, Md:	31.364	lb/lb mole
Meter Volume, Vwstd:	11.770	wscf	Gas Weight wet, Ms:	28.688	lb/lb mole
Isokinetic Variance:	104.2	%I	Excess Air:	87.365	%
			Gas Velocity, Vs:	40.901	fps
Test Length:	60.00	in mins.	Volumetric Flow:	228,994	acfm
Nozzle Diameter:	0.329	in inches	Volumetric Flow:	118,925	dscfm
Barometric Pressure:	27.13	in Hg	Volumetric Flow:	148,696	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3504.2	ml	Silica Initial Wt.	839.5	grams
Final Impinger Content:	3742.8	ml	Silica Final Wt.	850.8	grams
Impinger Difference:	238.6	ml	Silica Difference:	11.3	grams
Total Water Gain:	249.9		Moisture, Bws:	0.200	

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	10:45:00	0.40	2.57	207.576	276	69	69	263	261	55
1-2	10:50:00	0.35	2.25	212.240	275	69	69	251	260	55
1-3	10:55:00	0.28	1.80	216.510	274	69	69	262	260	58
	11:00:00			220.390						
2-1	11:03:00	0.42	2.68	220.390	277	67	67	265	261	62
2-2	11:08:00	0.38	2.42	225.070	277	65	65	250	260	57
2-3	11:13:00	0.30	1.91	229.530	277	64	64	265	262	53
	11:18:00			233.510						
3-1	11:21:00	0.41	2.60	233.510	277	64	64	264	261	55
3-2	11:26:00	0.39	2.48	238.100	277	64	64	260	260	52
3-3	11:31:00	0.34	2.17	242.690	277	66	66	264	260	53
	11:36:00			246.880						
4-1	11:39:00	0.40	2.56	246.880	277	68	68	258	259	54
4-2	11:44:00	0.35	2.24	251.490	277	68	68	260	260	55
4-3	11:49:00	0.29	1.86	255.800	277	68	68	261	260	56
	11:54:00			259.716						
Total	1:00:00			52.140		66.8	66.8			
Average			2.29		276.5	66.8				
Min			1.80		274.0	64.0				
Max			2.68		277.0	69.0				

Impinger Weight Sheet - Run 1B

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M234105**
Date:	**10/12/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV4**

Scale Calibration Check Date: **10/12/2023**

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	934.4	779.5	154.9
0.1N H2SO4	755.0	689.1	65.9
Empty	594.8	583.6	11.2
0.1N NaOH	749.2	745.7	3.5
0.1N NaOH	709.4	706.3	3.1
Silica Gel	850.8	839.5	11.3
	3,742.8	3,504.2	238.6
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	850.8	839.5	11.3
	Silica Final	**Silica Initial**	**Silica Gain**

Run 2B - Method 26A

Client: Ash Grove Cement Company | **Date: 10/12/23**

Facility: Durkee Cement Plant | **Start Time: 12:15**

Test Location: Main Kiln (Train B) | **End Time: 13:24**

Source Condition: Mill Off

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	2.25	In. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	59.1	F	Flue Pressure (Ps):	27.10	in. Hg. abs.
Sqrt P:	0.597	In. H_2O	Carbon Dioxide:	19.3	%
Stack Temperature, Ts:	277.0	F	Oxygen:	8.8	%
Meter Volume, Vm:	51.286	ft^3	Nitrogen:	71.9	%
Meter Volume, Vmstd:	46.924	dscf	Gas Weight dry, Md:	31.440	lb/lb mole
Meter Volume, Vwstd:	11.153	wscf	Gas Weight wet, Ms:	28.859	lb/lb mole
Isokinetic Variance:	103.5	%I	Excess Air:	86.430	%
			Gas Velocity, Vs:	40.722	fps
Test Length:	60.00	in mins.	Volumetric Flow:	227,991	acfm
Nozzle Diameter:	0.329	in inches	Volumetric Flow:	119,534	dscfm
Barometric Pressure:	27.13	in Hg	Volumetric Flow:	147,945	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3435.5	ml	Silica Initial Wt.	839.5	grams
Final Impinger Content:	3664.2	ml	Silica Final Wt.	847.6	grams
Impinger Difference:	228.7	ml	Silica Difference:	8.1	grams
Total Water Gain:	236.8		Moisture, Bws:	0.192	

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	12:15:00	0.41	2.60	259.890	277	63	63	260	261	55
1-2	12:20:00	0.39	2.48	264.530	277	64	64	260	260	56
1-3	12:25:00	0.35	2.23	269.020	277	65	65	261	261	58
	12:30:00			273.300						
2-1	12:33:00	0.40	2.51	273.300	277	57	57	261	259	59
2-2	12:38:00	0.37	2.31	277.790	277	56	56	259	261	58
2-3	12:43:00	0.32	2.00	282.160	277	56	56	258	262	59
	12:48:00			286.170						
3-1	12:51:00	0.40	2.51	286.170	277	57	57	260	259	62
3-2	12:56:00	0.35	2.19	290.650	277	57	57	260	258	62
3-3	13:01:00	0.30	1.88	294.740	277	57	57	261	262	62
	13:06:00			298.800						
4-1	13:09:00	0.39	2.45	298.800	277	59	59	260	260	58
4-2	13:14:00	0.32	2.01	303.270	277	59	59	260	261	58
4-3	13:19:00	0.29	1.82	307.320	277	59	59	261	261	59
	13:24:00			311.176						
Total	1:00:00			51.286		59.1	59.1			
Average			2.25		277.0	59.1				
Min			1.82		277.0	56.0				
Max			2.60		277.0	65.0				

Impinger Weight Sheet - Run 2B

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M234105**
Date:	**10/12/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV4**

Scale Calibration Check Date: **10/12/2023**

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	908.8	749.1	159.7
0.1N H2SO4	745.2	691.9	53.3
Empty	652.7	643.2	9.5
0.1N NaOH	747.1	742.6	4.5
0.1N NaOH	610.4	608.7	1.7
Silica Gel	847.6	839.5	8.1

Liquid Final	Liquid Initial	Liquid Gain
3,664.2	3,435.5	228.7

Silica Final	Silica Initial	Silica Gain
847.6	839.5	8.1

Run 3B - Method 26A

Client: Ash Grove Cement Company | **Date: 10/11/23**

Facility: Durkee Cement Plant | **Start Time: 13:50**

Test Location: Main Kiln (Train B) | **End Time: 14:59**

Source Condition: Mill Off

DRY GAS METER CONDITIONS			STACK CONDITIONS		
H:	2.24	In. H_2O	Static Pressure	-0.40	in. H_2O
Meter Temperature, Tm:	60.5	F	Flue Pressure (Ps):	27.10	in. Hg. abs.
Sqrt P:	0.595	In. H_2O	Carbon Dioxide:	19.1	%
Stack Temperature, Ts:	278.0	F	Oxygen:	8.8	%
Meter Volume, Vm:	51.331	ft^3	Nitrogen:	72.1	%
Meter Volume, Vmstd:	46.836	dscf	Gas Weight dry, Md:	31.408	lb/lb mole
Meter Volume, Vwstd:	10.847	wscf	Gas Weight wet, Ms:	28.887	lb/lb mole
Isokinetic Variance:	103.3	%I	Excess Air:	85.985	%
			Gas Velocity, Vs:	40.581	fps
Test Length:	60.00	in mins.	Volumetric Flow:	227,204	acfm
Nozzle Diameter:	0.329	in inches	Volumetric Flow:	119,548	dscfm
Barometric Pressure:	27.13	in Hg	Volumetric Flow:	147,235	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3506.8	ml	Silica Initial Wt.	850.6	grams
Final Impinger Content:	3722.2	ml	Silica Final Wt.	865.5	grams
Impinger Difference:	215.4	ml	Silica Difference:	14.9	grams
Total Water Gain:	230.3		Moisture, Bws:	0.188	

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	13:50:00	0.41	2.59	311.340	277	60	60	260	260	55
1-2	13:55:00	0.36	2.27	315.920	277	60	60	260	258	55
1-3	14:00:00	0.33	2.08	320.180	277	60	60	260	258	57
	14:05:00			324.360						
2-1	14:08:00	0.40	2.53	324.360	277	62	62	260	260	62
2-2	14:13:00	0.34	2.15	328.930	277	62	62	260	261	62
2-3	14:18:00	0.29	1.84	333.200	277	62	62	261	260	62
	14:23:00			336.990						
3-1	14:26:00	0.41	2.59	336.990	278	61	61	257	262	62
3-2	14:31:00	0.35	2.21	341.550	278	61	61	257	262	62
3-3	14:36:00	0.31	1.96	345.880	278	61	61	257	262	62
	14:41:00			349.950						
4-1	14:44:00	0.41	2.57	349.950	280	59	59	256	258	62
4-2	14:49:00	0.35	2.20	354.500	280	59	59	258	262	62
4-3	14:54:00	0.30	1.88	358.750	280	59	59	261	265	62
	14:59:00			362.671						
Total	1:00:00			51.331		60.5	60.5			
Average			2.24		278.0	60.5				
Min			1.84		277.0	59.0				
Max			2.59		280.0	62.0				

Impinger Weight Sheet - Run 3B

Client:	**Ash Grove Cement Company**
Facility:	**Durkee Cement Plant**
Test Location:	**Main Kiln (Train B)**
Project #:	**M234105**
Date:	**10/11/2023**
Test Method:	**26A**
Weighed/Measured By:	**RICHS**
Balance ID:	**LV4**

Scale Calibration Check Date: **10/12/2023**

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	925.3	767.5	157.8
0.1N H2SO4	744.2	696.6	47.6
Empty	590.5	583.4	7.1
0.1N NaOH	769.9	767.2	2.7
0.1N NaOH	692.3	692.1	0.2
Silica Gel	865.5	850.6	14.9

3,722.2	3,506.8	215.4
Liquid Final	**Liquid Initial**	**Liquid Gain**
865.5	850.6	14.9
Silica Final	**Silica Initial**	**Silica Gain**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/11/23

Run 1

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN1_000309.LAB	8:30	17.21	13.90	2.23	≤	0.10	191.20	0.92	10.28
RUN1_000310.LAB	8:31	17.25	14.13	2.22	≤	0.10	191.21	0.92	10.23
RUN1_000311.LAB	8:32	17.22	13.93	2.22	≤	0.10	191.22	0.92	10.26
RUN1_000312.LAB	8:33	17.26	14.02	2.24	≤	0.10	191.21	0.92	10.29
RUN1_000313.LAB	8:34	17.30	14.42	2.11	≤	0.10	191.21	0.92	10.15
RUN1_000314.LAB	8:35	17.15	14.11	2.25	≤	0.10	191.26	0.92	10.23
RUN1_000315.LAB	8:36	17.26	13.92	2.20	≤	0.10	191.23	0.92	10.30
RUN1_000316.LAB	8:37	17.27	13.95	2.18	≤	0.10	191.21	0.92	10.26
RUN1_000317.LAB	8:38	17.28	13.89	2.17	≤	0.10	191.19	0.92	10.33
RUN1_000318.LAB	8:39	17.27	14.25	2.21	≤	0.10	191.21	0.92	10.22
RUN1_000319.LAB	8:40	17.33	14.22	2.20	≤	0.10	191.19	0.92	10.24
RUN1_000320.LAB	8:41	17.40	13.93	2.20	≤	0.10	191.21	0.92	10.31
RUN1_000321.LAB	8:42	17.28	13.95	2.18	≤	0.10	191.23	0.92	10.29
RUN1_000322.LAB	8:43	17.45	13.97	2.20	≤	0.10	191.24	0.92	10.27
RUN1_000323.LAB	8:44	17.31	13.83	2.22	≤	0.10	191.25	0.92	10.29
RUN1_000324.LAB	8:45	17.19	13.91	2.28	≤	0.10	191.25	0.92	10.36
RUN1_000325.LAB	8:46	17.02	13.93	2.24	≤	0.10	191.24	0.92	10.31
RUN1_000326.LAB	8:47	17.03	13.96	2.27	≤	0.10	191.23	0.92	10.36
RUN1_000327.LAB	8:48	17.02	14.12	2.21	≤	0.10	191.21	0.92	10.32
RUN1_000328.LAB	8:49	16.94	13.83	2.28	≤	0.10	191.22	0.92	10.32
RUN1_000329.LAB	8:50	16.94	13.67	2.15	≤	0.10	191.22	0.92	10.38
RUN1_000330.LAB	8:51	17.11	13.98	2.23	≤	0.10	191.24	0.92	10.43
RUN1_000331.LAB	8:52	16.99	13.91	2.31	≤	0.10	191.26	0.92	10.31
RUN1_000332.LAB	8:53	17.07	14.11	2.26	≤	0.10	191.32	0.92	10.34
RUN1_000333.LAB	8:54	17.10	13.87	2.25	≤	0.10	191.32	0.92	10.32
RUN1_000334.LAB	8:55	17.10	13.89	2.26	≤	0.10	191.26	0.92	10.35
RUN1_000335.LAB	8:56	17.08	13.90	2.24	≤	0.10	191.20	0.92	10.34
RUN1_000336.LAB	8:57	17.13	13.84	2.23	≤	0.10	191.18	0.92	10.36
RUN1_000337.LAB	8:58	17.14	13.80	2.27	≤	0.10	191.26	0.92	10.38
RUN1_000338.LAB	8:59	17.08	13.89	2.30	≤	0.10	191.34	0.92	10.33
RUN1_000339.LAB	9:00	17.04	13.70	2.25	≤	0.10	191.28	0.92	10.35
RUN1_000340.LAB	9:01	17.20	13.67	2.17	≤	0.10	191.34	0.92	10.34
RUN1_000341.LAB	9:02	17.15	14.15	2.23	≤	0.10	191.34	0.92	10.46
RUN1_000342.LAB	9:03	17.14	14.27	2.23	≤	0.10	191.35	0.92	10.34
RUN1_000343.LAB	9:04	17.14	13.59	2.28	≤	0.10	191.34	0.92	10.26
RUN1_000344.LAB	9:05	17.02	13.47	2.17	≤	0.10	191.32	0.92	10.36
RUN1_000345.LAB	9:06	17.17	13.69	2.23	≤	0.10	191.30	0.92	10.53
RUN1_000346.LAB	9:07	17.23	13.87	2.25	≤	0.10	191.27	0.92	10.53
RUN1_000347.LAB	9:08	17.24	13.86	2.21	≤	0.10	191.28	0.92	10.49
RUN1_000348.LAB	9:09	17.22	13.67	2.21	≤	0.10	191.31	0.92	10.44
RUN1_000349.LAB	9:10	17.33	13.73	2.23	≤	0.10	191.25	0.92	10.48
RUN1_000350.LAB	9:11	17.41	13.81	2.21	≤	0.10	191.19	0.92	10.50
RUN1_000351.LAB	9:12	17.27	13.80	2.22	≤	0.10	191.15	0.92	10.44
RUN1_000352.LAB	9:13	17.16	13.51	2.18	≤	0.10	191.15	0.92	10.44
RUN1_000353.LAB	9:14	17.28	13.64	2.16	≤	0.10	191.14	0.92	10.38
RUN1_000354.LAB	9:15	17.32	13.67	2.13	≤	0.10	190.96	0.92	10.52
RUN1_000355.LAB	9:16	17.43	13.81	2.11	≤	0.10	190.78	0.92	10.48
RUN1_000356.LAB	9:17	17.30	13.88	2.07	≤	0.10	190.73	0.92	10.47
RUN1_000357.LAB	9:18	17.32	13.61	2.13	≤	0.10	190.85	0.92	10.41
RUN1_000358.LAB	9:19	17.30	13.60	2.08	≤	0.10	191.04	0.92	10.37
RUN1_000359.LAB	9:20	17.43	13.71	2.08	≤	0.10	191.18	0.92	10.44
RUN1_000360.LAB	9:21	17.32	13.69	2.09	≤	0.10	191.16	0.92	10.51
RUN1_000361.LAB	9:22	17.45	13.79	2.08	≤	0.10	191.15	0.92	10.41
RUN1_000362.LAB	9:23	17.33	13.75	2.15	≤	0.10	191.13	0.92	10.51
RUN1_000363.LAB	9:24	17.48	13.74	2.18	≤	0.10	191.16	0.92	10.45
RUN1_000364.LAB	9:25	17.29	13.81	2.18	≤	0.10	191.20	0.92	10.44
RUN1_000365.LAB	9:26	17.51	13.80	2.04	≤	0.10	191.19	0.92	10.45
RUN1_000366.LAB	9:27	17.34	13.82	2.04	≤	0.10	191.18	0.92	10.41
RUN1_000367.LAB	9:28	17.39	13.77	2.01	≤	0.10	191.23	0.92	10.41
RUN1_000368.LAB	9:29	17.22	13.57	2.02	≤	0.10	191.28	0.92	10.42
Average		**17.23**	**13.86**	**2.19**	**≤**	**0.10**	**191.20**	**0.92**	**10.37**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/11/23

Run 2

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN2_000527.LAB	10:10	17.28	14.1	1.87	≤	0.10	5.4	0.03	10.37
RUN2_000528.LAB	10:11	17.22	13.5	1.83	≤	0.10	5.3	0.10	10.53
RUN2_000529.LAB	10:12	17.21	13.5	1.84	≤	0.10	5.4	0.03	10.47
RUN2_000530.LAB	10:13	17.26	13.8	1.78	≤	0.10	5.3	0.08	10.41
RUN2_000531.LAB	10:14	17.18	13.8	1.84	≤	0.10	5.6	0.06	10.44
RUN2_000532.LAB	10:15	17.18	13.8	1.85	≤	0.10	5.4	0.13	10.47
RUN2_000533.LAB	10:16	17.36	13.7	1.79	≤	0.10	5.4	0.03	10.44
RUN2_000534.LAB	10:17	17.26	13.7	1.88	≤	0.10	5.5	0.10	10.44
RUN2_000535.LAB	10:18	17.27	13.7	1.73	≤	0.10	5.5	0.13	10.42
RUN2_000536.LAB	10:19	17.35	13.8	1.90	≤	0.10	5.3	0.12	10.37
RUN2_000537.LAB	10:20	17.19	13.8	1.72	≤	0.10	5.3	0.14	10.37
RUN2_000538.LAB	10:21	17.26	13.7	1.82	≤	0.10	5.3	0.11	10.39
RUN2_000539.LAB	10:22	17.34	13.9	1.81	≤	0.10	5.5	0.11	10.35
RUN2_000540.LAB	10:23	17.25	14.1	1.79	≤	0.10	5.4	0.04	10.27
RUN2_000541.LAB	10:24	17.42	14.3	1.77	≤	0.10	5.6	0.11	10.27
RUN2_000542.LAB	10:25	17.34	14.0	1.80	≤	0.10	5.3	0.14	10.25
RUN2_000543.LAB	10:26	17.47	13.7	1.88	≤	0.10	5.3	0.09	10.38
RUN2_000544.LAB	10:27	17.31	13.9	1.80	≤	0.10	5.4	0.08	10.27
RUN2_000545.LAB	10:28	17.43	13.9	1.80	≤	0.10	5.5	0.03	10.26
RUN2_000546.LAB	10:29	17.30	13.9	1.84	≤	0.10	5.3	0.09	10.27
RUN2_000547.LAB	10:30	17.34	13.8	1.75	≤	0.10	5.1	0.01	10.32
RUN2_000548.LAB	10:31	17.31	13.8	1.80	≤	0.10	5.3	0.08	10.27
RUN2_000549.LAB	10:32	17.34	13.9	1.77	≤	0.10	5.2	0.04	10.27
RUN2_000550.LAB	10:33	17.34	14.1	1.80	≤	0.10	5.2	-0.04	10.27
RUN2_000551.LAB	10:34	17.40	13.8	1.70	≤	0.10	5.1	0.09	10.30
RUN2_000552.LAB	10:35	17.25	13.5	1.70	≤	0.10	5.0	0.12	10.37
RUN2_000553.LAB	10:36	17.34	13.7	1.68	≤	0.10	5.1	0.02	10.43
RUN2_000554.LAB	10:37	17.42	13.8	1.76	≤	0.10	5.2	0.07	10.37
RUN2_000555.LAB	10:38	17.38	14.0	1.82	≤	0.10	5.2	-0.06	10.32
RUN2_000556.LAB	10:39	17.29	13.8	1.75	≤	0.10	5.1	0.03	10.28
RUN2_000557.LAB	10:40	17.44	13.8	1.79	≤	0.10	5.2	0.08	10.32
RUN2_000558.LAB	10:41	17.42	13.6	1.72	≤	0.10	5.2	0.12	10.38
RUN2_000559.LAB	10:42	17.53	13.9	1.82	≤	0.10	5.0	0.07	10.41
RUN2_000560.LAB	10:43	17.36	13.8	1.79	≤	0.10	4.9	0.04	10.31
RUN2_000561.LAB	10:44	17.46	13.8	1.82	≤	0.10	5.0	-0.01	10.33
RUN2_000562.LAB	10:45	17.55	13.7	1.78	≤	0.10	5.0	0.09	10.38
RUN2_000563.LAB	10:46	17.50	13.7	1.80	≤	0.10	5.0	0.06	10.39
RUN2_000564.LAB	10:47	17.52	13.9	1.83	≤	0.10	4.9	0.13	10.41
RUN2_000565.LAB	10:48	17.61	14.1	1.80	≤	0.10	4.9	0.07	10.31
RUN2_000566.LAB	10:49	17.59	14.0	1.81	≤	0.10	5.0	0.11	10.34
RUN2_000567.LAB	10:50	17.41	13.9	1.74	≤	0.10	4.9	0.04	10.32
RUN2_000568.LAB	10:51	17.39	13.7	1.72	≤	0.10	4.8	0.05	10.29
RUN2_000569.LAB	10:52	17.66	13.8	1.85	≤	0.10	4.9	0.01	10.35
RUN2_000570.LAB	10:53	17.63	14.1	1.80	≤	0.10	4.9	0.05	10.37
RUN2_000571.LAB	10:54	17.60	14.0	1.80	≤	0.10	4.9	0.04	10.31
RUN2_000572.LAB	10:55	17.59	13.6	1.82	≤	0.10	4.9	0.04	10.27
RUN2_000573.LAB	10:56	17.58	13.8	1.88	≤	0.10	4.8	0.12	10.34
RUN2_000574.LAB	10:57	17.70	13.8	1.82	≤	0.10	4.6	0.03	10.39
RUN2_000575.LAB	10:58	17.70	13.9	1.81	≤	0.10	4.9	0.16	10.34
RUN2_000576.LAB	10:59	17.38	13.8	1.81	≤	0.10	4.9	0.03	10.34
RUN2_000577.LAB	11:00	17.32	13.5	1.78	≤	0.10	4.8	0.05	10.27
RUN2_000578.LAB	11:01	17.51	13.9	1.78	≤	0.10	4.8	-0.01	10.38
RUN2_000579.LAB	11:02	17.53	14.7	1.83	≤	0.10	5.1	0.03	10.51
RUN2_000580.LAB	11:03	17.44	14.3	1.87	≤	0.10	5.0	-0.05	10.26
RUN2_000581.LAB	11:04	17.18	13.7	1.78	≤	0.10	5.1	0.09	10.13
RUN2_000582.LAB	11:05	17.36	13.8	1.84	≤	0.10	4.9	-0.01	10.23
RUN2_000583.LAB	11:06	17.43	13.8	1.87	≤	0.10	5.0	-0.01	10.38
RUN2_000584.LAB	11:07	17.58	14.1	1.91	≤	0.10	4.9	0.06	10.31
RUN2_000585.LAB	11:08	17.52	14.1	1.94	≤	0.10	4.9	0.02	10.33
RUN2_000586.LAB	11:09	17.55	13.8	1.88	≤	0.10	4.9	0.07	10.25
Average		**17.40**	**13.86**	**1.81**	**≤**	**0.10**	**5.13**	**0.06**	**10.34**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/11/23

Run 3

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN3_000657.LAB	11:45	17.56	13.7	1.72	≤	0.10	4.6	0.13	10.31
RUN3_000658.LAB	11:46	17.52	14.0	1.70	≤	0.10	4.7	0.07	10.30
RUN3_000659.LAB	11:47	17.66	13.8	1.72	≤	0.10	4.6	0.07	10.33
RUN3_000660.LAB	11:48	17.70	13.7	1.75	≤	0.10	4.7	0.03	10.31
RUN3_000661.LAB	11:49	17.48	13.7	1.73	≤	0.10	4.6	0.09	10.37
RUN3_000662.LAB	11:50	17.54	13.8	1.77	≤	0.10	4.6	0.02	10.35
RUN3_000663.LAB	11:51	17.73	13.7	1.74	≤	0.10	4.6	0.11	10.37
RUN3_000664.LAB	11:52	17.73	13.9	1.74	≤	0.10	4.4	0.07	10.31
RUN3_000665.LAB	11:53	17.75	13.6	1.69	≤	0.10	4.4	0.10	10.38
RUN3_000666.LAB	11:54	17.61	13.7	1.65	≤	0.10	4.4	0.02	10.41
RUN3_000667.LAB	11:55	17.51	13.6	1.62	≤	0.10	4.4	0.11	10.48
RUN3_000668.LAB	11:56	17.51	13.7	1.64	≤	0.10	4.4	0.04	10.46
RUN3_000669.LAB	11:57	17.55	13.9	1.64	≤	0.10	4.4	0.15	10.38
RUN3_000670.LAB	11:58	17.59	13.8	1.66	≤	0.10	4.4	0.07	10.37
RUN3_000671.LAB	11:59	17.65	13.7	1.63	≤	0.10	4.4	0.11	10.44
RUN3_000672.LAB	12:00	17.56	13.8	1.71	≤	0.10	4.4	0.07	10.38
RUN3_000673.LAB	12:01	17.49	13.8	1.73	≤	0.10	4.7	0.15	10.39
RUN3_000674.LAB	12:02	17.29	13.9	1.74	≤	0.10	4.5	0.16	10.38
RUN3_000675.LAB	12:03	17.27	13.8	1.69	≤	0.10	4.5	0.15	10.38
RUN3_000676.LAB	12:04	17.26	14.4	1.76	≤	0.10	4.5	0.09	10.32
RUN3_000677.LAB	12:05	17.20	13.8	1.70	≤	0.10	4.4	0.19	10.39
RUN3_000678.LAB	12:06	17.18	13.6	1.75	≤	0.10	4.3	0.20	10.52
RUN3_000679.LAB	12:07	17.18	13.6	1.73	≤	0.10	4.5	0.21	10.53
RUN3_000680.LAB	12:08	17.10	14.1	1.72	≤	0.10	4.4	0.14	10.49
RUN3_000681.LAB	12:09	16.93	14.2	1.61	≤	0.10	4.4	0.21	10.38
RUN3_000682.LAB	12:10	17.05	14.0	1.63	≤	0.10	4.4	0.19	10.44
RUN3_000683.LAB	12:11	17.00	13.7	1.68	≤	0.10	4.4	0.20	10.47
RUN3_000684.LAB	12:12	16.96	13.7	1.67	≤	0.10	4.5	0.24	10.52
RUN3_000685.LAB	12:13	16.91	13.9	1.69	≤	0.10	4.5	0.20	10.53
RUN3_000686.LAB	12:14	16.86	13.8	1.67	≤	0.10	4.5	0.27	10.48
RUN3_000687.LAB	12:15	16.85	13.8	1.70	≤	0.10	4.3	0.27	10.50
RUN3_000688.LAB	12:16	16.90	13.8	1.70	≤	0.10	4.5	0.27	10.48
RUN3_000689.LAB	12:17	16.99	13.8	1.60	≤	0.10	4.4	0.22	10.48
RUN3_000690.LAB	12:18	17.14	13.8	1.68	≤	0.10	4.4	0.24	10.48
RUN3_000691.LAB	12:19	16.99	14.0	1.75	≤	0.10	4.4	0.23	10.48
RUN3_000692.LAB	12:20	16.95	14.1	1.65	≤	0.10	4.6	0.32	10.37
RUN3_000693.LAB	12:21	17.01	13.8	1.71	≤	0.10	4.5	0.32	10.36
RUN3_000694.LAB	12:22	16.93	14.1	1.64	≤	0.10	4.6	0.32	10.36
RUN3_000695.LAB	12:23	16.80	14.3	1.62	≤	0.10	4.5	0.27	10.34
RUN3_000696.LAB	12:24	16.82	14.2	1.65	≤	0.10	4.6	0.33	10.27
RUN3_000697.LAB	12:25	16.73	13.8	1.63	≤	0.10	4.6	0.30	10.31
RUN3_000698.LAB	12:26	16.75	13.9	1.55	≤	0.10	4.6	0.23	10.38
RUN3_000699.LAB	12:27	16.81	13.9	1.65	≤	0.10	4.6	0.19	10.40
RUN3_000700.LAB	12:28	16.85	14.1	1.57	≤	0.10	4.7	0.23	10.40
RUN3_000701.LAB	12:29	16.67	14.1	1.61	≤	0.10	4.8	0.30	10.37
RUN3_000702.LAB	12:30	16.58	14.1	1.66	≤	0.10	4.7	0.24	10.30
RUN3_000703.LAB	12:31	16.60	14.1	1.59	≤	0.10	5.1	0.20	10.36
RUN3_000704.LAB	12:32	16.54	14.1	1.64	≤	0.10	4.8	0.27	10.36
RUN3_000705.LAB	12:33	16.48	14.2	1.53	≤	0.10	4.9	0.19	10.33
RUN3_000706.LAB	12:34	16.51	13.9	1.70	≤	0.10	4.8	0.23	10.36
RUN3_000707.LAB	12:35	16.74	13.7	1.59	≤	0.10	4.7	0.18	10.36
RUN3_000708.LAB	12:36	17.12	13.7	1.58	≤	0.10	4.6	0.19	10.45
RUN3_000709.LAB	12:37	17.40	13.8	1.67	≤	0.10	4.6	0.17	10.56
RUN3_000710.LAB	12:38	17.34	14.0	1.57	≤	0.10	4.5	0.11	10.47
RUN3_000711.LAB	12:39	17.36	13.4	1.61	≤	0.10	4.4	0.09	10.40
RUN3_000712.LAB	12:40	17.52	13.7	1.61	≤	0.10	4.4	0.14	10.35
RUN3_000713.LAB	12:41	17.49	13.9	1.61	≤	0.10	4.3	0.10	10.52
RUN3_000714.LAB	12:42	17.49	13.8	1.63	≤	0.10	4.2	0.09	10.39
RUN3_000715.LAB	12:43	17.56	13.7	1.64	≤	0.10	4.3	0.22	10.36
RUN3_000716.LAB	12:44	17.47	13.9	1.71	≤	0.10	4.2	0.12	10.33
Average		**17.18**	**13.87**	**1.66**	**≤**	**0.10**	**4.52**	**0.17**	**10.40**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/12/23

Run 1

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN1_000440.LAB	10:45	19.84	14.74	2.05	≤	0.10	190.83	0.94	8.99
RUN1_000441.LAB	10:46	19.83	14.73	1.99	≤	0.10	190.82	0.94	9.07
RUN1_000442.LAB	10:47	19.80	14.83	2.04	≤	0.10	190.84	0.94	9.06
RUN1_000443.LAB	10:48	19.80	14.90	2.04	≤	0.10	190.84	0.94	8.99
RUN1_000444.LAB	10:49	19.79	14.76	1.99	≤	0.10	190.83	0.94	9.03
RUN1_000445.LAB	10:50	19.80	14.77	1.99	≤	0.10	190.80	0.94	9.05
RUN1_000446.LAB	10:51	19.82	14.97	1.99	≤	0.10	190.81	0.94	9.02
RUN1_000447.LAB	10:52	19.82	14.86	2.06	≤	0.10	190.84	0.94	8.95
RUN1_000448.LAB	10:53	19.86	15.13	2.15	≤	0.10	190.84	0.94	8.96
RUN1_000449.LAB	10:54	19.83	15.30	2.11	≤	0.10	190.82	0.94	8.88
RUN1_000450.LAB	10:55	19.87	15.21	2.09	≤	0.10	190.77	0.93	8.87
RUN1_000451.LAB	10:56	19.79	14.97	2.11	≤	0.10	190.76	0.94	8.81
RUN1_000452.LAB	10:57	19.78	14.86	2.05	≤	0.10	190.72	0.94	8.91
RUN1_000453.LAB	10:58	19.88	14.97	2.13	≤	0.10	190.67	0.94	8.95
RUN1_000454.LAB	10:59	19.83	14.93	2.09	≤	0.10	190.69	0.94	8.89
RUN1_000455.LAB	11:00	19.90	15.00	2.09	≤	0.10	190.68	0.94	8.91
RUN1_000456.LAB	11:01	19.91	14.78	2.11	≤	0.10	190.74	0.93	8.85
RUN1_000457.LAB	11:02	19.95	14.92	2.11	≤	0.10	190.74	0.94	8.94
RUN1_000458.LAB	11:03	19.95	15.49	2.09	≤	0.10	190.73	0.94	8.91
RUN1_000459.LAB	11:04	19.90	15.19	2.11	≤	0.10	190.73	0.94	8.75
RUN1_000460.LAB	11:05	19.84	14.85	2.11	≤	0.10	190.73	0.94	8.75
RUN1_000461.LAB	11:06	19.92	14.91	2.06	≤	0.10	190.74	0.94	8.89
RUN1_000462.LAB	11:07	19.97	15.00	2.09	≤	0.10	190.73	0.94	8.94
RUN1_000463.LAB	11:08	19.93	15.24	2.05	≤	0.10	190.74	0.94	8.81
RUN1_000464.LAB	11:09	19.93	15.04	2.10	≤	0.10	190.76	0.94	8.74
RUN1_000465.LAB	11:10	19.94	14.93	2.12	≤	0.10	190.77	0.94	8.77
RUN1_000466.LAB	11:11	19.91	14.99	2.10	≤	0.10	190.77	0.93	8.81
RUN1_000467.LAB	11:12	19.84	15.09	2.06	≤	0.10	190.75	0.93	8.86
RUN1_000468.LAB	11:13	19.80	14.96	2.11	≤	0.10	190.82	0.94	8.88
RUN1_000469.LAB	11:14	19.82	14.91	2.10	≤	0.10	190.84	0.94	8.89
RUN1_000470.LAB	11:15	19.95	14.90	2.11	≤	0.10	190.84	0.94	8.98
RUN1_000471.LAB	11:16	19.83	14.97	2.13	≤	0.10	190.84	0.93	8.97
RUN1_000472.LAB	11:17	19.79	15.03	2.10	≤	0.10	190.81	0.93	8.94
RUN1_000473.LAB	11:18	19.81	15.02	2.16	≤	0.10	190.84	0.93	8.94
RUN1_000474.LAB	11:19	19.80	14.92	2.07	≤	0.10	190.84	0.94	8.97
RUN1_000475.LAB	11:20	19.81	14.76	2.07	≤	0.10	190.79	0.94	8.96
RUN1_000476.LAB	11:21	19.79	14.68	2.04	≤	0.10	190.56	0.93	8.96
RUN1_000477.LAB	11:22	19.82	15.09	2.09	≤	0.10	190.36	0.94	9.03
RUN1_000478.LAB	11:23	19.84	15.11	2.03	≤	0.10	190.28	0.94	9.02
RUN1_000479.LAB	11:24	19.79	14.85	2.11	≤	0.10	190.43	0.94	8.95
RUN1_000480.LAB	11:25	19.83	14.82	2.03	≤	0.10	190.57	0.94	8.89
RUN1_000481.LAB	11:26	19.83	14.93	2.03	≤	0.10	190.59	0.93	8.95
RUN1_000482.LAB	11:27	19.81	15.15	2.10	≤	0.10	190.63	0.94	9.02
RUN1_000483.LAB	11:28	19.86	15.00	2.03	≤	0.10	190.63	0.93	8.97
RUN1_000484.LAB	11:29	19.93	15.04	2.10	≤	0.10	190.67	0.94	8.94
RUN1_000485.LAB	11:30	19.99	14.94	2.12	≤	0.10	190.72	0.93	8.88
RUN1_000486.LAB	11:31	20.00	15.21	2.08	≤	0.10	190.74	0.94	8.87
RUN1_000487.LAB	11:32	20.04	15.63	2.16	≤	0.10	190.76	0.93	8.82
RUN1_000488.LAB	11:33	20.07	15.40	2.13	≤	0.10	190.74	0.94	8.79
RUN1_000489.LAB	11:34	20.07	15.37	2.11	≤	0.10	190.74	0.93	8.70
RUN1_000490.LAB	11:35	20.04	15.46	2.14	≤	0.10	190.73	0.94	8.58
RUN1_000491.LAB	11:36	20.02	15.50	2.13	≤	0.10	190.75	0.94	8.62
RUN1_000492.LAB	11:37	19.96	15.24	2.11	≤	0.10	190.83	0.93	8.59
RUN1_000493.LAB	11:38	19.96	15.02	2.10	≤	0.10	190.84	0.93	8.57
RUN1_000494.LAB	11:39	20.03	15.38	2.07	≤	0.10	190.84	0.93	8.61
RUN1_000495.LAB	11:40	19.94	15.43	2.07	≤	0.10	190.83	0.93	8.70
RUN1_000496.LAB	11:41	19.84	15.19	2.07	≤	0.10	190.84	0.93	8.79
RUN1_000497.LAB	11:42	19.80	14.95	2.10	≤	0.10	190.83	0.94	8.65
RUN1_000498.LAB	11:43	19.81	14.99	2.03	≤	0.10	190.83	0.94	8.65
RUN1_000499.LAB	11:44	19.81	15.23	2.06	≤	0.10	190.84	0.94	8.77
Average		**19.88**	**15.04**	**2.08**	**≤**	**0.10**	**190.75**	**0.94**	**8.87**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/12/23

Run 2

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN2_000581.LAB	12:15	19.56	15.3	2.10	≤	0.10	1.1	0.16	8.76
RUN2_000582.LAB	12:16	19.57	15.1	2.11	≤	0.10	1.1	0.24	8.93
RUN2_000583.LAB	12:17	19.63	15.1	2.05	≤	0.10	1.1	0.18	8.90
RUN2_000584.LAB	12:18	19.63	15.2	2.03	≤	0.10	1.1	0.21	8.93
RUN2_000585.LAB	12:19	19.65	15.2	2.08	≤	0.10	1.1	0.20	8.94
RUN2_000586.LAB	12:20	19.66	15.2	2.06	≤	0.10	1.1	0.20	8.96
RUN2_000587.LAB	12:21	19.68	15.1	2.05	≤	0.10	1.1	0.29	8.90
RUN2_000588.LAB	12:22	19.67	15.1	2.05	≤	0.10	1.1	0.19	8.95
RUN2_000589.LAB	12:23	19.72	15.2	2.08	≤	0.10	1.1	0.25	8.98
RUN2_000590.LAB	12:24	19.69	15.5	2.00	≤	0.10	1.1	0.16	8.90
RUN2_000591.LAB	12:25	19.67	15.2	2.00	≤	0.10	1.1	0.21	8.81
RUN2_000592.LAB	12:26	19.66	14.9	2.05	≤	0.10	1.1	0.14	8.91
RUN2_000593.LAB	12:27	19.70	15.1	2.01	≤	0.10	1.2	0.20	8.97
RUN2_000594.LAB	12:28	19.69	15.2	1.93	≤	0.10	1.2	0.20	8.87
RUN2_000595.LAB	12:29	19.75	15.1	2.07	≤	0.10	1.1	0.21	8.91
RUN2_000596.LAB	12:30	19.73	15.2	2.02	≤	0.10	1.1	0.18	8.89
RUN2_000597.LAB	12:31	19.72	15.2	2.01	≤	0.10	1.2	0.21	8.88
RUN2_000598.LAB	12:32	19.75	15.3	2.06	≤	0.10	1.2	0.18	8.89
RUN2_000599.LAB	12:33	19.77	15.8	2.04	≤	0.10	1.1	0.18	8.79
RUN2_000600.LAB	12:34	19.72	15.3	2.05	≤	0.10	1.2	0.25	8.68
RUN2_000601.LAB	12:35	19.74	14.9	2.11	≤	0.10	1.2	0.24	8.78
RUN2_000602.LAB	12:36	19.78	15.1	2.07	≤	0.10	1.2	0.18	8.96
RUN2_000603.LAB	12:37	19.80	15.3	2.05	≤	0.10	1.1	0.22	8.93
RUN2_000604.LAB	12:38	19.79	15.6	2.07	≤	0.10	1.1	0.19	8.86
RUN2_000605.LAB	12:39	19.76	15.3	2.04	≤	0.10	1.1	0.18	8.80
RUN2_000606.LAB	12:40	19.78	15.2	2.05	≤	0.10	1.2	0.21	8.78
RUN2_000607.LAB	12:41	19.87	15.4	1.98	≤	0.10	1.1	0.20	8.90
RUN2_000608.LAB	12:42	19.85	15.4	2.04	≤	0.10	1.2	0.21	8.88
RUN2_000609.LAB	12:43	19.29	15.5	2.14	≤	0.10	1.2	0.18	8.85
RUN2_000610.LAB	12:44	16.56	16.0	1.97	≤	0.10	1.7	0.21	8.80
RUN2_000611.LAB	12:45	16.30	15.9	1.99	≤	0.10	1.2	0.24	8.79
RUN2_000612.LAB	12:46	17.93	15.8	1.91	≤	0.10	1.3	0.21	8.89
RUN2_000613.LAB	12:47	18.70	16.0	1.97	≤	0.10	1.3	0.21	8.96
RUN2_000614.LAB	12:48	18.70	16.0	2.02	≤	0.10	1.2	0.25	8.82
RUN2_000615.LAB	12:49	18.71	15.8	2.05	≤	0.10	1.3	0.21	8.61
RUN2_000616.LAB	12:50	18.65	15.7	1.97	≤	0.10	1.3	0.23	8.55
RUN2_000617.LAB	12:51	18.64	15.6	1.97	≤	0.10	1.3	0.21	8.61
RUN2_000618.LAB	12:52	18.70	16.1	2.00	≤	0.10	1.3	0.26	8.70
RUN2_000619.LAB	12:53	18.74	16.2	2.00	≤	0.10	1.3	0.20	8.73
RUN2_000620.LAB	12:54	18.68	15.7	1.91	≤	0.10	1.2	0.20	8.63
RUN2_000621.LAB	12:55	18.66	15.7	1.89	≤	0.10	1.2	0.18	8.52
RUN2_000622.LAB	12:56	18.68	15.9	1.92	≤	0.10	1.2	0.17	8.60
RUN2_000623.LAB	12:57	18.61	15.9	1.91	≤	0.10	1.2	0.24	8.72
RUN2_000624.LAB	12:58	18.62	15.7	1.89	≤	0.10	1.2	0.27	8.68
RUN2_000625.LAB	12:59	18.90	15.6	1.96	≤	0.10	1.2	0.26	8.63
RUN2_000626.LAB	13:00	19.17	15.3	1.99	≤	0.10	1.3	0.27	8.66
RUN2_000627.LAB	13:01	19.25	15.7	2.05	≤	0.10	1.2	0.27	8.72
RUN2_000628.LAB	13:02	19.34	16.3	2.06	≤	0.10	1.2	0.27	8.77
RUN2_000629.LAB	13:03	19.40	15.8	2.07	≤	0.10	1.2	0.23	8.82
RUN2_000630.LAB	13:04	19.45	15.5	2.12	≤	0.10	1.7	0.32	8.62
RUN2_000631.LAB	13:05	19.48	15.7	2.05	≤	0.10	1.3	0.24	8.47
RUN2_000632.LAB	13:06	19.48	16.1	2.05	≤	0.10	1.4	0.27	8.61
RUN2_000633.LAB	13:07	19.46	16.1	2.06	≤	0.10	1.4	0.24	8.65
RUN2_000634.LAB	13:08	19.53	15.8	2.07	≤	0.10	1.5	0.19	8.63
RUN2_000635.LAB	13:09	19.53	15.7	2.10	≤	0.10	1.5	0.23	8.49
RUN2_000636.LAB	13:10	19.54	15.8	2.08	≤	0.10	1.4	0.25	8.48
RUN2_000637.LAB	13:11	19.54	15.9	2.04	≤	0.10	1.5	0.21	8.53
RUN2_000638.LAB	13:12	19.55	15.9	2.07	≤	0.10	1.5	0.26	8.53
RUN2_000639.LAB	13:13	19.57	15.9	2.06	≤	0.10	1.3	0.28	8.58
RUN2_000640.LAB	13:14	19.54	15.8	2.02	≤	0.10	1.8	0.21	8.56
Average		**19.28**	**15.54**	**2.03**	**≤**	**0.10**	**1.23**	**0.22**	**8.77**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/12/23

Run 3

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN3_000708.LAB	13:50	19.47	15.4	2.07	≤	0.10	1.1	0.13	8.61
RUN3_000709.LAB	13:51	19.52	15.7	2.14	≤	0.10	1.1	0.18	8.59
RUN3_000710.LAB	13:52	19.51	15.4	2.10	≤	0.10	1.1	0.23	8.69
RUN3_000711.LAB	13:53	19.58	15.2	2.09	≤	0.10	1.2	0.24	8.65
RUN3_000712.LAB	13:54	19.59	15.5	2.01	≤	0.10	1.2	0.17	8.59
RUN3_000713.LAB	13:55	19.58	15.7	2.08	≤	0.10	1.2	0.24	8.56
RUN3_000714.LAB	13:56	19.57	15.8	2.13	≤	0.10	1.2	0.15	8.52
RUN3_000715.LAB	13:57	19.56	15.6	2.06	≤	0.10	1.2	0.17	8.56
RUN3_000716.LAB	13:58	19.56	15.4	2.04	≤	0.10	1.2	0.21	8.66
RUN3_000717.LAB	13:59	19.54	15.6	2.01	≤	0.10	1.2	0.19	8.68
RUN3_000718.LAB	14:00	19.50	15.3	2.07	≤	0.10	1.2	0.18	8.81
RUN3_000719.LAB	14:01	19.56	15.6	2.02	≤	0.10	1.2	0.24	8.75
RUN3_000720.LAB	14:02	19.54	15.9	2.01	≤	0.10	1.3	0.18	8.58
RUN3_000721.LAB	14:03	19.51	15.7	2.04	≤	0.10	1.2	0.16	8.66
RUN3_000722.LAB	14:04	19.46	16.0	2.05	≤	0.10	1.2	0.22	8.65
RUN3_000723.LAB	14:05	19.42	15.8	2.02	≤	0.10	1.1	0.18	8.64
RUN3_000724.LAB	14:06	19.38	15.2	2.02	≤	0.10	1.1	0.15	8.82
RUN3_000725.LAB	14:07	19.31	15.0	1.98	≤	0.10	1.2	0.25	9.00
RUN3_000726.LAB	14:08	19.36	15.5	2.00	≤	0.10	1.2	0.10	9.02
RUN3_000727.LAB	14:09	19.35	15.6	1.98	≤	0.10	1.1	0.18	8.85
RUN3_000728.LAB	14:10	19.32	15.2	1.97	≤	0.10	1.1	0.18	8.89
RUN3_000729.LAB	14:11	19.30	15.1	1.98	≤	0.10	1.1	0.13	8.97
RUN3_000730.LAB	14:12	19.36	15.3	2.03	≤	0.10	1.1	0.13	9.01
RUN3_000731.LAB	14:13	19.41	15.3	2.01	≤	0.10	1.1	0.14	8.94
RUN3_000732.LAB	14:14	19.47	15.3	1.99	≤	0.10	1.1	0.14	8.89
RUN3_000733.LAB	14:15	19.47	15.3	2.01	≤	0.10	1.2	0.16	8.83
RUN3_000734.LAB	14:16	19.51	15.2	2.07	≤	0.10	1.1	0.09	8.80
RUN3_000735.LAB	14:17	19.58	15.4	2.00	≤	0.10	1.1	0.16	8.82
RUN3_000736.LAB	14:18	19.59	15.5	2.05	≤	0.10	1.2	0.16	8.73
RUN3_000737.LAB	14:19	19.58	15.4	1.97	≤	0.10	1.2	0.14	8.66
RUN3_000738.LAB	14:20	19.53	15.2	2.05	≤	0.10	1.2	0.17	8.70
RUN3_000739.LAB	14:21	19.57	15.4	2.02	≤	0.10	1.1	0.20	8.77
RUN3_000740.LAB	14:22	19.53	15.2	1.96	≤	0.10	1.2	0.11	8.69
RUN3_000741.LAB	14:23	19.55	15.4	1.96	≤	0.10	1.1	0.16	8.76
RUN3_000742.LAB	14:24	19.54	15.3	1.95	≤	0.10	1.1	0.14	8.75
RUN3_000743.LAB	14:25	19.58	15.5	2.01	≤	0.10	1.2	0.15	8.75
RUN3_000744.LAB	14:26	19.56	15.9	2.02	≤	0.10	1.2	0.17	8.69
RUN3_000745.LAB	14:27	19.59	15.5	2.01	≤	0.10	1.2	0.14	8.59
RUN3_000746.LAB	14:28	19.60	15.6	1.94	≤	0.10	1.2	0.18	8.63
RUN3_000747.LAB	14:29	19.62	15.5	2.01	≤	0.10	1.2	0.12	8.59
RUN3_000748.LAB	14:30	19.56	15.2	2.00	≤	0.10	1.1	0.21	8.53
RUN3_000749.LAB	14:31	19.53	15.4	1.93	≤	0.10	1.3	0.14	8.62
RUN3_000750.LAB	14:32	19.49	15.8	1.93	≤	0.10	1.2	0.17	8.74
RUN3_000751.LAB	14:33	19.51	15.6	1.94	≤	0.10	1.1	0.13	8.63
RUN3_000752.LAB	14:34	19.50	15.0	2.00	≤	0.10	1.1	0.13	8.55
RUN3_000753.LAB	14:35	18.86	15.0	1.97	≤	0.10	1.1	0.12	8.71
RUN3_000754.LAB	14:36	16.45	15.6	1.90	≤	0.10	1.1	0.19	8.91
RUN3_000755.LAB	14:37	16.22	16.0	1.83	≤	0.10	1.2	0.16	8.88
RUN3_000756.LAB	14:38	16.19	16.0	1.80	≤	0.10	1.2	0.19	8.88
RUN3_000757.LAB	14:39	16.23	15.6	1.85	≤	0.10	1.2	0.17	8.82
RUN3_000758.LAB	14:40	16.88	15.6	1.89	≤	0.10	1.2	0.32	8.80
RUN3_000759.LAB	14:41	17.57	15.6	1.87	≤	0.10	1.2	0.14	8.89
RUN3_000760.LAB	14:42	18.26	15.4	1.87	≤	0.10	1.2	0.17	8.86
RUN3_000761.LAB	14:43	18.74	15.3	1.97	≤	0.10	1.1	0.23	8.79
RUN3_000762.LAB	14:44	18.92	15.1	2.04	≤	0.10	1.2	0.21	8.77
RUN3_000763.LAB	14:45	19.18	15.3	2.03	≤	0.10	1.2	0.18	8.73
RUN3_000764.LAB	14:46	19.34	15.6	2.00	≤	0.10	1.1	0.24	8.80
RUN3_000765.LAB	14:47	19.42	15.5	2.04	≤	0.10	1.1	0.24	8.74
RUN3_000766.LAB	14:48	19.52	15.1	2.03	≤	0.10	1.1	0.15	8.59
RUN3_000767.LAB	14:49	19.56	15.0	2.02	≤	0.10	1.1	0.19	8.54
Average		**19.15**	**15.45**	**2.00**	**≤**	**0.10**	**1.16**	**0.17**	**8.74**

Stratification Test Results Summary
Ash Grove Cement Company
Durkee Cement Plant
Main Kiln
October 11, 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	8:09	10.55	0.25	0.03
	2	8:11	10.55	0.25	0.03
	3	8:13	10.47	0.51	0.05
Average			**10.52**		

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

Method 1 and 2 Cyclonic Flow Check Data

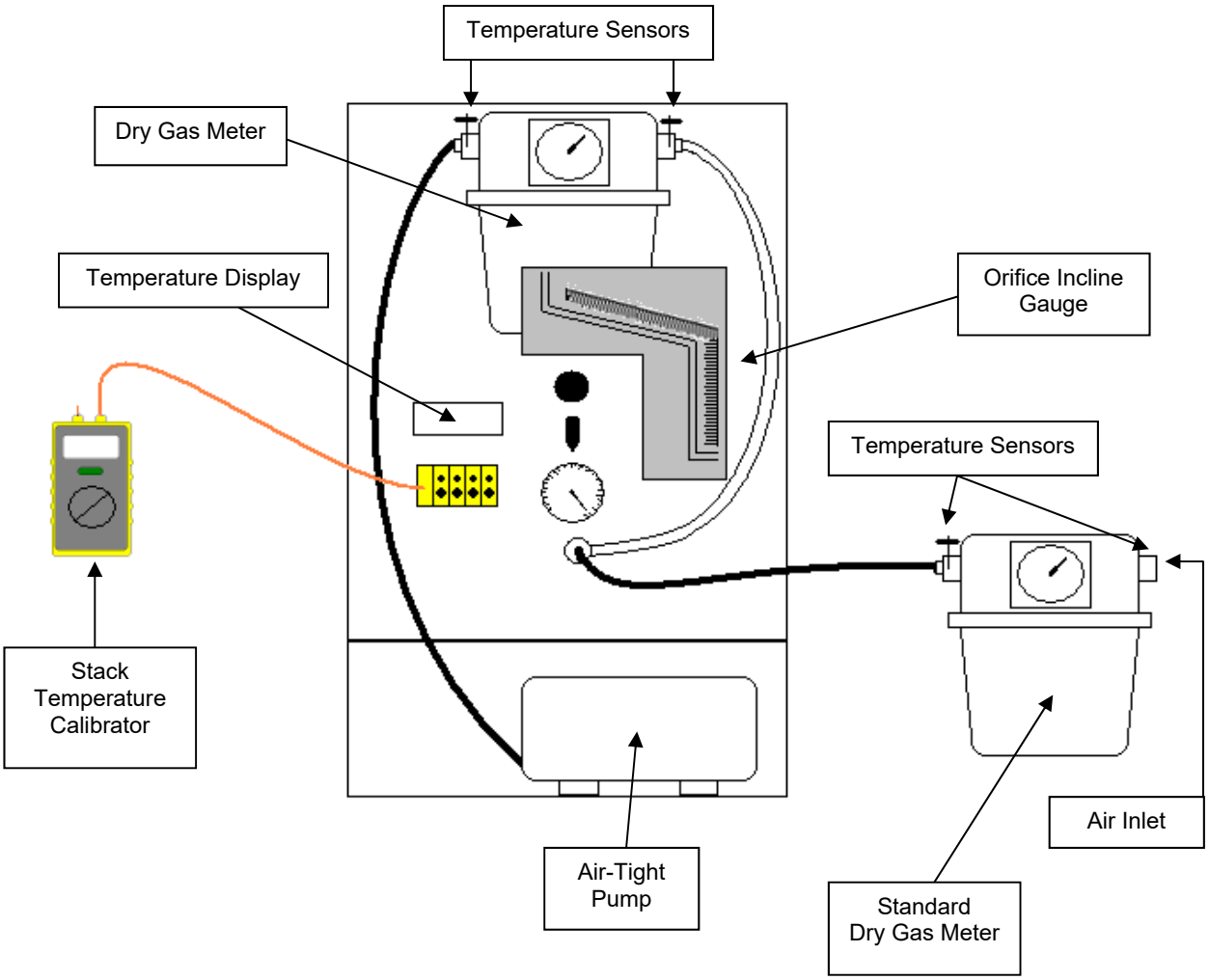
Project Number	M233901	**Source Condition:**	Normal
Client:	Ash Grove Cement Company	**Run No.:**	1
Facility:	Montana City Cement Plant	**Date:**	9/26/2023
Location:	Main Kiln (Train A)	**Start Time:**	14:07
Pitot ID:	S8-031A	**End Time:**	14:22
Pitot Coefficient:	0.820	**RM Testers:**	NJC
Probe Length: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

Appendix G - Calibration Data

Dry Gas Meter/Control Module Calibration Diagram



Dry Gas Meter Calibration Data

Dry Gas Meter No.	*CM46*	*Date:*	*September 5, 2023*
Standard Meter No.	*25125408*	*Calibrated By:*	*DV*
Standard Meter (Y)	*0.99800*	*Barometric Pressure:*	*28.09*

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			*109.822*	*84.911*	*80*	*79*	*79*					
Initial			*104.567*	*79.639*	*79*	*77*	*77*					
Difference	*1*	*0.20*	*5.255*	*5.272*	*80*	*78*	*78*	*78*	*19*	*36*	*0.991*	*1.714*
Final			*115.015*	*90.033*	*81*	*80*	*80*					
Initial			*109.822*	*84.911*	*80*	*79*	*79*					
Difference	*2*	*0.50*	*5.193*	*5.122*	*81*	*80*	*80*	*80*	*12*	*26*	*1.009*	*1.767*
Final			*120.336*	*95.378*	*81*	*81*	*81*					
Initial			*115.015*	*90.033*	*81*	*80*	*80*					
Difference	*3*	*0.70*	*5.321*	*5.345*	*81*	*81*	*81*	*81*	*10*	*39*	*0.991*	*1.729*
Final			*125.421*	*100.386*	*82*	*82*	*82*					
Initial			*120.336*	*95.378*	*81*	*81*	*81*					
Difference	*4*	*0.90*	*5.085*	*5.008*	*82*	*82*	*82*	*82*	*8*	*59*	*1.011*	*1.732*
Final			*133.350*	*108.110*	*82*	*83*	*83*					
Initial			*128.200*	*103.044*	*82*	*83*	*83*					
Difference	*5*	*1.20*	*5.150*	*5.066*	*82*	*83*	*83*	*83*	*7*	*51*	*1.013*	*1.717*
Final			*140.985*	*115.640*	*82*	*84*	*84*					
Initial			*133.350*	*108.110*	*82*	*83*	*83*					
Difference	*6*	*2.00*	*7.635*	*7.530*	*82*	*84*	*84*	*84*	*9*	*15*	*1.009*	*1.807*
								Average			***1.004***	***1.744***

Stack Temperature Sensor Calibration

Meter Box # : CM46 *Name :* DV

Ambient Temperature : 80.7 °F *Date :* September 5, 2023

Calibrator Model # : CL940A

Serial # : 526

Date Of Certification : December 28, 2022

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.	*CM46*	*Date:*	*November 17, 2023*
Standard Meter No.	*18654530*	*Calibrated By:*	*ER*
Standard Meter (Y)	*0.99730*	*Barometric Pressure:*	*28.27*

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			*80.549*	*65.360*	*65*	*66*	*66*					
Initial			*75.465*	*60.345*	*65*	*65*	*65*					
Difference	*1*	*0.20*	*5.084*	*5.015*	*65*	*66*	*66*	*66*	*18*	*5*	*1.011*	*1.504*
Final			*85.559*	*70.350*	*66*	*67*	*67*					
Initial			*80.549*	*65.360*	*65*	*66*	*66*					
Difference	*2*	*0.50*	*5.010*	*5.000*	*66*	*67*	*67*	*67*	*12*	*10*	*1.002*	*1.752*
Final			*90.641*	*75.396*	*66*	*68*	*68*					
Initial			*85.559*	*70.350*	*66*	*67*	*67*					
Difference	*3*	*0.70*	*5.082*	*5.046*	*66*	*68*	*68*	*68*	*10*	*10*	*1.005*	*1.665*
Final			*95.668*	*80.395*	*66*	*68*	*68*					
Initial			*90.641*	*75.396*	*66*	*68*	*68*					
Difference	*4*	*0.90*	*5.027*	*5.002*	*66*	*68*	*68*	*68*	*9*	*10*	*1.004*	*1.777*
Final			*100.775*	*85.482*	*67*	*70*	*70*					
Initial			*95.668*	*80.395*	*66*	*68*	*68*					
Difference	*5*	*1.20*	*5.107*	*5.087*	*67*	*69*	*69*	*69*	*8*	*10*	*1.003*	*1.822*
Final			*75.465*	*60.345*	*65*	*65*	*65*					
Initial			*70.355*	*55.335*	*65*	*65*	*65*					
Difference	*6*	*2.00*	*5.110*	*5.010*	*65*	*65*	*65*	*65*	*6*	*5*	*1.012*	*1.686*

Average	***1.006***	***1.701***

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	ER
Ambient Temperature, °F :	66.5	Date :	11/17/2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	May 1,2023
Serial # :	T-285668	Expiration Date:	May 2,2024

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.	*CM54*	*Date:*	*September 20, 2023*
Standard Meter No.	*18654530*	*Calibrated By:*	*IB*
Standard Meter (Y)	*0.99730*	*Barometric Pressure:*	*27.90*

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° 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			*46.811*	*120.965*	*85*	*88*	*88*					
Initial			*41.799*	*115.861*	*85*	*88*	*88*					
Difference	*1*	*0.20*	*5.012*	*5.104*	*85*	*88*	*88*	*88*	*20*	*5*	*0.984*	*1.998*
Final			*41.799*	*115.861*	*85*	*88*	*88*					
Initial			*36.741*	*110.737*	*86*	*87*	*87*					
Difference	*2*	*0.50*	*5.058*	*5.124*	*86*	*88*	*88*	*88*	*12*	*7*	*0.987*	*1.790*
Final			*36.741*	*110.737*	*86*	*87*	*87*					
Initial			*31.639*	*105.575*	*86*	*85*	*85*					
Difference	*3*	*0.70*	*5.102*	*5.162*	*86*	*86*	*86*	*86*	*10*	*27*	*0.984*	*1.841*
Final			*31.639*	*105.575*	*86*	*85*	*85*					
Initial			*26.613*	*100.508*	*86*	*85*	*85*					
Difference	*4*	*0.90*	*5.026*	*5.067*	*86*	*85*	*85*	*85*	*9*	*8*	*0.985*	*1.866*
Final			*26.613*	*100.508*	*86*	*85*	*85*					
Initial			*21.558*	*95.419*	*86*	*84*	*84*					
Difference	*5*	*1.20*	*5.055*	*5.089*	*86*	*85*	*85*	*85*	*8*	*15*	*0.985*	*2.009*
Final			*21.558*	*95.419*	*86*	*84*	*84*					
Initial			*16.526*	*90.382*	*85*	*84*	*84*					
Difference	*6*	*2.00*	*5.032*	*5.037*	*86*	*84*	*84*	*84*	*6*	*19*	*0.988*	*1.979*
										Average	***0.986***	***1.914***

Stack Temperature Sensor Calibration

Meter Box # : CM 54 *Name :* IB

Ambient Temperature : 88.7 °F *Date :* September 20, 2023

Calibrator Model # : CL940A

Serial # : 526

Date Of Certification : December 28, 2022

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	*250*	0.0
600	*599*	0.1
1200	*1200*	0.0

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

Dry Gas Meter Calibration Data

Dry Gas Meter No.	*CM54*	*Date:*	*December 1, 2023*
Standard Meter No.	*18654530*	*Calibrated By:*	*ER*
Standard Meter (Y)	*0.99730*	*Barometric Pressure:*	*28.09*

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			85.075	50.792	63	62	62					
Initial			80.075	45.760	62	61	61					
Difference	1	0.20	5.000	5.032	63	62	62	62	18	10	0.989	1.576
Final			90.083	55.842	63	64	64					
Initial			85.075	50.792	63	62	62					
Difference	2	0.50	5.008	5.050	63	63	63	63	12	5	0.988	1.736
Final			95.085	60.901	64	65	65					
Initial			90.083	55.842	63	64	64					
Difference	3	0.70	5.002	5.059	64	65	65	65	10	0	0.986	1.667
Final			100.343	66.210	64	66	66					
Initial			95.085	60.901	64	65	65					
Difference	4	0.90	5.258	5.309	64	66	66	66	9	15	0.988	1.659
Final			105.348	71.269	64	67	67					
Initial			100.343	66.210	64	66	66					
Difference	5	1.20	5.005	5.059	64	67	67	67	8	0	0.988	1.823
Final			80.075	45.760	62	61	61					
Initial			75.060	40.748	61	61	61					
Difference	6	2.00	5.015	5.012	62	61	61	61	6	0	0.992	1.704

Average	***0.988***	***1.694***

Stack Temperature Sensor Calibration

Meter Box # : CM54 *Name :* ER

Ambient Temperature : 63.5 °F *Date :* December 1, 2023

Calibrator Model # : CL940

Serial # : 526

Date Of Certification : December 28, 2022

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

Reference Source Temperature (°F)	***Test Thermometer Temperature (°F)***	***Temperature Difference %***
0	*1*	0.2
250	*252*	0.3
600	*602*	0.2
1200	*1205*	0.3

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

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

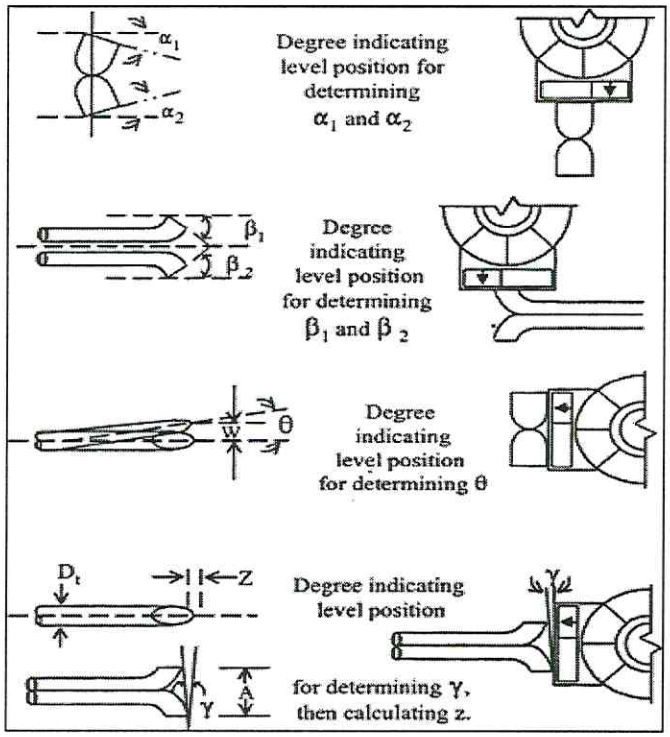
$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.45\%}$$ Pass

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°.

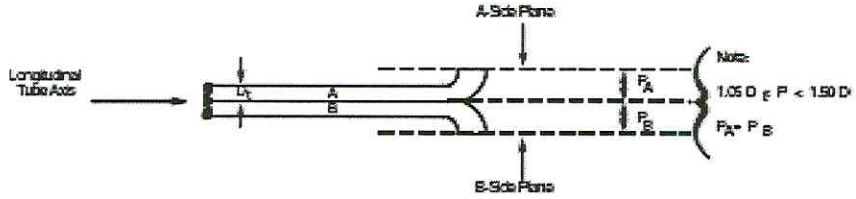
C_p = 0.818

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

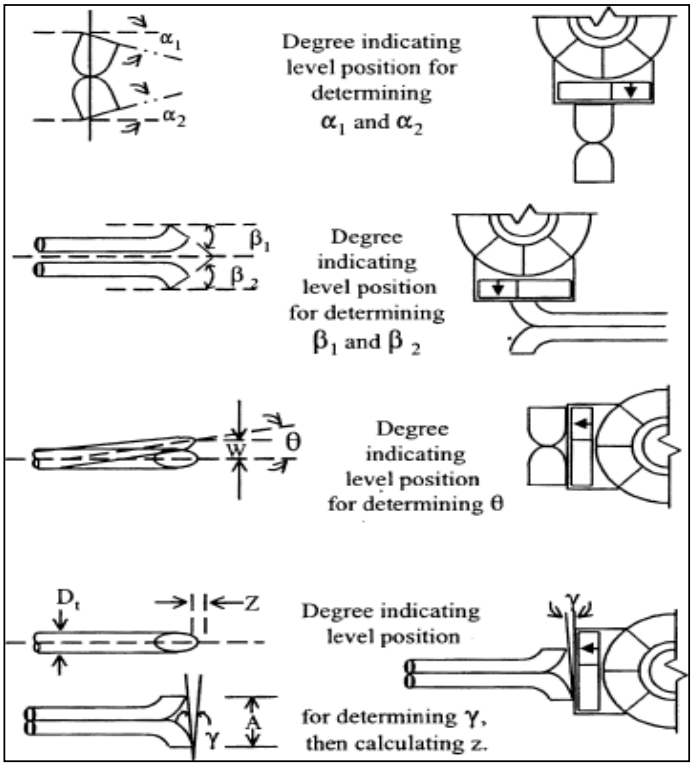
$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.43\%}$$ **Pass**

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.

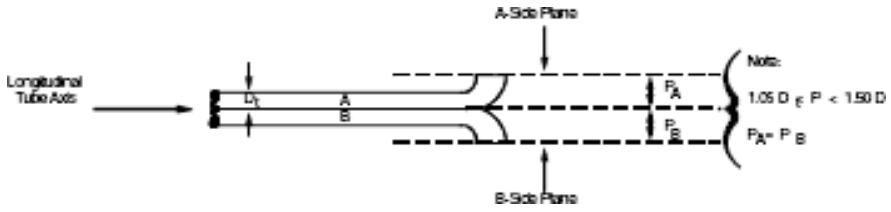
C_p = 0.821

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

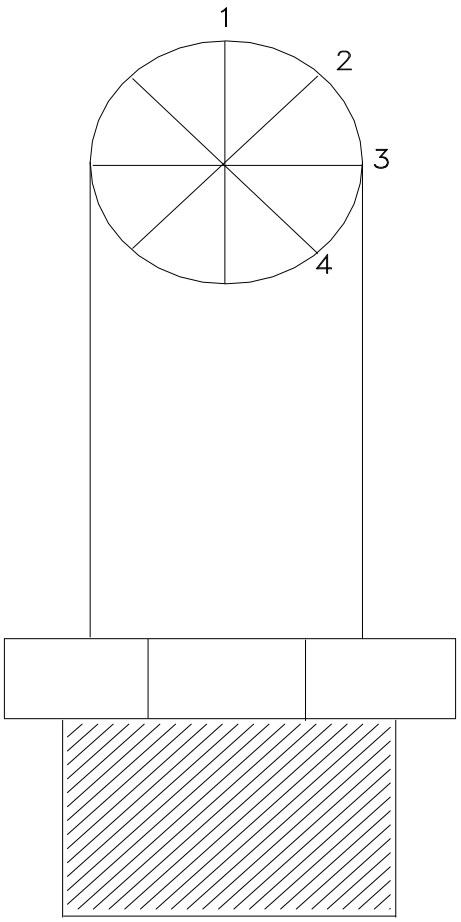
Nozzle Calibration

Date: 7/14/2023

Nozzle ID No.: 953

Analyst: RB

Material/Type: Glass



0.321	1
0.317	2
0.319	3
0.318	4

Out of Tolerance

Average
0.319

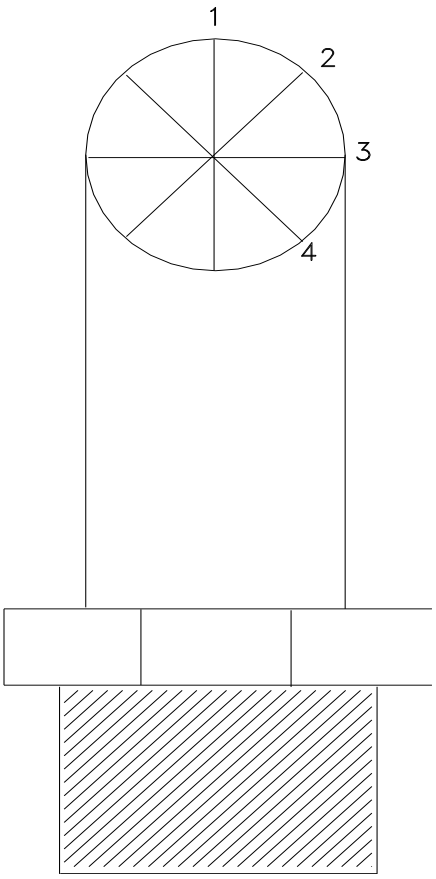
Nozzle Calibration

Date: 7/14/2023

Nozzle ID No.: 314

Analyst: RB

Material/Type: Quartz



0.276	1
0.275	2
0.276	3
0.276	4

Valid Data

Average
0.276

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/11/2023
Operator: R. Sollars
Operating Condition Mill On

Sample System:	FTIR				
Probe Length:	4.0	**ft**			
Probe Type:	FTIR				
Sample Plane:	Vertical				
Port Length:	8.5	**in.**			
Port Size (diameter):	6	**in.**			
Port Type:	Nipple				
Duct Shape:	Circular				
Diameter:	10.9	**ft**			
Duct Area:	93.31	**Sq. Ft.**			
Upstream Diameters:	4.13		Minimum Upstream Distance	5.5	Feet
Downstream Diameters:	16.52		Minimum Downstream Distance	21.8	Feet
Number of Ports Sampled:	1		Ideal Upstream Distance	21.8	Feet
Number of Points per Port:	1		Ideal Downstream Distance	87.2	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	-0.12	0.54%	N/A		1500
	Mid	CC153857	11.96	11.98	-0.09%	7/19/2031	53.37%	950
	High	CC420519	22.41	22.38	0.13%	7/15/2029		1000

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	CC401933	100.7	7/10/2026	1800
Analyte Spike Gas	HCN	CC768228	49.30	3/11/2024	1900
	SF6		5.009		

Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
O2 % (dry)	Servomex 1440	4447	25	22.41
HF ppmvw	MKS 2030	110161896	10	N/A
HCN ppmvw	MKS 2030	110161896	100	N/A

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Diluent: O2 %

Test Location: Main Kiln
Date: 10/11/23
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	11.96	12.00	11.91	-0.06	-0.06	-0.06	11.96	10.37	10.4	0.31	-0.40	-0.27	0.00
2	11.96	11.91	11.93	-0.06	-0.09	-0.08	11.92	10.34	10.4	0.22	0.09	-0.13	-0.13
3	11.96	11.93	11.91	-0.09	-0.10	-0.10	11.92	10.40	10.4	0.31	-0.09	-0.09	-0.04

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	10/11/23	8:30	9:29	17.23%	10.38	13.86	16.75	2.19	3.50	0.10	0.16
2	10/11/23	10:10	11:09	17.40%	10.39	13.86	16.78	1.81	2.89	0.10	0.16
3	10/11/23	11:45	12:44	17.18%	10.45	13.87	16.74	1.66	2.67	0.10	0.16

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Test Location: Main Kiln
Date: 10/11/23
Project #: M234105

Linearity Cal/Pre 1 Cal

Time	O2 % (dry)	
7:26	-0.05	
7:27	-0.11	
7:28	-0.12	iz
7:29	9.78	
7:30	21.36	
7:31	22.36	
7:32	22.38	ih
7:33	21.74	
7:34	12.94	
7:35	11.92	
7:36	11.98	im
7:37	14.65	
7:38	20.96	
7:39	20.24	
7:40	21.03	
7:41	21.08	
7:42	20.99	
7:43	19.18	
7:44	1.15	
7:45	0.05	
7:46	0.00	
7:47	6.50	
7:48	14.86	
7:49	0.56	
7:50	-0.01	
7:51	-0.04	
7:52	-0.05	
7:53	-0.06	z
7:54	-0.06	
7:55	7.32	
7:56	20.71	
7:57	20.99	
7:58	21.04	
7:59	21.06	
8:00	21.07	
8:01	21.09	
8:02	21.09	
8:03	16.20	
8:04	12.02	
8:05	12.00	m
8:06	11.99	

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/11/23

Post 1/Pre 2			Post 2/Pre 3		
Time	**O2 % (dry)**		**Time**	**O2 % (dry)**	
9:53	2.48		11:31	10.59	
9:54	0.00		11:32	11.87	
9:55	-0.05		11:33	11.91	
9:56	-0.07		11:34	11.92	
9:57	-0.06	**z**	11:35	11.93	**m**
9:58	9.55		11:36	11.93	
9:59	11.86		11:37	2.84	
10:00	11.91	**m**	11:38	0.00	
			11:39	-0.07	
			11:40	-0.09	**z**

Post 3		
Time	**O2 % (dry)**	
13:05	10.54	
13:06	11.85	
13:07	11.89	
13:08	11.91	**m**
13:09	4.70	
13:10	0.05	
13:11	-0.08	
13:12	-0.10	**z**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/12/2023
Operator: R. Sollars
Operating Condition Mill Off

Sample System:	FTIR			
Probe Length:	4.0	**ft**		
Probe Type:	FTIR			
Sample Plane:	Vertical			
Port Length:	8.5	**in.**		
Port Size (diameter):	6	**in.**		
Port Type:	Nipple			
Duct Shape:	Circular			
Diameter:	10.9	**ft**		
Duct Area:	93.31	**Sq. Ft.**		
Upstream Diameters:	4.13		Minimum Upstream Distance	5.5 Feet
Downstream Diameters:	16.52		Minimum Downstream Distance	21.8 Feet
Number of Ports Sampled:	1		Ideal Upstream Distance	21.8 Feet
Number of Points per Port:	1		Ideal Downstream Distance	87.2 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	-0.15	0.67%	N/A		1500
	Mid	CC153857	11.96	11.91	0.22%	7/19/2031	53.37%	950
	High	CC420519	22.41	22.41	0.00%	7/15/2029		1000

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	CC401933	100.7	7/10/2026	1800
Analyte Spike Gas	HCN	CC768228	49.30	3/11/2024	1900
	SF6		5.009		

Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
O2 % (dry)	Servomex 1440	4447	25	22.41
HF ppmvw	MKS 2030	110161896	10	N/A
HCN ppmvw	MKS 2030	110161896	100	N/A

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Diluent: O2 %

Test Location: Main Kiln
Date: 10/12/23
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	11.96	11.98	11.94	-0.11	-0.09	-0.10	11.96	8.87	8.9	-0.13	-0.18	-0.27	0.09
2	11.96	11.94	11.97	-0.09	-0.11	-0.10	11.96	8.76	8.8	-0.27	0.13	-0.18	-0.09
3	11.96	11.97	11.99	-0.11	-0.11	-0.11	11.98	8.74	8.8	-0.36	0.09	-0.18	0.00

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	10/12/23	10:45	11:44	19.88%	8.90	15.04	18.77	2.08	3.01	0.10	0.14
2	10/12/23	12:15	13:14	19.28%	8.79	15.55	19.26	2.03	2.88	0.10	0.14
3	10/12/23	13:50	14:49	19.15%	8.75	15.45	19.11	2.00	2.83	0.10	0.14

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Test Location: Main Kiln
Date: 10/12/23
Project #: M234105

Linearity Cal/Pre 1 Cal

Time	O2 % (dry)	
7:06	-0.03	
7:07	-0.15	iz
7:08	0.28	
7:09	17.02	
7:10	21.83	
7:11	22.49	
7:12	22.41	ih
7:13	22.22	
7:14	18.86	
7:15	12.45	
7:16	11.96	
7:17	11.91	im
7:18	14.02	
7:19	19.13	
7:20	20.85	
7:21	15.57	
7:22	1.26	
7:23	0.16	
7:24	14.40	
7:25	20.45	
7:26	20.89	
7:27	20.96	
7:28	20.98	
7:29	19.70	
7:30	10.03	
7:31	8.95	
7:32	9.01	
7:33	9.16	
7:34	6.55	
7:35	0.44	
7:36	-0.02	
7:37	-0.09	
7:38	-0.11	z
7:39	1.23	
7:40	10.58	
7:41	11.72	
7:42	11.87	
7:43	11.98	
7:44	11.97	
7:45	11.98	m

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Test Location: Main Kiln
Date: 10/12/23

Post 1/Pre 2			Post 2/Pre 3		
Time	**O2 % (dry)**		**Time**	**O2 % (dry)**	
12:00	6.15		13:31	2.20	
12:01	0.50		13:32	0.09	
12:02	-0.01		13:33	-0.08	
12:03	-0.09	**z**	13:34	-0.11	**z**
12:04	0.88		13:35	6.64	
12:05	10.52		13:36	11.63	
12:06	11.77		13:37	11.98	
12:07	11.94	**m**	13:38	11.97	**m**

Post 3		
Time	**O2 % (dry)**	
15:08	0.22	
15:09	-0.05	
15:10	-0.11	**z**
15:11	2.69	
15:12	11.09	
15:13	13.68	
15:14	12.31	
15:15	12.02	
15:16	11.99	**m**
15:17	11.99	

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	0.01 heated borosilicate glass fiber	191°C

A/ C procedures followed US EPA Method 320 guidelines. See below for A/ C 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 A/ C procedures were within the acceptance criteria allowance of the applicable EPA methodology. Detailed FTIR A/ C 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	100.7	Airgas	CC401933	Primary /- 1%
HCN/SF_6	49.30/5.009	Airgas	CC768228	Certified Standard-Spec /- 5%
Nitrogen	ZZero Gas	Airgas	ZZero 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.

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Operating Condition: Mill On

Test Location: Main Kiln
Date: 10/11/2023
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_000002.LAB	10/11/23	7:14:51	0.0	0.0	0.0	190.3	0.97	0.6	0.1	-0.003
N2_DIR_000003BKG.LAB	10/11/23	7:17:04	0.0	0.0	0.0	190.5	0.97	0.0	0.0	0.000
N2_DIR_000004.LAB	10/11/23	7:17:18	0.0	0.0	0.0	190.6	0.97	0.0	0.1	0.004
N2_DIR_000005.LAB	10/11/23	7:17:26	0.0	0.0	0.0	190.6	0.97	-0.1	0.0	-0.010
N2_DIR_000006.LAB	10/11/23	7:17:34	0.0	0.0	0.0	190.6	0.97	-0.1	-0.1	0.012
N2_DIR_000007.LAB	10/11/23	7:17:41	0.0	0.0	0.0	190.6	0.97	0.1	0.1	-0.004
N2_DIR_000008.LAB	10/11/23	7:17:49	0.0	0.0	0.0	190.6	0.97	-0.1	-0.3	0.000
N2_DIR_000009.LAB	10/11/23	7:17:57	0.0	0.0	0.0	190.6	0.97	-0.1	0.1	-0.009
N2_DIR_000010.LAB	10/11/23	7:18:05	0.0	0.0	0.0	190.6	0.97	-0.1	0.0	0.002

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_000038.LAB	10/11/23	7:23:09	0.0	0.0	0.0	191.1	0.91	99.9	-0.1	-0.034	**99.2%**
CTS_DIR_000039.LAB	10/11/23	7:23:17	0.0	0.0	0.0	191.1	0.91	99.6	-0.1	-0.023	**98.9%**
CTS_DIR_000040.LAB	10/11/23	7:23:25	0.0	0.0	0.0	191.1	0.91	99.7	-0.1	-0.024	**99.0%**
CTS_DIR_000041.LAB	10/11/23	7:23:32	0.0	0.0	0.0	191.1	0.91	99.7	0.1	-0.027	**99.0%**
CTS_DIR_000042.LAB	10/11/23	7:23:41	0.0	0.0	0.0	191.2	0.91	99.7	0.1	-0.022	**99.1%**
CTS_DIR_000043.LAB	10/11/23	7:23:48	0.0	0.0	0.0	191.1	0.91	100.1	-0.2	-0.020	**99.4%**
CTS_DIR_000044.LAB	10/11/23	7:23:56	0.0	0.0	0.0	191.1	0.91	99.6	0.0	-0.027	**98.9%**
	Average							**99.8**			**99.1%**

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
HCN_DIR_000060.LAB	10/11/23	7:27:39	0.0	0.0	0.0	191.2	0.93	-0.2	51.1	4.910	**103.8%**
HCN_DIR_000061.LAB	10/11/23	7:27:47	0.0	0.0	0.0	191.2	0.93	-0.1	51.5	4.915	**104.6%**
HCN_DIR_000062.LAB	10/11/23	7:27:55	0.0	0.0	0.1	191.2	0.92	0.1	51.6	4.899	**104.6%**
HCN_DIR_000063.LAB	10/11/23	7:28:03	0.0	0.0	0.0	191.2	0.93	-0.2	51.4	4.899	**104.3%**
HCN_DIR_000064.LAB	10/11/23	7:28:11	0.0	0.0	0.0	191.2	0.93	-0.1	51.4	4.904	**104.3%**
HCN_DIR_000065.LAB	10/11/23	7:28:19	0.0	0.0	0.0	191.2	0.93	-0.2	51.6	4.903	**104.7%**
HCN_DIR_000066.LAB	10/11/23	7:28:27	0.0	0.0	0.0	191.2	0.92	-0.2	51.3	4.908	**104.0%**
HCN_DIR_000067.LAB	10/11/23	7:28:34	0.0	0.0	0.1	191.2	0.92	-0.1	51.3	4.903	**104.0%**
	Average								**51.4**	**4.905**	**104.3%**

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
CTS_RT2_000094.LAB	10/11/23	7:43:53	0.0	0.0	0.0	191.1	0.92	99.3	-0.2	-0.033	**98.6%**
CTS_RT2_000095.LAB	10/11/23	7:44:01	0.0	0.0	0.0	191.2	0.92	99.5	0.0	-0.029	**98.8%**
CTS_RT2_000096.LAB	10/11/23	7:44:09	0.0	0.0	0.0	191.1	0.92	99.7	0.0	-0.028	**100.0%**
CTS_RT2_000097.LAB	10/11/23	7:44:17	0.0	0.0	0.0	191.2	0.92	99.7	-0.2	-0.035	**99.9%**
CTS_RT2_000098.LAB	10/11/23	7:44:25	0.0	0.0	0.0	191.2	0.92	99.6	-0.1	-0.032	**99.9%**
CTS_RT2_000099.LAB	10/11/23	7:44:33	0.0	0.0	0.0	191.2	0.92	100.0	-0.1	-0.037	**100.2%**
CTS_RT2_000100.LAB	10/11/23	7:44:41	0.0	0.0	0.0	191.2	0.92	100.1	-0.2	-0.024	**100.3%**
CTS_RT2_000101.LAB	10/11/23	7:44:48	0.0	0.0	0.1	191.2	0.92	99.9	0.0	-0.033	**100.1%**

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_000090.LAB	10/11/23	7:43:22	0.9	0.1	0.0	191.2	0.92	0.3	-0.3	-0.021	-
CTS_RT2_000091.LAB	10/11/23	7:43:30	0.8	0.0	0.0	191.2	0.92	7.7	0.5	-0.026	**15.527**
CTS_RT2_000092.LAB	10/11/23	7:43:38	0.2	0.0	0.0	191.2	0.92	91.4	0.8	-0.022	**23.527**
CTS_RT2_000093.LAB	10/11/23	7:43:45	0.1	0.0	0.0	191.2	0.92	98.9	-0.1	-0.034	
CTS_RT2_000094.LAB	10/11/23	7:43:53	0.0	0.0	0.0	191.1	0.92	99.3	-0.2	-0.033	
CTS_RT2_000095.LAB	10/11/23	7:44:01	0.0	0.0	0.0	191.2	0.92	99.5	0.0	-0.029	
CTS_RT2_000096.LAB	10/11/23	7:44:09	0.0	0.0	0.0	191.1	0.92	99.7	0.0	-0.028	
CTS_RT2_000097.LAB	10/11/23	7:44:17	0.0	0.0	0.0	191.2	0.92	99.7	-0.2	-0.035	
CTS_RT2_000098.LAB	10/11/23	7:44:25	0.0	0.0	0.0	191.2	0.92	99.6	-0.1	-0.032	

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Operating Condition: Mill On

Test Location: Main Kiln
Date: 10/11/2023
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_SAMPLE_000240.LAB	10/11/23	8:11:49	17.1	13.5	-0.1	191.1	0.92	1.1	2.1	-0.024
PRE1_SAMPLE_000241.LAB	10/11/23	8:11:57	17.0	13.6	-0.1	191.2	0.92	1.2	2.2	-0.021
PRE1_SAMPLE_000242.LAB	10/11/23	8:12:05	17.1	13.7	-0.2	191.2	0.92	1.1	2.1	-0.020
									2.2	**-0.022**

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_000255.LAB	10/11/23	8:16:07	15.7	12.5	-0.2	190.8	0.92	1.0	6.2	0.395	**0.081**	**101.9%**
PRE1_SPIKE_000256.LAB	10/11/23	8:16:15	15.8	12.4	-0.2	190.7	0.92	1.2	6.4	0.393	**0.080**	**105.1%**
PRE1_SPIKE_000257.LAB	10/11/23	8:16:23	15.8	12.3	-0.2	190.7	0.92	0.9	6.4	0.391	**0.080**	**104.6%**
PRE1_SPIKE_000258.LAB	10/11/23	8:16:31	15.8	12.3	-0.1	190.7	0.92	0.9	6.2	0.394	**0.080**	**101.0%**
PRE1_SPIKE_000259.LAB	10/11/23	8:16:38	15.8	12.3	-0.1	190.7	0.92	1.0	6.3	0.394	**0.080**	**102.7%**
PRE1_SPIKE_000260.LAB	10/11/23	8:16:46	15.7	12.4	-0.2	190.7	0.92	1.2	6.3	0.393	**0.080**	**103.0%**
PRE1_SPIKE_000261.LAB	10/11/23	8:16:54	15.7	12.5	-0.1	190.7	0.92	1.1	6.3	0.391	**0.080**	**104.4%**
PRE1_SPIKE_000262.LAB	10/11/23	8:17:02	15.7	12.6	-0.2	190.7	0.92	1.1	6.1	0.388	**0.079**	**100.7%**

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
RUN1_000374.LAB	10/11/23	9:38:41	17.3	13.7	-0.2	191.2	0.93	1.2	2.0	-0.023
RUN1_000375.LAB	10/11/23	9:39:44	17.2	13.9	-0.2	191.2	0.92	1.2	2.0	-0.022
RUN1_000376.LAB	10/11/23	9:40:47	17.4	13.7	-0.2	191.2	0.92	1.2	2.0	-0.023
									2.0	**-0.023**

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
POST1_SPK_000424.LAB	10/11/23	9:50:16	15.6	12.5	-0.2	191.2	0.93	1.1	6.1	0.404	**0.082**	**100.8%**
POST1_SPK_000425.LAB	10/11/23	9:50:24	15.7	12.4	-0.2	191.2	0.92	1.0	6.1	0.404	**0.082**	**101.0%**
POST1_SPK_000426.LAB	10/11/23	9:50:32	15.8	12.4	-0.2	191.2	0.93	1.0	6.2	0.407	**0.083**	**101.1%**
POST1_SPK_000427.LAB	10/11/23	9:50:40	15.8	12.5	-0.2	191.2	0.93	1.1	6.1	0.405	**0.083**	**99.5%**
POST1_SPK_000428.LAB	10/11/23	9:50:48	15.7	12.6	-0.2	191.2	0.93	1.0	6.1	0.410	**0.084**	**99.6%**
POST1_SPK_000429.LAB	10/11/23	9:50:55	15.7	12.7	-0.2	191.2	0.92	1.1	6.1	0.407	**0.083**	**100.1%**
POST1_SPK_000430.LAB	10/11/23	9:51:03	15.7	12.7	-0.2	191.2	0.92	1.0	6.2	0.400	**0.082**	**102.4%**
POST1_SPK_000431.LAB	10/11/23	9:51:11	15.8	12.7	-0.2	191.2	0.92	1.0	6.2	0.404	**0.082**	**101.6%**

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
POST1_CTS_000465.LAB	10/11/23	9:56:34	0.1	0.0	0.0	191.2	0.92	99.5	0.3	-0.035	**99.8%**
POST1_CTS_000466.LAB	10/11/23	9:56:42	0.1	0.0	0.0	191.2	0.92	99.7	0.1	-0.027	**99.9%**
POST1_CTS_000467.LAB	10/11/23	9:56:50	0.1	0.0	0.0	191.2	0.92	99.9	0.3	-0.036	**100.1%**
POST1_CTS_000468.LAB	10/11/23	9:56:58	0.1	0.0	0.0	191.2	0.92	99.7	0.2	-0.030	**99.9%**
POST1_CTS_000469.LAB	10/11/23	9:57:06	0.1	0.0	0.0	191.2	0.92	100.0	0.2	-0.035	**100.2%**
POST1_CTS_000470.LAB	10/11/23	9:57:13	0.1	0.0	0.0	191.2	0.92	99.5	0.0	-0.032	**99.7%**
POST1_CTS_000471.LAB	10/11/23	9:57:21	0.1	0.0	0.0	191.2	0.92	99.6	0.2	-0.029	**99.8%**
POST1_CTS_000472.LAB	10/11/23	9:57:29	0.1	0.0	0.0	191.2	0.92	99.7	0.2	-0.029	**99.9%**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Operating Condition: Mill On

Test Location: Main Kiln
Date: 10/11/2023
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_000594.LAB	10/11/23	11:20:18	17.2	13.9	-0.2	191.2	0.93	1.1	1.9	-0.018
RUN2_000595.LAB	10/11/23	11:21:20	17.4	13.9	-0.2	191.2	0.93	1.1	1.9	-0.020
RUN2_000596.LAB	10/11/23	11:22:23	17.8	13.8	-0.2	191.1	0.93	1.1	1.8	-0.020
									1.9	**-0.019**

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_000609.LAB	10/11/23	11:26:41	16.1	12.8	-0.2	191.0	0.93	0.9	5.8	0.398	**0.081**	**99.4%**
POST2_SPK_000610.LAB	10/11/23	11:26:49	16.1	12.8	-0.2	191.0	0.93	0.8	6.0	0.396	**0.081**	**102.7%**
POST2_SPK_000611.LAB	10/11/23	11:26:56	16.2	12.8	-0.2	191.0	0.93	1.1	5.7	0.399	**0.081**	**96.7%**
POST2_SPK_000612.LAB	10/11/23	11:27:04	16.2	12.8	-0.2	191.0	0.93	1.0	5.9	0.397	**0.081**	**100.5%**
POST2_SPK_000613.LAB	10/11/23	11:27:12	16.2	12.8	-0.2	191.0	0.93	1.2	6.0	0.400	**0.082**	**101.0%**
POST2_SPK_000614.LAB	10/11/23	11:27:20	16.2	12.8	-0.2	191.0	0.92	0.9	5.9	0.396	**0.081**	**100.7%**
POST2_SPK_000615.LAB	10/11/23	11:27:28	16.2	12.8	-0.2	191.0	0.93	0.8	6.0	0.391	**0.080**	**103.7%**
POST2_SPK_000616.LAB	10/11/23	11:27:35	16.2	12.8	-0.2	191.0	0.93	1.1	5.9	0.393	**0.080**	**101.9%**

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_000620.LAB	10/11/23	11:29:06	0.2	0.1	0.0	191.2	0.93	99.0	0.3	-0.025	**99.2%**
POST2_CTS_000621.LAB	10/11/23	11:29:14	0.2	0.1	0.0	191.2	0.93	99.1	0.3	-0.024	**99.3%**
POST2_CTS_000622.LAB	10/11/23	11:29:21	0.2	0.1	0.0	191.2	0.93	99.6	0.2	-0.025	**99.9%**
POST2_CTS_000623.LAB	10/11/23	11:29:29	0.2	0.1	0.0	191.1	0.93	99.3	0.3	-0.027	**99.5%**
POST2_CTS_000624.LAB	10/11/23	11:29:37	0.1	0.1	0.0	191.2	0.93	99.5	0.3	-0.027	**99.8%**
POST2_CTS_000625.LAB	10/11/23	11:29:45	0.1	0.1	0.0	191.2	0.93	99.1	0.3	-0.040	**99.3%**
POST2_CTS_000626.LAB	10/11/23	11:29:53	0.1	0.0	0.0	191.2	0.93	99.7	0.5	-0.032	**99.9%**
POST2_CTS_000627.LAB	10/11/23	11:30:01	0.1	0.0	0.0	191.2	0.93	99.3	0.1	-0.026	**99.5%**

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
RUN3_000721.LAB	10/11/23	12:52:05	17.7	13.7	-0.2	191.3	0.93	1.1	1.7	-0.017
RUN3_000722.LAB	10/11/23	12:53:08	17.5	13.6	-0.2	191.4	0.93	1.0	1.7	-0.017
RUN3_000723.LAB	10/11/23	12:54:10	17.6	13.9	-0.2	191.4	0.93	1.1	1.7	-0.016
									1.7	**-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_000747.LAB	10/11/23	13:00:13	16.0	12.5	-0.2	191.2	0.93	0.8	5.8	0.421	**0.086**	**97.1%**
POST3_SPK_000748.LAB	10/11/23	13:00:21	16.0	12.5	-0.2	191.2	0.93	1.0	6.0	0.425	**0.087**	**99.8%**
POST3_SPK_000749.LAB	10/11/23	13:00:29	16.1	12.6	-0.2	191.2	0.93	1.0	6.0	0.414	**0.084**	**101.1%**
POST3_SPK_000750.LAB	10/11/23	13:00:36	16.0	12.6	-0.2	191.2	0.93	0.9	6.0	0.421	**0.086**	**101.4%**
POST3_SPK_000751.LAB	10/11/23	13:00:44	15.9	12.6	-0.2	191.2	0.93	0.9	6.0	0.432	**0.088**	**98.6%**
POST3_SPK_000752.LAB	10/11/23	13:00:52	15.9	12.6	-0.3	191.2	0.93	0.9	5.8	0.427	**0.087**	**95.8%**
POST3_SPK_000753.LAB	10/11/23	13:01:00	15.9	12.7	-0.2	191.2	0.93	0.8	6.0	0.423	**0.086**	**100.3%**
POST3_SPK_000754.LAB	10/11/23	13:01:08	16.0	12.7	-0.2	191.2	0.93	0.9	6.1	0.419	**0.085**	**102.6%**

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
POST3_CTS_000762.LAB	10/11/23	13:03:04	0.2	0.1	0.0	191.3	0.93	99.2	0.1	-0.026	**99.4%**
POST3_CTS_000763.LAB	10/11/23	13:03:12	0.1	0.1	0.0	191.3	0.93	99.2	0.3	-0.031	**99.4%**
POST3_CTS_000764.LAB	10/11/23	13:03:20	0.1	0.1	0.0	191.2	0.93	99.3	0.1	-0.020	**99.6%**
POST3_CTS_000765.LAB	10/11/23	13:03:28	0.1	0.1	0.0	191.2	0.93	99.5	0.2	-0.028	**99.7%**
POST3_CTS_000766.LAB	10/11/23	13:03:36	0.1	0.1	0.0	191.2	0.93	99.4	0.1	-0.025	**99.6%**
POST3_CTS_000767.LAB	10/11/23	13:03:43	0.1	0.1	0.1	191.2	0.93	99.4	0.2	-0.025	**99.6%**
POST3_CTS_000768.LAB	10/11/23	13:03:51	0.1	0.1	0.0	191.2	0.93	99.6	0.1	-0.019	**99.8%**
POST3_CTS_000769.LAB	10/11/23	13:03:59	0.1	0.1	0.1	191.2	0.93	99.6	0.1	-0.029	**99.8%**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Operating Condition: Mill On

Test Location: Main Kiln
Date: 10/11/2023
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
POST3_CTS_DIR_000821.LAB	10/11/23	13:19:34	0.0	0.0	0.0	191.2	0.93	100.1	-0.1	-0.022	**100.3%**
POST3_CTS_DIR_000822.LAB	10/11/23	13:19:42	0.0	0.0	0.0	191.2	0.93	100.0	-0.2	-0.026	**100.3%**
POST3_CTS_DIR_000823.LAB	10/11/23	13:19:50	0.0	0.0	0.0	191.2	0.93	100.3	-0.2	-0.017	**100.6%**
POST3_CTS_DIR_000824.LAB	10/11/23	13:19:58	0.0	0.0	0.0	191.1	0.93	100.5	-0.1	-0.015	**100.7%**
POST3_CTS_DIR_000825.LAB	10/11/23	13:20:06	0.0	0.0	0.0	191.1	0.93	100.5	-0.1	-0.008	**100.7%**
POST3_CTS_DIR_000826.LAB	10/11/23	13:20:13	0.0	0.0	0.0	191.1	0.93	100.2	-0.3	-0.017	**100.4%**
POST3_CTS_DIR_000827.LAB	10/11/23	13:20:21	0.0	0.0	0.0	191.1	0.93	100.3	-0.1	-0.010	**100.6%**
POST3_CTS_DIR_000828.LAB	10/11/23	13:20:29	0.0	0.0	0.0	191.1	0.93	100.2	0.1	-0.014	**100.5%**
	Average							**100.3**			

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
POST3_N2_DIR_000831.LAB	10/11/23	13:26:43	0.0	0.0	0.0	191.1	0.93	0.0	-0.1	-0.002
POST3_N2_DIR_000832.LAB	10/11/23	13:28:49	0.0	0.0	0.0	190.8	0.93	0.0	-0.1	-0.001
POST3_N2_DIR_000833.LAB	10/11/23	13:30:54	0.0	0.0	0.0	190.6	0.93	0.0	-0.1	-0.002

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Operating Condition: Mill Off

Test Location: Main Kiln
Date: 10/12/2023
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_000002.LAB	10/12/23	6:56:40	0.0	0.0	0.0	190.8	0.93	-0.1	-0.2	-0.006
N2_DIR_000003BKG.LAB	10/12/23	6:58:53	0.0	0.0	0.0	190.8	0.93	0.0	0.0	0.000
N2_DIR_000004.LAB	10/12/23	6:59:07	0.0	0.0	0.1	190.7	0.93	0.0	0.1	-0.009
N2_DIR_000005.LAB	10/12/23	6:59:15	0.0	0.0	0.0	190.7	0.93	0.1	0.1	-0.002
N2_DIR_000006.LAB	10/12/23	6:59:23	0.0	0.0	0.0	190.7	0.93	0.2	0.1	-0.001
N2_DIR_000007.LAB	10/12/23	6:59:31	0.0	0.0	0.0	190.7	0.93	0.2	0.0	-0.001
N2_DIR_000008.LAB	10/12/23	6:59:39	0.0	0.0	0.0	190.7	0.93	0.0	0.0	0.009
N2_DIR_000009.LAB	10/12/23	6:59:46	0.0	0.0	0.0	190.7	0.93	0.1	-0.1	0.001
N2_DIR_000010.LAB	10/12/23	6:59:54	0.0	0.0	0.0	190.7	0.93	0.1	-0.1	-0.001

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_000021.LAB	10/12/23	7:02:19	0.0	0.0	0.0	190.7	0.93	99.8	-0.2	-0.021	**99.1%**
CTS_DIR_000022.LAB	10/12/23	7:02:27	0.0	0.0	0.0	190.7	0.93	100.0	0.0	-0.017	**99.3%**
CTS_DIR_000023.LAB	10/12/23	7:02:35	0.0	0.0	0.0	190.8	0.93	100.0	-0.1	-0.024	**99.4%**
CTS_DIR_000024.LAB	10/12/23	7:02:43	0.0	0.0	-0.1	190.8	0.93	99.4	-0.2	-0.023	**98.7%**
CTS_DIR_000025.LAB	10/12/23	7:02:50	0.0	0.0	0.0	190.7	0.93	99.7	0.2	-0.011	**99.0%**
CTS_DIR_000026.LAB	10/12/23	7:02:59	0.0	0.0	0.0	190.7	0.93	99.9	-0.1	-0.022	**99.2%**
CTS_DIR_000027.LAB	10/12/23	7:03:06	0.0	0.0	0.0	190.7	0.93	99.6	0.0	-0.022	**98.9%**
	Average							**99.8**			**99.1%**

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
HCN_DIR_000043.LAB	10/12/23	7:06:58	0.0	0.0	0.0	190.6	0.94	-0.2	50.9	4.875	**103.3%**
HCN_DIR_000044.LAB	10/12/23	7:07:06	0.0	0.0	0.0	190.6	0.94	-0.4	50.9	4.870	**103.3%**
HCN_DIR_000045.LAB	10/12/23	7:07:14	0.0	0.0	0.0	190.6	0.94	-0.4	51.0	4.873	**103.4%**
HCN_DIR_000046.LAB	10/12/23	7:07:21	0.0	0.0	0.0	190.6	0.94	-0.3	51.2	4.878	**103.8%**
HCN_DIR_000047.LAB	10/12/23	7:07:29	0.0	0.0	0.0	190.6	0.94	-0.2	51.2	4.875	**103.9%**
HCN_DIR_000048.LAB	10/12/23	7:07:37	0.0	0.0	0.0	190.6	0.94	-0.2	51.0	4.866	**103.4%**
HCN_DIR_000049.LAB	10/12/23	7:07:45	0.0	0.0	0.0	190.6	0.94	-0.4	50.9	4.883	**103.3%**
HCN_DIR_000050.LAB	10/12/23	7:07:53	0.0	0.0	0.0	190.6	0.94	-0.4	51.3	4.868	**104.1%**
	Average								**51.1**	**4.874**	**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
CTS_RT_000088.LAB	10/12/23	7:21:39	0.1	0.0	0.0	190.7	0.94	99.2	-0.1	-0.015	**98.5%**
CTS_RT_000089.LAB	10/12/23	7:21:46	0.1	0.0	0.0	190.7	0.94	99.4	0.0	-0.008	**98.7%**
CTS_RT_000090.LAB	10/12/23	7:21:54	0.0	0.0	0.0	190.7	0.94	99.1	0.0	-0.026	**99.3%**
CTS_RT_000091.LAB	10/12/23	7:22:02	0.1	0.0	0.0	190.7	0.94	99.2	0.0	-0.027	**99.4%**
CTS_RT_000092.LAB	10/12/23	7:22:10	0.1	0.0	0.0	190.7	0.94	99.1	0.2	-0.022	**99.3%**
CTS_RT_000093.LAB	10/12/23	7:22:18	0.0	0.0	0.0	190.7	0.94	99.2	0.0	-0.030	**99.4%**
CTS_RT_000094.LAB	10/12/23	7:22:26	0.1	0.0	0.0	190.7	0.94	99.0	0.1	-0.016	**99.2%**
CTS_RT_000095.LAB	10/12/23	7:22:34	0.0	0.0	0.0	190.7	0.94	99.2	0.2	-0.017	**99.4%**

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_RT_000082.LAB	10/12/23	7:20:52	0.9	0.0	0.0	190.7	0.94	-0.2	0.2	-0.005	-
CTS_RT_000083.LAB	10/12/23	7:20:59	0.8	0.2	0.0	190.7	0.94	29.0	1.6	-0.029	**15.626**
CTS_RT_000084.LAB	10/12/23	7:21:07	0.1	0.0	0.0	190.7	0.94	96.3	0.2	-0.018	**23.626**
CTS_RT_000085.LAB	10/12/23	7:21:15	0.1	0.0	0.0	190.7	0.94	98.3	0.1	-0.029	
CTS_RT_000086.LAB	10/12/23	7:21:23	0.1	0.0	0.0	190.7	0.94	98.6	0.1	-0.017	
CTS_RT_000087.LAB	10/12/23	7:21:31	0.1	0.0	0.0	190.7	0.94	99.2	0.1	-0.024	
CTS_RT_000088.LAB	10/12/23	7:21:39	0.1	0.0	0.0	190.7	0.94	99.2	-0.1	-0.015	
CTS_RT_000089.LAB	10/12/23	7:21:46	0.1	0.0	0.0	190.7	0.94	99.4	0.0	-0.008	
CTS_RT_000090.LAB	10/12/23	7:21:54	0.0	0.0	0.0	190.7	0.94	99.1	0.0	-0.026	

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Operating Condition: Mill Off

Test Location: Main Kiln
Date: 10/12/2023
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_SAMPLE_000218.LAB	10/12/23	7:48:00	20.4	14.0	-0.1	190.9	0.94	1.1	1.9	-0.010
PRE1_SAMPLE_000219.LAB	10/12/23	7:48:07	20.4	14.0	-0.2	190.9	0.94	1.2	1.8	-0.006
PRE1_SAMPLE_000220.LAB	10/12/23	7:48:15	20.4	14.1	-0.2	190.9	0.94	1.1	1.8	-0.005
									1.9	**-0.007**

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_SPK_000243.LAB	10/12/23	7:53:49	19.2	12.6	-0.2	190.7	0.94	1.0	5.4	0.372	**0.076**	**95.1%**
PRE1_SPK_000244.LAB	10/12/23	7:53:57	19.3	12.6	-0.1	190.7	0.94	1.0	5.4	0.371	**0.076**	**96.6%**
PRE1_SPK_000245.LAB	10/12/23	7:54:05	19.3	12.7	-0.2	190.7	0.94	1.0	5.3	0.373	**0.076**	**95.0%**
PRE1_SPK_000246.LAB	10/12/23	7:54:13	19.3	12.8	-0.2	190.7	0.94	1.1	5.5	0.373	**0.076**	**96.9%**
PRE1_SPK_000247.LAB	10/12/23	7:54:21	19.3	12.8	-0.2	190.7	0.94	1.0	5.5	0.372	**0.076**	**96.9%**
PRE1_SPK_000248.LAB	10/12/23	7:54:28	19.3	12.9	-0.2	190.7	0.94	1.0	5.3	0.363	**0.075**	**96.4%**
PRE1_SPK_000249.LAB	10/12/23	7:54:36	19.3	12.9	-0.2	190.7	0.94	1.1	5.5	0.365	**0.075**	**98.7%**
PRE1_SPK_000250.LAB	10/12/23	7:54:44	19.3	12.9	-0.2	190.7	0.94	1.2	5.3	0.366	**0.075**	**96.0%**

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
RUN1_000503.LAB	10/12/23	11:51:50	19.8	15.0	-0.2	190.8	0.93	1.1	2.1	-0.006
RUN1_000504.LAB	10/12/23	11:52:53	19.8	14.9	-0.2	190.8	0.93	1.1	2.1	-0.011
RUN1_000505.LAB	10/12/23	11:53:56	19.8	14.9	-0.2	190.8	0.93	1.1	2.1	-0.007
									2.1	**-0.008**

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
POST1_SPK_000523.LAB	10/12/23	11:58:10	18.3	14.2	-0.2	190.8	0.93	0.9	5.6	0.380	**0.078**	**94.6%**
POST1_SPK_000524.LAB	10/12/23	11:58:18	18.3	14.2	-0.2	190.8	0.93	1.0	5.6	0.383	**0.079**	**94.6%**
POST1_SPK_000525.LAB	10/12/23	11:58:26	18.2	14.1	-0.2	190.8	0.93	0.9	5.7	0.375	**0.077**	**97.0%**
POST1_SPK_000526.LAB	10/12/23	11:58:34	18.2	14.1	-0.2	190.8	0.93	0.9	5.5	0.373	**0.076**	**94.5%**
POST1_SPK_000527.LAB	10/12/23	11:58:41	18.2	14.0	-0.2	190.8	0.93	1.0	5.4	0.379	**0.078**	**91.7%**
POST1_SPK_000528.LAB	10/12/23	11:58:49	18.2	14.0	-0.2	190.8	0.93	1.0	5.6	0.376	**0.077**	**95.5%**
POST1_SPK_000529.LAB	10/12/23	11:58:57	18.3	14.0	-0.2	190.8	0.93	1.0	5.6	0.382	**0.078**	**94.3%**
POST1_SPK_000530.LAB	10/12/23	11:59:05	18.3	14.0	-0.2	190.8	0.93	0.8	5.6	0.378	**0.078**	**95.6%**

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
POST1_CTS_000551.LAB	10/12/23	12:02:36	1.2	0.0	0.0	190.8	0.94	98.2	0.3	-0.009	**98.4%**
POST1_CTS_000552.LAB	10/12/23	12:02:44	1.2	0.0	0.0	190.8	0.94	98.2	0.3	-0.008	**98.4%**
POST1_CTS_000553.LAB	10/12/23	12:02:52	1.2	0.0	0.0	190.8	0.94	98.1	0.5	-0.021	**98.3%**
POST1_CTS_000554.LAB	10/12/23	12:02:59	1.2	0.0	0.0	190.8	0.94	98.2	0.2	-0.016	**98.4%**
POST1_CTS_000555.LAB	10/12/23	12:03:08	1.1	0.0	0.0	190.9	0.94	98.1	0.4	-0.022	**98.3%**
POST1_CTS_000556.LAB	10/12/23	12:03:15	1.1	0.0	0.0	190.9	0.94	98.0	0.4	-0.007	**98.2%**
POST1_CTS_000557.LAB	10/12/23	12:03:23	1.1	0.0	0.0	190.9	0.94	98.0	0.2	-0.021	**98.2%**
POST1_CTS_000558.LAB	10/12/23	12:03:31	1.1	0.0	0.0	190.9	0.94	98.2	0.2	-0.013	**98.4%**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Operating Condition: Mill Off

Test Location: Main Kiln
Date: 10/12/2023
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_000645.LAB	10/12/23	13:22:43	19.6	16.0	-0.2	190.9	0.93	1.2	2.1	-0.009
RUN2_000646.LAB	10/12/23	13:23:46	19.7	16.0	-0.2	190.9	0.93	1.1	2.2	-0.007
RUN2_000647.LAB	10/12/23	13:24:49	19.6	16.4	-0.2	190.8	0.93	1.2	2.2	-0.012
									2.2	**-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_000653.LAB	10/12/23	13:28:44	17.7	15.3	-0.2	190.4	0.93	1.2	6.3	0.418	**0.086**	**98.6%**
POST2_SPK_000654.LAB	10/12/23	13:28:52	17.7	15.4	-0.2	190.4	0.93	1.0	6.3	0.417	**0.085**	**98.7%**
POST2_SPK_000655.LAB	10/12/23	13:29:00	17.7	15.3	-0.2	190.3	0.93	1.2	6.3	0.416	**0.085**	**100.1%**
POST2_SPK_000656.LAB	10/12/23	13:29:08	17.7	15.3	-0.2	190.3	0.93	1.1	6.1	0.412	**0.085**	**96.4%**
POST2_SPK_000657.LAB	10/12/23	13:29:16	17.7	15.3	-0.1	190.3	0.93	1.1	6.1	0.402	**0.082**	**99.3%**
POST2_SPK_000658.LAB	10/12/23	13:29:24	17.8	15.2	-0.2	190.3	0.94	1.1	6.2	0.407	**0.083**	**99.2%**
POST2_SPK_000659.LAB	10/12/23	13:29:31	17.8	15.2	-0.2	190.3	0.93	1.1	6.0	0.404	**0.083**	**95.8%**
POST2_SPK_000660.LAB	10/12/23	13:29:39	17.8	15.1	-0.1	190.3	0.93	1.1	6.1	0.410	**0.084**	**96.5%**

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
POST2_CTS_000670.LAB	10/12/23	13:32:55	0.8	0.0	0.0	190.6	0.93	98.4	0.5	-0.019	**98.6%**
POST2_CTS_000671.LAB	10/12/23	13:33:03	0.8	0.0	0.0	190.6	0.93	98.4	0.3	-0.013	**98.6%**
POST2_CTS_000672.LAB	10/12/23	13:33:11	0.8	0.0	-0.1	190.7	0.93	98.1	0.4	-0.012	**98.3%**
POST2_CTS_000673.LAB	10/12/23	13:33:19	0.8	0.0	0.0	190.7	0.93	97.9	0.5	-0.019	**98.1%**
POST2_CTS_000674.LAB	10/12/23	13:33:26	0.8	0.0	0.0	190.6	0.93	98.5	0.3	-0.018	**98.7%**
POST2_CTS_000675.LAB	10/12/23	13:33:35	0.7	0.0	0.0	190.7	0.93	98.3	0.3	-0.012	**98.6%**
POST2_CTS_000676.LAB	10/12/23	13:33:42	0.7	0.0	0.0	190.7	0.93	98.5	0.3	-0.020	**98.7%**
POST2_CTS_000677.LAB	10/12/23	13:33:50	0.7	0.0	0.0	190.7	0.93	98.8	0.4	-0.014	**99.0%**

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
RUN3_000774.LAB	10/12/23	14:59:08	19.9	15.3	-0.2	190.8	0.93	1.1	2.1	-0.008
RUN3_000775.LAB	10/12/23	15:00:11	19.9	15.5	-0.2	190.8	0.93	1.1	2.0	-0.007
RUN3_000776.LAB	10/12/23	15:01:14	19.9	15.3	-0.2	190.8	0.93	1.0	2.0	-0.006
									2.0	**-0.007**

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_000787.LAB	10/12/23	15:04:16	18.2	14.5	-0.2	190.7	0.93	0.9	5.6	0.373	**0.077**	**96.3%**
POST3_SPK_000788.LAB	10/12/23	15:04:24	18.2	14.4	-0.2	190.7	0.93	1.0	5.6	0.375	**0.077**	**95.6%**
POST3_SPK_000789.LAB	10/12/23	15:04:32	18.2	14.5	-0.2	190.7	0.93	1.1	5.6	0.379	**0.078**	**96.1%**
POST3_SPK_000790.LAB	10/12/23	15:04:40	18.2	14.4	-0.2	190.7	0.93	1.0	5.6	0.375	**0.077**	**95.4%**
POST3_SPK_000791.LAB	10/12/23	15:04:47	18.2	14.3	-0.2	190.7	0.93	0.9	5.6	0.377	**0.077**	**95.5%**
POST3_SPK_000792.LAB	10/12/23	15:04:55	18.2	14.2	-0.2	190.8	0.93	1.0	5.7	0.369	**0.076**	**99.1%**
POST3_SPK_000793.LAB	10/12/23	15:05:03	18.1	14.1	-0.2	190.7	0.93	1.1	5.6	0.370	**0.076**	**97.1%**
POST3_SPK_000794.LAB	10/12/23	15:05:11	18.1	14.0	-0.2	190.8	0.93	0.9	5.6	0.376	**0.077**	**95.7%**

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_000814.LAB	10/12/23	15:09:04	0.9	0.0	0.0	190.8	0.93	98.3	0.2	-0.020	**98.5%**
POST3_CTS_000815.LAB	10/12/23	15:09:12	0.9	0.0	0.0	190.8	0.93	98.2	0.3	-0.012	**98.4%**
POST3_CTS_000816.LAB	10/12/23	15:09:20	0.9	0.0	0.0	190.8	0.93	98.2	0.2	-0.019	**98.4%**
POST3_CTS_000817.LAB	10/12/23	15:09:28	0.9	0.0	0.1	190.8	0.93	98.1	0.3	-0.019	**98.3%**
POST3_CTS_000818.LAB	10/12/23	15:09:36	0.9	0.0	0.0	190.8	0.93	98.4	0.3	-0.018	**98.6%**
POST3_CTS_000819.LAB	10/12/23	15:09:43	0.9	0.0	0.0	190.8	0.93	98.4	0.2	-0.020	**98.6%**
POST3_CTS_000820.LAB	10/12/23	15:09:51	0.8	0.0	-0.1	190.8	0.93	98.1	0.4	-0.020	**98.3%**
POST3_CTS_000821.LAB	10/12/23	15:09:59	0.8	0.0	0.0	190.8	0.93	98.2	0.1	-0.019	**98.4%**

Client: Ash Grove Cement Company
Facility: Durkee Cement Plant
Project #: M234105
Operating Condition: Mill Off

Test Location: Main Kiln
Date: 10/12/2023
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
POST3_CTS_DIR_000854.LAB	10/12/23	15:24:18	0.0	0.0	0.0	190.7	0.93	99.4	0.0	-0.022	**99.7%**
POST3_CTS_DIR_000855.LAB	10/12/23	15:24:26	0.0	0.0	0.0	190.7	0.93	99.3	0.0	-0.015	**99.5%**
POST3_CTS_DIR_000856.LAB	10/12/23	15:24:34	0.0	0.0	0.0	190.7	0.93	99.6	0.0	-0.016	**99.8%**
POST3_CTS_DIR_000857.LAB	10/12/23	15:24:42	0.0	0.0	0.0	190.7	0.93	99.4	-0.1	-0.008	**99.6%**
POST3_CTS_DIR_000858.LAB	10/12/23	15:24:50	0.0	0.0	0.0	190.7	0.93	99.5	-0.1	-0.017	**99.8%**
POST3_CTS_DIR_000859.LAB	10/12/23	15:24:57	0.0	0.0	0.0	190.7	0.93	99.3	-0.2	-0.020	**99.5%**
POST3_CTS_DIR_000860.LAB	10/12/23	15:25:05	0.0	0.0	0.0	190.7	0.93	99.6	-0.2	-0.010	**99.8%**
POST3_CTS_DIR_000861.LAB	10/12/23	15:25:13	0.0	0.0	0.0	190.7	0.93	99.3	-0.1	-0.012	**99.5%**
	Average							**99.4**			

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
N2_DIR_000862.LAB	10/12/23	15:28:36	0.0	0.0	0.0	190.8	0.93	0.0	-0.1	0.006
N2_DIR_000863.LAB	10/12/23	15:30:42	0.0	0.0	0.0	190.8	0.93	0.1	-0.2	0.004
N2_DIR_000864.LAB	10/12/23	15:32:48	0.0	0.0	0.0	190.7	0.93	0.0	-0.1	0.004

Appendix I - Gas Cylinder Certifications

Airgas Specialty Gases
Airgas USA LLC
525 North Industrial Loop Road
Tooele, UT 84074
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI78E15A1066	Reference Number:	153-402794083-1
Cylinder Number:	CC153857	Cylinder Volume:	151.1 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72023	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Jul 19, 2023

Expiration Date: Jul 19, 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	10.00 %	9.914 %	G1	+/- 0.9% NIST Traceable	07/19/2023
OXYGEN	12.00 %	11.96 %	G1	+/- 1.0% NIST Traceable	07/19/2023
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060405	CC411744	7.489 % CARBON DIOXIDE/NITROGEN	0.6%	May 14, 2025
NTRM	98051010	SG9161286BAL	12.05 % OXYGEN/NITROGEN	0.7%	Dec 14, 2023

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA-510 SV4MEUTJ CO2	CO2 NDIR (Dixon)	Jun 28, 2023
Horiba MPA-510 W603MM58 O2	O2 Paramagnetic (DIXON)	Jun 29, 2023

Triad Data Available Upon Request

Signature on file
Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
525 North Industrial Loop Road
Tooele, UT 84074
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI59E15A3452	Reference Number:	153-402157382-1
Cylinder Number:	CC420519	Cylinder Volume:	159.0 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72021	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Jul 15, 2021

Expiration Date: Jul 15, 2029

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	19.00 %	18.99 %	G1	+/- 0.6% NIST Traceable	07/15/2021
OXYGEN	22.00 %	22.41 %	G1	+/- 0.3% NIST Traceable	07/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060802	CC415397	24.04 % CARBON DIOXIDE/NITROGEN	0.6%	Dec 11, 2025
NTRM	12062008	CC367433	22.883 % OXYGEN/NITROGEN	0.2%	May 14, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA-510 SV4MEUTJ CO2	CO2 NDIR (Dixon)	Jun 17, 2021
Horiba MPA-510 W603MM58 O2	O2 Paramagnetic (Mason)	Jul 12, 2021

Triad Data Available Upon Request

Signature on file
Approved for Release

Airgas Specialty Gases
Airgas USA LLC
525 North Industrial Loop Road
Tooele, UT 84074
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Part Number:	X02NI99C15A1268	Reference Number:	153-402780689-1
Cylinder Number:	CC401933	Cylinder Volume:	144.0 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
Analysis Date:	Jul 10, 2023	Valve Outlet:	350
Lot Number:	153-402780689-1		

Expiration Date: Jul 10, 2026

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	100.7 PPM	+/- 2%
NITROGEN	Balance		

Signature on file
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:	160-402841639-1
Cylinder Number:	CC768228	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
Analysis Date:	Sep 11, 2023	Valve Outlet:	350SS
Lot Number:	160-402841639-1		

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	5.009 PPM	+/- 5%
HYDROGEN CYANIDE	50.00 PPM	49.30 PPM	+/- 5%
NITROGEN	Balance		

Signature on file
Approved for Release

END OF THE REPORT