Section 114 Information Collection Request Emissions Test Report

---

Ash Grove Cement Company
Louisville Cement Plant
EPA Registry ID: 110020142941
Kiln 1 (ACL)
16215 NE-50
Louisville, Nebraska 68037
Report No. M233801A

mostardi platt

Section 114 Information Collection Request
Emissions Test Report

Ash Grove Cement Company
Louisville Cement Plant
EPA Registry ID: 110020142941
Kiln 1 (ACL)
16215 NE-50
Louisville, Nebraska 68037

Report Submittal Date:
March 4, 2024

Report No. M233801A

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

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

TABLE OF CONTENTS

1.0 INTRODUCTION

Mostardi Platt conducted an air emissions test program for Ash Grove Cement Company at the Louisville Cement Plant located in Louisville, Nebraska. 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 Louisville Cement Plant has two kiln systems. Kiln 1 is a ~350,000 TPY Leopold grate kiln vintage 1973. The kiln system employs a travelling grate design with separate raw mill. The kiln system employs an ESP followed by a polishing baghouse using DSI to control HCL.

This test program was completed to satisfy the requirements of the United States Environmental Protection Agency (USEPA) Section 114 Information Collection Request for Portland Cement Manufacturing facilities as described in "Attachment 3 Source Testing Request for Portland Cement: Reporting Requirements". Testing was performed at the Kiln 1 (ACL) breaching duct for both Methods 26A and 320 testing.

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

Location	**Address**	**Contact**
Test Coordinator	Ash Grove Cement Company Louisville Plant 16215 NE-50 Louisville, MI 68037	Alexander Blecha Environmental Manager (402) 234-4819 alexander.blecha@ashgrove.com
Test Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, IL 60126	Eric Ehlers VP, Field Operations (630) 993-2100 eehlers@mp-mail.com

2.0 TEST REQUIREMENTS

Testing was performed at the Kiln 1 (ACL) breaching duct. 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 1 (ACL) Breaching Duct	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.31 ppmvd @7% O_2	
		≤ 0.05 lb/hr	
		≤ 0.0013 lb/ton clinker	
	HF[1]	≤ 0.13 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.33 ppmvd @7% O_2	
		≤ 0.06 lb/hr	
		≤ 0.002 lb/ton clinker	
	Chlorine (Cl_2)[1]	≤ 0.04 ppmvw	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.10 ppmvd @7% O_2	
		≤ 0.06 lb/hr	
		≤ 0.002 lb/ton clinker	
	Hydrogen Cyanide (HCN)	1.21 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		3.71 ppmvd @7% O_2	
		0.79 lb/hr	
		0.0218 lb/ton clinker	
	Oxygen (O_2)	15.8 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO_2)	7.5 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H_20)	10.3 %	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.

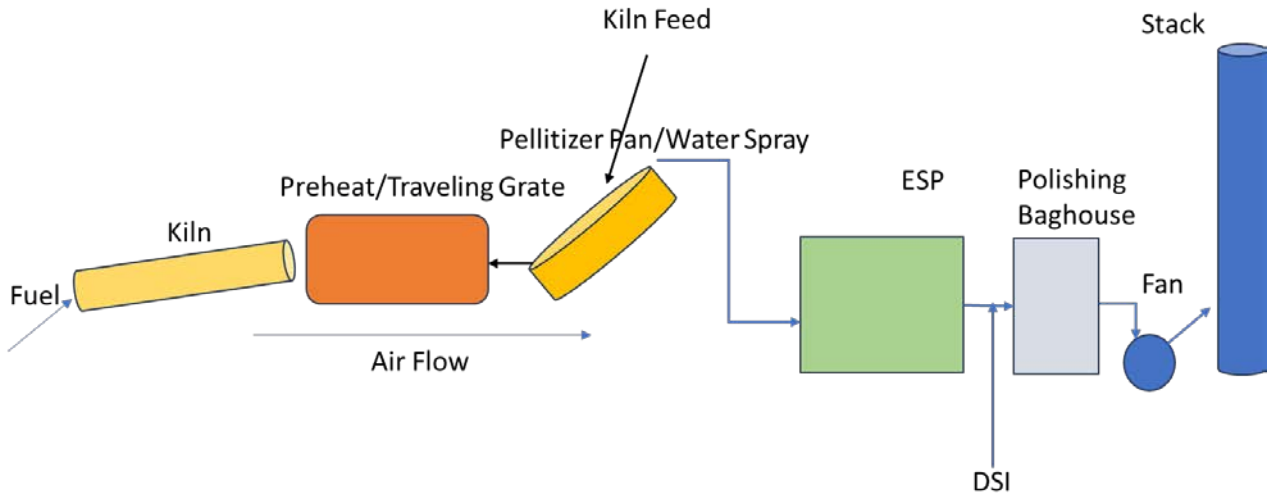
3.0 QA SPECIFICATIONS AND PROCESS DIAGRAM

3-1 QA/QC Specifications

Parameter	Method	QA/QC Specification	Acceptance Criteria	Actual Result
HCN	320	Method Detection Limit	0.5 ppm	0.2 ppmvw
		SNR	>2500 at 64 scans	4584 (Run 1 Average)
		S Beam	>0.9	0.937 (Run 1 Average)
		Direct HCN Analysis	±5% of tag value	+1.3%
		Dynamic Spike Analysis	≤10% of total sample volume	< 10% for all spikes
			Spike gas ~twice native concentration or 3-4 ppm addition to native concentration	+3.7 ppm
			≤±20% of expected value or ≤±0.5 ppm, whichever is less restrictive	±20% of expected value for all spikes
		Residuals	≤±0.3 ppm, or ≤±5% of measured value, whichever is less restrictive	0.2 ppmvw
HF/Cl_2	26A	Method Detection Limit	300 µg	150 µg
		Paired Train Agreement	≤10% Relative Deviation or ≤0.2 ppm, whichever is less restrictive.	8.3%

3-2 Process Flow Diagram

Kiln 1



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	Duct Dimensions (Feet)	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points
Kiln 1 Breaching Duct	6.3 Feet x 11.0 Feet	<2.0 Diameters	< 0.5 Diameters	HF/Cl_2 (26A)	45
				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. Additionally, because this source does not meet Method 1 upstream and downstream diameter criteria, a site acceptability test was performed previously on this test location which passed criteria in Section 11.5 of Method 1.

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 forty-five (45) test points were sampled per run. 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. The method detection limit (MDL) of was determined for both HF and Cl_2 using the “Definition and Procedure for the Determination of the Method Detection Limit, Revision 2”. A value of 150ug was used for both compounds. All equipment used was calibrated in accordance with the specifications of the method. Calibration data is appended.

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

4.5 Method 320 Speciated Flue Gas Concentration Determinations

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

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

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

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

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

5.0 TEST RESULTS SUMMARIES

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Test Location: Kiln 1 (ACL)
Test Method: 26A - Combined Results

Source Condition		**Normal**		**Normal**		**Normal**		
Date		**9/27/23**		**9/27/23**		**9/27/23**		
Start Time		**10:20**		**13:18**		**15:50**		
End Time		**12:41**		**15:10**		**17:41**		
		Run 1		**Run 2**		**Run 3**		**Average**
Stack Conditions								
Average Gas Velocity, ft/sec		55.553		55.081		54.497		55.044
Gas Volumetric Flow Rate, acfm		230,989		229,024		226,596		228,870
Gas Volumetric Flow Rate, dscfm		140,087		137,310		138,434		138,610
Gas Volumetric Flow Rate, scfm		156,406		155,941		154,956		155,768
Average %CO_2 by volume, dry basis		7.5		7.5		7.5		7.5
Average %O_2 by volume, dry basis		15.9		15.8		15.8		15.8
Clinker Production, ton/hr		36.4		36.5		36.4		36.4
Chloride (Cl2) Emissions								
ppm	≤	0.04	≤	0.04	≤	0.04	≤	0.04
ppm@7%O_2	≤	0.10	≤	0.10	≤	0.10	≤	0.10
lb/hr	≤	0.06	≤	0.06	≤	0.06	≤	0.06
lb/ton of clinker	≤	0.002	≤	0.002	≤	0.002	≤	0.002
Hydrogen Fluoride (HF) Emissions								
ppm	≤	0.13	≤	0.13	≤	0.13	≤	0.13
ppm@7%O_2	≤	0.34	≤	0.33	≤	0.33	≤	0.33
lb/hr	≤	0.06	≤	0.06	≤	0.06	≤	0.06
lb/ton of clinker	≤	0.002	≤	0.002	≤	0.002	≤	0.002

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Test Location: Kiln 1 (ACL)
Test Method: 26A - A Train

Source Condition		**Normal**		**Normal**		**Normal**		
Date		**9/27/23**		**9/27/23**		**9/27/23**		
Start Time		**10:20**		**13:18**		**15:50**		
End Time		**12:41**		**15:10**		**17:41**		
		Run 1A		**Run 2A**		**Run 3A**		**Average**
Stack Conditions								
Average Gas Temperature, °F		290.1		285.7		282.1		286.0
Flue Gas Moisture, percent by volume		10.6%		14.1%		11.0%		11.9%
Average Flue Pressure, in. Hg		28.72		28.72		28.72		28.72
Gas Sample Volume, dscf		54.291		54.102		53.972		54.122
Average Gas Velocity, ft/sec		55.260		55.650		54.853		55.254
Gas Volumetric Flow Rate, acfm		229,770		231,392		228,077		229,746
Gas Volumetric Flow Rate, dscfm		138,815		135,117		138,574		137,502
Gas Volumetric Flow Rate, scfm		155,254		157,267		155,771		156,097
Average %CO_2 by volume, dry basis		7.5		7.5		7.5		7.5
Average %O_2 by volume, dry basis		15.9		15.8		15.8		15.8
Isokinetic Variance		102.6		105.1		102.2		103.3
Chloride (Cl2) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.03	≤	0.03	≤	0.03	≤	0.03
Hydrogen Fluoride (HF) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.12	≤	0.12	≤	0.12	≤	0.12

Client:	**Ash Grove Cement Company**
Facility:	**Louisville,NE Cement**
Test Location:	**Kiln 1 (ACL)**
Test Method:	**26A - B Train**

Source Condition		**Normal**		**Normal**		**Normal**		
Date		**9/27/23**		**9/27/23**		**9/27/23**		
Start Time		**10:20**		**13:18**		**15:50**		
End Time		**12:41**		**15:10**		**17:41**		
		Run 1B		**Run 2B**		**Run 3B**		**Average**
Stack Conditions								
Average Gas Temperature, °F		287.0		283.0		280.2		283.4
Flue Gas Moisture, percent by volume		10.3%		9.8%		10.3%		10.1%
Average Flue Pressure, in. Hg		28.72		28.72		28.72		28.72
Gas Sample Volume, dscf		46.484		45.650		45.462		45.865
Average Gas Velocity, ft/sec		55.846		54.511		54.140		54.832
Gas Volumetric Flow Rate, acfm		232,207		226,656		225,115		227,993
Gas Volumetric Flow Rate, dscfm		141,359		139,502		138,294		139,718
Gas Volumetric Flow Rate, scfm		157,558		154,615		154,140		155,438
Average %CO_2 by volume, dry basis		7.5		7.5		7.5		7.5
Average %O_2 by volume, dry basis		15.9		15.8		15.8		15.8
Isokinetic Variance		101.4		100.9		101.4		101.2
Chloride (Cl2) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.04	≤	0.04	≤	0.04	≤	0.04
Hydrogen Fluoride (HF) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.14	≤	0.14	≤	0.14	≤	0.14

Ash Grove Cement Company Louisville Cement Plant Kiln 1 (ACL) Breaching Duct Reference Method Test Data									
Test No.	**Date**	**Start Time**	**End Time**	**O2 % (dry)**	**Moisture %**	**HCN ppmvw**	**HCN ppmvd @ 7% O2**	**HF ppmvw**	**HF ppmvd @ 7% O2**
1	9/27/2023	10:20	11:49	15.9	10.5%	1.19	3.69	≤ 0.10	≤ 0.31
2	9/27/2023	13:18	14:47	15.8	10.2%	1.19	3.65	≤ 0.10	≤ 0.31
3	9/27/2023	15:50	17:19	15.8	10.2%	1.25	3.79	≤ 0.10	≤ 0.30
Average				**15.8**	**10.3%**	**1.21**	**3.71**	**≤ 0.10**	**≤ 0.31**

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	9/27/2023	10:20	11:49	140,087	36.4	0.79	0.0216	≤ 0.05	≤ 0.0013
2	9/27/2023	13:18	14:47	137,310	36.5	0.77	0.0210	≤ 0.05	≤ 0.0013
3	9/27/2023	15:50	17:19	138,434	36.4	0.81	0.0223	≤ 0.05	≤ 0.0013
Average				**138,610**	**36.4**	**0.79**	**0.0216**	**≤ 0.05**	**≤ 0.0013**

6.0 CERTIFICATION

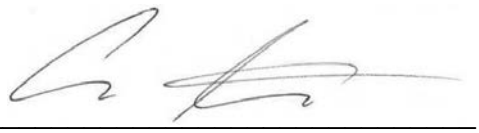
Mostardi Platt is pleased to have been of service to Ash Grove Cement Company If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

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

Eric L. Ehlers



Quality Assurance

Chet A. Gutwein

APPENDICES

Appendix A – Plant Operating Data

Date/Time	ACL_KS: CLINKER (TNHR) 1-Minute Block Average Expression Value
	Run 1
09/27/2023 10:20	36.0
09/27/2023 10:21	36.1
09/27/2023 10:22	36.8
09/27/2023 10:23	35.5
09/27/2023 10:24	35.4
09/27/2023 10:25	36.3
09/27/2023 10:26	36.2
09/27/2023 10:27	36.0
09/27/2023 10:28	36.7
09/27/2023 10:29	36.3
09/27/2023 10:30	36.3
09/27/2023 10:31	36.2
09/27/2023 10:32	36.0
09/27/2023 10:33	36.2
09/27/2023 10:34	36.4
09/27/2023 10:35	36.0
09/27/2023 10:36	36.3
09/27/2023 10:37	36.3
09/27/2023 10:38	36.5
09/27/2023 10:39	36.7
09/27/2023 10:40	37.0
09/27/2023 10:41	36.8
09/27/2023 10:42	35.7
09/27/2023 10:43	36.2
09/27/2023 10:44	36.6
09/27/2023 10:45	36.2
09/27/2023 10:46	36.3
09/27/2023 10:47	36.9
09/27/2023 10:48	36.7
09/27/2023 10:49	36.4
09/27/2023 10:50	36.8
09/27/2023 10:51	36.8
09/27/2023 10:52	36.4
09/27/2023 10:53	36.2
09/27/2023 10:54	36.2
09/27/2023 10:55	36.0
09/27/2023 10:56	36.6
09/27/2023 10:57	36.7
09/27/2023 10:58	37.0
09/27/2023 10:59	36.6
09/27/2023 11:00	36.4
09/27/2023 11:01	36.5
09/27/2023 11:02	36.6
09/27/2023 11:03	35.8
09/27/2023 11:04	36.1
09/27/2023 11:05	36.1
09/27/2023 11:06	36.9
09/27/2023 11:07	36.0
09/27/2023 11:08	36.7
09/27/2023 11:09	35.7
09/27/2023 11:10	35.6
09/27/2023 11:11	34.1
09/27/2023 11:12	34.3
09/27/2023 11:13	36.7
09/27/2023 11:14	37.4
09/27/2023 11:15	36.6
09/27/2023 11:16	37.3
09/27/2023 11:17	37.0
09/27/2023 11:18	36.9
09/27/2023 11:19	37.0
09/27/2023 11:20	37.1
09/27/2023 11:21	35.9
09/27/2023 11:22	36.7
09/27/2023 11:23	37.4
09/27/2023 11:24	37.2
09/27/2023 11:25	37.0
09/27/2023 11:26	36.6
09/27/2023 11:27	36.3
09/27/2023 11:28	36.5
09/27/2023 11:29	36.4
09/27/2023 11:30	36.4
09/27/2023 11:31	36.8
09/27/2023 11:32	36.7
09/27/2023 11:33	36.1
09/27/2023 11:34	36.6
09/27/2023 11:35	36.4
09/27/2023 11:36	36.7
09/27/2023 11:37	36.4
09/27/2023 11:38	36.1
09/27/2023 11:39	36.2
09/27/2023 11:40	36.8
09/27/2023 11:41	36.3
09/27/2023 11:42	36.9
09/27/2023 11:43	36.0
09/27/2023 11:44	36.5
09/27/2023 11:45	35.7
09/27/2023 11:46	36.9
09/27/2023 11:47	36.5
09/27/2023 11:48	36.2
09/27/2023 11:49	35.9
09/27/2023 11:50	35.5
09/27/2023 11:51	36.0
09/27/2023 11:52	36.4
09/27/2023 11:53	36.6
09/27/2023 11:54	37.3
09/27/2023 11:55	36.1
09/27/2023 11:56	36.2

Date/Time	ACL_KS: CLINKER (TNHR) 1-Minute Block Average Expression Value
09/27/2023 11:57	36.5
09/27/2023 11:58	36.6
09/27/2023 11:59	36.6
09/27/2023 12:00	36.8
09/27/2023 12:01	36.4
09/27/2023 12:02	36.4
09/27/2023 12:03	36.3
09/27/2023 12:04	36.9
09/27/2023 12:05	36.5
09/27/2023 12:06	36.6
09/27/2023 12:07	35.3
09/27/2023 12:08	36.4
09/27/2023 12:09	36.1
09/27/2023 12:10	36.6
09/27/2023 12:11	36.5
09/27/2023 12:12	36.9
09/27/2023 12:13	35.8
09/27/2023 12:14	36.0
09/27/2023 12:15	36.2
09/27/2023 12:16	36.5
09/27/2023 12:17	35.7
09/27/2023 12:18	36.5
09/27/2023 12:19	36.3
09/27/2023 12:20	36.6
09/27/2023 12:21	36.1
09/27/2023 12:22	36.9
09/27/2023 12:23	37.3
09/27/2023 12:24	36.7
09/27/2023 12:25	36.8
09/27/2023 12:26	37.3
09/27/2023 12:27	36.2
09/27/2023 12:28	36.1
09/27/2023 12:29	36.5
09/27/2023 12:30	36.6
09/27/2023 12:31	36.3
09/27/2023 12:32	36.7
09/27/2023 12:33	36.6
09/27/2023 12:34	36.8
09/27/2023 12:35	37.2
09/27/2023 12:36	36.4
09/27/2023 12:37	34.1
09/27/2023 12:38	35.9
09/27/2023 12:39	37.2
09/27/2023 12:40	37.2
09/27/2023 12:41	36.9
Run 1 Average	**36.4**

Date/Time	ACL_KS: CLINKER (TNHR) 1-Minute Block Average Expression Value
	Run 2
09/27/2023 13:18	35.9
09/27/2023 13:19	35.7
09/27/2023 13:20	35.6
09/27/2023 13:21	36.0
09/27/2023 13:22	36.2
09/27/2023 13:23	36.9
09/27/2023 13:24	36.7
09/27/2023 13:25	36.1
09/27/2023 13:26	36.8
09/27/2023 13:27	36.9
09/27/2023 13:28	36.8
09/27/2023 13:29	37.0
09/27/2023 13:30	37.3
09/27/2023 13:31	37.4
09/27/2023 13:32	37.0
09/27/2023 13:33	37.3
09/27/2023 13:34	37.1
09/27/2023 13:35	36.4
09/27/2023 13:36	36.6
09/27/2023 13:37	36.2
09/27/2023 13:38	36.5
09/27/2023 13:39	36.0
09/27/2023 13:40	37.2
09/27/2023 13:41	36.9
09/27/2023 13:42	36.8
09/27/2023 13:43	37.2
09/27/2023 13:44	37.0
09/27/2023 13:45	36.4
09/27/2023 13:46	36.9
09/27/2023 13:47	36.4
09/27/2023 13:48	36.8
09/27/2023 13:49	36.7
09/27/2023 13:50	36.9
09/27/2023 13:51	36.6
09/27/2023 13:52	37.1
09/27/2023 13:53	36.9
09/27/2023 13:54	37.3
09/27/2023 13:55	36.8
09/27/2023 13:56	36.6
09/27/2023 13:57	36.6
09/27/2023 13:58	36.3
09/27/2023 13:59	36.7
09/27/2023 14:00	36.4
09/27/2023 14:01	37.0
09/27/2023 14:02	37.0
09/27/2023 14:03	36.1
09/27/2023 14:04	36.7
09/27/2023 14:05	36.4
09/27/2023 14:06	37.0
09/27/2023 14:07	36.7
09/27/2023 14:08	36.5
09/27/2023 14:09	35.7
09/27/2023 14:10	36.5
09/27/2023 14:11	36.2
09/27/2023 14:12	36.7
09/27/2023 14:13	36.9
09/27/2023 14:14	36.4
09/27/2023 14:15	36.2
09/27/2023 14:16	36.3
09/27/2023 14:17	36.3
09/27/2023 14:18	36.2
09/27/2023 14:19	37.0
09/27/2023 14:20	36.9
09/27/2023 14:21	36.9
09/27/2023 14:22	36.2
09/27/2023 14:23	36.8
09/27/2023 14:24	33.8
09/27/2023 14:25	35.3
09/27/2023 14:26	36.9
09/27/2023 14:27	37.0
09/27/2023 14:28	36.9
09/27/2023 14:29	37.2
09/27/2023 14:30	36.9
09/27/2023 14:31	36.6
09/27/2023 14:32	35.9
09/27/2023 14:33	36.9
09/27/2023 14:34	36.6
09/27/2023 14:35	36.4
09/27/2023 14:36	34.9
09/27/2023 14:37	36.3
09/27/2023 14:38	36.0
09/27/2023 14:39	36.7
09/27/2023 14:40	36.2
09/27/2023 14:41	36.4
09/27/2023 14:42	34.9
09/27/2023 14:43	35.9
09/27/2023 14:44	35.3
09/27/2023 14:45	36.1
09/27/2023 14:46	36.0
09/27/2023 14:47	34.3
09/27/2023 14:48	37.2
09/27/2023 14:49	34.7
09/27/2023 14:50	36.2
09/27/2023 14:51	32.7
09/27/2023 14:52	38.2
09/27/2023 14:53	37.6
09/27/2023 14:54	36.7
09/27/2023 14:55	35.5
09/27/2023 14:56	37.6
09/27/2023 14:57	35.8

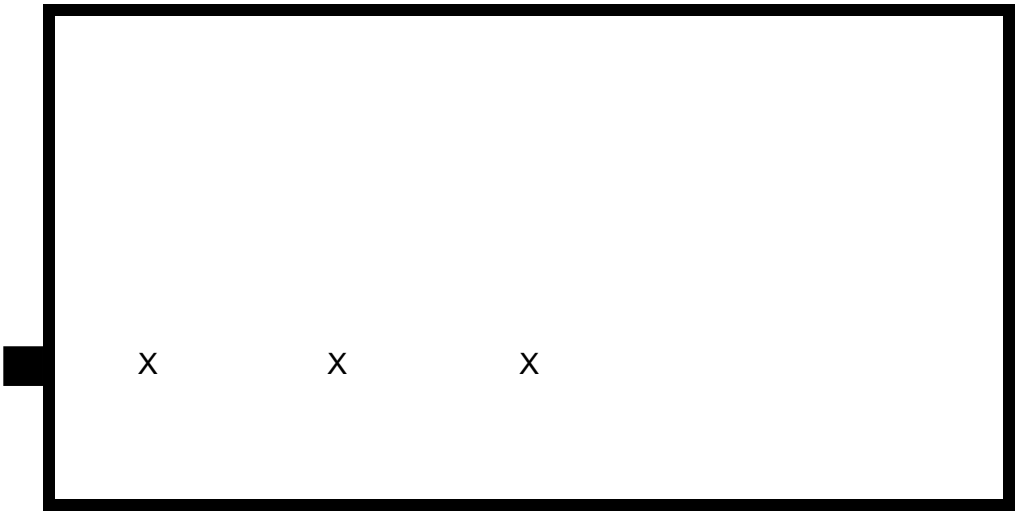
Date/Time	ACL_KS: CLINKER (TNHR) 1-Minute Block Average Expression Value
09/27/2023 14:58	35.3
09/27/2023 14:59	37.5
09/27/2023 15:00	36.1
09/27/2023 15:01	36.8
09/27/2023 15:02	36.0
09/27/2023 15:03	36.2
09/27/2023 15:04	36.7
09/27/2023 15:05	36.3
09/27/2023 15:06	36.1
09/27/2023 15:07	37.5
09/27/2023 15:08	37.3
09/27/2023 15:09	37.2
09/27/2023 15:10	37.0
Run 2 Average	**36.5**

Date/Time	ACL_KS: CLINKER (TNHR) 1-Minute Block Average Expression Value
	Run 3
09/27/2023 15:50	37.4
09/27/2023 15:51	37.4
09/27/2023 15:52	37.6
09/27/2023 15:53	36.8
09/27/2023 15:54	36.7
09/27/2023 15:55	36.3
09/27/2023 15:56	36.2
09/27/2023 15:57	36.3
09/27/2023 15:58	36.6
09/27/2023 15:59	36.9
09/27/2023 16:00	37.3
09/27/2023 16:01	37.3
09/27/2023 16:02	37.0
09/27/2023 16:03	36.8
09/27/2023 16:04	36.1
09/27/2023 16:05	36.8
09/27/2023 16:06	36.8
09/27/2023 16:07	36.7
09/27/2023 16:08	36.3
09/27/2023 16:09	36.1
09/27/2023 16:10	35.8
09/27/2023 16:11	36.5
09/27/2023 16:12	36.4
09/27/2023 16:13	36.2
09/27/2023 16:14	35.9
09/27/2023 16:15	36.1
09/27/2023 16:16	36.3
09/27/2023 16:17	36.5
09/27/2023 16:18	36.6
09/27/2023 16:19	36.5
09/27/2023 16:20	36.2
09/27/2023 16:21	36.2
09/27/2023 16:22	36.4
09/27/2023 16:23	36.4
09/27/2023 16:24	36.3
09/27/2023 16:25	36.1
09/27/2023 16:26	36.1
09/27/2023 16:27	35.9
09/27/2023 16:28	36.7
09/27/2023 16:29	36.4
09/27/2023 16:30	36.8
09/27/2023 16:31	36.4
09/27/2023 16:32	36.7
09/27/2023 16:33	36.5
09/27/2023 16:34	36.7
09/27/2023 16:35	36.6
09/27/2023 16:36	36.6
09/27/2023 16:37	36.5
09/27/2023 16:38	36.6
09/27/2023 16:39	36.2
09/27/2023 16:40	36.0
09/27/2023 16:41	36.6
09/27/2023 16:42	36.3
09/27/2023 16:43	36.4
09/27/2023 16:44	36.6
09/27/2023 16:45	36.9
09/27/2023 16:46	36.7
09/27/2023 16:47	36.2
09/27/2023 16:48	36.2
09/27/2023 16:49	36.3
09/27/2023 16:50	36.1
09/27/2023 16:51	35.8
09/27/2023 16:52	36.1
09/27/2023 16:53	36.2
09/27/2023 16:54	36.5
09/27/2023 16:55	36.9
09/27/2023 16:56	36.8
09/27/2023 16:57	37.1
09/27/2023 16:58	37.3
09/27/2023 16:59	36.4
09/27/2023 17:00	36.3
09/27/2023 17:01	36.3
09/27/2023 17:02	36.8
09/27/2023 17:03	36.9
09/27/2023 17:04	36.9
09/27/2023 17:05	36.7
09/27/2023 17:06	36.8
09/27/2023 17:07	36.6
09/27/2023 17:08	36.5
09/27/2023 17:09	36.7
09/27/2023 17:10	37.2
09/27/2023 17:11	36.9
09/27/2023 17:12	36.9
09/27/2023 17:13	36.7
09/27/2023 17:14	36.4
09/27/2023 17:15	36.0
09/27/2023 17:16	36.2
09/27/2023 17:17	36.4
09/27/2023 17:18	36.6
09/27/2023 17:19	36.8
09/27/2023 17:20	36.1
09/27/2023 17:21	36.4
09/27/2023 17:22	36.0
09/27/2023 17:23	36.1
09/27/2023 17:24	35.5
09/27/2023 17:25	35.0
09/27/2023 17:26	35.1
09/27/2023 17:27	35.4
09/27/2023 17:28	35.6
09/27/2023 17:29	35.3

Date/Time	ACL_KS: CLINKER (TNHR) 1-Minute Block Average Expression Value
09/27/2023 17:30	34.6
09/27/2023 17:31	36.0
09/27/2023 17:32	35.4
09/27/2023 17:33	36.1
09/27/2023 17:34	36.7
09/27/2023 17:35	37.0
09/27/2023 17:36	35.1
09/27/2023 17:37	35.8
09/27/2023 17:38	37.2
09/27/2023 17:39	36.7
09/27/2023 17:40	34.7
09/27/2023 17:41	35.1
Run 3 Average	**36.4**

Appendix B – Test Section Diagrams

STRATIFICATION
FOR RECTANGULAR DUCTS



Project: Ash Grove Cement Company
Louisville Cement Plant
Louisville, Nebraska

Stack Width: 6.3 Feet

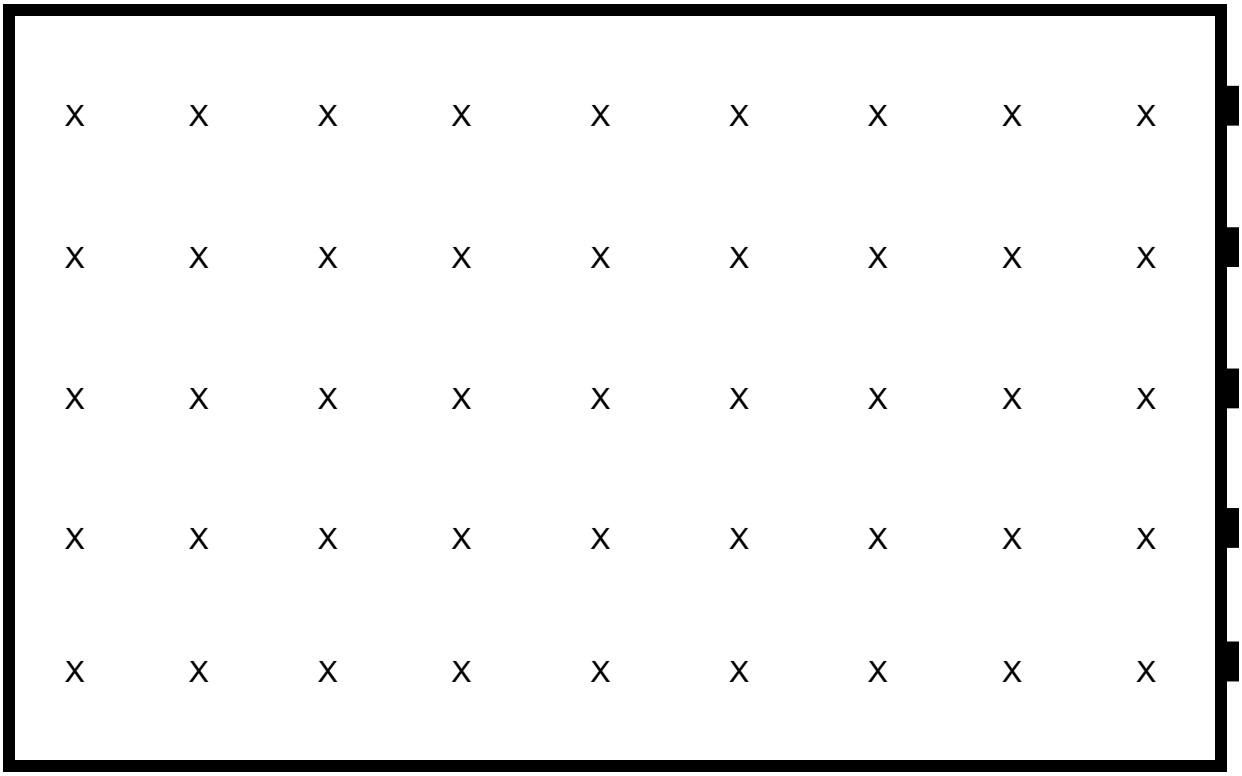
Stack Length: 11.0 Feet

Stack Area: 69.3 Square Feet

Test Location: K1 Breaching Duct

Tests Points per Port: 3

EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS



Project: Ash Grove Cement Company
Louisville Cement Plant
Louisville, Nebraska

Test Location: K1 Breaching Duct

Tests Port: 5

Tests Points per Port: 9

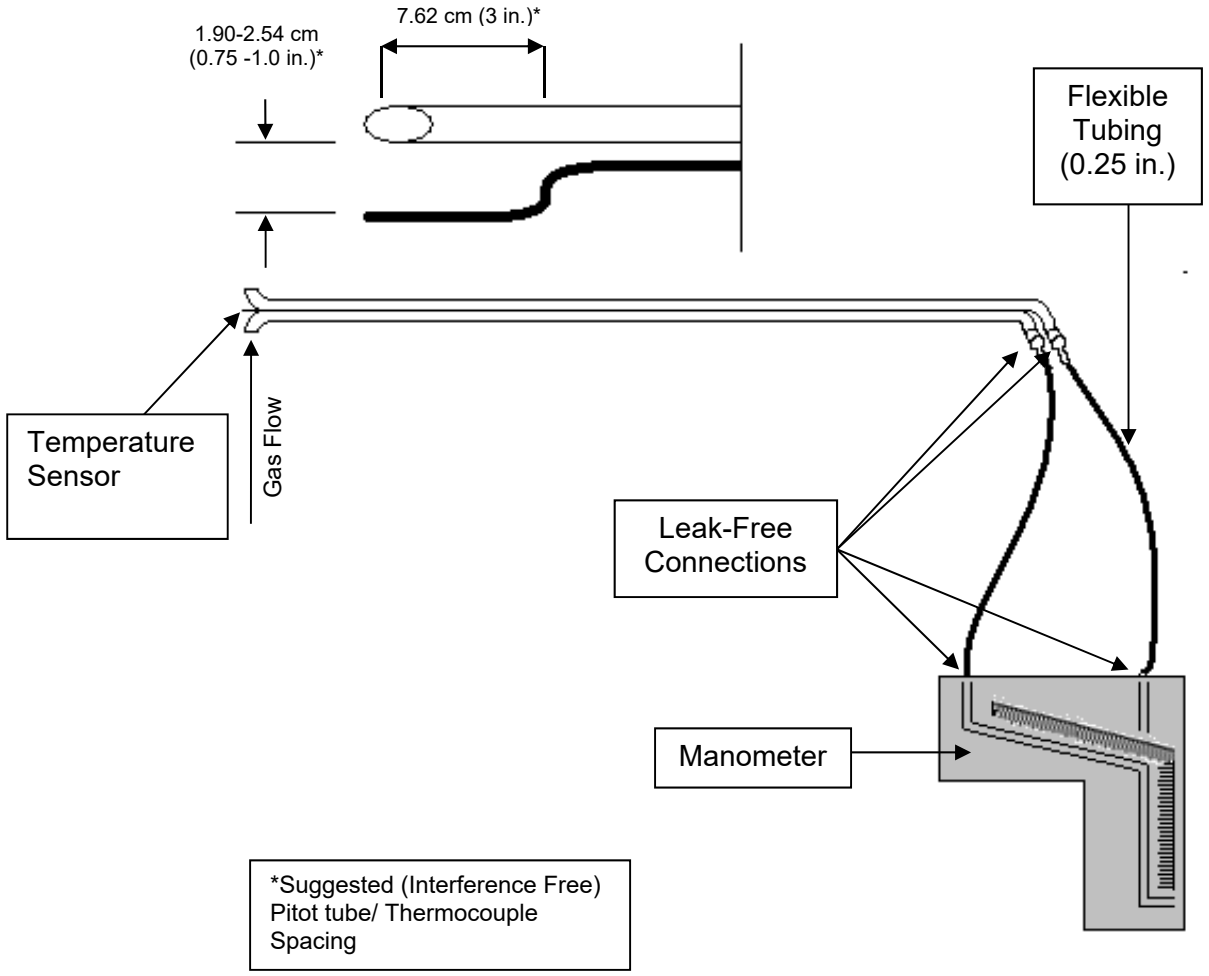
Stack Width: 6.3 feet

Stack Length: 11.0 feet

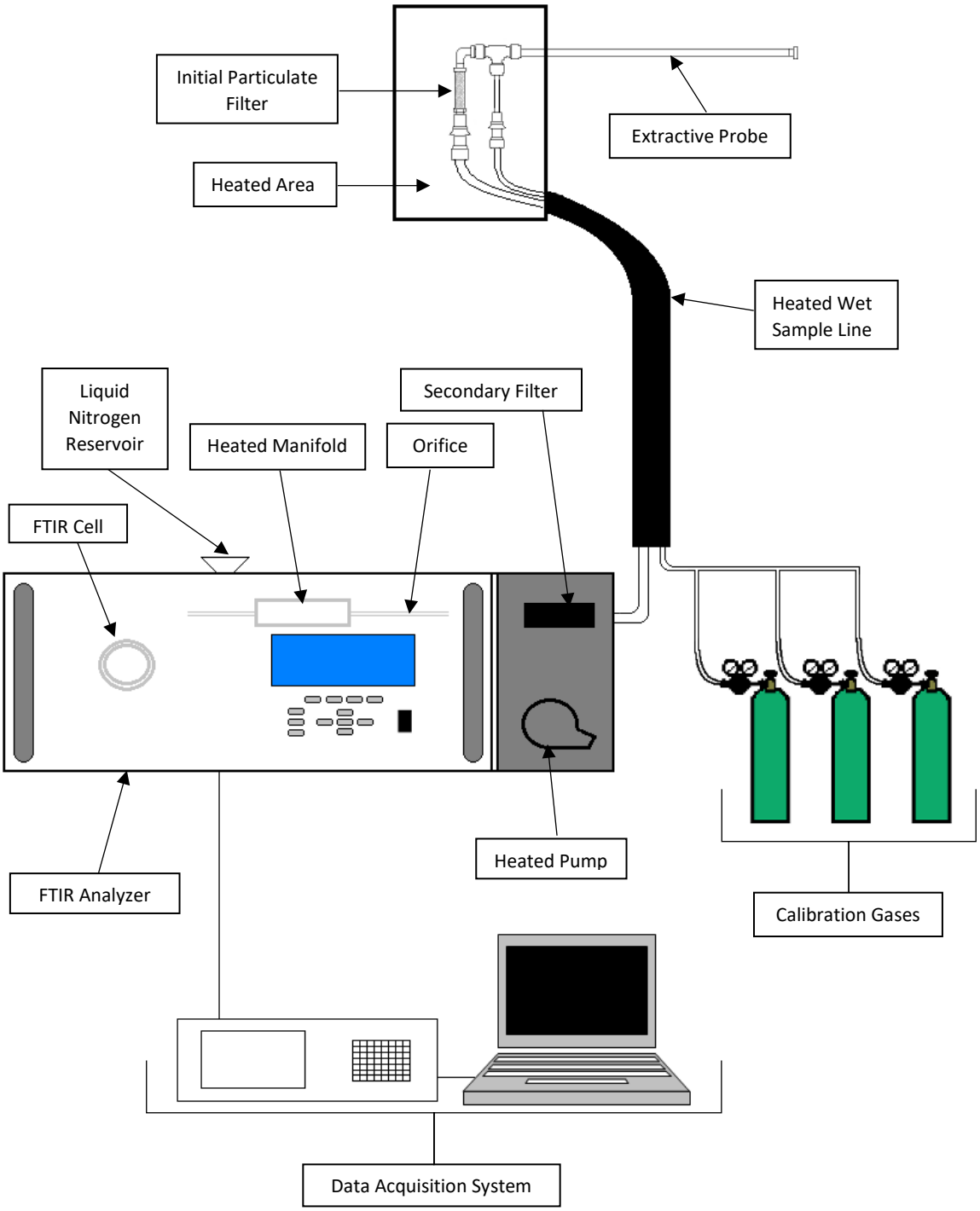
Stack Area: 69.3 square feet

Appendix C – Sample Train Diagrams

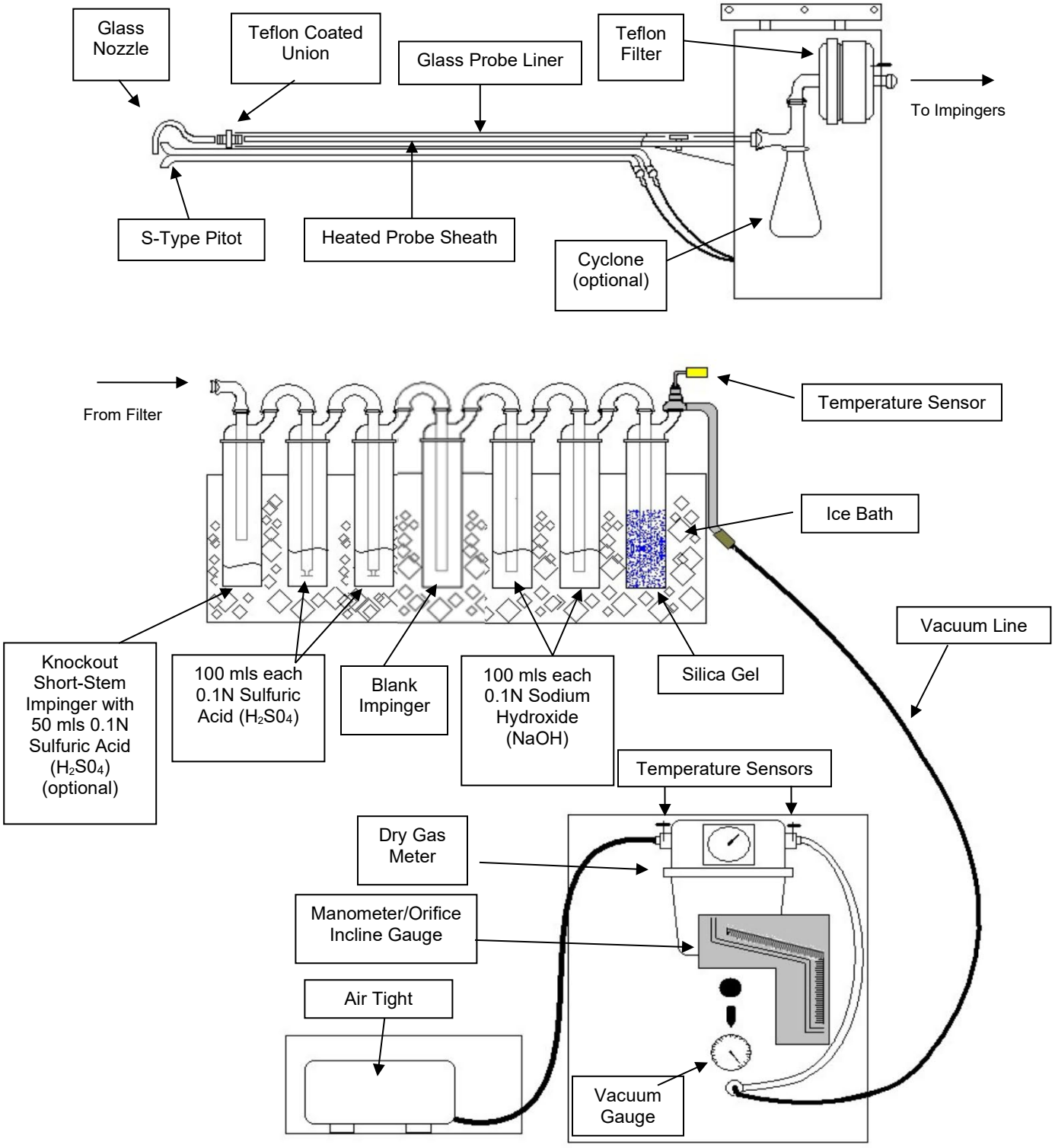
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



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: Louisville Cement Plant
Project #: M233801
Test Location: Kiln 1 (ACL) Breaching Duct
Date: 9/27/23

Sample Calculations

$$(15.98\ \% - 0.12\ \%) \times \frac{\text{O2 \% (dry)}\ 9.98\ \%}{10.09\ \% - 0.12\ \%} = 15.88\ \%$$

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

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: Louisville Cement Plant
Project #: M233801
Test Location: Kiln 1 (ACL) Breaching Duct
Date: 9/27/23

FTIR Sample Calculations

Direct Recovery % of Calibration Transfer Standard

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

Cma= 100.0 D_{cts} = 97.6

DR_{cts} = 97.6%

Recovery % with Calibration Transfer Standard System Purge

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

Sys_{cts} = 99.8 D_{cts} = 97.6

R_{cts} = 102%

Direct Recovery % of Analyte Spike Gas

SF6

$$DR_{sf6} = \frac{D_{sf6}}{Cma} \times 100$$

Cma= 5.0 D_{sf6} = 5.0

DR_{sf6} = 99%

HCN

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

Cma= 49.7 D_{asg} = 50.4

DR_{asg} = 101.4%

Dilution Factor for Analyte Spiking

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

Spk_{sf6} = 0.360 D_{sf6} = 4.991

DF = 0.072

Recovery % for Analyte Spike With HCN

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

Spk_x = 4.5 N_x = 1.2

DF = 0.072 D_{asg} = 50.4

R_x = 93.4 %

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

Client:	**Ash Grove Cement Company**
Facility:	**Louisville NE**
Test Location:	**Kiln 1 (ACL)**
Run:	**1**
Date:	**9/27/2023**
Method:	**26A**
Source Condition:	**Normal**

Dry Molecular Weight

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

$\%CO_2$ =	7.5	$\%O_2$ =	15.9	$\%N_2$ =	76.7

Md = 29.830

Wet Molecular Weight

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

Md =	29.830	Bws =	0.106

Ms = 28.578

Meter Volume at Standard Conditions

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

Y =	0.992	Vm =	56.905	Pbar =	28.8
DH =	1.2	Tm =	69.7		

Vm(std) = 54.291

Volume of Water Vapor Condensed

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

Net H_2O = 136.5

Vw(std) = 6.429

Moisture Content

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

Vw(std) =	6.429	Vm(std) =	54.291

Bws = 0.106

Client:	**Ash Grove Cement Company**
Facility:	**Louisville NE**
Test Location:	**Kiln 1 (ACL)**
Run:	**1**
Date:	**9/27/2023**
Method:	**26A**
Source Condition:	**Normal**

Average Duct Velocity

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

Cp =	**0.839**	**Ts (avg) =**	**290.1**	**Sqrt DP (avg):**	**0.806**
Ps =	**28.72**	**Ms =**	**28.578**		

Vs = 55.260

Volumetric Flow Rate (Actual Basis)

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

Vs =	**55.260**	**A =**	**69.300**

Q = 229,770

Volumetric Flow Rate (Standard Basis)

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

Q =	**229,770**	**Ps =**	**28.72**	**Ts (avg) =**	**290.1**

Qstd = 155,254

Volumetric Flow Rate (Standard Dry Basis)

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

Qstd =	**155,254**	**Bws =**	**0.106**

Qstd(dry) = 138,815

Isokinetic Variation:

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

Ts =	**290.1**	**Vm(std) =**	**54.291**	**Vs =**	**55.260**
An =	**0.0002936**	**θ =**	**90**	**Ps =**	**28.72**
Bws =	**0.106**				

%ISO = 102.6

Client:	**Ash Grove Cement Company**
Facility:	**Louisville NE**
Test Location:	**Kiln 1 (ACL)**
Run:	**1**
Date:	**9/27/2023**
Method:	**26A**
Source Condition:	**Normal**

Chloride (Cl2) Concentration:

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

mg= 0.15 Vm(std) = 54.291

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 = 138,815

Emission Rate lb/hr = 0.0507

$$\text{Emission Rate lb/ton} = \frac{\text{lb/hr of}}{\text{clinker production ton/hr}} \times \frac{20.9}{(20.9\text{-}O_2\%)}$$

lb/hr of = 0.0507 clinker ton/hr = 36.4

Emission Rate lb/ton = 0.0014

MOSTARDI PLATT

Moisture Calculations

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

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

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

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

Where:

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

MOSTARDI PLATT

Volumetric Flow Nomenclature

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

MOSTARDI PLATT

Volumetric Air Flow Calculations

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

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

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

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

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

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

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

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

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

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

MOSTARDI PLATT

Isokinetic Calculation Formulas

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

MOSTARDI PLATT

Isokinetic Nomenclature

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

MOSTARDI PLATT

Calculations for Hydrogen Fluoride By Method 26 or 26A

Concentration

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

where:

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

dscf = Volume of gas sampled

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

Parts Per Million

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

where:

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

106 = Conversion of ppm v/v

Emission Rate

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

MOSTARDI PLATT

Pollutant Concentration Correction 7% for Percent Oxygen

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

where:

C_{adj} = Pollutant concentration corrected to percent O_2

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

20.9 = Percent O_2 in air

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

C_d = Pollutant concentration measured, dry basis, ppm.

Appendix E- Laboratory Sample Analysis

mostardi platt

Chain-of-Custody Form

Project Number: M233801	Date Results Required:
Client: Ash Grove Cement Company	TAT Required:
Plant/Test Location: Louisville/K2 (HW) and K1 (ACL)	Project Supervisor: EE

Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
001	9/26/23	#1A K2 M26A H2SO4	1		HF	
002	9/26/23	#1A K2 M26A NaOH	1		Cl_2	
003	9/26/23	#1B K2 M26A H2SO4	1		HF	
004	9/26/23	#1B K2 M26A NaOH	1		Cl_2	
005	9/26/23	#2A K2 M26A H2SO4	1		HF	
006	9/26/23	#2A K2 M26A NaOH	1		Cl_2	
007	9/26/23	#2B K2 M26A H2SO4	1		HF	
008	9/26/23	#2B K2 M26A NaOH	1		Cl_2	
009	9/26/23	#3A K2 M26A H2SO4	1		HF	
010	9/26/23	#3A K2 M26A NaOH	1		Cl_2	
011	9/26/23	#3B K2 M26A H2SO4	1		HF	
012	9/26/23	#3B K2 M26A NaOH	1		Cl_2	
013	9/26/23	A Train Blank H2SO4	1		HF	
014	9/26/23	A Train Blank NaOH	1		Cl_2	
015	9/27/23	#1A K1 M26A H2SO4	1		HF	
016	9/27/23	#1A K1 M26A NaOH	1		Cl_2	
017	9/27/23	#1B K1 M26A H2SO4	1		HF	
018	9/27/23	#1B K1 M26A NaOH	1		Cl_2	
019	9/27/23	#2A K1 M26A H2SO4	1		HF	
020	9/27/23	#2A K1 M26A NaOH	1		Cl_2	

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

Laboratory Notes:

mostardi platt

Chain-of-Custody Form

Project Number:	Date Results Required:
Client:	TAT Required:
Plant/Test Location:	Project Supervisor:

Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
021	9/27/23	#2B K2 M26A H2SO4	1		HF	
022	9/27/23	#2B K2 M26A NaOH	1		Cl_2	
023	9/27/23	#3A K2 M26A H2SO4	1		HF	
024	9/27/23	#3A K2 M26A NaOH	1		Cl_2	
025	9/27/23	#3B K2 M26A H2SO4	1		HF	
026	9/27/23	#3B K2 M26A NaOH	1		Cl_2	
027	9/27/23	B Train Blank H2SO4	1		HF	
028	9/27/23	B Train Blank NaOH	1		Cl_2	
029	9/27/23	DI Reagent Blank	1		HF/Cl_2	
030	9/27/23	H2SO4 Reagent Blank	1		HF	
031	9/27/23	NaOH Reagent Blank	1		Cl_2	

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

Laboratory Notes:

Kiln 1

Client:	Ash Grove	Analysis Date:	10/4/2023
Facility:	Louisville	Analysis Location:	Elmhurst
Test Location:	Kiln 1	Analyst:	JMG
Project Number:	M233801		
Method:	M26a-RTR		
Date Samples Received:	10/2/2023		

Train A

Sampling Date		9/20/2023	9/20/2023	9/20/2023	9/20/2023		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	200	200	359	359		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		9/20/2023	9/20/2023				
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**			**RDL**	**MDL**
Sulfuric Acid Volume	ml	414	341				
Hydrofluoric Acid	ug	<150	<150			150	15

Train B

Sampling Date		9/27/2023	9/27/2023	9/27/2023	9/27/2023		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	200	200	350	350		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		9/27/2023	9/27/2023				
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**			**RDL**	**MDL**
Sulfuric Acid Volume	ml	414	341				
Hydrofluoric Acid	ug	<150	<150			150	15

Client:	Ash Grove	**Analysis Date:**	10/4/2023								
Facility:	Louisville	**Analysis Location:**	Elmhurst								
Test Location:	Kiln 1	**Analyst:**	JMG								
Project Number:	M233801										
Method:	M26a-RTR										
Date Samples Received:	10/2/2023										
Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**ope of Regression Curve**							
1	0.2034	0.2034	**0.93**	**0.2197**							
2	0.4109	0.2055	**1.87**								
5	1.1104	0.2221	**5.06**	**Response Factor Ave**							
8	1.8513	0.2314	**8.43**	**0.2195**							
10	2.3537	0.2354	**10.72**								
Lot Number	Ricca 8209004										
R²		**0.9995**									
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**
029	9/27/2023	DI Reagent Blank	0.0022	0.0100	0.0100	1	200	0.0020	0.0021		
029	9/27/2023	DI Reagent Blank	0.0007	0.0032	0.0032	1	200	0.0006	0.0007	**0.0014**	**1.390576133**
030	9/27/2023	H2SO4 Reagent Blank	0.0015	0.0068	0.0068	1	200	0.0014	0.0014		
030	9/27/2023	H2SO4 Reagent Blank	0.0025	0.0114	0.0114	1	200	0.0023	0.0024	**0.0019**	**1.918036046**
001	9/27/2023	Test 1 H2SO4 Imp	0.0732	0.3332	0.3332	1	359	0.1196	0.1260		
001	9/27/2023	Test 1 H2SO4 Imp	0.0686	0.3123	0.3123	1	359	0.1121	0.1181	**0.1220**	**122.0499082**
001	9/27/2023	Test 1 H2SO4 Imp	0.0678	0.3087	0.3087	1	359	0.1108	0.1167		
001	9/27/2023	Test 1 H2SO4 Imp	0.0685	0.3119	0.3119	1	359	0.1120	0.1179	**0.1173**	**117.3159555**
005	9/27/2023	Test 2 H2SO4 Imp	0.0632	0.2877	0.2877	1	414	0.1191	0.1255		
005	9/27/2023	Test 2 H2SO4 Imp	0.0618	0.2813	0.2813	1	414	0.1165	0.1227	**0.1241**	**124.0729567**
009	9/27/2023	Test 3 H2SO4 Imp	0.0697	0.3173	0.3173	1	341	0.1082	0.1140		
009	9/27/2023	Test 3 H2SO4 Imp	0.0710	0.3232	0.3232	1	341	0.1102	0.1161	**0.1150**	**115.031095**
013	9/27/2023	H2SO4 Imp Train Blank	0.0022	0.0100	0.0100	1	305	0.0031	0.0032		
013	9/27/2023	H2SO4 Imp Train Blank	0.0020	0.0091	0.0091	1	305	0.0028	0.0029	**0.0031**	**3.071255218**
					Expected Value	**% Difference**					
		Run 1 H2SO4 Spike W/ 2ppm	0.2566	1.1682	1.0967						
Lot Number: Thermo 21-191JKS		Run 1 H2SO4 Spike W/ 2ppm	0.2559	1.1650	1.0967	6.37%					
CCV ppm Cl	**Area**	**PPM Cl**									
1 ppm ICV	0.2154	0.9806									
5 ppm CCV	1.104	5.0260									
5 ppm CCV	1.1066	5.0379									
5 ppm CCV	1.115	5.0761									
5 ppm CCV		0.0000									
Standard ppm Cl	**Area**	**Difference**									
1	0.1878	4.15%									
2	0.3943	2.10%									
5	1.0655	2.11%									
8	1.7587	2.63%									
10	2.2343	2.67%									

Client:	Ash Grove	**Analysis Date:**	10/4/2023								
Facility:	Louisville	**Analysis Location:**	Elmhurst								
Test Location:	Kiln 1	**Analyst:**	JMG								
Project Number:	M233801										
Method:	M26a-RTR										
Date Samples Received:	10/2/2023										
Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**ope of Regression Curve**							
1	0.2034	0.2034	**0.93**	**0.2197**							
2	0.4109	0.2055	**1.87**								
5	1.1104	0.2221	**5.06**	**Response Factor Ave**							
8	1.8513	0.2314	**8.43**	**0.2195**							
10	2.3537	0.2354	**10.72**								
	Ricca 8209004										
R²		**0.9995**									
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**
029	9/27/2023	DI Reagent Blank	0.0022	0.0100	0.0100	1	200	0.0020	0.0021		
029	9/27/2023	DI Reagent Blank	0.0007	0.0032	0.0032	1	200	0.0006	0.0007	**0.0014**	**1.390576133**
030	9/27/2023	H2SO4 Reagent Blank	0.0015	0.0068	0.0068	1	200	0.0014	0.0014		
030	9/27/2023	H2SO4 Reagent Blank	0.0025	0.0114	0.0114	1	200	0.0023	0.0024	**0.0019**	**1.918036046**
002	9/27/2023	Test 1 H2SO4 Imp	0.0674	0.3068	0.3068	1	350	0.1074	0.1131		
002	9/27/2023	Test 1 H2SO4 Imp	0.0644	0.2932	0.2932	1	350	0.1026	0.1081	**0.1106**	**110.5987535**
002	9/27/2023	Test 1 H2SO4 Imp	0.0641	0.2918	0.2918	1	350	0.1021	0.1076		
002	9/27/2023	Test 1 H2SO4 Imp	0.0647	0.2946	0.2946	1	350	0.1031	0.1086	**0.1081**	**108.0813312**
007	9/27/2023	Test 2 H2SO4 Imp	0.0689	0.3137	0.3137	1	323	0.1013	0.1067		
007	9/27/2023	Test 2 H2SO4 Imp	0.0669	0.3046	0.3046	1	323	0.0984	0.1036	**0.1052**	**105.1644779**
011	9/27/2023	Test 3 H2SO4 Imp	0.0670	0.3050	0.3050	1	337	0.1028	0.1083		
011	9/27/2023	Test 3 H2SO4 Imp	0.0669	0.3046	0.3046	1	337	0.1026	0.1081	**0.1082**	**108.1875424**
CCV ppm F	**Area**	**PPM CI**									
1 ppm ICV	0.2154	0.9806									
5 ppm CCV	1.104	5.0260									
5 ppm CCV	1.1066	5.0379									
5 ppm CCV	1.115	5.0761									
5 ppm CCV	0	0.0000									
Standard ppm CI	**Area**	**Difference**									
1	0.2088	1.29%									
2	0.4134	0.30%									
5	1.1139	0.16%									
8	1.8649	0.36%									
10	2.2343	2.67%									

Kiln 1

Client:	Ash Grove	Analysis Date:	10/4/2023
Facility:	Louisville	Analysis Location:	Elmhurst
Test Location:	Kiln 1	Analyst:	JMG
Project Number:	M233801		
Method:	M26a-RTR		
Date Samples Received:	10/2/2023		

Train A

Sampling Date		9/27/2023	9/27/2023	9/27/2023	9/27/2023		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	200	200	220	220		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		9/27/2023	9/27/2023				
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**			**RDL**	**MDL**
Sodium Hydroxide Volume	ml	161	198				
Chlorine	ug	<150	<150			150	15

Train B

Sampling Date		9/27/2023	9/27/2023	9/27/2023	9/27/2023		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	200	200	205	205		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		9/27/2023	9/27/2023				
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**			**RDL**	**MDL**
Sodium Hydroxide Volume	ml	198	187				
Chlorine	ug	<150	<150			150	15

Client:	Ash Grove	**Analysis Date:**	10/4/2023							
Facility:	Louisville	**Analysis Location:**	Elmhurst Lab							
Test Location:	Kiln 1	**Analyst:**	JMG							
Project Number:	M233801									
Method:	M26a-RTR									
Date Samples Received:	10/2/2023									
Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**ope of Regression Curve**						
1	0.1398	0.1398	**1.02**	**0.1366**						
2	0.2575	0.1288	**1.88**							
5	0.6755	0.1351	**4.94**	**Response Factor Ave**						
8	1.1232	0.1404	**8.22**	**0.1365**						
10	1.3866	0.1387	**10.15**							
	Ricca 8209004									
R²		**0.9995**								
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 C2 in soln**
029	9/27/2023	DI Reagent Blank	0.0015	0.0110	0.0110	1	200	0.0022		
029	9/27/2023	DI Reagent Blank	0.0003	0.0022	0.0022	1	200	0.0004	**0.0013**	**1.31756064**
030	9/27/2023	H2SO4 Reagent Blank	0.0110	0.0805	0.0805	1	200	0.0161		
030	9/27/2023	H2SO4 Reagent Blank	0.0122	0.0893	0.0893	1	200	0.0179	**0.0170**	**16.98189269**
002	9/27/2023	Test 1 NaOH Imp	0.0129	0.0944	0.0944	1	220	0.0208		
002	9/27/2023	Test 1 NaOH Imp	0.0114	0.0834	0.0834	1	220	0.0184	**0.0196**	**19.5657755**
002	9/27/2023	Test 1 NaOH Imp	0.0096	0.0703	0.0703	1	220	0.0155		
002	9/27/2023	Test 1 NaOH Imp	0.0123	0.0900	0.0900	1	220	0.0198	**0.0176**	**17.63335323**
006	9/27/2023	Test 2 NaOH Imp	0.0266	0.1947	0.1947	1	161	0.0313		
006	9/27/2023	Test 2 NaOH Imp	0.0268	0.1962	0.1962	1	161	0.0316	**0.0315**	**31.46554401**
010	9/27/2023	Test 3 NaOH Imp	0.0875	0.6405	0.6405	1	198	0.1268		
010	9/27/2023	Test 3 NaOH Imp	0.0832	0.6090	0.6090	1	198	0.1206	**0.1237**	**123.6991807**
014	9/27/2023	NaOH Imp Train Blank	0.0097	0.0710	0.0710	1	305	0.0217		
014	9/27/2023	NaOH Imp Train Blank	0.0085	0.0622	0.0622	1	305	0.0190	**0.0203**	**20.31605309**
					Expected Value	**% Difference**				
		Run 1 H2SO4 Spike W/ 2ppm	0.1309	0.9582	0.9869					
		Run 1 H2SO4 Spike W/ 2ppm	0.1327	0.9713	0.9869	2.24%				
CCV ppm Cl	**Area**	**PPM Cl**								
5 ppm ICV	0.6866	5.0258								
5 ppm CCV	0.6861	5.0221								
5 ppm CCV		0.0000								
5 ppm CCV		0.0000								
5 ppm CCV		0.0000								
Standard ppm Cl	**Area**	**Difference**								
1	0.1314	3.20%								
2	0.2643	1.29%								
5	0.7151	2.77%								
8	1.1437	0.90%								
10	1.4265	1.40%								

Client:	Ash Grove	**Analysis Date:**	10/4/2023							
Facility:	Louisville	**Analysis Location:**	Elmhurst Lab							
Test Location:	Kiln 1	**Analyst:**	JMG							
Project Number:	M233801									
Method:	M26a-RTR									
Date Samples Received:	10/2/2023									
Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**ope of Regression Curve**						
1	0.1398	0.1398	**1.02**	**0.1366**						
2	0.2575	0.1288	**1.88**							
5	0.6755	0.1351	**4.94**	**Response Factor Ave**						
8	1.1232	0.1404	**8.22**	**0.1365**						
10	1.3866	0.1387	**10.15**							
	Ricca 8209004									
R²		**0.9995**								
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**
029	9/27/2023	DI Reagent Blank	0.0015	0.0110	0.0110	1	200	0.0022		
029	9/27/2023	DI Reagent Blank	0.0003	0.0022	0.0022	1	200	0.0004	**0.0013**	**1.31756064**
031	9/27/2023	NaOH Reagent Blank	0.0110	0.0805	0.0805	1	200	0.0161		
031	9/27/2023	NaOH Reagent Blank	0.0122	0.0893	0.0893	1	200	0.0179	**0.0170**	**16.98189269**
004	9/27/2023	Test 1 NaOH Imp	0.0231	0.1691	0.1691	1	205	0.0347		
004	9/27/2023	Test 1 NaOH Imp	0.0197	0.1442	0.1442	1	205	0.0296	**0.0321**	**32.1118807**
004	9/27/2023	Test 1 NaOH Imp	0.0214	0.1566	0.1566	1	205	0.0321		
004	9/27/2023	Test 1 NaOH Imp	0.0126	0.0922	0.0922	1	205	0.0189	**0.0255**	**25.50943794**
008	9/27/2023	Test 2 NaOH Imp	0.0149	0.1091	0.1091	1	198	0.0216		
008	9/27/2023	Test 2 NaOH Imp	0.0153	0.1120	0.1120	1	198	0.0222	**0.0219**	**21.88468223**
010	9/27/2023	Test 3 NaOH Imp	0.0020	0.0146	0.0146	1	187	0.0027		
010	9/27/2023	Test 3 NaOH Imp	0.0056	0.0410	0.0410	1	187	0.0077	**0.0052**	**5.201436615**
CCV ppm Cl	**Area**	**PPM Cl**								
5 ppm ICV	0.6866	5.0258								
5 ppm CCV	0.6861	5.0221								
5 ppm CCV	0	0.0000								
5 ppm CCV	0	0.0000								
5 ppm CCV	0	0.0000								
Standard ppm Cl	**Area**	**Difference**								
1	0.1314	3.20%								
2	0.2643	1.29%								
5	0.7151	2.77%								
8	1.1437	0.90%								
10	1.4265	1.40%								

Appendix F - Reference Method Test Data

Client:	Ash Grove Cement Company		
Facility:	Louisville NE		
Test Location:	Kiln 1 (ACL)		
Project #:	M233801		
Test Method:	26A		
Test Engineer:	ATW		
Test Technician:	DCS		
	Run 1A	**Run 2A**	**Run 3A**
Temp ID:	CM37	CM37	CM37
Meter ID:	CM37	CM37	CM37
Pitot ID:	S8-059-A	S8-059-A	S8-059-A
Filter ID:	11249	11251	11250
Filter Pre-Weight (grams):	0.37171	0.37964	0.37275
Nozzle Diameter (Inches):	0.232	0.232	0.232
Meter Calibration Date:	9/12/2023	9/12/2023	9/12/2023
Meter Calibration Factor (Y):	0.992	0.992	0.992
Meter Orifice Setting (Delta H):	1.889	1.889	1.889
Nozzle Kit ID Number and Material:	Teflon #24	Teflon #24	Teflon #24
Pitot Tube Coefficient:	0.839		
Probe Length (Feet):	8.0		
Probe Liner Material:	Glass		
Sample Plane:	Horizontal		
Port Length (Inches):	8.50		
Port Size (Diameter, Inches):	4.00		
Port Type:	Flange		
Duct Shape:	Rectangular		
Length (Feet):	6.3		
Width (Feet):	11		
Duct Area (Square Feet):	69.300		
Equivalent Diameter Rectangular Duct (Feet):	8.012		
Upstream Diameters:	<0.5		
Downstream Diameters:	<2.0		
Number of Ports Sampled:	5		
Number of Points per Port:	9		
Minutes per Point:	2.0		
Minutes per Reading:	2.0		
Total Number of Traverse Points:	45		
Test Length (Minutes):	90		
Train Type:	Anderson Box		
Source Condition:	Normal		
Diluent Model/Serial Number:	CAI 700 and MKS 2030		
Moisture Balance ID:	S168		
# of Runs	3		

Method 1 and 2 Cyclonic Flow Check Data

Project Number	M233801	**Source Condition:**	Normal
Client:	Ash Grove Cement Company	**Run No.:**	1
Facility:	Louisville NE	**Date:**	9/25/2023
Location:	Kiln 1 (ACL)	**Start Time:**	17:00
Pitot ID:	S8-059-A	**End Time:**	17:35
Pitot Coefficient:	0.839	**RM Testers:**	ATW/DCS
Probe Length:	8	**Port Length:**	8.50

Port	Point	DP (in. H_2O)	Sqrt. DP	Temp (^oF)	Yaw (o)	Port	Point	DP (in. H_2O)	Sqrt. DP	Temp (^oF)	Yaw (o)
A	**1**	0.70	0.8367	306.0	9.0	**C**	**1**	0.71	0.8426	295.0	9.0
A	**2**	0.61	0.7810	293.0	9.0	**C**	**2**	0.65	0.8062	306.0	9.0
A	**3**	0.46	0.6782	295.0	12.0	**C**	**3**	0.48	0.6928	297.0	10.0
B	**1**	0.66	0.8124	305.0	8.0	**D**	**1**	0.65	0.8062	295.0	9.0
B	**2**	0.55	0.7416	305.0	8.0	**D**	**2**	0.57	0.7550	305.0	7.0
B	**3**	0.45	0.6708	295.0	11.0	**D**	**3**	0.46	0.6782	296.0	10.0

Average Yaw Angle 9.3 ^{o}

Run 1A - Method 26A

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

Facility: Louisville NE | **Start Time: 10:20**

Test Location: Kiln 1 (ACL) | **End Time: 12:41**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.23	in. H_2O	Static Pressure	-0.80	in. H_2O
Meter Temperature, Tm:	69.7	°F	Flue Pressure (Ps):	28.72	in. Hg. abs.
Sqrt ΔP:	0.806	in. H_2O	Carbon Dioxide:	7.47	%
Stack Temperature, Ts:	290.1	°F	Oxygen:	15.88	%
Meter Volume, Vm:	56.905	ft^3	Nitrogen:	76.65	%
Meter Volume, Vmstd:	54.291	dscf	Gas Weight dry, Md:	29.830	lb/lb mole
Meter Volume, Vwstd:	6.429	wscf	Gas Weight wet, Ms:	28.578	lb/lb mole
Isokinetic Variance:	102.6	%I	Excess Air:	---	%
			Gas Velocity, Vs:	55.260	fps
Test Length:	90.00	in mins.	Volumetric Flow:	229,770	acfm
Nozzle Diameter:	0.232	in inches	Volumetric Flow:	138,815	dscfm
Barometric Pressure:	28.78	in Hg	Volumetric Flow:	155,254	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3462.5	ml	Silica Initial Wt.	868.8	grams
Final Impinger Content:	3585.6	ml	Silica Final Wt.	882.2	grams
Impinger Difference:	123.1	ml	Silica Difference:	13.4	grams

Total Water Gain: 136.5 Moisture, Bws: 0.106

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	10:20:00	0.25	0.47	240.385	289	63	63	259	259	57
1-2	10:22:00	0.28	0.53	241.155	289	63	63	260	262	59
1-3	10:24:00	0.33	0.62	241.970	289	64	64	262	260	59
1-4	10:26:00	0.33	0.62	242.855	289	64	64	262	265	59
1-5	10:28:00	0.25	0.47	243.735	289	65	65	265	265	56
1-6	10:30:00	0.38	0.72	244.505	289	65	65	257	260	56
1-7	10:32:00	0.41	0.78	245.455	289	65	65	260	260	55
1-8	10:34:00	0.40	0.76	246.435	289	65	65	262	263	55
1-9	10:36:00	0.36	0.68	247.720	289	65	65	260	262	55
	10:38:00			248.845						
2-1	10:49:00	1.00	1.90	248.845	290	67	67	260	260	54
2-2	10:51:00	0.93	1.70	250.395	290	67	67	262	264	54
2-3	10:53:00	0.84	1.60	251.885	290	68	68	261	262	52
2-4	10:55:00	0.70	1.30	253.300	290	68	68	260	261	52
2-5	10:57:00	0.64	1.20	255.320	290	68	68	260	261	52
2-6	10:59:00	0.59	1.10	256.555	289	68	68	260	262	53
2-7	11:01:00	0.56	1.00	257.750	289	68	68	261	261	53
2-8	11:03:00	0.53	1.00	258.910	289	68	68	261	262	54
2-9	11:05:00	0.50	0.97	260.035	280	68	68	264	262	54
	11:07:00			261.140						
3-1	11:23:00	0.86	1.60	261.140	291	69	69	259	262	53
3-2	11:25:00	0.99	1.90	262.580	291	70	70	265	261	55
3-3	11:27:00	1.00	1.90	264.125	291	70	70	259	263	54
3-4	11:29:00	0.97	1.80	265.680	291	70	70	263	263	53
3-5	11:31:00	0.94	1.80	267.210	291	70	70	263	262	53
3-6	11:33:00	0.84	1.60	268.715	291	70	70	262	261	54
3-7	11:35:00	0.76	1.40	270.145	291	70	70	258	262	54
3-8	11:37:00	0.72	1.30	271.495	291	70	70	257	263	54
3-9	11:39:00	0.61	1.10	272.815	291	71	71	266	263	53
	11:41:00			274.035						
4-1	11:52:00	0.46	0.88	274.035	292	71	71	263	263	57
4-2	11:54:00	0.51	0.91	275.100	292	71	71	259	262	58
4-3	11:56:00	0.57	1.00	276.205	292	72	72	257	261	59
4-4	11:58:00	0.63	1.20	277.380	292	72	72	261	262	60
4-5	12:00:00	0.66	1.20	278.620	292	72	72	263	263	60
4-6	12:02:00	0.69	1.30	279.885	292	72	72	262	264	60
4-7	12:04:00	0.71	1.30	281.180	292	73	73	264	262	60
4-8	12:06:00	0.73	1.40	282.495	292	73	73	262	261	60
4-9	12:08:00	0.57	1.10	283.825	292	73	73	262	262	60
	12:10:00			285.000						
5-1	12:23:00	0.57	1.10	285.000	290	74	74	262	260	60
5-2	12:25:00	0.57	1.10	286.185	290	74	74	261	263	60
5-3	12:27:00	0.62	1.20	287.365	290	74	74	262	265	60
5-4	12:29:00	0.64	1.20	288.600	290	74	74	258	260	60
5-5	12:31:00	0.72	1.30	289.855	290	74	74	256	263	62
5-6	12:33:00	0.80	1.50	291.185	290	75	75	261	265	62
5-7	12:35:00	0.99	1.90	292.585	290	75	75	262	263	63
5-8	12:37:00	1.00	1.90	294.150	290	75	75	265	259	63
5-9	12:39:00	1.00	1.90	295.720	290	75	75	261	264	64
	12:41:00			297.290						
Total	1:30:00			56.905		69.7	69.7			
Average			1.23		290.1	69.7				
Min			0.47		280.0	63.0				
Max			1.90		292.0	75.0				

Impinger Weight Sheet - Run 1A

Client:	**Ash Grove Cement Company**
Facility:	**Louisville NE**
Test Location:	**Kiln 1 (ACL)**
Project #:	**M233801**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	
Balance ID:	**S168**

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

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

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

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	838.5	744.6	93.9
0.1N H2SO4	760.6	737.7	22.9
Empty	501.8	496.6	5.2
0.1N NaOH	738.5	738.8	-0.3
0.1N NaOH	746.2	744.8	1.4
Silica Gel	882.2	868.8	13.4

Liquid Final	Liquid Initial	Liquid Gain
3,585.6	3,462.5	123.1

Silica Final	Silica Initial	Silica Gain
882.2	868.8	13.4

Run 2A - Method 26A

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

Facility: Louisville NE | **Start Time: 13:18**

Test Location: Kiln 1 (ACL) | **End Time: 15:10**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.26	In. H_2O	Static Pressure	-0.80	in. H_2O
Meter Temperature, Tm:	78.1	°F	Flue Pressure (Ps):	28.72	in. Hg. abs.
Sqrt ΔP:	0.808	In. H_2O	Carbon Dioxide:	7.50	%
Stack Temperature, Ts:	285.7	°F	Oxygen:	15.84	%
Meter Volume, Vm:	57.595	ft^3	Nitrogen:	76.7	%
Meter Volume, Vmstd:	54.102	dscf	Gas Weight dry, Md:	29.834	lb/lb mole
Meter Volume, Vwstd:	8.869	wscf	Gas Weight wet, Ms:	28.167	lb/lb mole
Isokinetic Variance:	105.1	%I	Excess Air:	---	%
			Gas Velocity, Vs:	55.650	fps
Test Length:	90.00	in mins.	Volumetric Flow:	231,392	acfm
Nozzle Diameter:	0.232	in inches	Volumetric Flow:	135,117	dscfm
Barometric Pressure:	28.78	in Hg	Volumetric Flow:	157,267	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3443.3	ml	Silica Initial Wt.	807.8	grams
Final Impinger Content:	3618.7	ml	Silica Final Wt.	820.7	grams
Impinger Difference:	175.4	ml	Silica Difference:	12.9	grams

Total Water Gain: 188.3 Moisture, Bws: 0.141

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	13:18:00	0.60	1.10	298.200	289	76	76	252	253	54
1-2	13:20:00	0.57	1.10	299.420	289	76	76	256	253	56
1-3	13:22:00	0.55	1.00	300.610	289	76	76	262	264	58
1-4	13:24:00	0.57	1.10	301.775	288	76	76	262	255	58
1-5	13:26:00	0.54	1.00	302.965	288	76	76	260	261	59
1-6	13:28:00	0.47	0.90	304.125	288	76	76	263	264	59
1-7	13:30:00	0.48	0.90	305.205	288	76	76	264	263	59
1-8	13:32:00	0.55	1.00	306.295	287	76	76	261	260	59
1-9	13:34:00	0.57	1.10	307.460	287	76	76	257	259	59
	13:36:00			308.655						
2-1	13:40:00	0.43	0.80	308.655	286	77	77	263	264	58
2-2	13:42:00	0.47	0.90	309.695	286	77	77	267	265	57
2-3	13:44:00	0.55	1.00	310.775	286	77	77	267	262	57
2-4	13:46:00	0.65	1.20	311.950	286	77	77	267	260	58
2-5	13:48:00	0.61	1.10	313.225	286	77	77	265	259	58
2-6	13:50:00	0.65	1.20	314.455	285	77	77	259	262	58
2-7	13:52:00	0.71	1.30	315.730	285	77	77	261	265	58
2-8	13:54:00	0.78	1.50	317.065	285	77	77	262	261	60
2-9	13:56:00	0.81	1.50	318.455	285	77	77	267	257	60
	13:58:00			319.880						
3-1	14:05:00	0.95	1.80	319.880	285	77	77	261	264	60
3-2	14:07:00	0.94	1.80	321.425	285	77	77	263	258	59
3-3	14:09:00	1.00	1.90	322.955	285	77	77	269	261	59
3-4	14:11:00	0.89	1.70	324.535	285	77	77	267	261	61
3-5	14:13:00	0.81	1.50	326.030	285	77	77	261	258	61
3-6	14:15:00	0.73	1.40	327.450	285	77	77	267	258	62
3-7	14:17:00	0.70	1.30	328.800	285	77	77	257	262	63
3-8	14:19:00	0.67	1.30	330.125	285	77	77	257	264	64
3-9	14:21:00	0.62	1.20	331.415	285	77	77	262	265	64
	14:23:00			332.660						
4-1	14:28:00	0.83	1.60	332.660	285	80	80	260	260	60
4-2	14:30:00	0.74	1.40	334.110	285	80	80	261	263	61
4-3	14:32:00	0.72	1.40	335.475	285	80	80	262	265	62
4-4	14:34:00	0.69	1.30	336.825	285	80	80	265	263	64
4-5	14:36:00	0.60	1.10	338.145	285	80	80	261	258	63
4-6	14:38:00	0.57	1.10	339.380	285	80	80	256	259	61
4-7	14:40:00	0.53	1.00	340.575	285	80	80	262	262	60
4-8	14:42:00	0.49	0.96	341.735	285	80	80	262	264	60
4-9	14:44:00	0.44	0.86	342.850	285	80	80	262	264	59
	14:46:00			343.905						
5-1	14:52:00	0.93	1.80	343.905	285	80	80	265	264	56
5-2	14:54:00	0.95	1.80	345.440	285	80	80	267	263	55
5-3	14:56:00	0.87	1.70	346.990	285	80	80	257	258	56
5-4	14:58:00	0.75	1.40	348.475	285	80	80	259	261	57
5-5	15:00:00	0.67	1.30	349.850	285	80	80	261	264	57
5-6	15:02:00	0.61	1.20	351.155	285	80	80	260	264	57
5-7	15:04:00	0.57	1.10	352.395	285	81	81	265	260	57
5-8	15:06:00	0.50	0.98	353.595	285	81	81	258	259	57
5-9	15:08:00	0.45	0.89	354.720	285	81	81	257	261	58
	15:10:00			355.795						
Total	1:30:00			57.595		78.1	78.1			
Average			1.26		285.7	78.1				
Min			0.80		285.0	76.0				
Max			1.90		289.0	81.0				

Impinger Weight Sheet - Run 2A

Client:	**Ash Grove Cement Company**
Facility:	**Louisville NE**
Test Location:	**Kiln 1 (ACL)**
Project #:	**M233801**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**0**
Balance ID:	**S168**

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

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

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

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	896.3	765.5	130.8
0.1N H2SO4	758.4	721.7	36.7
Empty	659.6	598.5	61.1
0.1N NaOH	636.2	669.6	-33.4
0.1N NaOH	668.2	688.0	-19.8
Silica Gel	820.7	807.8	12.9

Liquid Final	Liquid Initial	Liquid Gain
3,618.7	3,443.3	175.4

Silica Final	Silica Initial	Silica Gain
820.7	807.8	12.9

Run 3A - Method 26A

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

Facility: Louisville NE | **Start Time: 15:50**

Test Location: Kiln 1 (ACL) | **End Time: 17:41**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.29	In. H_2O	Static Pressure	-0.80	in. H_2O
Meter Temperature, Tm:	86.7	°F	Flue Pressure (Ps):	28.72	in. Hg. abs.
Sqrt ΔP:	0.804	In. H_2O	Carbon Dioxide:	7.49	%
Stack Temperature, Ts:	282.1	°F	Oxygen:	15.80	%
Meter Volume, Vm:	58.375	ft^3	Nitrogen:	76.71	%
Meter Volume, Vmstd:	53.972	dscf	Gas Weight dry, Md:	29.830	lb/lb mole
Meter Volume, Vwstd:	6.698	wscf	Gas Weight wet, Ms:	28.524	lb/lb mole
Isokinetic Variance:	102.2	%I	Excess Air:	---	%
			Gas Velocity, Vs:	54.853	fps
Test Length:	90.00	in mins.	Volumetric Flow:	228,077	acfm
Nozzle Diameter:	0.232	in inches	Volumetric Flow:	138,574	dscfm
Barometric Pressure:	28.78	in Hg	Volumetric Flow:	155,771	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3450.2	ml	Silica Initial Wt.	882.2	grams
Final Impinger Content:	3579.1	ml	Silica Final Wt.	895.5	grams
Impinger Difference:	128.9	ml	Silica Difference:	13.3	grams

Total Water Gain: 142.2 Moisture, Bws: 0.110

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	15:50:00	0.45	0.88	358.700	285	79	79	258	262	58
1-2	15:52:00	0.46	0.90	359.765	285	79	79	257	261	59
1-3	15:54:00	0.56	1.10	360.845	285	79	79	261	264	59
1-4	15:56:00	0.52	1.10	362.030	285	79	79	262	265	58
1-5	15:58:00	0.44	0.87	363.175	285	79	79	264	260	56
1-6	16:00:00	0.41	0.80	364.225	285	79	79	264	258	57
1-7	16:02:00	0.47	0.92	365.245	285	80	80	251	261	59
1-8	16:04:00	0.58	1.10	366.335	285	80	80	251	264	57
1-9	16:06:00	0.61	1.20	367.545	285	80	80	252	260	57
	16:08:00			368.785						
2-1	16:12:00	0.46	0.91	368.785	283	82	82	252	264	48
2-2	16:14:00	0.51	1.00	369.875	283	82	82	259	262	49
2-3	16:16:00	0.57	1.10	371.000	283	82	82	257	260	48
2-4	16:18:00	0.63	1.20	372.220	283	82	82	254	260	49
2-5	16:20:00	0.66	1.30	373.485	283	82	82	252	263	49
2-6	16:22:00	0.69	1.30	374.785	283	83	83	254	265	49
2-7	16:24:00	0.71	1.40	376.115	283	83	83	253	264	48
2-8	16:26:00	0.74	1.40	377.465	283	83	83	257	260	48
2-9	16:28:00	0.73	1.40	378.840	283	83	83	253	259	48
	16:30:00			380.215						
3-1	16:37:00	0.99	1.90	380.215	282	88	88	257	261	52
3-2	16:39:00	1.10	2.20	381.825	282	88	88	263	258	49
3-3	16:41:00	1.10	2.20	383.525	282	88	88	264	260	48
3-4	16:43:00	0.95	1.90	385.215	282	88	88	264	263	48
3-5	16:45:00	0.93	1.80	386.795	282	88	88	262	265	48
3-6	16:47:00	0.86	1.70	388.355	281	89	89	256	263	48
3-7	16:49:00	0.75	1.50	389.855	281	89	89	264	260	48
3-8	16:51:00	0.70	1.40	391.255	281	89	89	257	260	48
3-9	16:53:00	0.65	1.30	392.615	281	89	89	268	261	48
	16:55:00			393.925						
4-1	16:59:00	0.44	0.88	393.925	281	90	90	257	260	50
4-2	17:01:00	0.52	1.00	395.000	281	90	90	264	260	50
4-3	17:03:00	0.59	1.10	396.175	281	90	90	261	262	50
4-4	17:05:00	0.62	1.20	397.425	281	92	92	263	265	50
4-5	17:07:00	0.65	1.30	398.705	281	92	92	263	264	50
4-6	17:09:00	0.68	1.30	400.020	281	92	92	263	261	51
4-7	17:11:00	0.72	1.40	401.365	281	92	92	260	259	51
4-8	17:13:00	0.73	1.40	402.745	281	92	92	262	261	52
4-9	17:15:00	0.50	1.00	404.135	281	92	92	265	264	52
	17:17:00			405.295						
5-1	17:23:00	0.89	1.80	405.295	280	92	92	257	260	55
5-2	17:25:00	0.92	1.80	406.835	280	92	92	260	258	53
5-3	17:27:00	0.62	1.20	408.395	280	92	92	257	261	51
5-4	17:29:00	0.65	1.30	409.675	280	92	92	262	265	51
5-5	17:31:00	0.72	1.40	411.000	280	92	92	267	264	51
5-6	17:33:00	0.59	1.10	412.375	280	92	92	257	259	51
5-7	17:35:00	0.55	1.10	413.635	280	92	92	257	260	51
5-8	17:37:00	0.49	0.99	414.845	280	92	92	265	265	51
5-9	17:39:00	0.44	0.89	415.985	280	92	92	265	266	51
	17:41:00			417.075						
Total	1:30:00			58.375		86.7	86.7			
Average			1.29		282.1	86.7				
Min			0.80		280.0	79.0				
Max			2.20		285.0	92.0				

Impinger Weight Sheet - Run 3A

Client:	**Ash Grove Cement Company**
Facility:	**Louisville NE**
Test Location:	**Kiln 1 (ACL)**
Project #:	**M233801**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**0**
Balance ID:	**S168**

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

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

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

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	842.3	751.9	90.4
0.1N H2SO4	758.3	731.3	27.0
Empty	502.0	496.9	5.1
0.1N NaOH	728.9	726.7	2.2
0.1N NaOH	747.6	743.4	4.2
Silica Gel	895.5	882.2	13.3
	3,579.1	3,450.2	128.9
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	895.5	882.2	13.3
	Silica Final	**Silica Initial**	**Silica Gain**

Client:	Ash Grove Cement Company		
Facility:	Louisville,NE Cement		
Test Location:	Kiln 1 (ACL)		
Project #:	M233801		
Test Method:	26A		
Test Engineer:	AWB		
Test Technician:	EOS		
	Run 1B	**Run 2B**	**Run 3B**
Temp ID:	CM16	CM16	CM16
Meter ID:	CM16	CM16	CM16
Pitot ID:	S8-058-A	S8-058-A	S8-058-A
Filter ID:	11247	11248	11252
Filter Pre-Weight (grams):	0.37364	0.36356	0.37660
Nozzle Diameter (Inches):	0.214	0.214	0.214
Meter Calibration Date:	9/19/2023	9/19/2023	9/19/2023
Meter Calibration Factor (Y):	0.988	0.988	0.988
Meter Orifice Setting (Delta H):	1.777	1.777	1.777
Nozzle Kit ID Number and Material:	TEFLON #22/7W	TEFLON #22/7W	TEFLON #22/7W
Pitot Tube Coefficient:	0.834		
Probe Length (Feet):	8.0		
Probe Liner Material:	Glass		
Sample Plane:	Horizontal		
Port Length (Inches):	8.50		
Port Size (Diameter, Inches):	4.00		
Port Type:	Flange		
Duct Shape:	Rectangular		
Length (Feet):	6.3		
Width (Feet):	11		
Duct Area (Square Feet):	69.300		
Equivalent Diameter Rectangular Duct (Feet):	8.012		
Upstream Diameters:	<0.5		
Downstream Diameters:	<2.0		
Number of Ports Sampled:	5		
Number of Points per Port:	9		
Minutes per Point:	2.0		
Minutes per Reading:	2.0		
Total Number of Traverse Points:	45		
Test Length (Minutes):	90		
Train Type:	Anderson Box		
Source Condition:	Normal		
Diluent Model/Serial Number:	CAI 700 and MKS 2030		
Moisture Balance ID:	S168		
# of Runs	3		

Run 1B - Method 26A

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

Facility: Louisville,NE Cement | **Start Time: 10:20**

Test Location: Kiln 1 (ACL) | **End Time: 12:41**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	0.90	in. H_2O	Static Pressure	-0.80	in. H_2O
Meter Temperature, Tm:	70.6	°F	Flue Pressure (Ps):	28.72	in. Hg. abs.
Sqrt ΔP:	0.822	in. H_2O	Carbon Dioxide:	7.47	%
Stack Temperature, Ts:	287.0	°F	Oxygen:	15.88	%
Meter Volume, Vm:	49.044	ft^3	Nitrogen:	76.65	%
Meter Volume, Vmstd:	46.484	dscf	Gas Weight dry, Md:	29.830	lb/lb mole
Meter Volume, Vwstd:	5.327	wscf	Gas Weight wet, Ms:	28.614	lb/lb mole
Isokinetic Variance:	101.4	%I	Excess Air:	---	%
			Gas Velocity, Vs:	55.846	fps
Test Length:	90.00	in mins.	Volumetric Flow:	232,207	acfm
Nozzle Diameter:	0.214	in inches	Volumetric Flow:	141,359	dscfm
Barometric Pressure:	28.78	in Hg	Volumetric Flow:	157,558	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3506.6	ml	Silica Initial Wt.	890.0	grams
Final Impinger Content:	3606.3	ml	Silica Final Wt.	903.4	grams
Impinger Difference:	99.7	ml	Silica Difference:	13.4	grams

Total Water Gain: 113.1 Moisture, Bws: 0.103

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	10:20:00	0.86	1.10	42.029	284	65	64	262	262	52	
1-2	10:22:00	0.99	1.30	43.270	282	65	64	262	263	52	
1-3	10:24:00	1.00	1.30	44.580	284	66	64	263	263	51	
1-4	10:26:00	0.97	1.30	45.890	285	67	65	262	265	50	
1-5	10:28:00	0.94	1.20	47.190	285	68	65	262	261	51	
1-6	10:30:00	0.84	1.10	48.460	285	68	65	262	265	52	
1-7	10:32:00	0.76	0.99	49.670	285	69	65	262	261	53	
1-8	10:34:00	0.72	0.93	50.820	285	69	66	262	263	54	
1-9	10:36:00	0.68	0.88	51.940	285	69	66	262	264	56	
	10:38:00			53.013							
2-1	10:49:00	0.46	0.60	53.013	286	68	66	261	262	56	
2-2	10:51:00	0.51	0.66	53.093	287	69	67	261	261	56	
2-3	10:53:00	0.57	0.74	54.860	286	70	68	262	261	57	
2-4	10:55:00	0.63	0.82	55.860	288	70	68	262	261	57	
2-5	10:57:00	0.66	0.86	56.920	287	70	68	262	261	56	
2-6	10:59:00	0.69	0.90	57.990	287	70	68	262	263	57	
2-7	11:01:00	0.71	0.92	59.080	286	71	68	262	265	57	
2-8	11:03:00	0.73	0.95	60.200	287	70	69	263	264	58	
2-9	11:05:00	0.57	0.74	61.330	285	70	68	262	263	58	
	11:07:00			62.321							
3-1	11:23:00	0.55	0.71	62.321	286	70	69	262	264	57	
3-2	11:25:00	0.57	0.74	63.330	287	71	69	262	263	57	
3-3	11:27:00	0.62	0.81	64.340	287	72	69	262	261	56	
3-4	11:29:00	0.64	0.84	65.370	286	72	70	262	260	55	
3-5	11:31:00	0.72	0.94	66.430	288	73	69	262	260	56	
3-6	11:33:00	0.80	1.00	67.550	288	74	70	262	263	56	
3-7	11:35:00	0.92	1.20	68.740	287	74	70	262	263	56	
3-8	11:37:00	1.00	1.30	70.010	288	75	70	261	262	57	
3-9	11:39:00	1.00	1.30	71.340	288	75	70	262	261	57	
	11:41:00			72.668							
4-1	11:52:00	0.44	0.57	72.668	289	72	70	262	261	55	
4-2	11:54:00	0.46	0.60	73.570	289	73	71	262	263	57	
4-3	11:56:00	0.57	0.74	74.480	289	74	71	262	261	57	
4-4	11:58:00	0.50	0.65	75.470	288	74	71	262	264	56	
4-5	12:00:00	0.43	0.56	76.420	289	74	71	261	265	56	
4-6	12:02:00	0.40	0.52	77.280	289	74	71	263	264	57	
4-7	12:04:00	0.42	0.55	78.130	288	74	71	262	263	59	
4-8	12:06:00	0.85	1.10	78.970	289	74	71	262	261	59	
4-9	12:08:00	0.97	1.30	80.210	288	75	71	262	263	60	
	12:10:00			81.508							
5-1	12:23:00	0.89	1.30	81.508	288	74	72	262	261	61	
5-2	12:25:00	0.92	1.20	82.790	289	75	72	261	263	62	
5-3	12:27:00	0.61	0.80	84.060	288	76	73	262	261	62	
5-4	12:29:00	0.65	0.85	85.110	288	76	73	262	261	61	
5-5	12:31:00	0.71	0.93	86.190	288	77	73	262	261	62	
5-6	12:33:00	0.57	0.75	87.310	288	77	73	262	261	63	
5-7	12:35:00	0.54	0.71	88.310	287	77	73	263	262	64	
5-8	12:37:00	0.47	0.62	89.290	287	78	74	262	263	64	
5-9	12:39:00	0.43	0.56	90.220	289	78	74	262	261	64	
	12:41:00			91.073							
Total	1:30:00			49.044		72.0	69.2				
Average			0.90		287.0	70.6					
Min			0.52		282.0	64.0					
Max			1.30		289.0	78.0					

Impinger Weight Sheet - Run 1B

Client:	**Ash Grove Cement Company**
Facility:	**Louisville,NE Cement**
Test Location:	**Kiln 1 (ACL)**
Project #:	**M233801**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**ELE**
Balance ID:	**S168**

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

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

must be within ± 0.5g of certified mass

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

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	807.7	722.5	85.2
0.1N H2SO4	685.7	674.1	11.6
Empty	649.6	648.2	1.4
0.1N NaOH	727.7	727.0	0.7
0.1N NaOH	735.6	734.8	0.8
Silica Gel	903.4	890.0	13.4

3,606.3	3,506.6	99.7
Liquid Final	**Liquid Initial**	**Liquid Gain**
903.4	890.0	13.4
Silica Final	**Silica Initial**	**Silica Gain**

Run 2B - Method 26A

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

Facility: Louisville,NE Cement | **Start Time: 13:18**

Test Location: Kiln 1 (ACL) | **End Time: 15:10**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	0.88	In. H_2O	Static Pressure	-0.80	in. H_2O
Meter Temperature, Tm:	77.2	°F	Flue Pressure (Ps):	28.72	in. Hg. abs.
Sqrt ΔP:	0.805	In. H_2O	Carbon Dioxide:	7.50	%
Stack Temperature, Ts:	283.0	°F	Oxygen:	15.84	%
Meter Volume, Vm:	48.765	ft^3	Nitrogen:	76.7	%
Meter Volume, Vmstd:	45.650	dscf	Gas Weight dry, Md:	29.834	lb/lb mole
Meter Volume, Vwstd:	4.946	wscf	Gas Weight wet, Ms:	28.677	lb/lb mole
Isokinetic Variance:	100.9	%I	Excess Air:	---	%
			Gas Velocity, Vs:	54.511	fps
Test Length:	90.00	in mins.	Volumetric Flow:	226,656	acfm
Nozzle Diameter:	0.214	in inches	Volumetric Flow:	139,502	dscfm
Barometric Pressure:	28.78	in Hg	Volumetric Flow:	154,615	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3519.9	ml	Silica Initial Wt.	866.1	grams
Final Impinger Content:	3615.3	ml	Silica Final Wt.	875.7	grams
Impinger Difference:	95.4	ml	Silica Difference:	9.6	grams

Total Water Gain: 105.0 Moisture, Bws: 0.098

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	13:18:00	0.94	1.20	92.169	284	73	72	260	262	50
1-2	13:20:00	0.96	1.30	93.490	283	74	73	263	261	51
1-3	13:22:00	1.00	1.30	94.790	285	76	73	263	261	50
1-4	13:24:00	0.98	1.30	96.130	285	76	73	262	262	53
1-5	13:26:00	0.89	1.20	97.450	285	76	73	262	261	52
1-6	13:28:00	0.81	1.10	98.720	285	76	73	262	263	52
1-7	13:30:00	0.73	0.96	99.930	284	77	73	261	261	52
1-8	13:32:00	0.70	0.92	101.060	284	77	74	263	262	53
1-9	13:34:00	0.62	0.82	102.180	284	77	73	262	263	53
	13:36:00			103.221						
2-1	13:40:00	0.42	0.55	103.221	283	76	74	262	261	54
2-2	13:42:00	0.49	0.65	104.110	283	76	74	262	262	53
2-3	13:44:00	0.53	0.70	105.050	284	76	74	261	262	52
2-4	13:46:00	0.60	0.79	106.300	283	77	74	262	261	54
2-5	13:48:00	0.67	0.89	107.070	283	77	74	262	262	53
2-6	13:50:00	0.69	0.91	108.160	284	77	74	262	261	53
2-7	13:52:00	0.72	0.95	109.270	283	77	74	262	263	54
2-8	13:54:00	0.74	0.98	110.420	282	78	74	261	261	53
2-9	13:56:00	0.53	0.71	111.570	283	78	74	262	261	54
	13:58:00			112.532						
3-1	14:05:00	0.92	1.20	112.532	284	77	75	262	263	54
3-2	14:07:00	0.95	1.30	113.840	284	77	75	262	262	55
3-3	14:09:00	0.87	1.20	115.150	283	77	75	262	261	56
3-4	14:11:00	0.74	0.98	116.410	283	77	74	262	260	56
3-5	14:13:00	0.65	0.86	117.550	283	78	75	262	260	56
3-6	14:15:00	0.61	0.81	118.640	282	78	75	262	261	57
3-7	14:17:00	0.56	0.74	119.690	282	77	74	262	258	57
3-8	14:19:00	0.49	0.65	120.690	283	77	74	261	262	56
3-9	14:21:00	0.43	0.57	121.630	282	77	74	260	262	57
	14:23:00			122.497						
4-1	14:28:00	0.76	1.00	122.497	282	81	77	262	261	56
4-2	14:30:00	0.83	1.10	123.690	283	83	78	262	263	57
4-3	14:32:00	0.83	1.10	124.930	282	83	78	262	261	59
4-4	14:34:00	0.43	0.58	126.170	282	85	79	262	267	57
4-5	14:36:00	0.39	0.52	127.060	283	83	80	262	265	59
4-6	14:38:00	0.31	0.42	127.890	282	83	80	262	260	59
4-7	14:40:00	0.38	0.51	128.650	282	82	80	263	264	60
4-8	14:42:00	0.42	0.56	129.490	283	81	80	265	263	61
4-9	14:44:00	0.45	0.60	130.370	284	81	80	266	262	61
	14:46:00			131.268						
5-1	14:52:00	0.92	1.20	131.268	282	80	79	262	262	57
5-2	14:54:00	0.95	1.30	132.590	283	80	79	262	262	57
5-3	14:56:00	0.65	0.86	133.920	284	80	79	261	263	58
5-4	14:58:00	0.63	0.84	134.990	282	80	79	262	263	57
5-5	15:00:00	0.59	0.79	136.070	282	80	79	262	263	57
5-6	15:02:00	0.53	0.71	137.090	282	80	79	262	262	61
5-7	15:04:00	0.57	0.76	138.090	282	81	79	262	261	61
5-8	15:06:00	0.48	0.64	139.110	281	81	79	262	262	62
5-9	15:08:00	0.44	0.68	140.050	281	81	79	263	262	62
	15:10:00			140.934						
Total	1:30:00			48.765		78.5	75.9			
Average			0.88		283.0	77.2				
Min			0.42		281.0	72.0				
Max			1.30		285.0	85.0				

Impinger Weight Sheet - Run 2B

Client:	**Ash Grove Cement Company**
Facility:	**Louisville,NE Cement**
Test Location:	**Kiln 1 (ACL)**
Project #:	**M233801**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**ELE**
Balance ID:	**S168**

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

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

must be within ± 0.5g of certified mass

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

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	780.6	707.9	72.7
0.1N H2SO4	705.4	686.4	19.0
Empty	643.5	641.5	2.0
0.1N NaOH	747.6	746.6	1.0
0.1N NaOH	738.2	737.5	0.7
Silica Gel	875.7	866.1	9.6

Liquid Final	Liquid Initial	Liquid Gain
3,615.3	3,519.9	95.4

Silica Final	Silica Initial	Silica Gain
875.7	866.1	9.6

Run 3B - Method 26A

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

Facility: Louisville,NE Cement | **Start Time: 15:50**

Test Location: Kiln 1 (ACL) | **End Time: 17:41**

Source Condition: Normal

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	0.88	In. H_2O	Static Pressure	-0.80	in. H_2O
Meter Temperature, Tm:	80.3	°F	Flue Pressure (Ps):	28.72	in. Hg. abs.
Sqrt ΔP:	0.800	In. H_2O	Carbon Dioxide:	7.49	%
Stack Temperature, Ts:	280.2	°F	Oxygen:	15.80	%
Meter Volume, Vm:	48.838	ft^3	Nitrogen:	76.71	%
Meter Volume, Vmstd:	45.462	dscf	Gas Weight dry, Md:	29.830	lb/lb mole
Meter Volume, Vwstd:	5.209	wscf	Gas Weight wet, Ms:	28.614	lb/lb mole
Isokinetic Variance:	101.4	%I	Excess Air:	---	%
			Gas Velocity, Vs:	54.140	fps
Test Length:	90.00	in mins.	Volumetric Flow:	225,115	acfm
Nozzle Diameter:	0.214	in inches	Volumetric Flow:	138,294	dscfm
Barometric Pressure:	28.78	in Hg	Volumetric Flow:	154,140	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3498.3	ml	Silica Initial Wt.	903.4	grams
Final Impinger Content:	3600.7	ml	Silica Final Wt.	911.6	grams
Impinger Difference:	102.4	ml	Silica Difference:	8.2	grams

Total Water Gain: 110.6 Moisture, Bws: 0.103

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	15:50:00	0.99	1.30	41.556	282	78	76	262	262	49
1-2	15:52:00	1.10	1.50	42.930	282	78	76	263	262	50
1-3	15:54:00	1.10	1.50	44.330	283	80	77	262	261	51
1-4	15:56:00	0.98	1.30	45.750	282	80	77	262	262	52
1-5	15:58:00	0.93	1.20	47.080	281	81	77	262	263	53
1-6	16:00:00	0.86	1.10	48.390	281	81	77	262	262	54
1-7	16:02:00	0.75	1.00	49.630	280	81	77	262	262	56
1-8	16:04:00	0.70	0.93	50.820	280	81	77	261	253	56
1-9	16:06:00	0.65	0.87	51.930	281	81	77	262	252	58
	16:08:00			53.017						
2-1	16:12:00	0.43	0.57	53.017	280	80	77	262	261	58
2-2	16:14:00	0.51	0.68	53.940	282	79	77	262	258	57
2-3	16:16:00	0.54	0.72	54.880	282	80	77	263	263	56
2-4	16:18:00	0.63	0.84	55.870	283	80	77	262	261	56
2-5	16:20:00	0.65	0.87	56.960	281	80	77	262	262	57
2-6	16:22:00	0.68	0.91	58.030	282	81	77	262	262	58
2-7	16:24:00	0.72	0.96	59.140	281	80	77	262	262	57
2-8	16:26:00	0.73	0.97	60.310	282	81	77	262	262	58
2-9	16:28:00	0.48	0.64	61.450	280	81	77	262	263	58
	16:30:00			62.378						
3-1	16:37:00	0.94	1.30	62.378	281	80	78	262	260	57
3-2	16:39:00	0.97	1.30	63.710	281	81	78	262	264	55
3-3	16:41:00	0.78	1.00	65.050	281	82	78	262	262	55
3-4	16:43:00	0.73	0.98	66.230	280	83	78	262	262	56
3-5	16:45:00	0.63	0.85	67.400	280	84	79	262	263	58
3-6	16:47:00	0.59	0.79	68.470	280	84	78	262	262	57
3-7	16:49:00	0.55	0.74	69.520	279	84	78	262	261	58
3-8	16:51:00	0.51	0.69	70.530	280	85	79	262	261	57
3-9	16:53:00	0.46	0.61	71.510	280	85	79	262	263	57
	16:55:00			72.408						
4-1	16:59:00	0.70	0.94	72.408	280	82	79	261	262	56
4-2	17:01:00	0.74	0.99	73.570	280	84	79	262	259	57
4-3	17:03:00	0.61	0.82	74.740	280	85	79	262	260	55
4-4	17:05:00	0.41	0.55	75.800	281	85	80	262	262	56
4-5	17:07:00	0.38	0.51	76.670	279	84	80	262	261	56
4-6	17:09:00	0.30	0.40	77.510	279	84	80	262	261	57
4-7	17:11:00	0.35	0.47	78.260	280	83	79	263	261	59
4-8	17:13:00	0.39	0.52	79.060	278	83	80	262	262	60
4-9	17:15:00	0.43	0.58	79.910	279	83	79	261	260	60
	17:17:00			80.782						
5-1	17:23:00	0.98	1.30	80.782	278	82	80	262	262	61
5-2	17:25:00	1.00	1.30	82.150	279	83	80	262	262	59
5-3	17:27:00	0.73	0.98	83.520	279	83	80	262	262	60
5-4	17:29:00	0.52	0.70	84.670	279	84	80	262	260	61
5-5	17:31:00	0.47	0.63	85.650	278	84	81	261	258	62
5-6	17:33:00	0.45	0.61	86.590	279	84	81	262	261	62
5-7	17:35:00	0.44	0.59	87.510	280	84	81	262	263	61
5-8	17:37:00	0.52	0.70	88.380	278	84	80	263	263	62
5-9	17:39:00	0.56	0.76	89.370	277	84	80	262	262	61
	17:41:00			90.394						
Total	1:30:00			48.838		82.1	78.4			
Average			0.88		280.2	80.3				
Min			0.40		277.0	76.0				
Max			1.50		283.0	85.0				

Impinger Weight Sheet - Run 3B

Client:	**Ash Grove Cement Company**
Facility:	**Louisville,NE Cement**
Test Location:	**Kiln 1 (ACL)**
Project #:	**M233801**
Date:	**9/27/2023**
Test Method:	**26A**
Weighed/Measured By:	**ELE**
Balance ID:	**S168**

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

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

must be within ± 0.5g of certified mass

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

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	800.5	725.8	74.7
0.1N H2SO4	689.6	668.5	21.1
Empty	654.0	649.6	4.4
0.1N NaOH	729.0	729.5	-0.5
0.1N NaOH	727.6	724.9	2.7
Silica Gel	911.6	903.4	8.2

Liquid Final	Liquid Initial	Liquid Gain
3,600.7	3,498.3	102.4

Silica Final	Silica Initial	Silica Gain
911.6	903.4	8.2

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Test Location: Kiln 1 (ACL) Breaching Duct
Date: 9/27/23

Run 1

		FTIR Data						Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 1_004192.LAB	10:20	10.44	6.53	1.16	0.10	190.99	0.96	16.05
RUN 1_004193.LAB	10:21	10.43	6.53	1.17	0.10	190.94	0.96	16.03
RUN 1_004194.LAB	10:22	10.42	6.60	1.19	0.10	190.94	0.96	16.03
RUN 1_004195.LAB	10:23	10.43	6.60	1.15	0.10	190.99	0.96	16.04
RUN 1_004196.LAB	10:24	10.43	6.56	1.19	0.10	191.07	0.96	16.06
RUN 1_004197.LAB	10:25	10.41	6.55	1.22	0.10	191.15	0.96	16.03
RUN 1_004198.LAB	10:26	10.44	6.59	1.20	0.10	191.05	0.96	16.03
RUN 1_004199.LAB	10:27	10.44	6.56	1.21	0.10	190.94	0.96	16.04
RUN 1_004200.LAB	10:28	10.43	6.46	1.20	0.10	190.94	0.96	16.07
RUN 1_004201.LAB	10:29	10.43	6.47	1.14	0.10	190.94	0.96	16.05
RUN 1_004202.LAB	10:30	10.39	6.52	1.18	0.10	190.94	0.96	16.04
RUN 1_004203.LAB	10:31	10.35	6.63	1.22	0.10	191.01	0.96	16.03
RUN 1_004204.LAB	10:32	10.34	6.64	1.15	0.10	191.05	0.96	16.02
RUN 1_004205.LAB	10:33	10.32	6.59	1.21	0.10	191.05	0.96	16.05
RUN 1_004206.LAB	10:34	10.29	6.47	1.23	0.10	191.05	0.96	16.06
RUN 1_004207.LAB	10:35	10.29	6.41	1.14	0.10	191.05	0.96	16.07
RUN 1_004208.LAB	10:36	10.29	6.48	1.18	0.10	191.03	0.96	16.04
RUN 1_004209.LAB	10:37	10.33	6.67	1.12	0.10	190.94	0.96	15.99
RUN 1_004210.LAB	10:38	10.38	6.66	1.15	0.10	190.94	0.96	15.98
RUN 1_004211.LAB	10:39	10.49	6.73	1.14	0.10	190.94	0.96	15.97
RUN 1_004212.LAB	10:40	10.59	6.72	1.23	0.10	190.94	0.96	15.94
RUN 1_004213.LAB	10:41	10.56	6.64	1.19	0.10	190.94	0.96	15.99
RUN 1_004214.LAB	10:42	10.62	6.67	1.16	0.10	190.94	0.96	15.97
RUN 1_004215.LAB	10:43	10.63	6.61	1.23	0.10	190.96	0.96	15.97
RUN 1_004216.LAB	10:44	10.69	6.60	1.15	0.10	191.05	0.96	15.97
RUN 1_004217.LAB	10:45	10.72	6.64	1.24	0.10	191.05	0.96	15.98
RUN 1_004218.LAB	10:46	10.76	6.61	1.28	0.10	191.05	0.96	15.96
RUN 1_004219.LAB	10:47	10.73	6.53	1.24	0.10	191.05	0.96	15.98
RUN 1_004220.LAB	10:48	10.76	6.64	1.27	0.10	191.05	0.96	16.00
RUN 1_004221.LAB	10:49	10.74	6.72	1.28	0.10	191.05	0.96	15.98
RUN 1_004222.LAB	10:50	10.72	6.73	1.32	0.10	190.96	0.96	15.97
RUN 1_004223.LAB	10:51	10.65	6.75	1.25	0.10	190.94	0.96	15.98
RUN 1_004224.LAB	10:52	10.60	6.78	1.28	0.10	190.94	0.96	15.99
RUN 1_004225.LAB	10:53	10.54	6.74	1.28	0.10	190.94	0.96	15.98
RUN 1_004226.LAB	10:54	10.49	6.65	1.24	0.10	190.94	0.96	15.98
RUN 1_004227.LAB	10:55	10.48	6.65	1.23	0.10	190.94	0.96	16.01
RUN 1_004228.LAB	10:56	10.43	6.74	1.23	0.10	190.94	0.96	16.00
RUN 1_004229.LAB	10:57	10.40	6.79	1.15	0.10	190.96	0.96	15.98
RUN 1_004230.LAB	10:58	10.37	6.74	1.19	0.10	191.05	0.96	15.98
RUN 1_004231.LAB	10:59	10.26	6.62	1.12	0.10	191.05	0.96	15.98
RUN 1_004232.LAB	11:00	10.19	6.56	1.20	0.10	191.05	0.96	16.03
RUN 1_004233.LAB	11:01	10.18	6.63	1.29	0.10	191.05	0.96	16.04
RUN 1_004234.LAB	11:02	10.21	6.75	1.18	0.10	191.05	0.96	16.04
RUN 1_004235.LAB	11:03	10.23	6.76	1.23	0.10	191.05	0.96	16.01
RUN 1_004236.LAB	11:04	10.24	6.67	1.16	0.10	190.94	0.96	16.00
RUN 1_004237.LAB	11:05	10.28	6.64	1.19	0.10	190.94	0.96	16.00
RUN 1_004238.LAB	11:06	10.33	6.68	1.14	0.10	190.94	0.96	16.02
RUN 1_004239.LAB	11:07	10.38	6.79	1.15	0.10	190.94	0.96	16.01
RUN 1_004240.LAB	11:08	10.43	6.77	1.12	0.10	190.94	0.96	16.00
RUN 1_004241.LAB	11:09	10.47	6.66	1.17	0.10	190.94	0.96	15.96
RUN 1_004242.LAB	11:10	10.49	6.52	1.19	0.10	190.96	0.96	15.96
RUN 1_004243.LAB	11:11	10.52	6.53	1.08	0.10	191.05	0.96	15.99
RUN 1_004244.LAB	11:12	10.58	6.70	1.27	0.10	191.05	0.96	16.02
RUN 1_004245.LAB	11:13	10.59	6.81	1.18	0.10	191.05	0.96	16.00
RUN 1_004246.LAB	11:14	10.62	6.88	1.22	0.10	191.05	0.96	15.95
RUN 1_004247.LAB	11:15	10.64	6.83	1.28	0.10	191.05	0.96	15.92
RUN 1_004248.LAB	11:16	10.67	6.78	1.29	0.10	191.02	0.96	15.93
RUN 1_004249.LAB	11:17	10.68	6.73	1.33	0.10	190.94	0.96	15.92
RUN 1_004250.LAB	11:18	10.70	6.74	1.28	0.10	190.94	0.96	15.94
RUN 1_004251.LAB	11:19	10.70	6.80	1.21	0.10	190.94	0.96	15.96
RUN 1_004252.LAB	11:20	10.69	6.77	1.26	0.10	190.94	0.96	15.95
RUN 1_004253.LAB	11:21	10.60	6.77	1.18	0.10	190.94	0.96	15.96
RUN 1_004254.LAB	11:22	10.61	6.87	1.17	0.10	190.94	0.96	15.94
RUN 1_004255.LAB	11:23	10.57	6.81	1.27	0.10	190.98	0.96	15.96
RUN 1_004256.LAB	11:24	10.51	6.78	1.17	0.10	191.05	0.96	15.96
RUN 1_004257.LAB	11:25	10.46	6.67	1.21	0.10	191.05	0.96	15.93
RUN 1_004258.LAB	11:26	10.47	6.62	1.27	0.10	191.03	0.96	15.94
RUN 1_004259.LAB	11:27	10.52	6.69	1.14	0.10	190.94	0.96	15.94
RUN 1_004260.LAB	11:28	10.57	6.87	1.18	0.10	190.94	0.96	15.96
RUN 1_004261.LAB	11:29	10.59	6.84	1.17	0.10	190.94	0.96	15.97
RUN 1_004262.LAB	11:30	10.55	6.81	1.17	0.10	190.94	0.96	15.96
RUN 1_004263.LAB	11:31	10.44	6.72	1.14	0.10	191.00	0.96	15.92
RUN 1_004264.LAB	11:32	10.37	6.71	1.19	0.10	191.05	0.96	15.91
RUN 1_004265.LAB	11:33	10.30	6.76	1.13	0.10	191.05	0.96	15.94
RUN 1_004266.LAB	11:34	10.25	6.80	1.20	0.10	191.05	0.96	15.96
RUN 1_004267.LAB	11:35	10.31	6.82	1.14	0.10	191.05	0.96	15.97
RUN 1_004268.LAB	11:36	10.29	6.78	1.14	0.10	191.04	0.96	15.97
RUN 1_004269.LAB	11:37	10.28	6.75	1.19	0.10	190.94	0.96	15.96
RUN 1_004270.LAB	11:38	10.28	6.84	1.14	0.10	190.94	0.96	15.97
RUN 1_004271.LAB	11:39	10.28	6.91	1.20	0.10	190.94	0.96	15.95
RUN 1_004272.LAB	11:40	10.34	6.81	1.16	0.10	190.94	0.96	15.95
RUN 1_004273.LAB	11:41	10.40	6.73	1.08	0.10	190.94	0.96	15.96
RUN 1_004274.LAB	11:42	10.46	6.67	1.10	0.10	190.99	0.96	15.93
RUN 1_004275.LAB	11:43	10.47	6.71	1.07	0.10	191.05	0.96	15.92
RUN 1_004276.LAB	11:44	10.47	6.74	1.11	0.10	191.05	0.96	15.94
RUN 1_004277.LAB	11:45	10.43	6.75	1.11	0.10	191.00	0.96	15.96
RUN 1_004278.LAB	11:46	10.43	6.73	1.20	0.10	190.94	0.96	15.96
RUN 1_004279.LAB	11:47	10.43	6.79	1.15	0.10	190.95	0.96	15.97
RUN 1_004280.LAB	11:48	10.47	6.89	1.28	0.10	191.05	0.96	15.96
RUN 1_004281.LAB	11:49	10.54	6.83	1.20	0.10	191.05	0.96	15.95
Average		**10.47**	**6.69**	**1.19**	**0.10**	**190.99**	**0.96**	**15.98**

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Test Location: Kiln 1 (ACL) Breaching Duct
Date: 9/27/23

Run 2

		FTIR Data						Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 2_004429.LAB	13:18	10.20	6.7	1.13	0.10	191.0	0.96	15.96
RUN 2_004430.LAB	13:19	10.15	6.7	1.14	0.10	191.0	0.96	15.93
RUN 2_004431.LAB	13:20	10.19	6.7	1.10	0.10	191.0	0.96	15.94
RUN 2_004432.LAB	13:21	10.14	6.7	1.16	0.10	191.0	0.96	15.92
RUN 2_004433.LAB	13:22	10.18	6.8	1.12	0.10	191.0	0.96	15.92
RUN 2_004434.LAB	13:23	10.24	6.8	1.28	0.10	191.0	0.96	15.94
RUN 2_004435.LAB	13:24	10.25	6.7	1.21	0.10	191.0	0.96	15.92
RUN 2_004436.LAB	13:25	10.32	6.8	1.23	0.10	191.0	0.96	15.91
RUN 2_004437.LAB	13:26	10.38	6.8	1.23	0.10	191.0	0.96	15.92
RUN 2_004438.LAB	13:27	10.43	6.7	1.18	0.10	191.0	0.96	15.93
RUN 2_004439.LAB	13:28	10.47	6.7	1.19	0.10	191.0	0.96	15.92
RUN 2_004440.LAB	13:29	10.52	6.7	1.15	0.10	191.0	0.96	15.91
RUN 2_004441.LAB	13:30	10.56	6.7	1.21	0.10	191.0	0.96	15.93
RUN 2_004442.LAB	13:31	10.56	6.7	1.19	0.10	191.0	0.96	15.94
RUN 2_004443.LAB	13:32	10.54	6.6	1.16	0.10	191.0	0.96	15.95
RUN 2_004444.LAB	13:33	10.50	6.7	1.25	0.10	190.9	0.96	15.94
RUN 2_004445.LAB	13:34	10.50	6.7	1.25	0.10	190.9	0.96	15.92
RUN 2_004446.LAB	13:35	10.49	6.7	1.31	0.10	191.0	0.96	15.92
RUN 2_004447.LAB	13:36	10.51	6.7	1.31	0.10	191.0	0.96	15.91
RUN 2_004448.LAB	13:37	10.51	6.7	1.30	0.10	191.0	0.96	15.93
RUN 2_004449.LAB	13:38	10.49	6.8	1.23	0.10	191.0	0.96	15.94
RUN 2_004450.LAB	13:39	10.50	6.8	1.12	0.10	191.0	0.96	15.90
RUN 2_004451.LAB	13:40	10.46	6.9	1.15	0.10	191.0	0.96	15.92
RUN 2_004452.LAB	13:41	10.32	6.9	1.12	0.10	191.0	0.96	15.95
RUN 2_004453.LAB	13:42	10.23	6.8	1.15	0.10	190.9	0.96	15.95
RUN 2_004454.LAB	13:43	10.00	6.7	1.17	0.10	190.9	0.96	16.00
RUN 2_004455.LAB	13:44	9.92	6.6	1.16	0.10	191.0	0.96	16.02
RUN 2_004456.LAB	13:45	9.85	6.7	1.19	0.10	191.0	0.96	16.02
RUN 2_004457.LAB	13:46	9.86	6.7	1.21	0.10	191.0	0.96	16.01
RUN 2_004458.LAB	13:47	9.83	6.8	1.19	0.10	191.0	0.96	15.99
RUN 2_004459.LAB	13:48	9.88	6.8	1.15	0.10	190.9	0.96	15.99
RUN 2_004460.LAB	13:49	9.94	6.8	1.11	0.10	190.9	0.96	15.97
RUN 2_004461.LAB	13:50	9.99	6.8	1.08	0.10	190.9	0.96	15.98
RUN 2_004462.LAB	13:51	10.00	6.8	1.10	0.10	190.9	0.96	15.97
RUN 2_004463.LAB	13:52	10.03	6.7	1.12	0.10	191.0	0.96	15.98
RUN 2_004464.LAB	13:53	10.00	6.7	1.01	0.10	191.0	0.96	15.98
RUN 2_004465.LAB	13:54	10.01	6.7	1.10	0.10	191.0	0.96	15.99
RUN 2_004466.LAB	13:55	10.08	6.8	1.13	0.10	191.0	0.96	15.98
RUN 2_004467.LAB	13:56	10.14	6.8	1.17	0.10	191.0	0.96	15.98
RUN 2_004468.LAB	13:57	10.20	6.8	1.13	0.10	191.0	0.96	15.95
RUN 2_004469.LAB	13:58	10.24	6.7	1.19	0.10	190.9	0.96	15.95
RUN 2_004470.LAB	13:59	10.35	6.8	1.13	0.10	190.9	0.96	15.97
RUN 2_004471.LAB	14:00	10.44	6.8	1.17	0.10	190.9	0.96	15.96
RUN 2_004472.LAB	14:01	10.48	6.8	1.17	0.10	190.9	0.96	15.93
RUN 2_004473.LAB	14:02	10.51	6.8	1.14	0.10	190.9	0.96	15.93
RUN 2_004474.LAB	14:03	10.54	6.7	1.16	0.10	190.9	0.96	15.94
RUN 2_004475.LAB	14:04	10.51	6.7	1.19	0.10	191.0	0.96	15.93
RUN 2_004476.LAB	14:05	10.51	6.8	1.21	0.10	191.0	0.96	15.93
RUN 2_004477.LAB	14:06	10.47	6.8	1.21	0.10	191.0	0.96	15.94
RUN 2_004478.LAB	14:07	10.47	6.8	1.23	0.10	191.0	0.96	15.93
RUN 2_004479.LAB	14:08	10.45	6.7	1.21	0.10	191.0	0.96	15.95
RUN 2_004480.LAB	14:09	10.37	6.7	1.20	0.10	191.0	0.96	15.96
RUN 2_004481.LAB	14:10	10.29	6.7	1.24	0.10	191.0	0.96	15.96
RUN 2_004482.LAB	14:11	10.27	6.7	1.23	0.10	190.9	0.96	15.97
RUN 2_004483.LAB	14:12	10.27	6.7	1.25	0.10	190.9	0.96	15.99
RUN 2_004484.LAB	14:13	10.26	6.7	1.29	0.10	190.9	0.96	15.97
RUN 2_004485.LAB	14:14	10.25	6.6	1.29	0.10	190.9	0.96	15.97
RUN 2_004486.LAB	14:15	10.20	6.6	1.20	0.10	190.9	0.96	15.97
RUN 2_004487.LAB	14:16	10.22	6.7	1.17	0.10	191.0	0.96	16.00
RUN 2_004488.LAB	14:17	10.22	6.6	1.16	0.10	191.0	0.96	16.01
RUN 2_004489.LAB	14:18	10.16	6.6	1.16	0.10	191.0	0.96	16.00
RUN 2_004490.LAB	14:19	10.12	6.5	1.14	0.10	191.0	0.96	15.99
RUN 2_004491.LAB	14:20	10.10	6.6	1.13	0.10	191.0	0.96	16.00
RUN 2_004492.LAB	14:21	10.08	6.7	1.15	0.10	191.0	0.96	16.00
RUN 2_004493.LAB	14:22	10.10	6.8	1.09	0.10	191.0	0.96	16.01
RUN 2_004494.LAB	14:23	9.99	6.8	1.08	0.10	190.9	0.96	15.99
RUN 2_004495.LAB	14:24	9.98	6.7	1.18	0.10	190.9	0.96	15.97
RUN 2_004496.LAB	14:25	9.93	6.8	1.14	0.10	190.9	0.96	15.93
RUN 2_004497.LAB	14:26	9.93	6.8	1.23	0.10	190.9	0.96	15.95
RUN 2_004498.LAB	14:27	9.93	6.8	1.18	0.10	191.0	0.96	15.96
RUN 2_004499.LAB	14:28	9.92	6.8	1.19	0.10	191.0	0.96	15.98
RUN 2_004500.LAB	14:29	9.91	6.9	1.29	0.10	191.0	0.96	15.96
RUN 2_004501.LAB	14:30	9.91	6.9	1.22	0.10	191.0	0.96	15.96
RUN 2_004502.LAB	14:31	9.91	6.9	1.31	0.10	191.0	0.96	15.96
RUN 2_004503.LAB	14:32	9.93	6.9	1.28	0.10	191.0	0.96	15.95
RUN 2_004504.LAB	14:33	10.02	6.8	1.25	0.10	191.0	0.96	15.94
RUN 2_004505.LAB	14:34	10.14	6.9	1.29	0.10	190.9	0.96	15.92
RUN 2_004506.LAB	14:35	10.25	6.8	1.33	0.10	190.9	0.96	15.94
RUN 2_004507.LAB	14:36	10.31	6.8	1.24	0.10	190.9	0.96	15.94
RUN 2_004508.LAB	14:37	10.33	6.8	1.28	0.10	190.9	0.96	15.94
RUN 2_004509.LAB	14:38	10.38	6.7	1.22	0.10	190.9	0.96	15.94
RUN 2_004510.LAB	14:39	10.40	6.6	1.18	0.10	191.0	0.96	15.94
RUN 2_004511.LAB	14:40	10.45	6.6	1.15	0.10	191.0	0.96	15.95
RUN 2_004512.LAB	14:41	10.49	6.6	1.29	0.10	191.0	0.96	15.95
RUN 2_004513.LAB	14:42	10.47	6.6	1.23	0.10	191.0	0.96	15.95
RUN 2_004514.LAB	14:43	10.43	6.5	1.22	0.10	191.0	0.96	15.99
RUN 2_004515.LAB	14:44	10.41	6.6	1.21	0.10	191.0	0.96	15.98
RUN 2_004516.LAB	14:45	10.38	6.6	1.25	0.10	191.0	0.96	15.95
RUN 2_004517.LAB	14:46	10.39	6.6	1.20	0.10	190.9	0.96	15.98
RUN 2_004518.LAB	14:47	10.40	6.8	1.22	0.10	190.9	0.96	15.98
Average		**10.24**	**6.73**	**1.19**	**0.10**	**191.00**	**0.96**	**15.96**

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Test Location: Kiln 1 (ACL) Breaching Duct
Date: 9/27/23

Run 3

		FTIR Data						Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 3_004672.LAB	15:50	10.36	6.8	1.2	0.10	191.0	0.96	15.86
RUN 3_004673.LAB	15:51	10.37	6.9	1.3	0.10	191.0	0.96	15.86
RUN 3_004674.LAB	15:52	10.29	6.9	1.3	0.10	190.9	0.96	15.88
RUN 3_004675.LAB	15:53	10.27	6.8	1.3	0.10	190.9	0.96	15.90
RUN 3_004676.LAB	15:54	10.28	6.7	1.3	0.10	191.0	0.96	15.91
RUN 3_004677.LAB	15:55	10.31	6.8	1.3	0.10	191.0	0.96	15.89
RUN 3_004678.LAB	15:56	10.29	6.8	1.3	0.10	191.0	0.96	15.90
RUN 3_004679.LAB	15:57	10.28	6.8	1.3	0.10	191.0	0.96	15.90
RUN 3_004680.LAB	15:58	10.27	6.8	1.3	0.10	191.0	0.96	15.91
RUN 3_004681.LAB	15:59	10.24	6.8	1.2	0.10	191.0	0.96	15.90
RUN 3_004682.LAB	16:00	10.24	6.8	1.3	0.10	190.9	0.96	15.88
RUN 3_004683.LAB	16:01	10.19	6.8	1.2	0.10	191.0	0.96	15.91
RUN 3_004684.LAB	16:02	10.15	6.8	1.3	0.10	191.0	0.96	15.91
RUN 3_004685.LAB	16:03	10.09	6.8	1.3	0.10	191.0	0.96	15.92
RUN 3_004686.LAB	16:04	10.02	6.9	1.3	0.10	191.0	0.96	15.92
RUN 3_004687.LAB	16:05	10.04	6.8	1.3	0.10	191.0	0.96	15.91
RUN 3_004688.LAB	16:06	9.96	6.8	1.2	0.10	191.0	0.96	15.94
RUN 3_004689.LAB	16:07	9.99	6.9	1.2	0.10	191.0	0.96	15.93
RUN 3_004690.LAB	16:08	10.05	6.8	1.2	0.10	190.9	0.96	15.90
RUN 3_004691.LAB	16:09	10.11	6.8	1.3	0.10	190.9	0.96	15.91
RUN 3_004692.LAB	16:10	10.12	6.6	1.2	0.10	191.0	0.96	15.90
RUN 3_004693.LAB	16:11	10.06	6.6	1.2	0.10	191.0	0.96	15.93
RUN 3_004694.LAB	16:12	10.05	6.7	1.2	0.10	191.0	0.96	15.95
RUN 3_004695.LAB	16:13	10.05	6.7	1.2	0.10	191.0	0.96	15.94
RUN 3_004696.LAB	16:14	10.03	6.7	1.2	0.10	191.0	0.96	15.93
RUN 3_004697.LAB	16:15	10.07	6.7	1.3	0.10	191.0	0.96	15.94
RUN 3_004698.LAB	16:16	10.07	6.7	1.2	0.10	191.0	0.96	15.92
RUN 3_004699.LAB	16:17	10.07	6.7	1.2	0.10	191.0	0.96	15.93
RUN 3_004700.LAB	16:18	10.07	6.8	1.2	0.10	191.0	0.96	15.93
RUN 3_004701.LAB	16:19	10.10	6.7	1.2	0.10	191.0	0.96	15.91
RUN 3_004702.LAB	16:20	10.21	6.7	1.1	0.10	191.0	0.96	15.91
RUN 3_004703.LAB	16:21	10.35	6.7	1.3	0.10	191.0	0.96	15.92
RUN 3_004704.LAB	16:22	10.43	6.7	1.4	0.10	191.0	0.96	15.93
RUN 3_004705.LAB	16:23	10.48	6.6	1.3	0.10	191.0	0.96	15.93
RUN 3_004706.LAB	16:24	10.54	6.6	1.2	0.10	190.9	0.96	15.93
RUN 3_004707.LAB	16:25	10.56	6.7	1.2	0.10	190.9	0.96	15.93
RUN 3_004708.LAB	16:26	10.58	6.7	1.2	0.10	190.9	0.96	15.93
RUN 3_004709.LAB	16:27	10.63	6.7	1.2	0.10	191.0	0.96	15.92
RUN 3_004710.LAB	16:28	10.64	6.7	1.2	0.10	191.0	0.96	15.92
RUN 3_004711.LAB	16:29	10.61	6.8	1.3	0.10	191.0	0.96	15.91
RUN 3_004712.LAB	16:30	10.49	6.9	1.2	0.10	191.0	0.96	15.91
RUN 3_004713.LAB	16:31	10.40	7.0	1.2	0.10	191.0	0.96	15.88
RUN 3_004714.LAB	16:32	10.29	7.0	1.3	0.10	191.0	0.96	15.85
RUN 3_004715.LAB	16:33	10.21	7.0	1.3	0.10	191.0	0.96	15.85
RUN 3_004716.LAB	16:34	10.09	7.0	1.2	0.10	191.0	0.96	15.87
RUN 3_004717.LAB	16:35	10.06	6.9	1.2	0.10	191.0	0.96	15.87
RUN 3_004718.LAB	16:36	10.08	6.9	1.1	0.10	191.0	0.96	15.89
RUN 3_004719.LAB	16:37	10.12	6.9	1.1	0.10	190.9	0.96	15.89
RUN 3_004720.LAB	16:38	10.13	6.7	1.1	0.10	190.9	0.96	15.91
RUN 3_004721.LAB	16:39	10.08	6.6	1.2	0.10	190.9	0.96	15.92
RUN 3_004722.LAB	16:40	10.05	6.6	1.2	0.10	191.0	0.96	15.89
RUN 3_004723.LAB	16:41	9.98	6.6	1.2	0.10	191.1	0.96	15.92
RUN 3_004724.LAB	16:42	9.93	6.6	1.2	0.10	191.1	0.96	15.95
RUN 3_004725.LAB	16:43	9.91	6.6	1.2	0.10	191.1	0.96	15.96
RUN 3_004726.LAB	16:44	9.91	6.6	1.3	0.10	191.1	0.96	15.99
RUN 3_004727.LAB	16:45	9.95	6.5	1.2	0.10	191.0	0.96	15.99
RUN 3_004728.LAB	16:46	9.96	6.5	1.3	0.10	190.9	0.96	15.98
RUN 3_004729.LAB	16:47	10.01	6.6	1.2	0.10	190.9	0.96	15.97
RUN 3_004730.LAB	16:48	10.12	6.6	1.3	0.10	191.0	0.96	15.98
RUN 3_004731.LAB	16:49	10.18	6.6	1.2	0.10	190.9	0.96	15.99
RUN 3_004732.LAB	16:50	10.24	6.7	1.2	0.10	191.0	0.96	16.01
RUN 3_004733.LAB	16:51	10.27	6.6	1.3	0.10	191.0	0.96	15.98
RUN 3_004734.LAB	16:52	10.37	6.6	1.3	0.10	191.0	0.96	15.96
RUN 3_004735.LAB	16:53	10.47	6.8	1.3	0.10	191.0	0.96	15.95
RUN 3_004736.LAB	16:54	10.55	6.8	1.3	0.10	191.0	0.96	15.91
RUN 3_004737.LAB	16:55	10.56	6.6	1.4	0.10	191.0	0.96	15.92
RUN 3_004738.LAB	16:56	10.55	6.6	1.4	0.10	191.0	0.96	15.95
RUN 3_004739.LAB	16:57	10.53	6.6	1.3	0.10	190.9	0.96	15.92
RUN 3_004740.LAB	16:58	10.52	6.6	1.3	0.10	191.0	0.96	15.89
RUN 3_004741.LAB	16:59	10.56	6.6	1.4	0.10	191.0	0.96	15.90
RUN 3_004742.LAB	17:00	10.61	6.6	1.4	0.10	191.0	0.96	15.94
RUN 3_004743.LAB	17:01	10.57	6.5	1.4	0.10	191.0	0.96	15.95
RUN 3_004744.LAB	17:02	10.57	6.6	1.4	0.10	190.9	0.96	15.94
RUN 3_004745.LAB	17:03	10.44	6.6	1.3	0.10	191.0	0.96	15.95
RUN 3_004746.LAB	17:04	10.34	6.6	1.2	0.10	191.0	0.96	15.96
RUN 3_004747.LAB	17:05	10.28	6.7	1.1	0.10	191.0	0.96	15.95
RUN 3_004748.LAB	17:06	10.17	6.7	1.2	0.10	191.0	0.96	15.99
RUN 3_004749.LAB	17:07	10.07	6.7	1.2	0.10	191.0	0.96	15.97
RUN 3_004750.LAB	17:08	10.02	6.7	1.3	0.10	191.0	0.96	15.99
RUN 3_004751.LAB	17:09	9.94	6.7	1.2	0.10	190.9	0.96	15.97
RUN 3_004752.LAB	17:10	9.90	6.8	1.3	0.10	191.0	0.96	15.96
RUN 3_004753.LAB	17:11	9.92	6.7	1.2	0.10	191.0	0.96	15.96
Average		**10.23**	**6.72**	**1.25**	**0.10**	**191.01**	**0.96**	**15.93**

Stratification Test Results Summary
Ash Grove Cement Company
Louisville Cement Plant
Kiln 1 (ACL) Breaching Duct
September 27, 2023

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

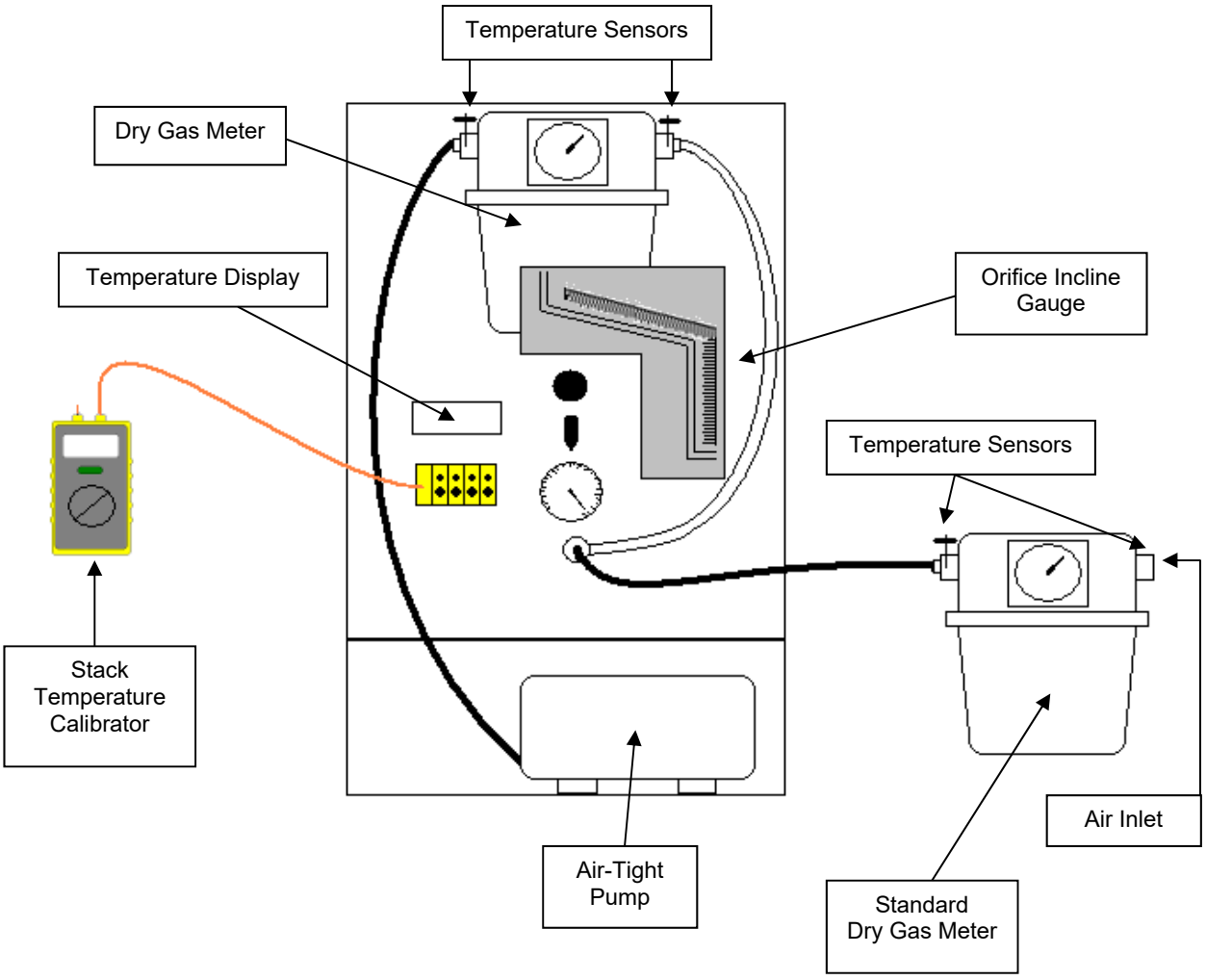
Port No.	Point No.	Time	O_2%	Actual % Difference O_2%	Mean Difference O_2%
1	1	8:45	16.06	0.00	0.00
	2	8:50	16.01	0.31	0.05
	3	8:55	16.11	0.31	0.05
Average			**16.06**		

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

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

Appendix G - Calibration Data

Dry Gas Meter/Control Module Calibration Diagram



Dry Gas Meter Calibration Data

Dry Gas Meter No.	*CM 16*	*Date:*	*September 19, 2023*
Standard Meter No.	*366118*	*Calibrated By:*	*HH*
Standard Meter (Y)	*0.99950*	*Barometric Pressure:*	*29.35*

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			109.922	51.523	65	68	68					
Initial			104.888	46.413	64	68	68					
Difference	1	0.20	5.034	5.110	65	68	68	68	20	12	0.991	1.823
Final			115.238	56.930	65	69	68					
Initial			110.208	51.817	65	68	68					
Difference	2	0.50	5.030	5.113	65	69	68	68	12	31	0.988	1.755
Final			120.758	62.539	65	70	68					
Initial			115.732	57.425	65	69	68					
Difference	3	0.70	5.026	5.114	65	70	68	69	10	28	0.988	1.719
Final			126.185	68.081	65	70	69					
Initial			121.165	62.952	65	69	68					
Difference	4	0.90	5.020	5.129	65	70	69	69	9	16	0.983	1.736
Final			131.552	73.581	66	71	68					
Initial			126.512	68.425	66	70	68					
Difference	5	1.20	5.040	5.156	66	71	68	69	8	13	0.980	1.811
Final			104.705	46.215	65	69	68					
Initial			99.446	40.930	64	68	68					
Difference	6	2.00	5.259	5.285	65	69	68	68	6	40	0.997	1.818

Average	***0.988***	***1.777***

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	HH
Ambient Temperature, °F :	68.2	Date :	9/19/2023

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	250	0.0
600	600	0.0
1200	1202	0.1

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

Dry Gas Meter Calibration Data

Dry Gas Meter No.	*CM16*	*Date:*	*October 5, 2023*
Standard Meter No.	*16541852*	*Calibrated By:*	*ATW*
Standard Meter (Y)	*1.00440*	*Barometric Pressure:*	*29.23*

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			*72.844*	*35.558*	*72*	*73*	*73*					
Initial			*67.674*	*30.285*	*72*	*73*	*73*					
Difference	*1*	*0.20*	*5.170*	*5.273*	*72*	*73*	*73*	*73*	*20*	*0*	*0.986*	*1.717*
Final			*84.537*	*47.472*	*72*	*74*	*73*					
Initial			*79.438*	*42.285*	*71*	*74*	*73*					
Difference	*2*	*0.50*	*5.099*	*5.187*	*72*	*74*	*73*	*74*	*12*	*30*	*0.990*	*1.719*
Final			*95.569*	*58.744*	*71*	*75*	*73*					
Initial			*90.564*	*53.633*	*71*	*74*	*73*					
Difference	*3*	*0.70*	*5.005*	*5.111*	*71*	*75*	*73*	*74*	*10*	*30*	*0.987*	*1.758*
Final			*90.170*	*53.227*	*71*	*75*	*73*					
Initial			*85.023*	*47.965*	*72*	*75*	*74*					
Difference	*4*	*0.90*	*5.147*	*5.262*	*72*	*75*	*74*	*74*	*9*	*30*	*0.985*	*1.751*
Final			*78.980*	*41.815*	*72*	*74*	*73*					
Initial			*73.758*	*36.473*	*72*	*73*	*73*					
Difference	*5*	*1.20*	*5.222*	*5.342*	*72*	*74*	*73*	*73*	*8*	*20*	*0.981*	*1.752*
Final			*67.502*	*30.090*	*72*	*74*	*73*					
Initial			*62.432*	*24.935*	*72*	*73*	*73*					
Difference	*6*	*2.00*	*5.070*	*5.155*	*72*	*74*	*73*	*73*	*6*	*15*	*0.985*	*1.743*
										Average	***0.986***	***1.740***

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	ATW
Ambient Temperature, °F :	75.6	Date :	October 5, 2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	May 2, 2023
Serial # :	T-285668	Expiration Date:	May 1, 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	250	0.0
600	600	0.0
1200	1202	0.1

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

Dry Gas Meter Calibration Data

Dry Gas Meter No.	cm37	Date:	September 12, 2023
Standard Meter No.	18654530	Calibrated By:	TRY
Standard Meter (Y)	0.98400	Barometric Pressure:	29.38

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			110.030	39.037	72	74	74					
Initial			104.990	34.009	72	74	74					
Difference	1	0.20	5.040	5.028	72	74	74	74	19	40	0.990	1.807
Final			116.293	46.244	70	70	70					
Initial			110.740	40.732	69	69	69					
Difference	2	0.50	5.553	5.512	70	70	70	70	13	58	0.990	1.875
Final			122.108	52.014	71	70	70					
Initial			116.502	46.440	70	70	70					
Difference	3	0.70	5.606	5.574	71	70	70	70	11	51	0.987	1.860
Final			129.380	58.258	70	71	72					
Initial			123.291	52.192	70	71	71					
Difference	4	0.90	6.089	6.066	70	71	72	71	11	40	0.988	1.956
Final			134.752	63.568	70	72	72					
Initial			129.578	58.459	70	71	71					
Difference	5	1.20	5.174	5.109	70	72	72	72	8	40	0.996	1.993
Final			103.523	32.539	72	74	74					
Initial			98.310	27.425	72	74	74					
Difference	6	2.00	5.213	5.114	72	74	74	74	6	30	1.002	1.845
Average											**0.992**	**1.889**

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	TRY
Ambient Temperature, °F :	79.9	Date :	9/12/2023

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	1	0.0
250	251	0.2
600	602	0.2
1200	1206	0.1

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

Client: Ash Grove Cement Company
Facility: Louisville NE
Test Location: Kiln 1 (ACL)
Test Method: 26A
Meter ID: CM37

Alternative Method 5 Post Test Calibration - ALT-009

	Run Time (min):	Vm (dscf):	Tm (oR):	Pbar ("Hg):	DHavg ("H2O):	Md:	Orifice DH@:	Meter Yi:	Yqa:	Calibration Status:
Test Run 1	90	54.29	529.73	28.78	1.23	29.8304	1.889	0.9920	1.008	
Test Run 2	90	54.10	538.07	28.78	1.26	29.8336	1.889	0.9920	1.031	**Pass**
Test Run 3	90	53.97	546.71	28.78	1.29	29.8304	1.889	0.9920	1.055	
								0.9920	1.031	

Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date:	9/21/2023
Temperature (^{o}F):	72.6
Pressure ("Hg):	29.48
Personnel:	wgj
Probe:	S8-058-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	1.15	0.831	0.832	0.000	0.000	Pass
0.81	0.81	1.15	0.832		0.000		
0.81	0.81	1.15	0.832		0.000		
1.81	1.82	2.55	0.837	0.837	0.000	0.001	Pass
1.81	1.82	2.55	0.837		0.000		
1.81	1.82	2.55	0.838		0.001		

Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date:	9/21/2023
Temperature (^{o}F):	72.6
Pressure ("Hg):	29.48
Personnel:	wgj
Probe:	S8-058-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	1.15	0.833	0.833	0.000	0.000	Pass
0.81	0.81	1.15	0.832		0.000		
0.81	0.81	1.15	0.833		0.000		
1.81	1.82	2.56	0.835	0.836	0.000	0.000	Pass
1.81	1.83	2.56	0.836		0.000		
1.81	1.83	2.56	0.836		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:	S8-058-A
Probe Calibration Date:	09/21/23
Test Point Location:	center
Ambient Temperature (^oF):	72.6
Barometric Pressure ("Hg):	29.48

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	72.6	1.15	0	0.83
2	60	0.81	72.6	1.15	0	0.83
3	60	0.81	72.6	1.15	0	0.83
					Average ($C_{p(avg-low)}$)	0.83

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	72.6	2.55	0	0.84
2	90	1.82	72.6	2.55	0	0.84
3	90	1.82	72.6	2.55	0	0.84
					Average ($C_{p(avg-high)}$)	0.84

$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.67\%}$$ **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 = 0.834

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:	S8-058-B
Probe Calibration Date:	09/21/23
Test Point Location:	center
Ambient Temperature (^oF):	72.6
Barometric Pressure ("Hg):	29.48

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	72.6	1.15	0	0.83
2	60	0.81	72.6	1.15	0	0.83
3	60	0.81	72.6	1.15	0	0.83
					Average ($C_{p(avg-low)}$)	0.83

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	72.6	2.56	0	0.84
2	90	1.83	72.6	2.56	0	0.84
3	90	1.83	72.6	2.56	0	0.84
					Average ($C_{p(avg-high)}$)	0.84

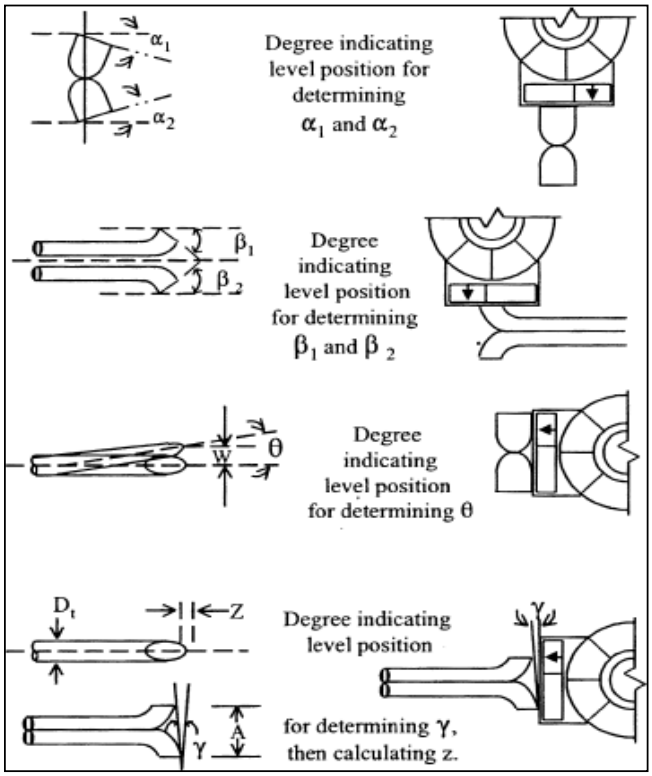
$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.37\%}$$ **Pass**

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.

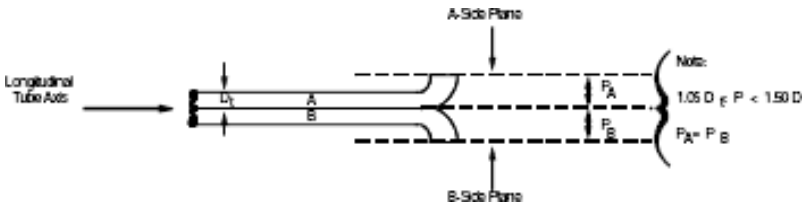
C_p = 0.834

Airflow Sciences Corporation

Probe Inspection for Method 2G



α_1	0.4 (°)	Pass
α_2	0.5 (°)	Pass
β_1	0.3 (°)	Pass
β_2	0.3 (°)	Pass
D_t	0.375 (")	Pass
P_a	0.474 (")	Pass
P_b	0.474 (")	Pass
z	<0.02 (")	Pass
w	0.007 (")	Pass



Certification

I certify that Type S probe ID **S8-058** meets or exceeds all specifications, criteria, and applicable design features.

Certified by: W Jambeck Date: 9/21/2023

Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date:	9/21/2023
Temperature (^{o}F):	72.8
Pressure ("Hg):	29.48
Personnel:	wgj
Probe:	S8-059-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	1.13	0.838	0.838	0.000	0.000	Pass
0.81	0.81	1.14	0.837		0.000		
0.81	0.81	1.14	0.838		0.000		
1.81	1.81	2.51	0.840	0.840	0.000	0.000	Pass
1.81	1.81	2.51	0.840		0.000		
1.81	1.81	2.51	0.840		0.000		

Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date:	9/21/2023
Temperature (^{o}F):	73.1
Pressure ("Hg):	29.47
Personnel:	wgj
Probe:	S8-059-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	1.16	0.828	0.828	0.000	0.000	Pass
0.81	0.81	1.16	0.828		0.000		
0.81	0.81	1.16	0.828		0.000		
1.81	1.81	2.58	0.829	0.829	0.000	0.000	Pass
1.81	1.81	2.58	0.829		0.000		
1.81	1.81	2.58	0.829		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:	S8-059-A
Probe Calibration Date:	09/21/23
Test Point Location:	center
Ambient Temperature (^oF):	72.8
Barometric Pressure ("Hg):	29.48

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	72.8	1.13	0	0.84
2	60	0.81	72.8	1.14	0	0.84
3	60	0.81	72.8	1.14	0	0.84
					Average ($C_{p(avg-low)}$)	0.84

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	72.8	2.51	0	0.84
2	90	1.81	72.8	2.51	0	0.84
3	90	1.81	72.8	2.51	0	0.84
					Average ($C_{p(avg-high)}$)	0.84

$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.30\%}$$ **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 = 0.839

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:	S8-059-B
Probe Calibration Date:	09/21/23
Test Point Location:	center
Ambient Temperature (^oF):	73.1
Barometric Pressure ("Hg):	29.47

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	73.1	1.16	0	0.83
2	60	0.81	73.1	1.16	0	0.83
3	60	0.81	73.1	1.16	0	0.83
					Average ($C_{p(avg-low)}$)	0.83

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	73.1	2.58	0	0.83
2	90	1.81	73.1	2.58	0	0.83
3	90	1.81	73.1	2.58	0	0.83
					Average ($C_{p(avg-high)}$)	0.83

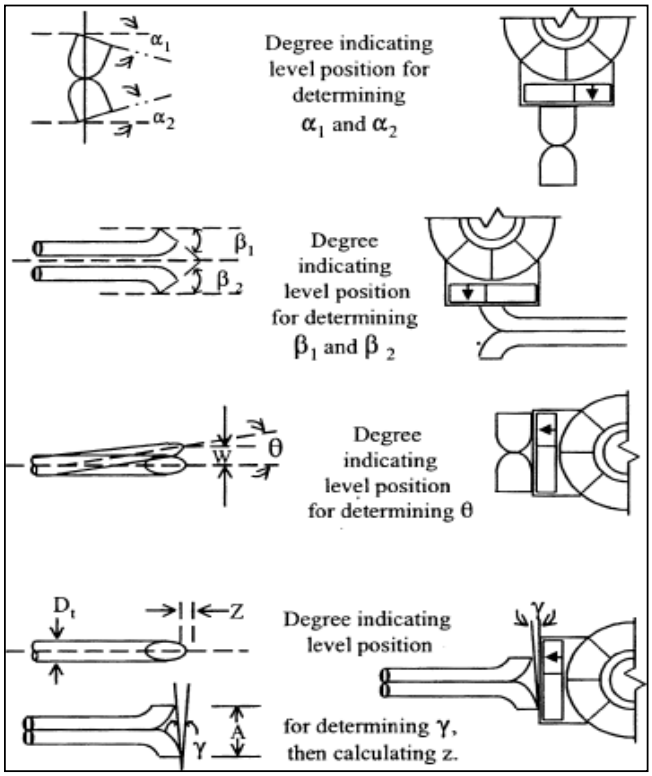
$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.17\%}$$ **Pass**

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.

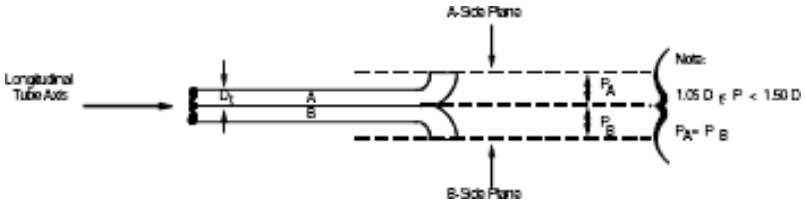
C_p = 0.829

Airflow Sciences Corporation

Probe Inspection for Method 2G



α_1	0.9 (°)	Pass
α_2	0.5 (°)	Pass
β_1	0.7 (°)	Pass
β_2	0.9 (°)	Pass
D_t	0.375 (")	Pass
P_a	0.471 (")	Pass
P_b	0.471 (")	Pass
z	<0.02 (")	Pass
w	0.005 (")	Pass



Certification

I certify that Type S probe ID **S8-059** meets or exceeds all specifications, criteria, and applicable design features.

Certified by: W Jambeck Date: 9/21/2023

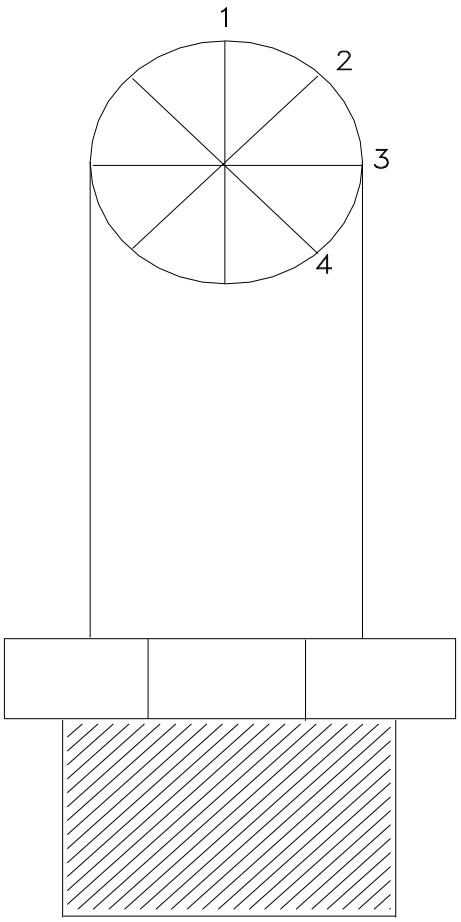
Nozzle Calibration

Date: 6/13/2017

Nozzle ID No.: #7T-3

Analyst: MDK

Material/Type: Teflon



0.214	1
0.214	2
0.214	3
0.214	4

Average
0.214

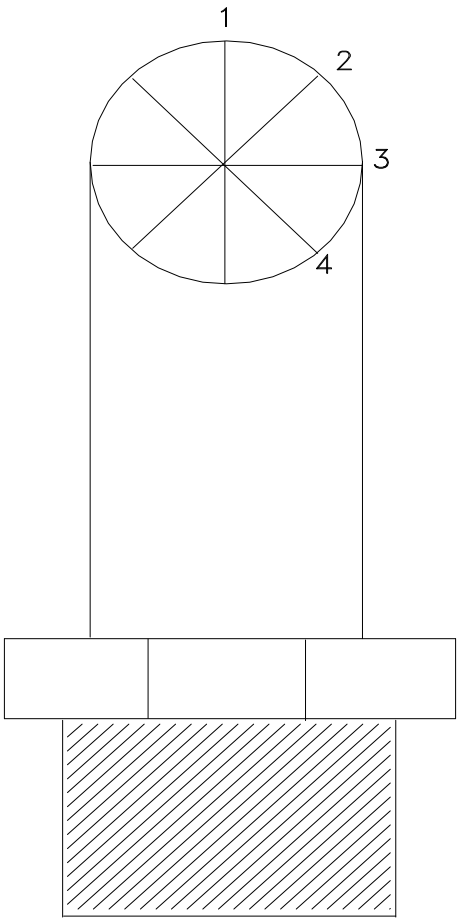
Nozzle Calibration

Date: 6/14/2023

Nozzle ID No.: T8Y

Analyst: AWB

Material/Type: Teflon



0.232	1
0.232	2
0.232	3
0.232	4

Average
0.232

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Test Location: Kiln 1 (ACL) Breaching Duct
Date: 9/27/2023
Operator: E. Ehlers
Operating Condition >90% Production

Sample System:	FTIR			
Probe Length:	8.0	**ft**		
Probe Type:	FTIR			
Sample Plane:	Horizontal			
Port Length:	4	**in.**		
Port Size (diameter):	3	**in.**		
Port Type:	Coupling		Plant Hg Probe	
Duct Shape:	Rectangular			
Length (traverse side of duct):	6.3	**ft**		
Width:	11	**ft**		
Location of Test Ports:	Side of duct			
Duct Area:	69.30	**Sq. Ft.**		
Upstream Diameters:	0.50		Minimum Upstream Distance	4.0 Feet
Downstream Diameters:	1.00		Minimum Downstream Distance	16.0 Feet
Number of Ports Sampled:	1		Ideal Upstream Distance	16.0 Feet
Number of Points per Port:	1		Ideal Downstream Distance	64.1 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		0.0	0.05	-0.26%				1500
	Mid	SG9125104BAL	9.98	10.10	-0.65%	8/9/2031	52.48%		1800
	High	CC432067	19.01	19.14	-0.68%	12/20/2030			1950

Type	Compound	Cylinder ID	Cylinder Value	Expiration Date	Final Bottle Pressure, PSI
Zero Gas	Nitrogen	Zero Nitrogen	0.0	N/A	
Calibration Transfer Standard	Ethylene	EB0153589	99.97	9/6/2031	
Analyte Spike Gas	HCN	CC768249	49.72	3/11/2024	
	SF6		5.022		

Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
O2 % (dry)	CAI 700	2204015	25	19.01
HCN ppmvw	MKS 2030	00583	100	N/A

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Diluent: O2 %

Test Location: Kiln 1 (ACL) Breaching Duct
Date: 9/27/23
Operator: E. Ehlers
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	9.98	10.10	10.07	0.20	0.04	0.12	10.09	15.98	15.9	0.16	-0.16	0.05	-0.84
2	9.976	10.07	10.06	0.04	0.06	0.05	10.07	15.96	15.8	0.21	-0.05	-0.05	0.11
3	9.976	10.06	10.10	0.06	0.05	0.06	10.08	15.93	15.8	0.00	0.21	0.00	-0.05

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

Calibration Corrected and Calculated Data

Run #	Run Date	Start Time	End Time	Moisture %	O2 % (dry)	CO2 % (wet)	CO2 % (dry)	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2
1	9/27/23	10:20	11:49	10.47%	15.88	6.69	7.47	1.19	3.69	0.10	0.31
2	9/27/23	13:18	14:47	10.24%	15.84	6.73	7.50	1.19	3.65	0.10	0.31
3	9/27/23	15:50	17:19	10.23%	15.80	6.72	7.49	1.25	3.79	0.10	0.30

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Test Location: Kiln 1 (ACL) Breaching Duct
Date: 9/27/23
Project #: M233801

Time	Linearity Cal/Pre 1 Cal O2 % (dry)	
8:10	0.05	iz
8:11	9.72	
8:12	18.74	
8:13	19.12	
8:14	19.14	ih
8:15	15.00	
8:16	10.20	
8:17	10.10	im
8:18	10.99	
8:19	20.63	
8:20	20.52	
8:21	12.25	
8:22	0.20	z
8:23	8.20	
8:24	10.09	
8:25	10.10	m

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Test Location: Kiln 1 (ACL) Breaching Duct
Date: 9/27/23

Post 1/Pre 2			Post 2/Pre 3		
Time	**O2 % (dry)**		**Time**	**O2 % (dry)**	
12:10	1.60		15:18	0.79	
12:11	2.65		15:19	9.78	
12:12	10.01		15:20	10.06	**m**
12:13	10.07	**m**	15:21	8.93	
12:14	6.56		15:22	0.19	
12:15	0.10		15:23	0.06	**z**
12:16	0.06				
12:17	0.05				
12:18	0.05				
12:19	0.04	**z**			

Post 3		
Time	**O2 % (dry)**	
17:49	0.09	
17:50	7.08	
17:51	10.05	
17:52	10.10	**m**
17:53	3.23	
17:54	0.08	
17:55	0.06	
17:56	0.05	
17:57	0.05	**z**

Appendix H - FTIR QA/QC

Method 320 FTIR Detector Multi-Gas Determination QA/QC

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

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

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

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

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

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

CALIBRATION GAS STANDARDS				
Components	**Concentration (ppm)**	**Vendor**	**Cylinder #**	**Standard Type**
Ethylene	99.97	Airgas	EB0153589	Primary +/- 1%
HCN/SF_6	49.72/5.022	Airgas	CC768249	Certified Standard-Spec +/- 5%
Nitrogen	Zero Gas	Airgas	Zero Nitrogen	UHP Grade

Analyte Spiking

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

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

The following equation illustrates the percent recovery calculation.

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

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

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

Post Collection Data Validation

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

Detection Limit

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

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

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

Zero Gas and In-Stack Detection Limit Study
Ash Grove Cement Company
Louisville Cement Plant
Kiln 1 (ACL) Breaching Duct
9/27/2023

	DL summary - zero gas		Time	DL summary - in stack	
Time	HF ppm (10) 191C	HCN (100) 191C		HF ppm (10) 191C	HCN (100) 191C
8:01:13 AM	0.01	0.02	9:35:50 AM	-0.03	0.46
8:01:21 AM	0.00	0.06	9:36:54 AM	-0.04	0.42
8:01:30 AM	0.02	0.07	9:37:57 AM	-0.06	0.47
8:01:38 AM	0.02	-0.02	9:39:01 AM	-0.04	0.40
8:01:46 AM	0.05	-0.02	9:40:05 AM	-0.05	0.40
8:01:54 AM	0.01	0.03	9:41:09 AM	-0.05	0.38
8:02:03 AM	-0.02	-0.05	9:42:13 AM	-0.06	0.32
Standard Deviation	**0.02**	**0.04**	**Standard Deviation**	**0.01**	**0.05**
3x = DL	**0.06**	**0.12**	**3x = DL**	**0.02**	**0.14**

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Operating Condition: >90% Production

Test Location: Kiln 1 (ACL) Breaching D
Date: 9/27/2023
Operator: E. Ehlers
FTIR s/n: 00583

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_003846.LAB	9/27/23	7:58:29	0.0	0.0	0.0	191.0	0.96	0.0	0.0	0.004
N2 DIR_003847.LAB	9/27/23	7:58:37	0.0	0.0	0.0	191.0	0.96	0.0	0.0	0.007
N2 DIR_003848.LAB	9/27/23	7:58:45	0.0	0.0	0.0	191.0	0.96	0.0	-0.1	0.001
N2 DIR_003849.LAB	9/27/23	7:58:53	0.0	0.0	0.0	191.0	0.96	0.1	0.0	0.003
N2 DIR_003850.LAB	9/27/23	7:59:01	0.0	0.0	0.0	191.0	0.96	0.0	0.0	0.002
N2 DIR_003851.LAB	9/27/23	7:59:10	0.0	0.0	0.0	191.0	0.96	-0.1	0.1	0.001
N2 DIR_003852.LAB	9/27/23	7:59:18	0.0	0.0	0.0	191.0	0.96	0.0	-0.1	0.008
N2 DIR_003853.LAB	9/27/23	7:59:26	0.0	0.0	0.0	191.0	0.96	0.0	0.0	0.001
N2 DIR_003854.LAB	9/27/23	7:59:34	0.0	0.0	0.0	191.0	0.96	0.0	0.0	0.009

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_003898.LAB	9/27/23	8:06:53	0.0	0.0	0.0	190.9	0.96	97.8	0.0	-0.003	**97.8%**
CTS DIR_003899.LAB	9/27/23	8:07:01	0.0	0.0	0.0	190.9	0.96	97.6	-0.1	-0.002	**97.6%**
CTS DIR_003900.LAB	9/27/23	8:07:10	0.0	0.0	0.0	190.9	0.96	97.5	0.0	0.004	**97.5%**
CTS DIR_003901.LAB	9/27/23	8:07:18	0.0	0.0	0.0	190.9	0.96	97.5	0.0	-0.005	**97.5%**
CTS DIR_003902.LAB	9/27/23	8:07:26	0.0	0.0	0.0	190.9	0.96	97.6	0.0	0.002	**97.6%**
CTS DIR_003903.LAB	9/27/23	8:07:34	0.0	0.0	0.0	190.9	0.96	97.5	0.0	0.004	**97.5%**
CTS DIR_003904.LAB	9/27/23	8:07:42	0.0	0.0	0.0	190.9	0.96	97.7	0.1	0.005	**97.7%**
	Average							**97.6**			**97.6%**

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_003927.LAB	9/27/23	8:11:12	0.0	0.0	0.0	191.0	0.96	-0.1	50.4	4.985	**101.4%**
HCN DIR_003928.LAB	9/27/23	8:11:20	0.0	0.0	0.0	191.0	0.96	-0.2	50.4	5.000	**101.4%**
HCN DIR_003929.LAB	9/27/23	8:11:28	0.0	0.0	0.0	191.0	0.96	-0.1	50.4	4.992	**101.4%**
HCN DIR_003930.LAB	9/27/23	8:11:37	0.0	0.0	0.0	191.0	0.96	-0.1	50.4	5.007	**101.3%**
HCN DIR_003931.LAB	9/27/23	8:11:45	0.0	0.0	0.0	191.0	0.96	-0.2	50.4	4.991	**101.3%**
HCN DIR_003932.LAB	9/27/23	8:11:53	0.0	0.0	0.0	191.0	0.96	-0.1	50.4	5.004	**101.3%**
HCN DIR_003933.LAB	9/27/23	8:12:01	0.0	0.0	0.0	191.0	0.96	-0.1	50.8	5.040	**102.1%**
HCN DIR_003934.LAB	9/27/23	8:12:10	0.0	0.0	0.0	191.0	0.96	-0.3	50.3	4.907	**101.1%**
	Average								**50.4**	**4.991**	**101.4%**

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS REMOTE_003998.LAB	9/27/23	8:22:35	0.1	0.0	0.0	191.0	0.96	99.5	0.5	0.006	**99.5%**
CTS REMOTE_003999.LAB	9/27/23	8:22:43	0.1	0.0	0.0	191.0	0.96	99.7	0.4	0.008	**99.7%**
CTS REMOTE_004000.LAB	9/27/23	8:22:51	0.1	0.0	0.0	191.0	0.96	99.8	0.3	0.004	**102.2%**
CTS REMOTE_004001.LAB	9/27/23	8:22:59	0.1	0.0	0.0	191.0	0.96	99.9	0.4	-0.001	**102.4%**
CTS REMOTE_004002.LAB	9/27/23	8:23:07	0.0	0.0	0.0	191.0	0.96	100.0	0.3	0.005	**102.5%**
CTS REMOTE_004003.LAB	9/27/23	8:23:16	0.0	0.0	0.0	191.0	0.96	99.4	0.2	-0.003	**101.9%**
CTS REMOTE_004004.LAB	9/27/23	8:23:24	0.0	0.0	0.0	191.0	0.96	99.5	0.2	0.006	**102.0%**
CTS REMOTE_004005.LAB	9/27/23	8:23:32	0.0	0.0	0.0	191.0	0.96	99.7	0.2	-0.001	**102.2%**

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 REMOTE_003996.LAB	9/27/23	8:22:18	1.6	0.1	0.1	191.0	0.96	3.0	4.4	0.015	-
CTS REMOTE_003997.LAB	9/27/23	8:22:26	0.7	0.0	0.1	191.0	0.96	91.0	1.6	-0.002	**16.249**
CTS REMOTE_003998.LAB	9/27/23	8:22:35	0.1	0.0	0.0	191.0	0.96	99.5	0.5	0.006	**24.249**
CTS REMOTE_003999.LAB	9/27/23	8:22:43	0.1	0.0	0.0	191.0	0.96	99.7	0.4	0.008	
CTS REMOTE_004000.LAB	9/27/23	8:22:51	0.1	0.0	0.0	191.0	0.96	99.8	0.3	0.004	
CTS REMOTE_004001.LAB	9/27/23	8:22:59	0.1	0.0	0.0	191.0	0.96	99.9	0.4	-0.001	
CTS REMOTE_004002.LAB	9/27/23	8:23:07	0.0	0.0	0.0	191.0	0.96	100.0	0.3	0.005	
CTS REMOTE_004003.LAB	9/27/23	8:23:16	0.0	0.0	0.0	191.0	0.96	99.4	0.2	-0.003	
CTS REMOTE_004004.LAB	9/27/23	8:23:24	0.0	0.0	0.0	191.0	0.96	99.5	0.2	0.006	

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Operating Condition: >90% Production

Test Location: Kiln 1 (ACL) Breaching D
Date: 9/27/2023
Operator: E. Ehlers
FTIR s/n: 00583

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
NATIVE_004065.LAB	9/27/23	8:33:00	9.7	6.6	0.0	191.0	0.96	0.7	1.1	-0.011
NATIVE_004066.LAB	9/27/23	8:33:08	9.8	6.6	0.0	191.0	0.96	0.9	1.3	-0.002
NATIVE_004067.LAB	9/27/23	8:33:16	9.8	6.6	0.0	191.0	0.96	0.8	1.3	-0.007
									1.2	**-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
NATIVE_004077.LAB	9/27/23	8:34:39	9.2	6.1	0.0	191.0	0.96	0.7	4.5	0.360	**0.072**	**93.4%**
NATIVE_004078.LAB	9/27/23	8:34:47	9.2	6.1	0.0	191.0	0.96	0.6	4.7	0.359	**0.072**	**98.1%**
NATIVE_004079.LAB	9/27/23	8:34:55	9.2	6.1	0.0	191.0	0.96	0.6	4.5	0.363	**0.073**	**93.3%**
NATIVE_004080.LAB	9/27/23	8:35:03	9.2	6.1	0.0	191.0	0.96	0.7	4.4	0.361	**0.072**	**92.2%**
NATIVE_004081.LAB	9/27/23	8:35:12	9.2	6.1	0.0	190.9	0.96	0.6	4.5	0.356	**0.071**	**95.7%**
NATIVE_004082.LAB	9/27/23	8:35:20	9.2	6.1	0.0	190.9	0.96	0.5	4.5	0.364	**0.073**	**92.7%**
NATIVE_004083.LAB	9/27/23	8:35:28	9.2	6.1	0.0	190.9	0.96	0.7	4.7	0.373	**0.075**	**95.8%**
NATIVE_004084.LAB	9/27/23	8:35:36	9.3	6.1	0.0	190.9	0.96	0.7	4.5	0.350	**0.070**	**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
RUN 1_004290.LAB	9/27/23	12:04:44	10.3	6.7	-0.1	191.0	0.96	0.6	1.2	-0.007
RUN 1_004291.LAB	9/27/23	12:05:48	10.3	6.8	-0.1	191.0	0.96	0.7	1.2	-0.004
RUN 1_004292.LAB	9/27/23	12:06:52	10.3	6.8	-0.1	191.0	0.96	0.6	1.3	-0.004
									1.2	**-0.005**

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
POST RUN 1 SPIKE_004300.LAB	9/27/23	12:08:59	9.5	6.2	0.0	190.9	0.96	0.6	5.5	0.453	**0.091**	**96.6%**
POST RUN 1 SPIKE_004301.LAB	9/27/23	12:09:07	9.4	6.2	-0.1	190.9	0.96	0.6	5.5	0.453	**0.091**	**97.0%**
POST RUN 1 SPIKE_004302.LAB	9/27/23	12:09:16	9.5	6.2	0.0	190.9	0.96	0.6	5.4	0.453	**0.091**	**93.9%**
POST RUN 1 SPIKE_004303.LAB	9/27/23	12:09:24	9.5	6.2	0.0	190.9	0.96	0.5	5.4	0.452	**0.091**	**94.9%**
POST RUN 1 SPIKE_004304.LAB	9/27/23	12:09:32	9.5	6.2	0.0	190.9	0.96	0.6	5.6	0.459	**0.092**	**96.4%**
POST RUN 1 SPIKE_004305.LAB	9/27/23	12:09:40	9.5	6.2	0.0	190.9	0.96	0.5	5.4	0.454	**0.091**	**94.2%**
POST RUN 1 SPIKE_004306.LAB	9/27/23	12:09:49	9.4	6.2	0.0	190.9	0.96	0.4	5.6	0.453	**0.091**	**97.6%**
POST RUN 1 SPIKE_004307.LAB	9/27/23	12:09:57	9.5	6.2	-0.1	190.9	0.96	0.6	5.4	0.461	**0.092**	**93.9%**

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
POST RUN 1 CTS_004312.LAB	9/27/23	12:11:01	0.1	0.0	0.0	190.9	0.96	99.1	0.6	0.011	**101.6%**
POST RUN 1 CTS_004313.LAB	9/27/23	12:11:09	0.1	0.0	0.0	190.9	0.96	99.7	0.5	-0.001	**102.2%**
POST RUN 1 CTS_004314.LAB	9/27/23	12:11:17	0.1	0.0	0.0	190.9	0.96	99.6	0.4	0.008	**102.0%**
POST RUN 1 CTS_004315.LAB	9/27/23	12:11:25	0.1	0.0	0.0	190.9	0.96	99.8	0.4	0.001	**102.2%**
POST RUN 1 CTS_004316.LAB	9/27/23	12:11:33	0.0	0.0	0.0	190.9	0.96	99.6	0.3	0.001	**102.0%**
POST RUN 1 CTS_004317.LAB	9/27/23	12:11:42	0.0	0.0	0.0	190.9	0.96	99.5	0.3	0.002	**102.0%**
POST RUN 1 CTS_004318.LAB	9/27/23	12:11:50	0.0	0.0	0.1	190.9	0.96	99.8	0.3	-0.002	**102.3%**
POST RUN 1 CTS_004319.LAB	9/27/23	12:11:58	0.0	0.0	0.0	190.9	0.96	100.0	0.4	0.003	**102.5%**

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Operating Condition: >90% Production

Test Location: Kiln 1 (ACL) Breaching D
Date: 9/27/2023
Operator: E. Ehlers
FTIR s/n: 00583

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 2_004533.LAB	9/27/23	15:09:16	10.0	6.8	-0.1	191.0	0.96	0.6	1.3	-0.005
RUN 2_004534.LAB	9/27/23	15:10:20	10.0	6.7	-0.1	191.0	0.96	0.6	1.2	-0.006
RUN 2_004535.LAB	9/27/23	15:11:24	10.2	6.8	-0.1	191.0	0.96	0.6	1.2	-0.004
									1.2	**-0.005**

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
RUN 2 POST SPIKE_004557.LAB	9/27/23	15:16:10	9.6	6.2	0.0	190.9	0.96	0.6	4.9	0.399	**0.080**	**95.0%**
RUN 2 POST SPIKE_004558.LAB	9/27/23	15:16:18	9.6	6.2	0.0	190.9	0.96	0.6	4.9	0.398	**0.080**	**94.3%**
RUN 2 POST SPIKE_004559.LAB	9/27/23	15:16:26	9.6	6.3	-0.1	190.9	0.96	0.5	5.0	0.395	**0.079**	**96.9%**
RUN 2 POST SPIKE_004560.LAB	9/27/23	15:16:34	9.7	6.3	0.0	190.9	0.96	0.6	4.8	0.390	**0.078**	**95.4%**
RUN 2 POST SPIKE_004561.LAB	9/27/23	15:16:43	9.7	6.3	0.0	190.9	0.96	0.8	4.7	0.393	**0.079**	**92.8%**
RUN 2 POST SPIKE_004562.LAB	9/27/23	15:16:51	9.7	6.4	-0.1	190.9	0.96	0.6	4.7	0.391	**0.078**	**91.5%**
RUN 2 POST SPIKE_004563.LAB	9/27/23	15:16:59	9.7	6.4	-0.1	190.9	0.96	0.5	5.0	0.402	**0.081**	**96.4%**
RUN 2 POST SPIKE_004564.LAB	9/27/23	15:17:07	9.7	6.4	-0.1	190.9	0.96	0.5	4.8	0.393	**0.079**	**93.6%**

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
RUN 2 POST CTS_004569.LAB	9/27/23	15:18:18	0.1	0.0	0.0	190.9	0.96	99.4	0.4	0.011	**101.8%**
RUN 2 POST CTS_004570.LAB	9/27/23	15:18:26	0.1	0.0	0.0	190.9	0.96	99.1	0.4	0.004	**101.6%**
RUN 2 POST CTS_004571.LAB	9/27/23	15:18:35	0.1	0.0	0.0	190.9	0.96	99.6	0.4	0.004	**102.1%**
RUN 2 POST CTS_004572.LAB	9/27/23	15:18:43	0.0	0.0	0.0	190.9	0.96	99.4	0.3	-0.001	**101.8%**
RUN 2 POST CTS_004573.LAB	9/27/23	15:18:51	0.0	0.0	0.0	190.9	0.96	99.3	0.2	0.001	**101.8%**
RUN 2 POST CTS_004574.LAB	9/27/23	15:18:59	0.0	0.0	0.0	190.9	0.96	99.2	0.2	0.001	**101.7%**
RUN 2 POST CTS_004575.LAB	9/27/23	15:19:08	0.0	0.0	0.0	190.9	0.96	99.4	0.2	0.002	**101.9%**
RUN 2 POST CTS_004576.LAB	9/27/23	15:19:16	0.0	0.0	0.0	190.9	0.96	99.4	0.2	0.003	**101.9%**

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 3_004774.LAB	9/27/23	17:40:42	10.3	6.8	-0.1	191.0	0.96	0.6	1.3	-0.006
RUN 3_004775.LAB	9/27/23	17:41:46	10.3	6.8	-0.1	190.9	0.96	0.7	1.3	-0.006
RUN 3_004776.LAB	9/27/23	17:42:50	10.3	6.8	-0.1	190.9	0.96	0.6	1.3	-0.007
									1.3	**-0.006**

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
RUN 3 POST SPIKE_004786.LAB	9/27/23	17:45:57	9.2	6.1	0.0	190.9	0.96	0.5	5.6	0.477	**0.096**	**94.0%**
RUN 3 POST SPIKE_004787.LAB	9/27/23	17:46:05	9.2	6.1	-0.1	190.9	0.96	0.5	5.6	0.478	**0.096**	**93.3%**
RUN 3 POST SPIKE_004788.LAB	9/27/23	17:46:13	9.2	6.2	0.0	190.9	0.96	0.4	5.6	0.482	**0.096**	**92.5%**
RUN 3 POST SPIKE_004789.LAB	9/27/23	17:46:21	9.2	6.1	-0.1	190.9	0.96	0.5	5.5	0.473	**0.095**	**93.2%**
RUN 3 POST SPIKE_004790.LAB	9/27/23	17:46:29	9.2	6.1	0.0	190.9	0.96	0.5	5.7	0.478	**0.096**	**95.9%**
RUN 3 POST SPIKE_004791.LAB	9/27/23	17:46:38	9.2	6.2	-0.1	190.9	0.96	0.4	5.7	0.481	**0.096**	**95.0%**
RUN 3 POST SPIKE_004792.LAB	9/27/23	17:46:46	9.2	6.1	-0.1	190.9	0.96	0.6	5.7	0.471	**0.094**	**96.1%**
RUN 3 POST SPIKE_004793.LAB	9/27/23	17:46:54	9.1	6.1	-0.1	190.9	0.96	0.6	5.7	0.476	**0.095**	**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
RUN 3 POST CTS_004808.LAB	9/27/23	17:49:21	0.1	0.0	0.0	191.0	0.96	99.3	0.4	0.002	**101.7%**
RUN 3 POST CTS_004809.LAB	9/27/23	17:49:30	0.1	0.0	0.0	191.0	0.96	99.3	0.3	0.005	**101.8%**
RUN 3 POST CTS_004810.LAB	9/27/23	17:49:38	0.0	0.0	0.0	191.0	0.96	99.0	0.4	0.006	**101.5%**
RUN 3 POST CTS_004811.LAB	9/27/23	17:49:46	0.0	0.0	0.0	191.0	0.96	99.1	0.2	0.002	**101.6%**
RUN 3 POST CTS_004812.LAB	9/27/23	17:49:54	0.0	0.0	0.0	191.0	0.96	99.4	0.4	-0.001	**101.9%**
RUN 3 POST CTS_004813.LAB	9/27/23	17:50:03	0.0	0.0	0.0	191.0	0.96	98.9	0.2	0.005	**101.4%**
RUN 3 POST CTS_004814.LAB	9/27/23	17:50:11	0.0	0.0	0.0	191.0	0.96	99.4	0.3	0.004	**101.9%**
RUN 3 POST CTS_004815.LAB	9/27/23	17:50:19	0.0	0.0	0.0	191.0	0.96	99.1	0.3	0.001	**101.5%**

Client: Ash Grove Cement Company
Facility: Louisville Cement Plant
Project #: M233801
Operating Condition: >90% Production

Test Location: Kiln 1 (ACL) Breaching D
Date: 9/27/2023
Operator: E. Ehlers
FTIR s/n: 00583

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
RUN 3 POST CTS DIR_004932.LAB	9/27/23	18:07:25	0.9	0.0	0.0	191.0	0.96	98.7	0.6	0.006	**101.2%**
RUN 3 POST CTS DIR_004933.LAB	9/27/23	18:07:33	0.9	0.0	0.0	191.0	0.96	98.8	0.6	0.007	**101.2%**
RUN 3 POST CTS DIR_004934.LAB	9/27/23	18:07:42	0.8	0.0	0.0	190.9	0.96	98.8	0.7	0.006	**101.3%**
RUN 3 POST CTS DIR_004935.LAB	9/27/23	18:07:50	0.8	0.0	0.0	190.9	0.96	99.1	0.6	0.002	**101.6%**
RUN 3 POST CTS DIR_004936.LAB	9/27/23	18:07:58	0.8	0.0	0.0	190.9	0.96	98.8	0.6	0.002	**101.3%**
RUN 3 POST CTS DIR_004937.LAB	9/27/23	18:08:06	0.7	0.0	0.0	190.9	0.96	98.9	0.6	0.005	**101.3%**
RUN 3 POST CTS DIR_004938.LAB	9/27/23	18:08:15	0.7	0.0	0.0	190.9	0.96	98.7	0.7	0.006	**101.2%**
RUN 3 POST CTS DIR_004939.LAB	9/27/23	18:08:23	0.7	0.0	0.0	190.9	0.96	99.4	0.6	-0.002	**101.8%**
	Average							**98.9**			

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
RUN 3 POST N2 DIR_004943.LAB	9/27/23	18:13:28	0.1	0.0	0.0	190.8	0.96	0.0	0.3	-0.001
RUN 3 POST N2 DIR_004944.LAB	9/27/23	18:15:40	0.0	0.0	0.0	190.9	0.96	-0.2	0.2	-0.003
RUN 3 POST N2 DIR_004945.LAB	9/27/23	18:17:51	0.0	0.0	0.0	191.0	0.96	0.1	0.2	0.001

Appendix I - Gas Cylinder Certifications

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
12722 S. Wentworth Ave.
Chicago, IL 60628
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI80E15A0138	Reference Number:	54-402808730-1
Cylinder Number:	SG9125104BAL	Cylinder Volume:	141.0 CF
Laboratory:	124 - Chicago (SAP) - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12023	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Aug 09, 2023

Expiration Date: Aug 09, 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 %	9.950 %	G1	+/- 0.6% NIST Traceable	08/09/2023
OXYGEN	10.00 %	9.976 %	G1	+/- 0.3% NIST Traceable	08/09/2023
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	190604-14	6162723Y	11.105 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Dec 04, 2025
NTRM	11060620	CC340439	14.93 % OXYGEN/NITROGEN	+/- 0.2%	Nov 02, 2028

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO2-1 HORIBA VIA-510 V1E3H7P5	NDIR	Aug 07, 2023
O2-1 HORIBA VA-5003 YH82Y07B	PARAMAGNETIC	Aug 07, 2023

Triad Data Available Upon Request

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
12722 S. Wentworth Ave.
Chicago, IL 60628
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI62E15A3356	Reference Number:	54-402616997-1
Cylinder Number:	CC432067	Cylinder Volume:	159.0 CF
Laboratory:	124 - Chicago (SAP) - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12022	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Dec 20, 2022

Expiration Date: Dec 20, 2030

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 %	18.76 %	G1	+/- 0.7% NIST Traceable	12/20/2022
OXYGEN	19.00 %	19.01 %	G1	+/- 0.5% NIST Traceable	12/20/2022
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060818	CC417105	24.04 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Dec 11, 2025
NTRM	8010239	K026333	23.20 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO2-1 HORIBA VIA-510 V1E3H7P5	NDIR	Dec 05, 2022
O2-1 HORIBA VA-5003 YH82Y07B	PARAMAGNETIC	Dec 05, 2022

Triad Data Available Upon Request

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
24075 US Hwy 6
Stryker, OH 43557
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Part Number:	X02NI99P15AD524	Reference Number:	141-402838188-1
Cylinder Number:	EB0153589	Cylinder Volume:	140.0 CF
Laboratory:	124 - Stryker (SAP) - OH	Cylinder Pressure:	2015 PSIG
Analysis Date:	Sep 06, 2023	Valve Outlet:	350
Lot Number:	141-402838188-1		

Expiration Date: Sep 06, 2031

Primary Standard Gas Mixtures are 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	99.97 PPM	+/- 1%
NITROGEN	Balance		

Eric Yurchekfredd

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:	160-402841763-1
Cylinder Number:	CC768249	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
Analysis Date:	Sep 11, 2023	Valve Outlet:	350SS
Lot Number:	160-402841763-1		

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	5.022 PPM	+/- 5%
HYDROGEN CYANIDE	50.00 PPM	49.72 PPM	+/- 5%
NITROGEN	Balance		

Signature on file
Approved for Release

END OF THE REPORT