Section 114 Information Collection Request Emissions Test Report

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Holcim (US) Inc.
Ravena Cement Plant
EPA Registry ID: 110070733606
1916 Rte 9W
Ravena, NY 12143
Report No. M234506C

mostardi platt

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Report Submittal Date:
April 8, 2024

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1.0 INTRODUCTION

Mostardi Platt conducted an air emissions test program for Holcim (US) Inc. at the Ravena Cement Plant located in Ravena, New York. 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 Holcim US Ravena Cement Plant includes a single Kiln (Main Kiln) ~2,000,000 TPY preheater/pre-calciner having an in-line raw mill. Ravena operates a KHD Pyroclone low NO_x precalciner. The kiln system employs a SNCR as needed to control NO_x, has a baghouse fabric filtration, and a wet scrubber system. Emissions exhaust to a common stack. Emission testing was performed at the common stack testing location used for all compliance testing. This site-specific plan calls for testing in these two operational scenarios (mill on and off), as directed in EPA's Request and instructions.

This test program was completed to satisfy the requirements of the United States Environmental Protection Agency (USEPA) Section 114 Information Collection Request for Portland Cement Manufacturing facilities.

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

Location	Address	Contact
Test Coordinator	Holcim (US) Inc. Ravena Cement Plant 1916 US9W Ravena, NY 12143	Alicia Prioleau Area Environmental and Public Affairs Manager (518) 821-9785 Alicia.prioleau@holcim.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 stack. The following table presents a list of the parameters tested, the applicable methodologies utilized, and average test results:

Source	Parameter Tested	Test Results	Method/Regulation Citation
Main Kiln Stack Mill On	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.28 ppmvd @7% O_2	
		≤ 0.19 lb/hr	
		≤ 0.0010 lb/ton clinker	
	HF[1]	≤ 0.12 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.31 ppmvd @7% O_2	
		≤ 0.21 lb/hr	
		≤ 0.0011 lb/ton clinker	
	Chlorine (Cl_2)[1]	≤ 0.03 ppmvd	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.09 ppmvd @7% O_2	
		≤ 0.21 lb/hr	
		≤ 0.0011 lb/ton clinker	
	Hydrogen Cyanide (HCN)	1.22 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		3.44 ppmvd @7% O_2	
		3.17 lb/hr	
		0.0159 lb/ton clinker	
	Oxygen (O_2)	15.5 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO_2)	8.8 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H_2O)	9.0 %	USEPA Method 320, 40CFR63, Appendix A
	Cyclonic Flow Determination	PASS	USEPA Method 1, 40CFR60, Appendix A, Section 11.4
	Three-point O_2 Stratification Determination	< 5 %	USEPA Method 3A, 40CFR60, Appendix A and Method 7E, Section 8.1.2

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

Source	Parameter Tested	Test Results	Method/Regulation Citation
Main Kiln Stack Mill Off	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.20 ppmvd @7% O_2	
		≤ 0.14 lb/hr	
		≤ 0.0007 lb/ton clinker	
	HF[2]	≤ 0.17 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.29 ppmvd @7% O_2	
		≤ 0.21 lb/hr	
		≤ 0.0010 lb/ton clinker	
	Chlorine (Cl_2)[2]	≤ 0.05 ppmvd	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.08 ppmvd @7% O_2	
		≤ 0.21 lb/hr	
		≤ 0.0010 lb/ton clinker	
	Hydrogen Cyanide (HCN)	1.52 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		3.08 ppmvd @7% O_2	
		2.90 lb/hr	
		0.0139 lb/ton clinker	
	Oxygen (O_2)	13.0 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO_2)	12.9 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H_2O)	12.9 %	USEPA Method 320, 40CFR63, Appendix A
	Cyclonic Flow Determination	PASS	USEPA Method 1, 40CFR60, Appendix A, Section 11.4
	Three-point O_2 Stratification Determination	< 5 %	USEPA Method 3A, 40CFR60, Appendix A and Method 7E, Section 8.1.2

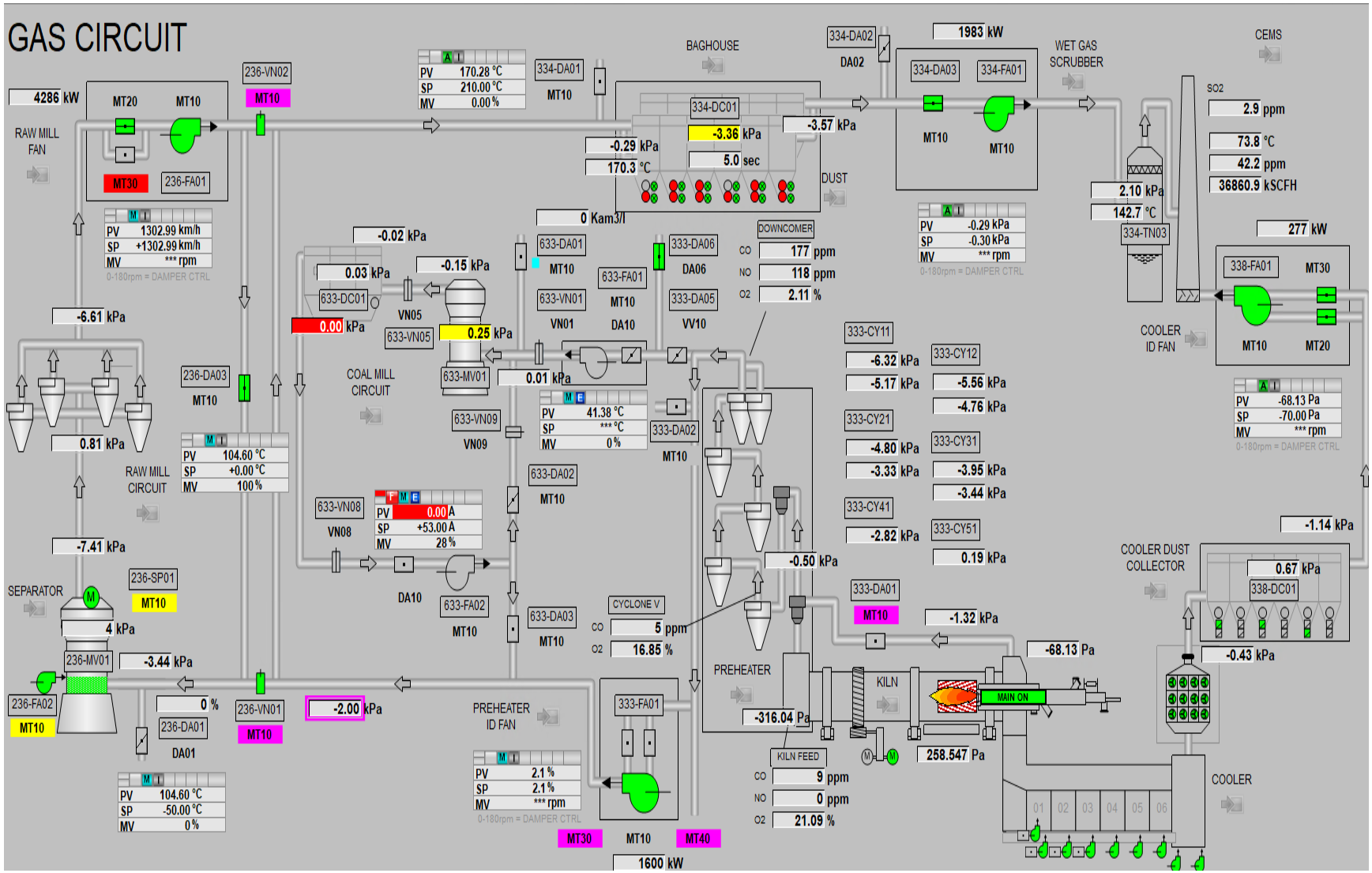
[2] HF and Cl_2 Method 26A results are reported as the average from Train A and Train B.

3.0 QA SPECIFICATIONS AND PROCESS DIAGRAM

Table 3-1 QA/QC Specifications

Parameter	Method	QA/QC Specification	Acceptance Criteria	Actual Result
HCN	320	Method Detection Limit	0.5 ppm	0.2 ppmvw
		SNR	>2500 at 64 scans	2864 (Run 1 Average)
		S Beam	>0.9	1.003 (Run 1 Average)
		Direct HCN Analysis	±5% of tag value	+0.1%
		Dynamic Spike Analysis	≤10% of total sample volume	9.9%
			Spike gas ~twice native concentration or 3-4 ppm addition to native concentration	+4 ppm
			≤±20% of expected value or ≤±0.5 ppm, whichever is less restrictive	≤±20% of expected value
		Residuals	≤±0.3 ppm, or ≤±5% of measured value, whichever is less restrictive	≤±0.3 ppm
Cl_2	26A	Detection Limit	300 µg	150 µg
		Paired Train Agreement	≤10% Relative Deviation or ≤0.2 ppm, whichever is less restrictive.	≤10% Relative Deviation

Figure 3-2 Process Flow Diagram



4.0 TEST PROCEDURES

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

4.1 Method 1 Sample and Velocity Traverse Determination

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

Sample Point Selection

Test Location	Stack Diameter	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points
Main Kiln Stack	17.708'	3.3 Diameters	8.8 Diameters	HF/Cl_2 (26A)	12
				O_2 (3A)	3 (stratification)
				$HCN/HF/O_2$ (320/3A)	1

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

4.2 Method 2 Volumetric Flow Rate Determination

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

Velocity pressures were determined by traversing the duct with wind tunnel calibrated S-type pitot tube. Temperatures were measured using K-type thermocouples with calibrated digital temperature indicators. The molecular weight and moisture content of the gases were also determined to permit the calculation of the volumetric flowrate.

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

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

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

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

HF and Cl_2 concentrations and emission rates were determined in accordance with Method 26A, 40CFR60, Appendix A. Paired sampling trains were used to collect the samples. A total of twelve (12) test points were sampled per run on at Main Kiln stack location. The sample was extracted isokinetically from the gas stream and passed through dilute sulfuric acid (0.1N H_2SO_4). HF was collected in the dilute acid. Cl_2 was collected in the dilute sodium hydroxide (0.1N NaOH) solution. The sample train consisted of a Teflon coated nozzle, a heated borosilicate glass probe liner, a Teflon® filter placed on the outlet of the glass probe liner, and six impingers. The first two impingers contained the 0.1N H_2SO_4, the third remained empty (and was recovered with the first two impingers), the fourth and fifth impingers contained the 0.1N NaOH, while the sixth impinger contained silica gel to absorb any remaining moisture. A de-ionized water rinse was performed on each set of impingers, and samples were stored in Nalgene sample containers for transport. The 0.1N H_2SO_4 impinger catch samples were analyzed for HF while the 0.1N NaOH impinger catch samples were analyzed for Cl_2. A method detection limit (MDL) of 150 µg was determined for both HF and Cl_2 using the “Definition and Procedure for the Determination of the Method Detection Limit, Revision 2”. All equipment used was calibrated in accordance with the specifications of the method. Calibration data is appended.

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

4.5 Method 320 Speciated Flue Gas Concentration Determinations

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

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

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

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

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

5.0 TEST RESULTS SUMMARIES

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Test Location: Kiln 3 Common Stack
Test Method: 26A - Combined Trains

Source Condition		**Mill On**		**Mill On**		**Mill On**		
Date		**1/30/24**		**1/30/24**		**1/30/24**		
Start Time		**8:15**		**9:50**		**11:25**		
End Time		**9:30**		**11:05**		**12:40**		
		Run 1		**Run 2**		**Run 3**		**Average**
Stack Conditions								
Average Gas Velocity, ft/sec		49.127		48.491		48.922		48.847
Gas Volumetric Flow Rate, acfm		725,933		716,534		722,909		721,792
Gas Volumetric Flow Rate, dscfm		571,763		558,443		561,458		563,888
Gas Volumetric Flow Rate, scfm		621,649		613,805		617,215		617,556
Average %CO_2 by volume, dry basis		8.8		8.9		8.8		8.8
Average %O_2 by volume, dry basis		15.6		15.4		15.5		15.5
Clinker production, ton/hr		198.7		199.1		199.6		199.1
Hydrogen Fluoride (HF) Emissions								
ppm	≤	0.12	≤	0.12	≤	0.12	≤	0.12
ppm@7%O2	≤	0.32	≤	0.31	≤	0.31	≤	0.31
lb/hr	≤	0.22	≤	0.21	≤	0.21	≤	0.21
lb/ton of clinker	≤	0.0011	≤	0.0011	≤	0.0011	≤	0.0011
Chlorine (Cl2) Emissions								
ppm	≤	0.03	≤	0.04	≤	0.03	≤	0.03
ppm@7%O2	≤	0.09	≤	0.09	≤	0.09	≤	0.09
lb/hr	≤	0.21	≤	0.22	≤	0.21	≤	0.21
lb/ton of clinker	≤	0.0011	≤	0.0011	≤	0.0011	≤	0.0011

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Test Location: Kiln 3 Common Stack
Test Method: 26A - A Train

Source Condition		**Mill On**		**Mill On**		**Mill On**		
Date		**1/30/24**		**1/30/24**		**1/30/24**		
Start Time		**8:15**		**9:50**		**11:25**		
End Time		**9:30**		**11:05**		**12:40**		
		Run 1A		**Run 2A**		**Run 3A**		**Average**
Stack Conditions								
Average Gas Temperature, °F		152.3		151.1		154.6		152.7
Flue Gas Moisture, percent by volume		9.1%		8.9%		9.4%		9.1%
Average Flue Pressure, in. Hg		29.71		29.71		29.71		29.71
Gas Sample Volume, dscf		47.397		46.444		46.672		46.838
Average Gas Velocity, ft/sec		49.158		48.137		48.672		48.656
Gas Volumetric Flow Rate, acfm		726,395		711,309		719,217		718,974
Gas Volumetric Flow Rate, dscfm		565,178		556,249		555,941		559,123
Gas Volumetric Flow Rate, scfm		621,960		610,290		613,560		615,270
Average %CO_2 by volume, dry basis		8.8		8.9		8.8		8.8
Average %O_2 by volume, dry basis		15.6		15.4		15.5		15.5
Isokinetic Variance		101.0		100.6		101.1		100.9
Hydrogen Fluoride (HF) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.13	≤	0.14	≤	0.14	≤	0.14
Chlorine (Cl2) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.04	≤	0.04	≤	0.04	≤	0.04

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Test Location: Kiln 3 Common Stack
Test Method: 26A - B Train

Source Condition		**Mill On**		**Mill On**		**Mill On**		
Date		**1/30/24**		**1/30/24**		**1/30/24**		
Start Time		**8:15**		**9:50**		**11:25**		
End Time		**9:30**		**11:05**		**12:40**		
		Run 1B		**Run 2B**		**Run 3B**		**Average**
Stack Conditions								
Average Gas Temperature, °F		152.2		153.0		153.6		152.9
Flue Gas Moisture, percent by volume		6.9%		9.2%		8.7%		8.3%
Average Flue Pressure, in. Hg		29.71		29.71		29.71		29.71
Gas Sample Volume, dscf		59.687		59.025		59.460		59.391
Average Gas Velocity, ft/sec		49.095		48.844		49.172		49.037
Gas Volumetric Flow Rate, acfm		725,471		721,759		726,601		724,610
Gas Volumetric Flow Rate, dscfm		578,347		560,637		566,975		568,653
Gas Volumetric Flow Rate, scfm		621,338		617,319		620,870		619,842
Average %CO_2 by volume, dry basis		8.8		8.9		8.8		8.8
Average %O_2 by volume, dry basis		15.6		15.4		15.5		15.5
Isokinetic Variance		99.1		101.1		100.7		100.3
Hydrogen Fluoride (HF) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.11	≤	0.11	≤	0.11	≤	0.11
Chlorine (Cl2) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.03	≤	0.03	≤	0.03	≤	0.03

Holcim (US) Inc.
Ravena Cement Plant
Kiln 3 Common Stack
Mill On
Reference Method Test Data

Test No.	Date	Start Time	End Time	O2 % (dry)	Moisture %	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2
1	1/30/2024	8:15	9:13	15.6	9.1%	1.20	3.46	≤ 0.10	≤ 0.29
2	1/30/2024	9:50	10:49	15.4	9.0%	1.25	3.48	≤ 0.10	≤ 0.28
3	1/30/2024	11:25	12:24	15.5	8.9%	1.20	3.37	≤ 0.10	≤ 0.28
Average				**15.5**	**9.0%**	**1.22**	**3.44**	**≤ 0.10**	**≤ 0.28**

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	1/30/2024	8:15	9:13	571,763	198.7	3.17	0.0159	≤ 0.20	≤ 0.0010
2	1/30/2024	9:50	10:49	558,443	199.1	3.23	0.0162	≤ 0.19	≤ 0.0010
3	1/30/2024	11:25	12:24	561,458	199.6	3.12	0.0156	≤ 0.19	≤ 0.0010
Average				**563,888**	**199.1**	**3.17**	**0.0159**	**≤ 0.19**	**≤ 0.0010**

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Test Method:	**26A - Combined Trains**

Source Condition		**Mill Off**		**Mill Off**		**Mill Off**		
Date		**1/31/24**		**1/31/24**		**1/31/24**		
Start Time		**8:20**		**9:55**		**11:40**		
End Time		**9:35**		**11:10**		**12:55**		
		Run 1		**Run 2**		**Run 3**		**Average**
Stack Conditions								
Average Gas Velocity, ft/sec		35.107		37.767		36.763		36.546
Gas Volumetric Flow Rate, acfm		518,775		558,068		543,244		540,029
Gas Volumetric Flow Rate, dscfm		381,066		410,454		390,056		393,858
Gas Volumetric Flow Rate, scfm		429,553		458,531		445,593		444,559
Average %CO_2 by volume, dry basis		12.9		12.9		12.9		12.9
Average %O_2 by volume, dry basis		12.9		12.9		13.1		13.0
Clinker production, ton/hr		209.0		208.7		209.6		209.1
Hydrogen Fluoride (HF) Emissions								
ppm	≤	0.17	≤	0.16	≤	0.17	≤	0.17
ppm@7%O2	≤	0.30	≤	0.28	≤	0.30	≤	0.29
lb/hr	≤	0.20	≤	0.21	≤	0.21	≤	0.21
lb/ton of clinker	≤	0.0010	≤	0.0010	≤	0.0010	≤	0.0010
Chlorine (Cl2) Emissions								
ppm	≤	0.05	≤	0.05	≤	0.05	≤	0.05
ppm@7%O2	≤	0.08	≤	0.08	≤	0.09	≤	0.08
lb/hr	≤	0.20	≤	0.21	≤	0.21	≤	0.21
lb/ton of clinker	≤	0.0010	≤	0.0010	≤	0.0010	≤	0.0010

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Test Location: Kiln 3 Common Stack
Test Method: 26A - A Train

Source Condition	**Mill Off**		**Mill Off**		**Mill Off**		
Date	**1/31/24**		**1/31/24**		**1/31/24**		
Start Time	**8:20**		**9:55**		**11:40**		
End Time	**9:35**		**11:10**		**12:55**		
	Run 1A		**Run 2A**		**Run 3A**		**Average**
Stack Conditions							
Average Gas Temperature, °F	173.7		178.5		179.9		177.4
Flue Gas Moisture, percent by volume	11.9%		10.2%		12.0%		11.4%
Average Flue Pressure, in. Hg	29.73		29.73		29.73		29.73
Gas Sample Volume, dscf	34.329		35.506		34.075		34.637
Average Gas Velocity, ft/sec	35.305		38.209		36.968		36.827
Gas Volumetric Flow Rate, acfm	521,701		564,608		546,272		544,194
Gas Volumetric Flow Rate, dscfm	380,477		416,526		393,964		396,989
Gas Volumetric Flow Rate, scfm	431,948		463,934		447,874		447,919
Average %CO_2 by volume, dry basis	12.9		12.9		12.9		12.9
Average %O_2 by volume, dry basis	12.9		12.9		13.1		13.0
Isokinetic Variance	108.7		102.7		104.2		105.2
Hydrogen Fluoride (HF) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.19	≤	0.18	≤	0.19	≤	0.18
Chlorine (Cl2) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.05	≤	0.05	≤	0.05	≤	0.05

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Test Location: Kiln 3 Common Stack
Test Method: 26A - B Train

Source Condition		**Mill Off**		**Mill Off**		**Mill Off**		
Date		**1/31/24**		**1/31/24**		**1/31/24**		
Start Time		**8:20**		**9:55**		**11:40**		
End Time		**9:35**		**11:10**		**12:55**		
		Run 1B		**Run 2B**		**Run 3B**		**Average**
Stack Conditions								
Average Gas Temperature, °F		173.6		178.6		179.3		177.2
Flue Gas Moisture, percent by volume		10.7%		10.8%		12.9%		11.5%
Average Flue Pressure, in. Hg		29.73		29.73		29.73		29.73
Gas Sample Volume, dscf		40.927		43.214		41.870		42.004
Average Gas Velocity, ft/sec		34.909		37.324		36.558		36.264
Gas Volumetric Flow Rate, acfm		515,848		551,528		540,215		535,864
Gas Volumetric Flow Rate, dscfm		381,654		404,382		386,147		390,728
Gas Volumetric Flow Rate, scfm		427,158		453,127		443,312		441,199
Average %CO_2 by volume, dry basis		12.9		12.9		12.9		12.9
Average %O_2 by volume, dry basis		12.9		12.9		13.1		13.0
Isokinetic Variance		103.0		102.6		104.1		103.2
Hydrogen Fluoride (HF) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.16	≤	0.15	≤	0.15	≤	0.15
Chlorine (Cl2) Emissions								
ug of sample collected	≤	150.00	≤	150.00	≤	150.00	≤	150.00
ppm	≤	0.04	≤	0.04	≤	0.04	≤	0.04

Holcim (US) Inc.
Ravena Cement Plant
Kiln 3 Common Stack
Mill Off
Reference Method Test Data

Test No.	Date	Start Time	End Time	O2 % (dry)	Moisture %	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2
1	1/31/2024	8:20	9:18	12.9	12.8%	1.46	2.92	≤ 0.10	≤ 0.20
2	1/31/2024	9:55	10:54	12.9	12.8%	1.52	3.04	≤ 0.10	≤ 0.20
3	1/31/2024	11:40	12:39	13.1	13.1%	1.59	3.27	≤ 0.10	≤ 0.21
Average				**13.0**	**12.9%**	**1.52**	**3.08**	**≤ 0.10**	**≤ 0.20**

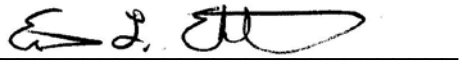
Test No.	Date	Start Time	End Time	Volumetric Flow, DSCFM	Clinker Production, ton/hr	HCN lb/hr	HCN lb/ton	HF lb/hr	HF lb/ton
1	1/31/2024	8:20	9:18	381,066	209.0	2.68	0.0128	≤ 0.14	≤ 0.0007
2	1/31/2024	9:55	10:54	410,454	208.7	3.01	0.0144	≤ 0.15	≤ 0.0007
3	1/31/2024	11:40	12:39	390,056	209.6	3.00	0.0143	≤ 0.14	≤ 0.0007
Average				**393,859**	**209.1**	**2.90**	**0.0139**	**≤ 0.14**	**≤ 0.0007**

6.0 CERTIFICATION

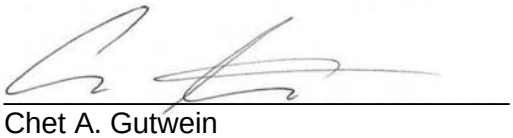
Mostardi Platt is pleased to have been of service to Holcim (US) Inc. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

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



Eric L. Ehlers — Project Manager



Chet A. Gutwein — Quality Assurance

APPENDICES

Appendix A – Plant Operating Data

Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/30/2024 08:15	196.0
01/30/2024 08:16	202.5
01/30/2024 08:17	200.3
01/30/2024 08:18	199.3
01/30/2024 08:19	193.8
01/30/2024 08:20	209.5
01/30/2024 08:21	194.0
01/30/2024 08:22	199.8
01/30/2024 08:23	197.0
01/30/2024 08:24	203.5
01/30/2024 08:25	197.5
01/30/2024 08:26	202.9
01/30/2024 08:27	195.0
01/30/2024 08:28	201.5
01/30/2024 08:29	195.4
01/30/2024 08:30	195.3
01/30/2024 08:31	199.2
01/30/2024 08:32	201.7
01/30/2024 08:33	198.7
01/30/2024 08:34	196.9
01/30/2024 08:35	200.2
01/30/2024 08:36	197.4
01/30/2024 08:37	203.0
01/30/2024 08:38	196.1
01/30/2024 08:39	202.8
01/30/2024 08:40	193.1
01/30/2024 08:41	202.9
01/30/2024 08:42	200.3
01/30/2024 08:43	203.5
01/30/2024 08:44	197.1
01/30/2024 08:45	205.8
01/30/2024 08:46	196.9
01/30/2024 08:47	204.4
01/30/2024 08:48	196.3
01/30/2024 08:49	200.4
01/30/2024 08:50	201.3
01/30/2024 08:51	202.4
01/30/2024 08:52	200.5
01/30/2024 08:53	198.5
01/30/2024 08:54	196.4
01/30/2024 08:55	197.8
01/30/2024 08:56	195.1

Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/30/2024 08:57	203.0
01/30/2024 08:58	197.8
01/30/2024 08:59	198.5
01/30/2024 09:00	203.0
01/30/2024 09:01	196.5
01/30/2024 09:02	201.1
01/30/2024 09:03	194.1
01/30/2024 09:04	203.8
01/30/2024 09:05	191.5
01/30/2024 09:06	201.2
01/30/2024 09:07	194.4
01/30/2024 09:08	201.6
01/30/2024 09:09	196.1
01/30/2024 09:10	201.8
01/30/2024 09:11	194.3
01/30/2024 09:12	199.1
01/30/2024 09:13	193.0
01/30/2024 09:14	200.4
01/30/2024 09:15	195.1
01/30/2024 09:16	200.7
01/30/2024 09:17	194.8
01/30/2024 09:18	200.4
01/30/2024 09:19	196.0
01/30/2024 09:20	195.4
01/30/2024 09:21	195.3
01/30/2024 09:22	196.4
01/30/2024 09:23	198.5
01/30/2024 09:24	197.1
01/30/2024 09:25	200.6
01/30/2024 09:26	194.0
01/30/2024 09:27	200.6
01/30/2024 09:28	194.6
01/30/2024 09:29	201.2
Average	**198.7**

Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/30/2024 09:50	201.7
01/30/2024 09:51	197.5
01/30/2024 09:52	196.4
01/30/2024 09:53	195.4
01/30/2024 09:54	200.6
01/30/2024 09:55	198.7
01/30/2024 09:56	199.6
01/30/2024 09:57	199.5
01/30/2024 09:58	201.4
01/30/2024 09:59	195.9
01/30/2024 10:00	200.8
01/30/2024 10:01	197.2
01/30/2024 10:02	201.9
01/30/2024 10:03	196.3
01/30/2024 10:04	199.8
01/30/2024 10:05	200.7
01/30/2024 10:06	203.7
01/30/2024 10:07	201.4
01/30/2024 10:08	199.2
01/30/2024 10:09	202.4
01/30/2024 10:10	193.1
01/30/2024 10:11	203.9
01/30/2024 10:12	197.4
01/30/2024 10:13	199.3
01/30/2024 10:14	198.1
01/30/2024 10:15	200.6
01/30/2024 10:16	194.4
01/30/2024 10:17	207.8
01/30/2024 10:18	196.0
01/30/2024 10:19	202.1
01/30/2024 10:20	197.9
01/30/2024 10:21	205.0
01/30/2024 10:22	197.0
01/30/2024 10:23	208.1
01/30/2024 10:24	195.7
01/30/2024 10:25	199.6
01/30/2024 10:26	196.3
01/30/2024 10:27	198.2
01/30/2024 10:28	196.5
01/30/2024 10:29	195.5
01/30/2024 10:30	198.1
01/30/2024 10:31	200.0

Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/30/2024 10:32	196.2
01/30/2024 10:33	197.6
01/30/2024 10:34	200.3
01/30/2024 10:35	196.4
01/30/2024 10:36	200.4
01/30/2024 10:37	193.7
01/30/2024 10:38	201.5
01/30/2024 10:39	192.9
01/30/2024 10:40	200.3
01/30/2024 10:41	190.9
01/30/2024 10:42	200.2
01/30/2024 10:43	191.9
01/30/2024 10:44	200.5
01/30/2024 10:45	193.2
01/30/2024 10:46	198.3
01/30/2024 10:47	194.8
01/30/2024 10:48	198.3
01/30/2024 10:49	193.7
01/30/2024 10:50	202.4
01/30/2024 10:51	195.1
01/30/2024 10:52	207.2
01/30/2024 10:53	198.6
01/30/2024 10:54	199.5
01/30/2024 10:55	203.4
01/30/2024 10:56	202.1
01/30/2024 10:57	205.4
01/30/2024 10:58	201.4
01/30/2024 10:59	206.8
01/30/2024 11:00	196.0
01/30/2024 11:01	208.9
01/30/2024 11:02	195.3
01/30/2024 11:03	200.8
01/30/2024 11:04	196.3
Average	**199.1**

Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/30/2024 11:25	192.6
01/30/2024 11:26	196.2
01/30/2024 11:27	196.9
01/30/2024 11:28	201.9
01/30/2024 11:29	196.4
01/30/2024 11:30	202.4
01/30/2024 11:31	198.1
01/30/2024 11:32	199.0
01/30/2024 11:33	193.8
01/30/2024 11:34	203.3
01/30/2024 11:35	196.9
01/30/2024 11:36	204.7
01/30/2024 11:37	197.2
01/30/2024 11:38	201.1
01/30/2024 11:39	196.7
01/30/2024 11:40	204.1
01/30/2024 11:41	197.1
01/30/2024 11:42	200.3
01/30/2024 11:43	203.7
01/30/2024 11:44	200.6
01/30/2024 11:45	201.4
01/30/2024 11:46	199.7
01/30/2024 11:47	202.1
01/30/2024 11:48	199.4
01/30/2024 11:49	203.3
01/30/2024 11:50	195.0
01/30/2024 11:51	203.3
01/30/2024 11:52	193.1
01/30/2024 11:53	200.6
01/30/2024 11:54	194.9
01/30/2024 11:55	201.3
01/30/2024 11:56	196.9
01/30/2024 11:57	200.7
01/30/2024 11:58	195.8
01/30/2024 11:59	202.3
01/30/2024 12:00	195.2
01/30/2024 12:01	198.5
01/30/2024 12:02	196.8
01/30/2024 12:03	194.3
01/30/2024 12:04	197.8
01/30/2024 12:05	196.1
01/30/2024 12:06	199.4

Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/30/2024 12:07	196.0
01/30/2024 12:08	201.2
01/30/2024 12:09	197.6
01/30/2024 12:10	201.6
01/30/2024 12:11	196.5
01/30/2024 12:12	202.2
01/30/2024 12:13	196.3
01/30/2024 12:14	201.9
01/30/2024 12:15	195.5
01/30/2024 12:16	204.7
01/30/2024 12:17	200.4
01/30/2024 12:18	202.3
01/30/2024 12:19	199.1
01/30/2024 12:20	200.7
01/30/2024 12:21	202.6
01/30/2024 12:22	200.7
01/30/2024 12:23	205.4
01/30/2024 12:24	199.3
01/30/2024 12:25	202.1
01/30/2024 12:26	204.4
01/30/2024 12:27	203.7
01/30/2024 12:28	203.4
01/30/2024 12:29	200.6
01/30/2024 12:30	202.6
01/30/2024 12:31	201.2
01/30/2024 12:32	202.8
01/30/2024 12:33	200.6
01/30/2024 12:34	197.0
01/30/2024 12:35	201.3
01/30/2024 12:36	197.4
01/30/2024 12:37	204.0
01/30/2024 12:38	196.1
01/30/2024 12:39	201.3
Average	**199.6**

Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/31/2024 08:20	206.2
01/31/2024 08:21	213.2
01/31/2024 08:22	206.8
01/31/2024 08:23	211.9
01/31/2024 08:24	212.0
01/31/2024 08:25	207.5
01/31/2024 08:26	211.4
01/31/2024 08:27	206.7
01/31/2024 08:28	214.6
01/31/2024 08:29	203.7
01/31/2024 08:30	212.9
01/31/2024 08:31	205.9
01/31/2024 08:32	212.0
01/31/2024 08:33	205.4
01/31/2024 08:34	209.3
01/31/2024 08:35	204.6
01/31/2024 08:36	210.3
01/31/2024 08:37	206.0
01/31/2024 08:38	210.7
01/31/2024 08:39	207.2
01/31/2024 08:40	209.7
01/31/2024 08:41	206.8
01/31/2024 08:42	210.4
01/31/2024 08:43	205.8
01/31/2024 08:44	207.0
01/31/2024 08:45	209.0
01/31/2024 08:46	206.7
01/31/2024 08:47	206.8
01/31/2024 08:48	205.7
01/31/2024 08:49	208.1
01/31/2024 08:50	205.6
01/31/2024 08:51	208.4
01/31/2024 08:52	205.4
01/31/2024 08:53	211.6
01/31/2024 08:54	205.5
01/31/2024 08:55	210.8
01/31/2024 08:56	207.9
01/31/2024 08:57	210.9
01/31/2024 08:58	206.4
01/31/2024 08:59	211.4
01/31/2024 09:00	206.1
01/31/2024 09:01	211.6
01/31/2024 09:02	206.0
01/31/2024 09:03	210.0

Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/31/2024 09:04	208.9
01/31/2024 09:05	214.1
01/31/2024 09:06	208.3
01/31/2024 09:07	211.8
01/31/2024 09:08	212.9
01/31/2024 09:09	214.1
01/31/2024 09:10	215.9
01/31/2024 09:11	216.7
01/31/2024 09:12	212.6
01/31/2024 09:13	208.3
01/31/2024 09:14	213.5
01/31/2024 09:15	204.5
01/31/2024 09:16	210.2
01/31/2024 09:17	202.2
01/31/2024 09:18	210.3
01/31/2024 09:19	201.8
01/31/2024 09:20	211.8
01/31/2024 09:21	204.5
01/31/2024 09:22	211.4
01/31/2024 09:23	203.6
01/31/2024 09:24	212.1
01/31/2024 09:25	204.3
01/31/2024 09:26	212.2
01/31/2024 09:27	207.6
01/31/2024 09:28	210.7
01/31/2024 09:29	209.8
01/31/2024 09:30	210.3
01/31/2024 09:31	212.3
01/31/2024 09:32	208.1
01/31/2024 09:33	210.0
01/31/2024 09:34	211.3
Average	**209.0**

Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/31/2024 09:55	207.5
01/31/2024 09:56	206.9
01/31/2024 09:57	208.2
01/31/2024 09:58	208.1
01/31/2024 09:59	208.8
01/31/2024 10:00	208.8
01/31/2024 10:01	205.1
01/31/2024 10:02	210.5
01/31/2024 10:03	205.0
01/31/2024 10:04	214.2
01/31/2024 10:05	203.7
01/31/2024 10:06	208.0
01/31/2024 10:07	201.3
01/31/2024 10:08	208.6
01/31/2024 10:09	202.1
01/31/2024 10:10	205.8
01/31/2024 10:11	200.4
01/31/2024 10:12	207.6
01/31/2024 10:13	201.3
01/31/2024 10:14	208.6
01/31/2024 10:15	207.2
01/31/2024 10:16	208.2
01/31/2024 10:17	207.0
01/31/2024 10:18	206.1
01/31/2024 10:19	210.8
01/31/2024 10:20	209.3
01/31/2024 10:21	212.2
01/31/2024 10:22	208.6
01/31/2024 10:23	211.6
01/31/2024 10:24	205.3
01/31/2024 10:25	215.6
01/31/2024 10:26	206.9
01/31/2024 10:27	212.4
01/31/2024 10:28	207.0
01/31/2024 10:29	216.7
01/31/2024 10:30	206.9
01/31/2024 10:31	218.5
01/31/2024 10:32	209.0
01/31/2024 10:33	221.1
01/31/2024 10:34	206.6
01/31/2024 10:35	215.8
01/31/2024 10:36	209.3
01/31/2024 10:37	208.2
01/31/2024 10:38	209.4

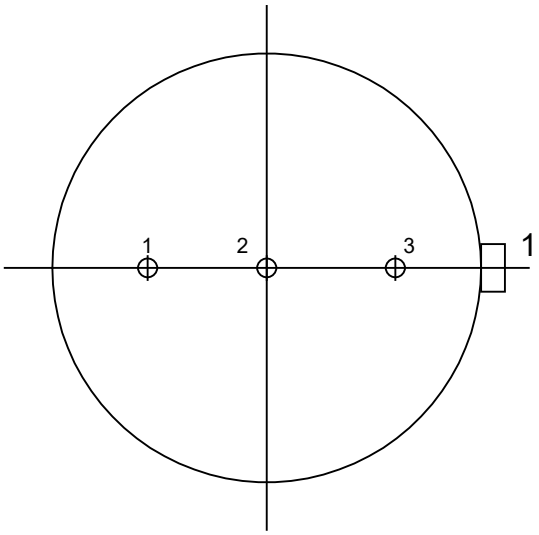
Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/31/2024 10:39	209.7
01/31/2024 10:40	210.2
01/31/2024 10:41	204.5
01/31/2024 10:42	207.2
01/31/2024 10:43	207.1
01/31/2024 10:44	208.2
01/31/2024 10:45	204.6
01/31/2024 10:46	207.8
01/31/2024 10:47	204.1
01/31/2024 10:48	207.1
01/31/2024 10:49	202.4
01/31/2024 10:50	208.4
01/31/2024 10:51	208.6
01/31/2024 10:52	212.1
01/31/2024 10:53	207.5
01/31/2024 10:54	213.8
01/31/2024 10:55	205.4
01/31/2024 10:56	210.8
01/31/2024 10:57	208.7
01/31/2024 10:58	213.5
01/31/2024 10:59	209.2
01/31/2024 11:00	209.8
01/31/2024 11:01	206.6
01/31/2024 11:02	208.4
01/31/2024 11:03	208.8
01/31/2024 11:04	209.1
01/31/2024 11:05	212.6
01/31/2024 11:06	208.3
01/31/2024 11:07	213.1
01/31/2024 11:08	211.1
01/31/2024 11:09	213.7
Average	**208.7**

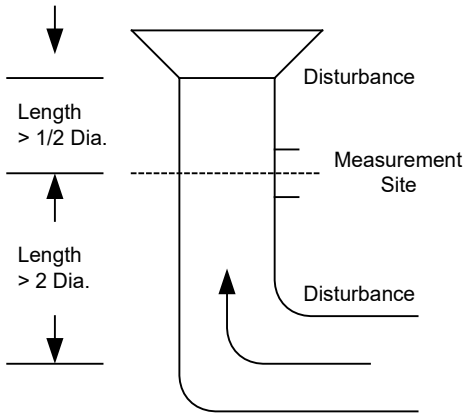
Date/Time	KILN: CLINKER_PROD_TONS (TON) Expression Value
01/31/2024 11:40	210.7
01/31/2024 11:41	204.8
01/31/2024 11:42	212.3
01/31/2024 11:43	207.7
01/31/2024 11:44	216.6
01/31/2024 11:45	209.8
01/31/2024 11:46	219.1
01/31/2024 11:47	210.8
01/31/2024 11:48	214.7
01/31/2024 11:49	208.9
01/31/2024 11:50	216.3
01/31/2024 11:51	206.1
01/31/2024 11:52	214.4
01/31/2024 11:53	209.5
01/31/2024 11:54	212.0
01/31/2024 11:55	212.7
01/31/2024 11:56	213.4
01/31/2024 11:57	211.0
01/31/2024 11:58	207.0
01/31/2024 11:59	211.4
01/31/2024 12:00	215.1
01/31/2024 12:01	213.4
01/31/2024 12:02	207.1
01/31/2024 12:03	211.4
01/31/2024 12:04	203.6
01/31/2024 12:05	207.6
01/31/2024 12:06	201.7
01/31/2024 12:07	216.3
01/31/2024 12:08	202.3
01/31/2024 12:09	211.1
01/31/2024 12:10	203.6
01/31/2024 12:11	208.3
01/31/2024 12:12	203.9
01/31/2024 12:13	209.2
01/31/2024 12:14	207.9
01/31/2024 12:15	208.8
01/31/2024 12:16	207.9
01/31/2024 12:17	210.0
01/31/2024 12:18	208.9
01/31/2024 12:19	206.5
01/31/2024 12:20	213.8
01/31/2024 12:21	206.5
01/31/2024 12:22	212.9
01/31/2024 12:23	206.9

01/31/2024 12:24	211.2
01/31/2024 12:25	207.8
01/31/2024 12:26	214.5
01/31/2024 12:27	206.0
01/31/2024 12:28	216.9
01/31/2024 12:29	206.5
01/31/2024 12:30	220.7
01/31/2024 12:31	207.3
01/31/2024 12:32	216.8
01/31/2024 12:33	209.4
01/31/2024 12:34	211.9
01/31/2024 12:35	211.0
01/31/2024 12:36	206.5
01/31/2024 12:37	210.7
01/31/2024 12:38	210.2
01/31/2024 12:39	211.4
01/31/2024 12:40	211.0
01/31/2024 12:41	206.2
01/31/2024 12:42	206.8
01/31/2024 12:43	206.7
01/31/2024 12:44	206.2
01/31/2024 12:45	205.7
01/31/2024 12:46	204.8
01/31/2024 12:47	209.4
01/31/2024 12:48	205.5
01/31/2024 12:49	211.6
01/31/2024 12:50	205.0
01/31/2024 12:51	211.1
01/31/2024 12:52	201.9
01/31/2024 12:53	212.5
01/31/2024 12:54	202.6
Average	**209.6**

Appendix B – Test Section Diagrams

STRATIFICATION TEST FOR ROUND DUCTS





Job: Holcim (US) Inc.
Ravena Cement Plant
Ravena, New York

Test Location: Common Stack

Stack Diameter: 17.708 Feet

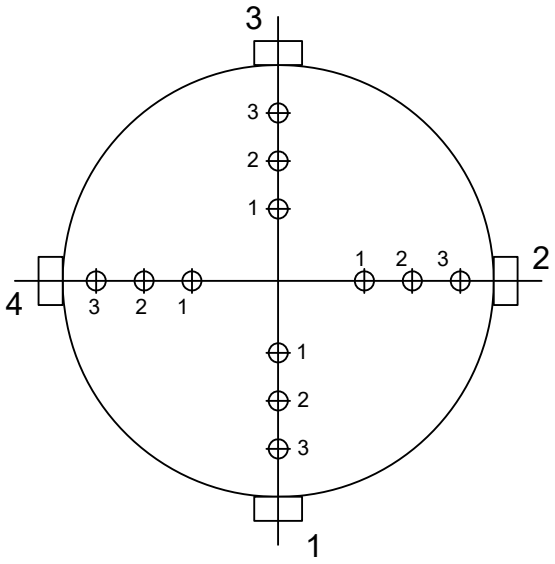
Stack Area: 246.280 Square Feet

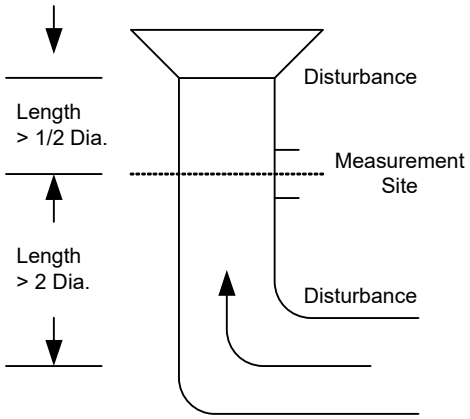
No. Sample Points: 3

Distance from Inside Wall
To Traverse Point:

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

EQUAL AREA TRAVERSE FOR ROUND DUCTS

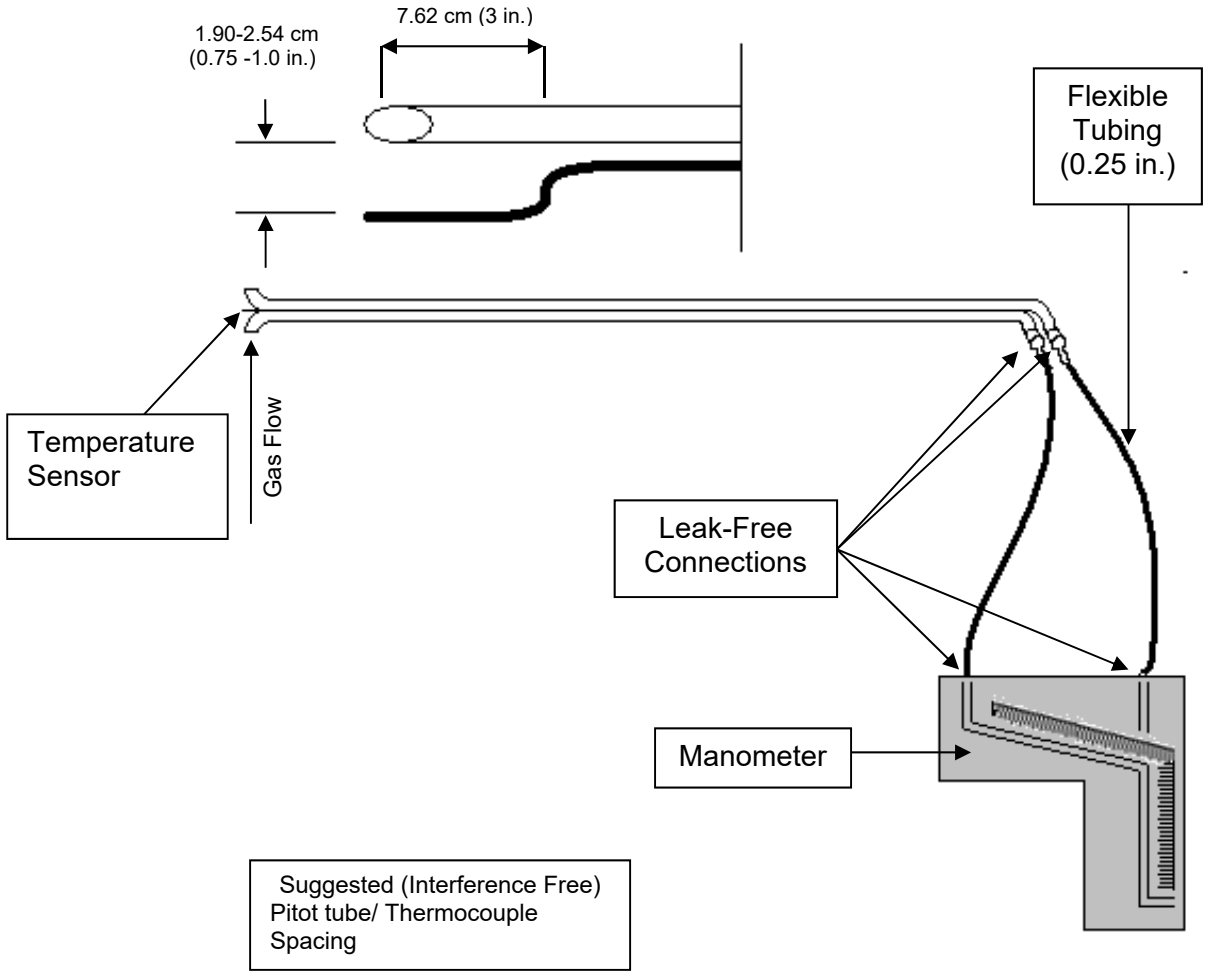




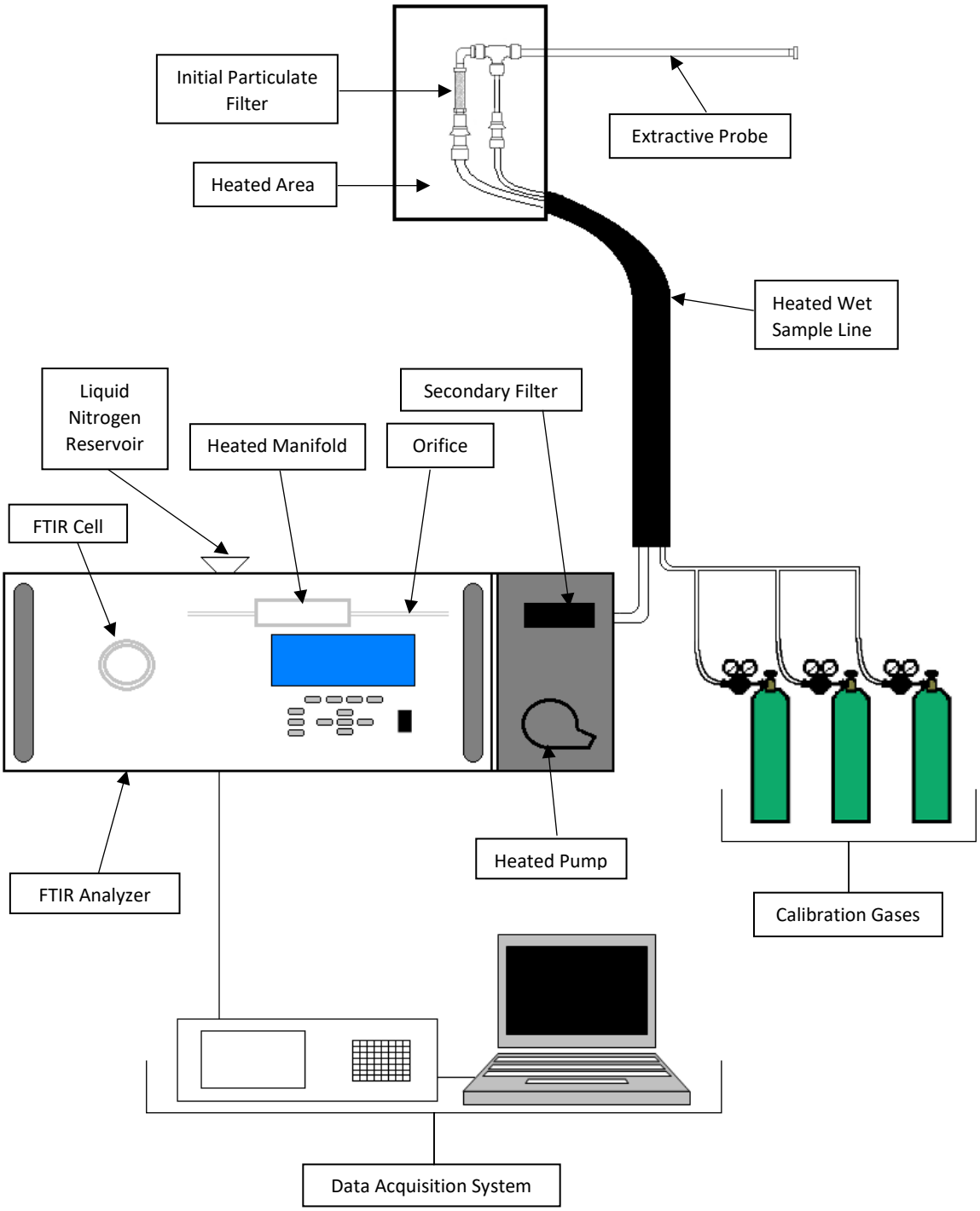
Project:	Holcim (US) Inc. Ravena Cement Plant Ravena, New York
Test Location:	Common Stack
Stack Diameter:	17.708 Feet
Stack Area:	246.280 Square Feet
No. Points Across Diameter:	6
No. of Ports:	4

Appendix C – Sample Train Diagrams

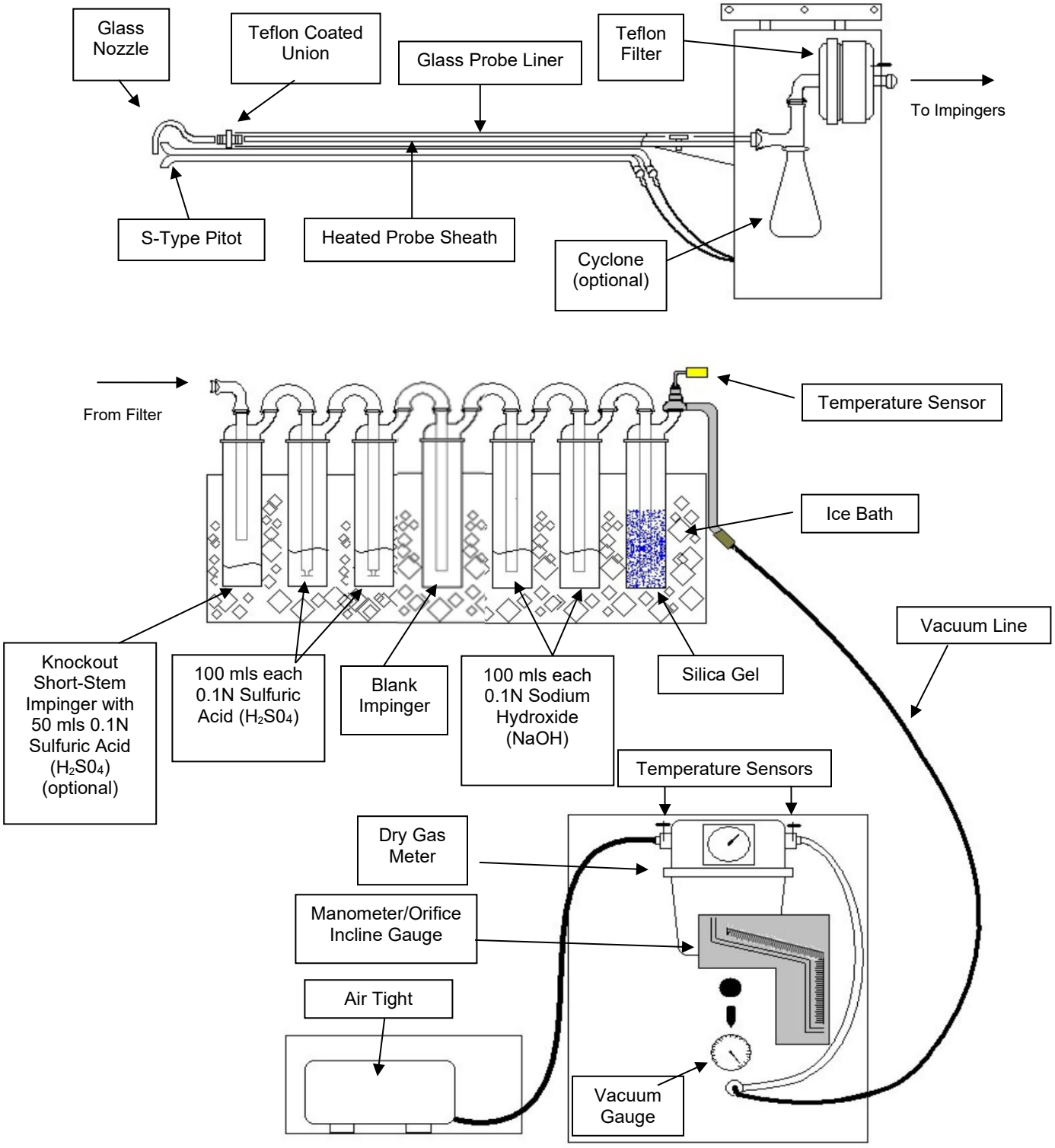
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



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: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Test Location: Kiln 3 Common Stack
Date: 1/30/24

Sample Calculations

$$(15.73\ \% - 0.09\ \%) \times \frac{\textbf{O2 \% (dry)}\ 11.92\ \%}{12.04\ \% - 0.09\ \%} = 15.61\ \%$$

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

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: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Test Location: Kiln 3 Common Stack
Date: 1/30/24

FTIR Sample Calculations

Direct Recovery % of Calibration Transfer Standard

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

Cma= 100.0 D_{cts} = 97.5

DR_{cts} = 97.5%

Recovery % with Calibration Transfer Standard System Purge

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

Sys_{cts} = 97.8 D_{cts} = 97.5

R_{cts} = 100%

Direct Recovery % of Analyte Spike Gas

SF6			HCN		
$DR_{sf6} = \frac{D_{sf6}}{Cma} \times 100$			$DR_{asg} = \frac{D_{asg}}{Cma} \times 100$		
Cma= 5.0	D_{sf6} = 4.9		Cma= 49.7	D_{asg} = 49.8	
DR_{sf6} = 97%			DR_{asg} = 100.1%		

Dilution Factor for Analyte Spiking

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

Spk_{sf6} = 0.486 D_{sf6} = 4.860

DF = 0.100

Recovery % for Analyte Spike With HCN

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

Spk_x = 5.7 N_x = 1.3

DF = 0.100 D_{asg} = 49.8

R_x = 93.8 %

where:

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

MOSTARDI PLATT

Moisture Calculations

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

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

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

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

Where:

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

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Volumetric Flow Nomenclature

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

MOSTARDI PLATT

Volumetric Air Flow Calculations

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

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

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

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

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

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

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

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

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

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

MOSTARDI PLATT

Isokinetic Calculation Formulas

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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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

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Chain-of-Custody Form

Project Number: M234506	Date Results Required:
Client: Holcim (US) Cement	TAT Required:
Plant/Test Location: Ravenna/Main Kiln Stack	Project Supervisor: EE

Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
001	1/30/24	#1A M26A H2SO4 Mill on	1		HF	
002	1/30/24	#1A M26A NaOH Mill on	1		Cl_2	
003	1/30/24	#1B M26A H2SO4 Mill on	1		HF	
004	1/30/24	#1B M26A NaOH Mill on	1		Cl_2	
005	1/30/24	#2A M26A H2SO4 Mill on	1		HF	
006	1/30/24	#2A M26A NaOH Mill on	1		Cl_2	
007	1/30/24	#2B M26A H2SO4 Mill on	1		HF	
008	1/30/24	#2B M26A NaOH Mill on	1		Cl_2	
009	1/30/24	#3A M26A H2SO4 Mill on	1		HF	
010	1/30/24	#3A M26A NaOH Mill on	1		Cl_2	
011	1/30/24	#3B M26A H2SO4 Mill on	1		HF	
012	1/30/24	#3B M26A NaOH Mill on	1		Cl_2	
013	1/30/24	A Train Blank H2SO4 Mill on	1		HF	
014	1/30/24	A Train Blank NaOH Mill on	1		Cl_2	
015	1/31/24	#1A M26A H2SO4 Mill off	1		HF	
016	1/31/24	#1A M26A NaOH Mill off	1		Cl_2	
017	1/31/24	#1B M26A H2SO4 Mill off	1		HF	
018	1/31/24	#1B M26A NaOH Mill off	1		Cl_2	
019	1/31/24	#2A M26A H2SO4 Mill off	1		HF	
020	1/31/24	#2A M26A NaOH Mill off	1		Cl_2	

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

Laboratory Notes:

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Chain-of-Custody Form

Project Number: M234506	Date Results Required:
Client: Holcim (US) Cement	TAT Required:
Plant/Test Location: Ravenna/Main Kiln Stack	Project Supervisor: EE

Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
021	1/31/24	#2B M26A H2SO4 Mill off	1		HF	
022	1/31/24	#2B M26A NaOH Mill off	1		Cl_2	
023	1/31/24	#3A M26A H2SO4 Mill off	1		HF	
024	1/31/24	#3A M26A NaOH Mill off	1		Cl_2	
025	1/31/24	#3B M26A H2SO4 Mill off	1		HF	
026	1/31/24	#3B M26A NaOH Mill off	1		Cl_2	
027	1/30/24	B Train Blank H2SO4 Mill off	1		HF	
028	1/30/24	B Train Blank NaOH Mill off	1		Cl_2	
029	1/30/24	DI Reagent Blank	1		HF/Cl_2	
030	1/30/24	H2SO4 Reagent Blank	1		HF	
031	1/30/24	NaOH Reagent Blank	1		Cl_2	

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

Laboratory Notes:

Main Kiln-Mill Off

Client:	Holcim	Analysis Date:	2/26/2024
Facility:	Ravena	Analysis Location:	Elmhurst
Test Location:	Main Kiln-Mill Off	Analyst:	JMG
Project Number:	M234506		
Method:	26A		
Date Samples Received:	2/5/2024		

Train A

Sampling Date		1/31/2024	1/31/2024	1/31/2024	1/31/2024		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	172	226	361	361		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		1/31/2024	1/31/2024				
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**			**RDL**	**MDL**
Sulfuric Acid Volume	ml	300	345				
Hydrofluoric Acid	ug	<150	<150			150	15

Train B

Sampling Date		1/31/2024	1/31/2024	1/31/2024	1/31/2024		
	UNITS	**M26A DI Blank**	**M26A H2SO4 Blank**	**M26A H2SO4-R1**	**M26A H2SO4-R1 Dup**	**RDL**	**MDL**
Sulfuric Acid Volume	ml	172	226	361	361		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		1/31/2024	1/31/2024				
	UNITS	**M26A- H2SO4 R2**	**M26A- H2SO4 R3**			**RDL**	**MDL**
Sulfuric Acid Volume	ml	384	380				
Hydrofluoric Acid	ug	<150	<150			150	15

Client:	Holcim	**Analysis Date:**	2/26/2024								
Facility:	Ravena	**Analysis Location:**	Elmhurst								
Test Location:	Main Kiln-Mill Off	**Analyst:**	JMG								
Project Number:	M234506										
Method:	26A										
Date Samples Received:	2/5/2024										
Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**							
1	0.2139	0.2139	**0.95**	**0.2253**							
2	0.4332	0.2166	**1.92**								
5	1.1237	0.2247	**4.99**	**Response Factor Ave**							
8	1.8439	0.2305	**8.19**	**0.2250**							
10	2.3932	0.2393	**10.62**								
Lot Number	Ricca 830603B										
	R²	**0.9989**									
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	1/31/2024	DI Reagent Blank	0.0036	0.0160	0.0160	1	172	0.0027	0.0029		
029	1/31/2024	DI Reagent Blank	0.0018	0.0080	0.0080	1	172	0.0014	0.0014	**0.0022**	**2.171465421**
030	1/31/2024	H2SO4 Reagent Blank	0.0028	0.0124	0.0124	1	226	0.0028	0.0030		
030	1/31/2024	H2SO4 Reagent Blank	0.0038	0.0169	0.0169	1	226	0.0038	0.0040	**0.0035**	**3.487250023**
015	1/31/2024	Test 1A H2SO4 Imp	0.0229	0.1017	0.1017	1	361	0.0367	0.0387		
015	1/31/2024	Test 1A H2SO4 Imp	0.0248	0.1101	0.1101	1	361	0.0397	0.0419	**0.0403**	**40.25837974**
015	1/31/2024	Test 1A H2SO4 Imp	0.0245	0.1088	0.1088	1	361	0.0393	0.0414		
015	1/31/2024	Test 1A H2SO4 Imp	0.0235	0.1043	0.1043	1	361	0.0377	0.0397	**0.0405**	**40.5115771**
019	1/31/2024	Test 2A H2SO4 Imp	0.0096	0.0426	0.0426	1	300	0.0128	0.0135		
019	1/31/2024	Test 2A H2SO4 Imp	0.0117	0.0519	0.0519	1	300	0.0156	0.0164	**0.0149**	**14.93934543**
023	1/31/2024	Test 3A H2SO4 Imp	0.0239	0.1061	0.1061	1	345	0.0366	0.0386		
023	1/31/2024	Test 3A H2SO4 Imp	0.0279	0.1239	0.1239	1	345	0.0427	0.0450	**0.0418**	**41.78107077**
					Expected Value	**% Difference**					
		Run 1 H2SO4 Spike W/ 2ppm	0.2209	0.9807	1.0145						
Lot Number: Thermo 21-191JKS		Run 1 H2SO4 Spike W/ 2ppm	0.2169	0.9629	1.0145	4.21%					
CCV ppm F	**Area**	**PPM F**									
1 ppm ICV	0.2386	1.0592									
5 ppm CCV	1.1537	5.1217									
5 ppm CCV	1.1391	5.0569									
5 ppm CCV	1.1364	5.0449									
5 ppm CCV	1.1283	5.0089									
Standard ppm F	**Area**	**Difference**									
1	0.2068	1.72%									
2	0.4337	0.06%									
5	1.1254	0.08%									
8	1.8928	1.29%									
10	2.4171	0.49%									

Client:	Holcim	**Analysis Date:**	2/26/2024								
Facility:	Ravena	**Analysis Location:**	Elmhurst								
Test Location:	Main Kiln-Mill Off	**Analyst:**	JMG								
Project Number:	M234506										
Method:	26A										
Date Samples Received:	2/5/2024										

Standard ppm HF	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**
1	0.2139	0.2139	**0.95**	**0.2253**
2	0.4332	0.2166	**1.92**	
5	1.1237	0.2247	**4.99**	**Response Factor Ave**
8	1.8439	0.2305	**8.19**	**0.2250**
10	2.3932	0.2393	**10.62**	
Lot Number	Ricca 8209004			
	R^2	**0.9989**		

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	1/31/2024	DI Reagent Blank	0.0036	0.0160	0.0160	1	172	0.0027	0.0029		
029	1/31/2024	DI Reagent Blank	0.0018	0.0080	0.0080	1	172	0.0014	0.0014	**0.0022**	**2.171465421**
030	1/31/2024	H2SO4 Reagent Blank	0.0028	0.0124	0.0124	1	226	0.0028	0.0030		
030	1/31/2024	H2SO4 Reagent Blank	0.0038	0.0169	0.0169	1	226	0.0038	0.0040	**0.0035**	**3.487250023**
017	1/31/2024	Test 1B H2SO4 Imp	0.0111	0.0493	0.0493	1	361	0.0178	0.0187		
017	1/31/2024	Test 1B H2SO4 Imp	0.0105	0.0466	0.0466	1	361	0.0168	0.0177	**0.0182**	**18.2302097**
017	1/31/2024	Test 1B H2SO4 Imp	0.0105	0.0466	0.0466	1	361	0.0168	0.0177		
017	1/31/2024	Test 1B H2SO4 Imp	0.0110	0.0488	0.0488	1	361	0.0176	0.0186	**0.0181**	**18.14581058**
021	1/31/2024	Test 2B H2SO4 Imp	0.0210	0.0932	0.0932	1	384	0.0358	0.0377		
021	1/31/2024	Test 2B H2SO4 Imp	0.0196	0.0870	0.0870	1	384	0.0334	0.0352	**0.0364**	**36.44919735**
025	1/31/2024	Test 3B H2SO4 Imp	0.0147	0.0653	0.0653	1	380	0.0248	0.0261		
025	1/31/2024	Test 3B H2SO4 Imp	0.0171	0.0759	0.0759	1	380	0.0288	0.0304	**0.0283**	**28.25149456**

CCV ppm F	**Area**	**PPM F**
1 ppm ICV	0.2386	1.0592
5 ppm CCV	1.1537	5.1217
5 ppm CCV	1.1391	5.0569
5 ppm CCV	1.1364	5.0449
5 ppm CCV	1.1283	5.0089

Standard ppm F	**Area**	**Difference**
1	0.2068	1.72%
2	0.4337	0.06%
5	1.1254	0.08%
8	1.8928	1.29%
10	2.4171	0.49%

Main Kiln-Mill Off

Client:	Holcim	Analysis Date:	2/26/2024
Facility:	Ravena	Analysis Location:	Elmhurst
Test Location:	Main Kiln-Mill Off	Analyst:	JMG
Project Number:	M234506		
Method:	26A		
Date Samples Received:	2/5/2024		

Train A

Sampling Date		1/31/2024	1/31/2024	1/31/2024	1/31/2024		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	172	223	245	245		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		1/31/2024	1/31/2024				
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**			**RDL**	**MDL**
Sodium Hydroxide Volume	ml	209	249				
Chlorine	ug	<150	<150			150	15

Train B

Sampling Date		1/31/2024	1/31/2024	1/31/2024	1/31/2024		
	UNITS	**M26A DI Blank**	**M26A NaOH Blank**	**M26A NaOH-R1**	**M26A NaOH-R1 Dup**	**RDL**	**MDL**
Sodium Hydroxide Volume	ml	172	223	214	214		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		1/31/2024	1/31/2024				
	UNITS	**M26A- NaOH R2**	**M26A- NaOH R3**			**RDL**	**MDL**
Sodium Hydroxide Volume	ml	238	249				
Chlorine	ug	<150	<150			150	15

Client:	Holcim	**Analysis Date:**	2/26/2024							
Facility:	Ravena	**Analysis Location:**	Elmhurst Lab							
Test Location:	Main Kiln-Mill Off	**Analyst:**	JMG							
Project Number:	M234506									
Method:	26A									
Date Samples Received:	2/5/2024									
Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**						
1	0.1189	0.1189	**0.94**	**0.1270**						
2	0.2477	0.1239	**1.95**							
5	0.6397	0.1279	**5.04**	**Response Factor Ave**						
8	1.0453	0.1307	**8.23**	**0.1270**						
10	1.3356	0.1336	**10.51**							
Lot Number	Ricca 830603B									
	R^2	**0.9996**								
Sample Number	**Sample Date**	**Sample ID**	**Sample Area**	**PPM Cl**	**PPM X Dilution Factor**	**Dilution Factor**	**Total ml**	**mg Cl in soln**	**ug Cl2 in soln**	**ug Cl2 in soln**
029	1/31/2024	DI Reagent Blank	0.0019	0.0150	0.0150	1	172	0.0026		
029	1/31/2024	DI Reagent Blank	0.0007	0.0055	0.0055	1	172	0.0009	**0.0018**	**1.760226855**
031	1/31/2024	NaOH Reagent Blank	0.0067	0.0527	0.0527	1	223	0.0118		
031	1/31/2024	NaOH Reagent Blank	0.0068	0.0535	0.0535	1	223	0.0119	**0.0118**	**11.84964881**
016	1/31/2024	Test 1A NaOH Imp	0.0072	0.0567	0.0567	1	245	0.0139		
016	1/31/2024	Test 1A NaOH Imp	0.0039	0.0307	0.0307	1	245	0.0075	**0.0107**	**10.7042418**
016	1/31/2024	Test 1A NaOH Imp	0.0027	0.0213	0.0213	1	245	0.0052		
016	1/31/2024	Test 1A NaOH Imp	0.0039	0.0307	0.0307	1	245	0.0075	**0.0064**	**6.364684314**
020	1/31/2024	Test 2A NaOH Imp	0.0046	0.0362	0.0362	1	209	0.0076		
020	1/31/2024	Test 2A NaOH Imp	0.0046	0.0362	0.0362	1	209	0.0076	**0.0076**	**7.568345701**
024	1/31/2024	Test 3A NaOH Imp	0.0038	0.0299	0.0299	1	249	0.0074		
024	1/31/2024	Test 3A NaOH Imp	0.0030	0.0236	0.0236	1	249	0.0059	**0.0067**	**6.664615634**
					Expected Value	**% Difference**				
		Run 1 H2SO4 Spike W/ 2ppm	0.1023	0.8053	0.9968					
		Run 1 H2SO4 Spike W/ 2ppm	0.1014	0.7982	0.9968	19.57%				
CCV ppm Cl	**Area**	**PPM Cl**								
5 ppm ICV	0.6506	5.1217								
5 ppm CCV	0.6395	5.0343								
5 ppm CCV	0.6387	5.0280								
5 ppm CCV	0.6452	5.0792								
5 ppm CCV	0.6458	5.0839								

Client:	Holcim	**Analysis Date:**	2/26/2024							
Facility:	Ravena	**Analysis Location:**	Elmhurst Lab							
Test Location:	Main Kiln-Mill Off	**Analyst:**	JMG							
Project Number:	M234506									
Method:	26A									
Date Samples Received:	2/5/2024									
Standard ppm Cl	**Area**	**Response Factor**	**Calculated Value**	**Slope of Regression Curve**						
1	0.1189	0.1189	**0.94**	**0.1270**						
2	0.2477	0.1239	**1.95**							
5	0.6397	0.1279	**5.04**	**Response Factor Ave**						
8	1.0453	0.1307	**8.23**	**0.1270**						
10	1.3356	0.1336	**10.51**							
Lot Number	Ricca 8209004									
	R^2	**0.9996**								
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	1/31/2024	DI Reagent Blank	0.0019	0.0150	0.0150	1	172	0.0026		
029	1/31/2024	DI Reagent Blank	0.0007	0.0055	0.0055	1	172	0.0009	**0.0018**	**1.760226855**
031	1/31/2024	NaOH Reagent Blank	0.0067	0.0527	0.0527	1	223	0.0118		
031	1/31/2024	NaOH Reagent Blank	0.0068	0.0535	0.0535	1	223	0.0119	**0.0118**	**11.84964881**
018	1/31/2024	Test 1B NaOH Imp	0.0063	0.0496	0.0496	1	214	0.0106		
018	1/31/2024	Test 1B NaOH Imp	0.0050	0.0394	0.0394	1	214	0.0084	**0.0095**	**9.518292893**
018	1/31/2024	Test 1B NaOH Imp	0.0069	0.0543	0.0543	1	214	0.0116		
018	1/31/2024	Test 1B NaOH Imp	0.0074	0.0583	0.0583	1	214	0.0125	**0.0120**	**12.04527331**
022	1/31/2024	Test 2B NaOH Imp	0.0111	0.0874	0.0874	1	238	0.0208		
022	1/31/2024	Test 2B NaOH Imp	0.0105	0.0827	0.0827	1	238	0.0197	**0.0202**	**20.23473662**
026	1/31/2024	Test 3B NaOH Imp	0.0055	0.0433	0.0433	1	249	0.0108		
026	1/31/2024	Test 3B NaOH Imp	0.0071	0.0559	0.0559	1	249	0.0139	**0.0123**	**12.34914073**
CCV ppm Cl	**Area**	**PPM Cl**								
5 ppm ICV	0.6506	5.1217								
5 ppm CCV	0.6395	5.0343								
5 ppm CCV	0.6387	5.0280								
5 ppm CCV	0.6452	5.0792								

Appendix F - Reference Method Test Data

Client:	Holcim (US) Inc.													
Facility:	Ravena Cement Plant													
Test Location:	Kiln 3 Common Stack													
Project #:	M234506													
Test Method:	26A													
Test Engineer:	PPP													
Test Technician:	LPH													
	Run 1A				**Run 2A**				**Run 3A**					
Meter ID:	CM43				CM43				CM43					
Pitot ID:	S8-058				S8-058				S8-058					
Nozzle Diameter (Inches):	0.250				0.250				0.250					
Meter Calibration Date:	1/19/2024				1/19/2024				1/19/2024					
Meter Calibration Factor (Y):	0.994				0.994				0.994					
Meter Orifice Setting (Delta H):	1.788				1.788				1.788					
Nozzle Kit ID Number and Material:	Glass #1 865				Glass #1 865				Glass #1 865					
	Leak Checks													
Pre Pitot Leak Check	**0.0**	**@**	**3.4**	**"H_2O**	**0.0**	**@**	**3.3**	**"H_2O**	**0.0**	**@**	**3.5**	**"H_2O**		
Post Pitot Leak Check	**0.0**	**@**	**3.2**	**"H_2O**	**0.0**	**@**	**3.4**	**"H_2O**	**0.0**	**@**	**3.2**	**"H_2O**		
Pre Nozzle Leak Check	**0.0018**	**@**	**13**	**"Hg**	**0.0000**	**@**	**12**	**"Hg**	**0.0000**	**@**	**13**	**"Hg**		
Post Nozzle Leak Check	**0.0000**	**@**	**11**	**"Hg**	**0.0000**	**@**	**12**	**"Hg**	**0.0000**	**@**	**11**	**"Hg**		
Pitot Tube Coefficient:	0.834													
Probe Length (Feet):	7.0													
Probe Liner Material:	Glass													
Sample Plane:	Horizontal													
Port Length (Inches):	12.00													
Port Size (Diameter, Inches):	4.00													
Port Type:	Flange													
Duct Shape:	Circular													
Diameter (Feet):	17.708													
Duct Area (Square Feet):	246.280													
Upstream Diameters:	3.3													
Downstream Diameters:	8.8													
Number of Ports Sampled:	4													
Number of Points per Port:	3													
Minutes per Point:	5.0													
Minutes per Reading:	5.0													
Total Number of Traverse Points:	12													
Test Length (Minutes):	60													
Train Type:	Anderson Box													
Source Condition:	Mill on													
Moisture Balance ID:	S10-31													
# of Runs	3													

Run 1A - Method 26A

Client: Holcim (US) Inc. | **Date: 1/30/24**
Facility: Ravena Cement Plant | **Start Time: 8:15**
Test Location: Kiln 3 Common Stack | **End Time: 9:30**
Source Condition: Mill on

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.02	in. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	73.8	°F	Flue Pressure (Ps):	29.71	in. Hg. abs.
Sqrt ΔP:	0.817	in. H_2O	Carbon Dioxide:	8.75	%
Stack Temperature, Ts:	152.3	°F	Oxygen:	15.61	%
Meter Volume, Vm:	48.488	ft^3	Nitrogen:	75.64	%
Meter Volume, Vmstd:	47.397	dscf	Gas Weight dry, Md:	30.024	lb/lb mole
Meter Volume, Vwstd:	4.762	wscf	Gas Weight wet, Ms:	28.927	lb/lb mole
Isokinetic Variance:	101.0	%I	Excess Air:	---	%
			Gas Velocity, Vs:	49.158	fps
Test Length:	60.00	in mins.	Volumetric Flow:	726,395	acfm
Nozzle Diameter:	0.250	in inches	Volumetric Flow:	565,178	dscfm
Barometric Pressure:	29.60	in Hg	Volumetric Flow:	621,960	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3457.1	ml	Silica Initial Wt.	861.1	grams
Final Impinger Content:	3548.9	ml	Silica Final Wt.	870.4	grams
Impinger Difference:	91.8	ml	Silica Difference:	9.3	grams

Total Water Gain: 101.1 Moisture, Bws: 0.091 **Supersaturation Value, Bws: 0.270**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	8:15:00	0.64	1.90	154.272	153	70	70	5	261	260	43
1-2	8:20:00	0.69	2.10	158.570	154	70	70	4	266	260	41
1-3	8:25:00	0.60	1.80	162.410	155	71	71	4	252	258	44
	8:30:00			166.145							
2-1	8:35:00	0.69	2.10	166.145	155	73	73	4	256	258	44
2-2	8:40:00	0.70	2.10	170.310	153	73	73	5	260	264	46
2-3	8:45:00	0.65	1.90	174.430	151	74	74	5	253	262	48
	8:50:00			178.338							
3-1	8:55:00	0.68	2.10	178.338	151	75	75	5	252	261	47
3-2	9:00:00	0.69	2.10	182.530	151	75	75	5	257	264	49
3-3	9:05:00	0.66	2.00	186.640	151	75	75	5	256	261	50
	9:10:00			190.564							
4-1	9:15:00	0.67	2.00	190.564	152	76	76	5	254	261	45
4-2	9:20:00	0.70	2.20	194.830	151	77	77	4	254	261	47
4-3	9:25:00	0.64	1.90	198.970	151	77	77	4	266	262	48
	9:30:00			202.760							
Total	1:00:00			48.488		73.8	73.8				
Average			2.02		152.3	73.8		5			
Min			1.80		151.0	70.0		4			
Max			2.20		155.0	77.0		5			

Impinger Weight Sheet - Run 1A

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/30/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/30/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	821.2	783.7	37.5
0.1N H2SO4	707.8	672.5	35.3
Empty	611.5	596.8	14.7
0.1N NaOH	648.8	645.6	3.2
0.1N NaOH	759.6	758.5	1.1
Silica Gel	870.4	861.1	9.3

Liquid Final	Liquid Initial	Liquid Gain
3,548.9	3,457.1	91.8

Silica Final	Silica Initial	Silica Gain
870.4	861.1	9.3

Run 2A - Method 26A

Client: Holcim (US) Inc. | **Date:** 1/30/24
Facility: Ravena Cement Plant | **Start Time:** 9:50
Test Location: Kiln 3 Common Stack | **End Time:** 11:05
Source Condition: Mill on

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.96	In. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	77.5	°F	Flue Pressure (Ps):	29.71	in. Hg. abs.
Sqrt ΔP:	0.801	In. H_2O	Carbon Dioxide:	8.91	%
Stack Temperature, Ts:	151.1	°F	Oxygen:	15.42	%
Meter Volume, Vm:	47.847	ft^3	Nitrogen:	75.7	%
Meter Volume, Vmstd:	46.444	dscf	Gas Weight dry, Md:	30.042	lb/lb mole
Meter Volume, Vwstd:	4.512	wscf	Gas Weight wet, Ms:	28.976	lb/lb mole
Isokinetic Variance:	100.6	%I	Excess Air:	---	%
			Gas Velocity, Vs:	48.137	fps
Test Length:	60.00	in mins.	Volumetric Flow:	711,309	acfm
Nozzle Diameter:	0.250	in inches	Volumetric Flow:	556,249	dscfm
Barometric Pressure:	29.60	in Hg	Volumetric Flow:	610,290	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3501.8	ml	Silica Initial Wt.	870.4	grams
Final Impinger Content:	3591.9	ml	Silica Final Wt.	876.1	grams
Impinger Difference:	90.1	ml	Silica Difference:	5.7	grams

Total Water Gain: 95.8 | Moisture, Bws: 0.089 | **Supersaturation Value, Bws: 0.262**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	9:50:00	0.64	1.90	203.750	151	78	78	4	264	255	45
1-2	9:55:00	0.67	2.10	207.830	147	78	78	5	252	263	46
1-3	10:00:00	0.62	2.00	211.940	127	78	78	5	259	260	48
	10:05:00			215.873							
2-1	10:10:00	0.61	1.80	215.873	154	78	78	5	261	259	46
2-2	10:15:00	0.69	2.10	219.930	153	78	78	5	269	262	49
2-3	10:20:00	0.62	1.90	223.910	154	78	78	5	263	258	51
	10:25:00			227.739							
3-1	10:30:00	0.63	1.90	227.739	155	77	77	5	255	260	50
3-2	10:35:00	0.67	2.00	231.740	155	77	77	5	253	261	50
3-3	10:40:00	0.62	1.90	235.860	153	77	77	5	263	261	50
	10:45:00			239.643							
4-1	10:50:00	0.62	1.90	239.643	153	77	77	5	266	260	52
4-2	10:55:00	0.70	2.10	243.640	155	77	77	5	254	260	53
4-3	11:00:00	0.62	1.90	247.830	156	77	77	5	251	260	53
	11:05:00			251.597							
Total	1:00:00			47.847		77.5	77.5				
Average			1.96		151.1	77.5		5			
Min			1.80		127.0	77.0		4			
Max			2.10		156.0	78.0		5			

Impinger Weight Sheet - Run 2A

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/30/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/30/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	710.6	686.2	24.4
0.1N H2SO4	786.2	745.3	40.9
Empty	667.5	650.7	16.8
0.1N NaOH	739.8	733.2	6.6
0.1N NaOH	687.8	686.4	1.4
Silica Gel	876.1	870.4	5.7

3,591.9	3,501.8	90.1
Liquid Final	**Liquid Initial**	**Liquid Gain**
876.1	870.4	5.7
Silica Final	**Silica Initial**	**Silica Gain**

Run 3A - Method 26A

Client: Holcim (US) Inc. | **Date:** 1/30/24
Facility: Ravena Cement Plant | **Start Time:** 11:25
Test Location: Kiln 3 Common Stack | **End Time:** 12:40
Source Condition: Mill on

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.92	In. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	66.8	°F	Flue Pressure (Ps):	29.71	in. Hg. abs.
Sqrt ΔP:	0.807	In. H_2O	Carbon Dioxide:	8.83	%
Stack Temperature, Ts:	154.6	°F	Oxygen:	15.45	%
Meter Volume, Vm:	47.132	ft^3	Nitrogen:	75.72	%
Meter Volume, Vmstd:	46.672	dscf	Gas Weight dry, Md:	30.031	lb/lb mole
Meter Volume, Vwstd:	4.837	wscf	Gas Weight wet, Ms:	28.901	lb/lb mole
Isokinetic Variance:	101.1	%I	Excess Air:	---	%
			Gas Velocity, Vs:	48.672	fps
Test Length:	60.00	in mins.	Volumetric Flow:	719,217	acfm
Nozzle Diameter:	0.250	in inches	Volumetric Flow:	555,941	dscfm
Barometric Pressure:	29.60	in Hg	Volumetric Flow:	613,560	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3440.7	ml	Silica Initial Wt.	870.4	grams
Final Impinger Content:	3536.1	ml	Silica Final Wt.	877.7	grams
Impinger Difference:	95.4	ml	Silica Difference:	7.3	grams

Total Water Gain: 102.7 | Moisture, Bws: 0.094 | **Supersaturation Value, Bws: 0.285**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	11:25:00	0.60	1.80	251.857	154	69	69	5	253	260	38
1-2	11:30:00	0.67	2.00	255.740	155	69	69	5	255	257	40
1-3	11:35:00	0.63	1.70	259.790	155	68	68	5	263	259	44
	11:40:00			263.525							
2-1	11:45:00	0.66	2.00	263.525	154	67	67	5	257	261	45
2-2	11:50:00	0.69	2.00	267.620	155	67	67	5	260	261	45
2-3	11:55:00	0.63	1.90	271.740	154	67	67	5	262	260	45
	12:00:00			275.385							
3-1	12:05:00	0.67	2.00	275.385	154	66	66	5	264	260	45
3-2	12:10:00	0.70	2.00	279.460	155	66	66	5	260	259	46
3-3	12:15:00	0.63	1.90	283.720	155	67	67	5	257	259	47
	12:20:00			287.284							
4-1	12:25:00	0.64	1.90	287.284	154	66	66	5	254	260	48
4-2	12:30:00	0.68	2.00	291.340	155	65	65	5	251	262	48
4-3	12:35:00	0.62	1.80	295.370	155	65	65	5	254	259	49
	12:40:00			298.989							
Total	1:00:00			47.132		66.8	66.8				
Average			1.92		154.6	66.8		5			
Min			1.70		154.0	65.0		5			
Max			2.00		155.0	69.0		5			

Impinger Weight Sheet - Run 3A

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/30/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/30/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	801.5	767.4	34.1
0.1N H2SO4	709.3	672.4	36.9
Empty	613.7	601.8	11.9
0.1N NaOH	652.9	641.8	11.1
0.1N NaOH	758.7	757.3	1.4
Silica Gel	877.7	870.4	7.3
	3,536.1	3,440.7	95.4
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	877.7	870.4	7.3
	Silica Final	**Silica Initial**	**Silica Gain**

Client:	Holcim (US) Inc.													
Facility:	Ravena Cement Plant													
Test Location:	Kiln 3 Common Stack													
Project #:	M234506													
Test Method:	26A													
Test Engineer:	CMB													
Test Technician:	LPH													
	Run 1B				**Run 2B**				**Run 3B**					
Meter ID:	CM13				CM13				CM13					
Pitot ID:	S8-059				S8-059				S8-059					
Nozzle Diameter (Inches):	0.280				0.280				0.280					
Meter Calibration Date:	1/16/2024				1/16/2024				1/16/2024					
Meter Calibration Factor (Y):	0.987				0.987				0.987					
Meter Orifice Setting (Delta H):	1.516				1.516				1.516					
Nozzle Kit ID Number and Material:	GLASS #1				GLASS #1				GLASS #1					
	Leak Checks													
Pre Pitot Leak Check	**0.0**	**@**	**7.0**	**"H_2O**	**0.0**	**@**	**7.0**	**"H_2O**	**0.0**	**@**	**7.0**	**"H_2O**		
Post Pitot Leak Check	**0.0**	**@**	**7.0**	**"H_2O**	**0.0**	**@**	**7.0**	**"H_2O**	**0.0**	**@**	**7.0**	**"H_2O**		
Pre Nozzle Leak Check	**0.0000**	**@**	**10**	**"Hg**	**0.0000**	**@**	**10**	**"Hg**	**0.0000**	**@**	**10**	**"Hg**		
Post Nozzle Leak Check	**0.0000**	**@**	**10**	**"Hg**	**0.0000**	**@**	**10**	**"Hg**	**0.0000**	**@**	**10**	**"Hg**		
Pitot Tube Coefficient:	0.839													
Probe Length (Feet):	7.0													
Probe Liner Material:	Glass													
Sample Plane:	Horizontal													
Port Length (Inches):	12.00													
Port Size (Diameter, Inches):	4.00													
Port Type:	Flange													
Duct Shape:	Circular													
Diameter (Feet):	17.708													
Duct Area (Square Feet):	246.280													
Upstream Diameters:	3.3													
Downstream Diameters:	8.8													
Number of Ports Sampled:	4													
Number of Points per Port:	3													
Minutes per Point:	5.0													
Minutes per Reading:	5.0													
Total Number of Traverse Points:	12													
Test Length (Minutes):	60													
Train Type:	Anderson Box													
Source Condition:	Mill on													
Diluent Model/Serial Number:	Servomex Single													
Moisture Balance ID:	S10-31													
# of Runs	3													

Run 1B - Method 26A

Client: Holcim (US) Inc. | **Date: 1/30/24**
Facility: Ravena Cement Plant | **Start Time: 8:15**
Test Location: Kiln 3 Common Stack | **End Time: 9:30**
Source Condition: Mill on

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.65	in. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	73.7	°F	Flue Pressure (Ps):	29.71	in. Hg. abs.
Sqrt ΔP:	0.815	in. H_2O	Carbon Dioxide:	8.75	%
Stack Temperature, Ts:	152.2	°F	Oxygen:	15.61	%
Meter Volume, Vm:	61.384	ft^3	Nitrogen:	75.64	%
Meter Volume, Vmstd:	59.687	dscf	Gas Weight dry, Md:	30.024	lb/lb mole
Meter Volume, Vwstd:	4.437	wscf	Gas Weight wet, Ms:	29.192	lb/lb mole
Isokinetic Variance:	99.1	%I	Excess Air:	---	%
			Gas Velocity, Vs:	49.095	fps
Test Length:	60.00	in mins.	Volumetric Flow:	725,471	acfm
Nozzle Diameter:	0.280	in inches	Volumetric Flow:	578,347	dscfm
Barometric Pressure:	29.60	in Hg	Volumetric Flow:	621,338	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3680.6	ml	Silica Initial Wt.	849.6	grams
Final Impinger Content:	3760.2	ml	Silica Final Wt.	864.2	grams
Impinger Difference:	79.6	ml	Silica Difference:	14.6	grams

Total Water Gain: 94.2 | Moisture, Bws: 0.069 | **Supersaturation Value, Bws: 0.269**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	8:15:00	0.65	2.60	12.438	153	69	65	5	257	259	40
1-2	8:20:00	0.68	2.70	17.450	154	68	66	5	257	258	37
1-3	8:25:00	0.63	2.50	22.550	155	70	67	5	260	255	40
	8:30:00			27.450							
2-1	8:35:00	0.70	2.80	27.450	155	74	68	5	263	260	41
2-2	8:40:00	0.71	2.80	32.700	153	76	68	5	260	262	41
2-3	8:45:00	0.62	2.50	37.950	152	79	70	5	259	260	43
	8:50:00			42.900							
3-1	8:55:00	0.67	2.70	42.900	151	79	71	5	261	258	46
3-2	9:00:00	0.68	2.70	48.050	151	81	71	5	264	262	46
3-3	9:05:00	0.63	2.50	53.250	151	85	73	5	256	260	47
	9:10:00			58.300							
4-1	9:15:00	0.68	2.70	58.300	151	82	74	5	260	259	44
4-2	9:20:00	0.70	2.80	63.550	150	82	74	5	257	258	44
4-3	9:25:00	0.62	2.50	68.850	150	83	74	5	256	267	45
	9:30:00			73.822							
Total	1:00:00			61.384		77.3	70.1				
Average			2.65		152.2	73.7		5			
Min			2.50		150.0	65.0		5			
Max			2.80		155.0	85.0		5			

Impinger Weight Sheet - Run 1B

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/30/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/30/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	781.1	743.1	38.0
0.1N H2SO4	782.7	742.6	40.1
Empty	660.2	638.5	21.7
0.1N NaOH	791.1	776.2	14.9
0.1N NaOH	745.1	780.2	-35.1
Silica Gel	864.2	849.6	14.6
	3,760.2 Liquid Final	3,680.6 Liquid Initial	79.6 Liquid Gain
	864.2 Silica Final	849.6 Silica Initial	14.6 Silica Gain

Run 2B - Method 26A

Client: Holcim (US) Inc. | **Date:** 1/30/24
Facility: Ravena Cement Plant | **Start Time:** 9:50
Test Location: Kiln 3 Common Stack | **End Time:** 11:05
Source Condition: Mill on

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.63	In. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	79.1	°F	Flue Pressure (Ps):	29.71	in. Hg. abs.
Sqrt ΔP:	0.806	In. H_2O	Carbon Dioxide:	8.91	%
Stack Temperature, Ts:	153.0	°F	Oxygen:	15.42	%
Meter Volume, Vm:	61.322	ft^3	Nitrogen:	75.7	%
Meter Volume, Vmstd:	59.025	dscf	Gas Weight dry, Md:	30.042	lb/lb mole
Meter Volume, Vwstd:	5.968	wscf	Gas Weight wet, Ms:	28.937	lb/lb mole
Isokinetic Variance:	101.1	%I	Excess Air:	---	%
			Gas Velocity, Vs:	48.844	fps
Test Length:	60.00	in mins.	Volumetric Flow:	721,759	acfm
Nozzle Diameter:	0.280	in inches	Volumetric Flow:	560,637	dscfm
Barometric Pressure:	29.60	in Hg	Volumetric Flow:	617,319	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3572.5	ml	Silica Initial Wt.	835.5	grams
Final Impinger Content:	3684.9	ml	Silica Final Wt.	849.8	grams
Impinger Difference:	112.4	ml	Silica Difference:	14.3	grams

Total Water Gain: 126.7 | Moisture, Bws: 0.092 | **Supersaturation Value, Bws: 0.274**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	9:50:00	0.67	2.70	75.453	151	79	75	5	266	257	53
1-2	9:55:00	0.71	2.90	80.650	151	84	75	5	250	259	57
1-3	10:00:00	0.61	2.50	86.000	152	88	76	5	260	261	55
	10:05:00			90.950							
2-1	10:10:00	0.62	2.50	90.950	155	84	75	5	264	260	53
2-2	10:15:00	0.65	2.60	95.950	154	85	75	5	260	260	54
2-3	10:20:00	0.64	2.60	101.050	153	86	75	5	270	259	55
	10:25:00			106.150							
3-1	10:30:00	0.65	2.60	106.150	155	83	74	5	260	261	53
3-2	10:35:00	0.69	2.80	111.250	155	84	74	5	260	259	53
3-3	10:40:00	0.60	2.50	116.500	142	86	75	5	260	260	53
	10:45:00			121.450							
4-1	10:50:00	0.69	2.80	121.450	156	81	75	5	260	258	49
4-2	10:55:00	0.67	2.70	126.700	156	81	74	5	260	261	50
4-3	11:00:00	0.61	2.40	131.850	156	81	74	5	260	258	50
	11:05:00			136.775							
Total	1:00:00			61.322		83.5	74.8				
Average			2.63		153.0	79.1		5			
Min			2.40		142.0	74.0		5			
Max			2.90		156.0	88.0		5			

Impinger Weight Sheet - Run 2B

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/30/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/30/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	712.8	686.7	26.1
0.1N H2SO4	807.2	758.2	49.0
Empty	667.9	645.0	22.9
0.1N NaOH	765.2	753.8	11.4
0.1N NaOH	731.8	728.8	3.0
Silica Gel	849.8	835.5	14.3

3,684.9	3,572.5	112.4
Liquid Final	**Liquid Initial**	**Liquid Gain**
849.8	835.5	14.3
Silica Final	**Silica Initial**	**Silica Gain**

Run 3B - Method 26A

Client: Holcim (US) Inc. | **Date:** 1/30/24
Facility: Ravena Cement Plant | **Start Time:** 11:25
Test Location: Kiln 3 Common Stack | **End Time:** 12:40
Source Condition: Mill on

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.58	In. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	63.0	°F	Flue Pressure (Ps):	29.71	in. Hg. abs.
Sqrt ΔP:	0.812	In. H_2O	Carbon Dioxide:	8.83	%
Stack Temperature, Ts:	153.6	°F	Oxygen:	15.45	%
Meter Volume, Vm:	59.939	ft^3	Nitrogen:	75.72	%
Meter Volume, Vmstd:	59.460	dscf	Gas Weight dry, Md:	30.031	lb/lb mole
Meter Volume, Vwstd:	5.652	wscf	Gas Weight wet, Ms:	28.986	lb/lb mole
Isokinetic Variance:	100.7	%I	Excess Air:	---	%
			Gas Velocity, Vs:	49.172	fps
Test Length:	60.00	in mins.	Volumetric Flow:	726,601	acfm
Nozzle Diameter:	0.280	in inches	Volumetric Flow:	566,975	dscfm
Barometric Pressure:	29.60	in Hg	Volumetric Flow:	620,870	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3606.5	ml	Silica Initial Wt.	864.2	grams
Final Impinger Content:	3714.5	ml	Silica Final Wt.	876.2	grams
Impinger Difference:	108.0	ml	Silica Difference:	12.0	grams

Total Water Gain: 120.0 | Moisture, Bws: 0.087 | **Supersaturation Value, Bws: 0.278**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	11:25:00	0.66	2.60	39.750	154	67	67	5	260	258	39
1-2	11:30:00	0.68	2.70	44.800	154	68	64	5	260	259	43
1-3	11:35:00	0.63	2.50	49.900	155	69	63	5	260	261	43
	11:40:00			54.800							
2-1	11:45:00	0.67	2.60	54.800	153	65	61	5	260	260	44
2-2	11:50:00	0.70	2.80	59.850	148	65	60	5	259	259	44
2-3	11:55:00	0.62	2.40	65.000	151	66	60	5	261	261	46
	12:00:00			69.850							
3-1	12:05:00	0.68	2.60	69.850	155	63	58	5	260	259	48
3-2	12:10:00	0.71	2.80	74.900	155	64	58	5	260	259	48
3-3	12:15:00	0.63	2.40	80.050	154	64	58	5	260	260	48
	12:20:00			84.900							
4-1	12:25:00	0.65	2.50	84.900	154	67	57	5	260	260	54
4-2	12:30:00	0.68	2.60	89.850	155	67	57	5	260	261	55
4-3	12:35:00	0.61	2.40	94.900	155	68	57	5	260	261	56
	12:40:00			99.689							
Total	1:00:00			59.939		66.1	60.0				
Average			2.58		153.6	63.0		5			
Min			2.40		148.0	57.0		5			
Max			2.80		155.0	69.0		5			

Impinger Weight Sheet - Run 3B

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/30/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/30/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	766.6	726.0	40.6
0.1N H2SO4	781.2	738.5	42.7
Empty	658.5	644.7	13.8
0.1N NaOH	765.6	757.5	8.1
0.1N NaOH	742.6	739.8	2.8
Silica Gel	876.2	864.2	12.0

3,714.5	3,606.5	108.0
Liquid Final	**Liquid Initial**	**Liquid Gain**
876.2	864.2	12.0
Silica Final	**Silica Initial**	**Silica Gain**

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Test Location: Kiln 3 Common Stack
Date: 1/30/24

Run 1

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 1_000233.LAB	8:15	9.04	7.84	1.13	≤	0.10	190.88	0.99	15.71
RUN 1_000234.LAB	8:16	9.06	8.08	1.41	≤	0.10	190.93	0.99	15.65
RUN 1_000235.LAB	8:17	9.09	8.33	1.32	≤	0.10	190.85	0.99	15.46
RUN 1_000236.LAB	8:18	9.05	8.06	1.18	≤	0.10	190.84	0.99	15.58
RUN 1_000237.LAB	8:19	9.02	8.10	1.30	≤	0.10	190.87	0.99	15.61
RUN 1_000238.LAB	8:20	9.00	7.89	1.26	≤	0.10	190.83	0.99	15.70
RUN 1_000239.LAB	8:21	9.01	7.93	1.36	≤	0.10	190.88	0.99	15.70
RUN 1_000240.LAB	8:22	8.98	7.91	1.28	≤	0.10	190.87	0.99	15.69
RUN 1_000241.LAB	8:23	8.97	7.95	1.26	≤	0.10	190.84	0.99	15.67
RUN 1_000242.LAB	8:24	8.98	8.09	1.36	≤	0.10	190.78	0.99	15.65
RUN 1_000243.LAB	8:25	9.04	7.98	1.27	≤	0.10	190.86	0.99	15.61
RUN 1_000244.LAB	8:26	9.01	7.77	1.15	≤	0.10	190.84	0.99	15.73
RUN 1_000245.LAB	8:27	9.01	7.99	1.26	≤	0.10	190.85	0.99	15.70
RUN 1_000246.LAB	8:28	9.05	7.92	1.24	≤	0.10	190.80	0.99	15.69
RUN 1_000247.LAB	8:29	9.03	8.03	1.04	≤	0.10	190.83	0.99	15.65
RUN 1_000248.LAB	8:30	9.05	7.94	1.22	≤	0.10	190.85	0.99	15.66
RUN 1_000249.LAB	8:31	9.04	7.87	1.32	≤	0.10	190.85	0.99	15.68
RUN 1_000250.LAB	8:32	9.05	7.92	1.11	≤	0.10	190.84	0.99	15.74
RUN 1_000251.LAB	8:33	9.05	7.94	1.08	≤	0.10	190.79	0.99	15.71
RUN 1_000252.LAB	8:34	9.04	7.85	1.38	≤	0.10	190.81	0.99	15.72
RUN 1_000253.LAB	8:35	9.03	7.99	1.29	≤	0.10	190.76	0.99	15.74
RUN 1_000254.LAB	8:36	9.04	7.96	1.25	≤	0.10	190.75	0.99	15.70
RUN 1_000255.LAB	8:37	9.01	7.78	1.18	≤	0.10	190.75	0.99	15.71
RUN 1_000256.LAB	8:38	9.01	7.91	1.21	≤	0.10	190.73	0.99	15.77
RUN 1_000257.LAB	8:39	8.82	8.00	1.10	≤	0.10	190.75	0.99	15.74
RUN 1_000258.LAB	8:40	8.87	7.85	1.17	≤	0.10	190.70	0.99	15.69
RUN 1_000259.LAB	8:41	9.08	8.00	1.26	≤	0.10	190.77	0.99	15.76
RUN 1_000260.LAB	8:42	9.10	7.85	1.12	≤	0.10	190.76	0.99	15.73
RUN 1_000261.LAB	8:43	9.07	7.97	1.23	≤	0.10	190.77	0.99	15.79
RUN 1_000262.LAB	8:44	9.05	7.90	1.20	≤	0.10	190.74	0.99	15.77
RUN 1_000263.LAB	8:45	9.06	7.97	1.35	≤	0.10	190.71	0.99	15.74
RUN 1_000264.LAB	8:46	9.07	7.80	1.18	≤	0.10	190.76	0.99	15.75
RUN 1_000265.LAB	8:47	9.13	7.86	1.12	≤	0.10	190.74	0.99	15.76
RUN 1_000266.LAB	8:48	9.07	7.93	1.27	≤	0.10	190.75	0.99	15.81
RUN 1_000267.LAB	8:49	9.03	8.04	0.99	≤	0.10	190.75	0.99	15.79
RUN 1_000268.LAB	8:50	9.01	7.99	1.14	≤	0.10	190.79	0.99	15.78
RUN 1_000269.LAB	8:51	9.04	8.08	1.31	≤	0.10	190.76	0.99	15.76
RUN 1_000270.LAB	8:52	9.01	8.00	1.14	≤	0.10	190.75	0.99	15.74
RUN 1_000271.LAB	8:53	9.05	7.96	1.05	≤	0.10	190.73	0.99	15.71
RUN 1_000272.LAB	8:54	9.08	7.96	1.33	≤	0.10	190.84	0.99	15.75
RUN 1_000273.LAB	8:55	9.09	8.04	1.03	≤	0.10	190.79	0.99	15.78
RUN 1_000274.LAB	8:56	9.10	8.09	1.20	≤	0.10	190.74	0.99	15.78
RUN 1_000275.LAB	8:57	9.08	8.02	1.17	≤	0.10	190.79	0.99	15.74
RUN 1_000276.LAB	8:58	9.07	8.06	1.27	≤	0.10	190.74	0.99	15.72
RUN 1_000277.LAB	8:59	9.09	8.00	1.23	≤	0.10	190.68	0.99	15.74
RUN 1_000278.LAB	9:00	9.10	7.98	1.23	≤	0.10	190.74	0.99	15.73
RUN 1_000279.LAB	9:01	9.10	7.92	1.16	≤	0.10	190.75	0.99	15.75
RUN 1_000280.LAB	9:02	9.10	7.94	1.15	≤	0.10	190.75	0.99	15.77
RUN 1_000281.LAB	9:03	9.13	7.93	1.23	≤	0.10	190.85	0.99	15.76
RUN 1_000282.LAB	9:04	9.12	7.94	0.94	≤	0.10	190.80	0.99	15.79
RUN 1_000283.LAB	9:05	9.12	8.06	1.12	≤	0.10	190.84	0.99	15.78
RUN 1_000284.LAB	9:06	9.09	7.84	1.04	≤	0.10	190.86	0.99	15.82
RUN 1_000285.LAB	9:07	9.07	7.98	1.15	≤	0.10	190.83	0.99	15.78
RUN 1_000286.LAB	9:08	9.10	8.03	1.15	≤	0.10	190.80	0.99	15.82
RUN 1_000287.LAB	9:09	9.12	8.06	1.08	≤	0.10	190.84	0.99	15.87
RUN 1_000288.LAB	9:10	9.14	7.90	1.13	≤	0.10	190.82	0.99	15.78
RUN 1_000289.LAB	9:11	9.14	7.85	1.09	≤	0.10	190.82	0.99	15.79
RUN 1_000290.LAB	9:12	9.14	7.84	1.26	≤	0.10	190.85	0.99	15.78
RUN 1_000291.LAB	9:13	9.07	7.92	1.25	≤	0.10	190.88	0.99	15.83
RUN 1_000292.LAB	9:14	8.82	7.96	1.19	≤	0.10	190.81	0.99	15.88
Average		**9.05**	**7.96**	**1.20**	**≤**	**0.10**	**190.80**	**0.99**	**15.73**

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Test Location: Kiln 3 Common Stack
Date: 1/30/24

Run 2

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 2_000376.LAB	9:50	8.97	8.0	1.22	≤	0.10	190.6	0.99	15.49
RUN 2_000377.LAB	9:51	8.96	8.2	1.42	≤	0.10	190.6	0.99	15.37
RUN 2_000378.LAB	9:52	8.99	8.4	1.34	≤	0.10	190.6	0.99	15.28
RUN 2_000379.LAB	9:53	9.02	8.2	1.31	≤	0.10	190.6	0.99	15.37
RUN 2_000380.LAB	9:54	8.86	8.0	1.27	≤	0.10	190.6	0.99	15.45
RUN 2_000381.LAB	9:55	8.70	8.1	1.38	≤	0.10	190.6	0.99	15.43
RUN 2_000382.LAB	9:56	8.64	8.0	1.16	≤	0.10	190.6	0.99	15.48
RUN 2_000383.LAB	9:57	8.86	8.4	1.22	≤	0.10	190.6	0.99	15.38
RUN 2_000384.LAB	9:58	8.93	8.2	1.32	≤	0.10	190.6	0.99	15.38
RUN 2_000385.LAB	9:59	8.87	8.2	1.34	≤	0.10	190.6	0.99	15.37
RUN 2_000386.LAB	10:00	9.05	7.9	1.19	≤	0.10	190.6	0.99	15.48
RUN 2_000387.LAB	14:57	9.10	8.1	1.28	≤	0.10	190.6	0.99	15.46
RUN 2_000388.LAB	14:58	9.05	8.1	1.28	≤	0.10	190.7	0.99	15.45
RUN 2_000389.LAB	14:59	9.02	8.0	1.06	≤	0.10	190.7	0.99	15.46
RUN 2_000390.LAB	15:00	9.04	8.0	1.44	≤	0.10	190.7	0.99	15.51
RUN 2_000391.LAB	15:01	9.00	8.2	1.17	≤	0.10	190.6	0.99	15.45
RUN 2_000392.LAB	15:02	9.00	8.0	1.25	≤	0.10	190.7	0.99	15.41
RUN 2_000393.LAB	15:03	8.97	8.1	1.06	≤	0.10	190.7	0.99	15.54
RUN 2_000394.LAB	15:04	8.88	8.3	1.32	≤	0.10	190.6	0.99	15.37
RUN 2_000395.LAB	15:05	8.86	8.5	1.29	≤	0.10	190.5	0.99	15.32
RUN 2_000396.LAB	15:06	8.90	8.4	1.30	≤	0.10	190.8	0.99	15.23
RUN 2_000397.LAB	15:07	8.94	8.3	1.21	≤	0.10	190.5	0.99	15.29
RUN 2_000398.LAB	15:08	9.01	8.4	1.39	≤	0.10	190.6	0.99	15.32
RUN 2_000399.LAB	15:09	9.04	8.2	1.26	≤	0.10	190.5	0.99	15.31
RUN 2_000400.LAB	15:10	9.01	7.8	1.36	≤	0.10	190.6	0.99	15.54
RUN 2_000401.LAB	15:11	9.03	8.2	1.24	≤	0.10	190.4	0.99	15.70
RUN 2_000402.LAB	15:12	9.04	8.1	1.16	≤	0.10	190.6	0.99	15.49
RUN 2_000403.LAB	15:13	9.05	8.1	1.36	≤	0.10	190.5	0.99	15.51
RUN 2_000404.LAB	15:14	9.00	8.1	1.36	≤	0.10	190.5	0.99	15.53
RUN 2_000405.LAB	15:15	9.05	8.1	1.23	≤	0.10	190.5	0.99	15.52
RUN 2_000406.LAB	15:16	9.07	8.0	1.29	≤	0.10	190.6	0.99	15.50
RUN 2_000407.LAB	15:17	9.02	8.1	1.30	≤	0.10	190.5	0.99	15.52
RUN 2_000408.LAB	15:18	9.05	7.9	1.21	≤	0.10	190.4	0.99	15.53
RUN 2_000409.LAB	15:19	9.10	8.1	1.25	≤	0.10	190.5	0.99	15.56
RUN 2_000410.LAB	15:20	9.07	8.0	1.17	≤	0.10	190.5	0.99	15.51
RUN 2_000411.LAB	15:21	9.09	8.1	1.27	≤	0.10	190.5	0.99	15.53
RUN 2_000412.LAB	15:22	9.09	8.1	1.24	≤	0.10	190.5	0.99	15.49
RUN 2_000413.LAB	15:23	9.09	8.2	1.29	≤	0.10	190.5	0.99	15.48
RUN 2_000414.LAB	15:24	9.11	8.0	1.14	≤	0.10	190.5	0.99	15.44
RUN 2_000415.LAB	15:25	9.05	8.2	1.27	≤	0.10	190.5	0.99	15.48
RUN 2_000416.LAB	15:26	9.07	8.1	1.24	≤	0.10	190.5	0.99	15.51
RUN 2_000417.LAB	15:27	9.06	8.1	1.35	≤	0.10	190.5	0.99	15.45
RUN 2_000418.LAB	15:28	9.02	8.1	1.29	≤	0.10	190.5	0.99	15.49
RUN 2_000419.LAB	15:29	8.72	8.2	1.22	≤	0.10	190.5	0.99	15.49
RUN 2_000420.LAB	15:30	8.82	8.1	1.13	≤	0.10	190.5	0.99	15.45
RUN 2_000421.LAB	15:31	8.89	8.0	1.17	≤	0.10	190.5	0.99	15.45
RUN 2_000422.LAB	15:32	9.20	8.0	1.22	≤	0.10	190.5	0.99	15.44
RUN 2_000423.LAB	15:33	9.20	8.1	1.18	≤	0.10	190.5	0.99	15.51
RUN 2_000424.LAB	15:34	9.19	8.0	1.26	≤	0.10	190.5	0.99	15.49
RUN 2_000425.LAB	15:35	9.14	8.0	1.13	≤	0.10	190.5	0.99	15.47
RUN 2_000426.LAB	15:36	9.13	8.0	1.30	≤	0.10	190.6	0.99	15.51
RUN 2_000427.LAB	15:37	9.11	8.1	1.31	≤	0.10	190.5	0.99	15.54
RUN 2_000428.LAB	15:38	9.10	8.1	1.19	≤	0.10	190.5	0.99	15.54
RUN 2_000429.LAB	15:39	9.10	8.1	1.25	≤	0.10	190.4	0.99	15.48
RUN 2_000430.LAB	15:40	9.10	8.0	1.24	≤	0.10	190.5	0.99	15.50
RUN 2_000431.LAB	15:41	9.10	8.1	1.26	≤	0.10	190.5	0.99	15.53
RUN 2_000432.LAB	15:42	9.07	7.9	1.09	≤	0.10	190.5	0.99	15.46
RUN 2_000433.LAB	15:43	9.07	7.9	1.14	≤	0.10	190.5	0.99	15.48
RUN 2_000434.LAB	15:44	9.10	7.9	1.12	≤	0.10	190.5	0.99	15.53
RUN 2_000435.LAB	15:45	9.11	7.9	1.29	≤	0.10	190.5	0.99	15.54
Average		**9.01**	**8.11**	**1.25**	**≤**	**0.10**	**190.55**	**0.99**	**15.46**

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Test Location: Kiln 3 Common Stack
Date: 1/30/24

Run 3

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 3_000510.LAB	11:25	8.92	8.2	1.19	≤	0.10	190.5	0.99	15.30
RUN 3_000511.LAB	11:26	8.91	8.0	1.02	≤	0.10	190.4	0.99	15.36
RUN 3_000512.LAB	11:27	8.89	8.1	1.17	≤	0.10	190.4	0.99	15.37
RUN 3_000513.LAB	11:28	8.88	7.9	1.27	≤	0.10	190.5	0.99	15.38
RUN 3_000514.LAB	11:29	8.86	8.1	1.28	≤	0.10	190.5	0.99	15.39
RUN 3_000515.LAB	11:30	8.86	8.1	1.20	≤	0.10	190.5	0.99	15.37
RUN 3_000516.LAB	11:31	8.84	8.0	1.07	≤	0.10	190.4	0.99	15.33
RUN 3_000517.LAB	11:32	8.85	8.0	1.13	≤	0.10	190.5	0.99	15.38
RUN 3_000518.LAB	11:33	8.82	8.0	1.09	≤	0.10	190.4	0.99	15.37
RUN 3_000519.LAB	11:34	8.85	7.9	1.04	≤	0.10	190.5	0.99	15.40
RUN 3_000520.LAB	11:35	8.86	8.1	1.15	≤	0.10	190.5	0.99	15.39
RUN 3_000521.LAB	11:36	8.86	8.0	1.16	≤	0.10	190.5	0.99	15.36
RUN 3_000522.LAB	11:37	8.88	8.1	1.32	≤	0.10	190.5	0.99	15.37
RUN 3_000523.LAB	11:38	8.91	8.0	1.16	≤	0.10	190.4	0.99	15.35
RUN 3_000524.LAB	11:39	8.91	8.1	1.18	≤	0.10	190.4	0.99	15.33
RUN 3_000525.LAB	11:40	8.92	8.0	1.22	≤	0.10	190.6	0.99	15.32
RUN 3_000526.LAB	11:41	8.95	8.1	1.22	≤	0.10	190.6	0.99	15.35
RUN 3_000527.LAB	11:42	8.96	8.1	1.19	≤	0.10	190.5	0.99	15.33
RUN 3_000528.LAB	11:43	8.96	8.2	1.24	≤	0.10	190.6	0.99	15.32
RUN 3_000529.LAB	11:44	8.93	8.1	1.22	≤	0.10	190.7	0.99	15.24
RUN 3_000530.LAB	11:45	8.95	8.0	1.12	≤	0.10	190.6	0.99	15.29
RUN 3_000531.LAB	11:46	8.77	8.1	1.21	≤	0.10	190.6	0.99	15.31
RUN 3_000532.LAB	11:47	8.61	8.1	1.18	≤	0.10	190.6	0.99	15.33
RUN 3_000533.LAB	11:48	8.53	8.1	1.05	≤	0.10	190.6	0.99	15.29
RUN 3_000534.LAB	11:49	8.68	8.1	1.23	≤	0.10	190.6	0.99	15.31
RUN 3_000535.LAB	11:50	8.98	8.1	1.29	≤	0.10	190.6	0.99	15.31
RUN 3_000536.LAB	11:51	8.97	8.1	1.29	≤	0.10	190.6	0.99	15.30
RUN 3_000537.LAB	11:52	8.95	8.0	1.19	≤	0.10	190.6	0.99	15.28
RUN 3_000538.LAB	11:53	8.96	8.0	1.15	≤	0.10	190.6	0.99	15.32
RUN 3_000539.LAB	11:54	8.97	8.2	1.26	≤	0.10	190.6	0.99	15.31
RUN 3_000540.LAB	11:55	8.95	8.1	1.14	≤	0.10	190.7	0.99	15.32
RUN 3_000541.LAB	11:56	8.93	8.0	1.23	≤	0.10	190.5	0.99	15.27
RUN 3_000542.LAB	11:57	8.96	8.4	1.30	≤	0.10	190.6	0.99	15.32
RUN 3_000543.LAB	11:58	8.95	8.3	1.26	≤	0.10	190.6	0.99	15.32
RUN 3_000544.LAB	11:59	8.94	8.2	1.04	≤	0.10	190.6	0.99	15.15
RUN 3_000545.LAB	12:00	8.92	8.1	1.20	≤	0.10	190.6	0.99	15.21
RUN 3_000546.LAB	12:01	8.92	8.1	1.24	≤	0.10	190.6	0.99	15.25
RUN 3_000547.LAB	12:02	8.92	7.9	1.31	≤	0.10	190.7	0.99	15.31
RUN 3_000548.LAB	12:03	8.93	8.1	1.34	≤	0.10	190.7	0.99	15.32
RUN 3_000549.LAB	12:04	8.90	8.0	1.20	≤	0.10	190.7	0.99	15.36
RUN 3_000550.LAB	12:05	8.92	8.1	1.13	≤	0.10	190.6	0.99	15.33
RUN 3_000551.LAB	12:06	8.95	8.0	1.17	≤	0.10	190.6	0.99	15.33
RUN 3_000552.LAB	12:07	8.96	7.9	1.06	≤	0.10	190.6	0.99	15.32
RUN 3_000553.LAB	12:08	8.99	8.0	1.23	≤	0.10	190.6	0.99	15.33
RUN 3_000554.LAB	12:09	9.02	8.0	1.11	≤	0.10	190.6	0.99	15.33
RUN 3_000555.LAB	12:10	9.03	7.9	1.11	≤	0.10	190.6	0.99	15.36
RUN 3_000556.LAB	12:11	9.07	8.1	1.26	≤	0.10	190.6	0.99	15.35
RUN 3_000557.LAB	12:12	9.08	8.0	1.39	≤	0.10	190.7	0.99	15.41
RUN 3_000558.LAB	12:13	9.09	8.0	1.28	≤	0.10	190.6	0.99	15.35
RUN 3_000559.LAB	12:14	9.05	8.0	1.23	≤	0.10	190.7	0.99	15.37
RUN 3_000560.LAB	12:15	9.04	8.0	1.29	≤	0.10	190.6	0.99	15.36
RUN 3_000561.LAB	12:16	9.00	8.0	1.15	≤	0.10	190.6	0.99	15.40
RUN 3_000562.LAB	12:17	9.01	8.0	1.26	≤	0.10	190.7	0.99	15.37
RUN 3_000563.LAB	12:18	8.98	7.9	1.21	≤	0.10	190.6	0.99	15.38
RUN 3_000564.LAB	12:19	8.98	7.9	1.08	≤	0.10	190.7	0.99	15.37
RUN 3_000565.LAB	12:20	8.98	7.9	1.25	≤	0.10	190.7	0.99	15.36
RUN 3_000566.LAB	12:21	8.98	8.1	1.30	≤	0.10	190.7	0.99	15.40
RUN 3_000567.LAB	12:22	8.98	8.1	1.25	≤	0.10	190.7	0.99	15.42
RUN 3_000568.LAB	12:23	8.68	8.0	1.38	≤	0.10	190.7	0.99	15.42
RUN 3_000569.LAB	12:24	8.74	8.0	1.30	≤	0.10	190.7	0.99	15.33
Average		**8.92**	**8.04**	**1.20**	**≤**	**0.10**	**190.59**	**0.99**	**15.34**

Client:	Holcim (US) Inc.													
Facility:	Ravena Cement Plant													
Test Location:	Kiln 3 Common Stack													
Project #:	M234506													
Test Method:	26A													
Test Engineer:	FJD													
Test Technician:	LPH													
	Run 1A				**Run 2A**				**Run 3A**			
Meter ID:	CM43				CM43				CM43			
Pitot ID:	S8-058				S8-058				S8-058			
Nozzle Diameter (Inches):	0.250				0.250				0.250			
Meter Calibration Date:	1/19/2024				1/19/2024				1/19/2024			
Meter Calibration Factor (Y):	0.994				0.994				0.994			
Meter Orifice Setting (Delta H):	1.788				1.788				1.788			
Nozzle Kit ID Number and Material:	Glass #1 865				Glass #1 865				Glass #1 865			
	Leak Checks											
Pre Pitot Leak Check	**0.0**	**@**	**3.5**	**"H_2O**	**0.0**	**@**	**3.5**	**"H_2O**	**0.0**	**@**	**3.5**	**"H_2O**
Post Pitot Leak Check	**0.0**	**@**	**3.5**	**"H_2O**	**0.0**	**@**	**3.5**	**"H_2O**	**0.0**	**@**	**3.5**	**"H_2O**
Pre Nozzle Leak Check	**0.0000**	**@**	**14**	**"Hg**	**0.0000**	**@**	**14**	**"Hg**	**0.0000**	**@**	**14**	**"Hg**
Post Nozzle Leak Check	**0.0000**	**@**	**14**	**"Hg**	**0.0000**	**@**	**14**	**"Hg**	**0.0000**	**@**	**14**	**"Hg**
Pitot Tube Coefficient:	0.834											
Probe Length (Feet):	7.0											
Probe Liner Material:	Glass											
Sample Plane:	Horizontal											
Port Length (Inches):	12.00											
Port Size (Diameter, Inches):	4.00											
Port Type:	Flange											
Duct Shape:	Circular											
Diameter (Feet):	17.708											
Duct Area (Square Feet):	246.280											
Upstream Diameters:	3.3											
Downstream Diameters:	8.8											
Number of Ports Sampled:	4											
Number of Points per Port:	3											
Minutes per Point:	5.0											
Minutes per Reading:	5.0											
Total Number of Traverse Points:	12											
Test Length (Minutes):	60											
Train Type:	Anderson Box											
Source Condition:	Mill OFF											
Moisture Balance ID:	S10-31											
# of Runs	3											

Run 1A - Method 26A

Client: Holcim (US) Inc. | **Date: 1/31/24**
Facility: Ravena Cement Plant | **Start Time: 8:20**
Test Location: Kiln 3 Common Stack | **End Time: 9:35**
Source Condition: Mill OFF

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	0.94	in. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	50.2	°F	Flue Pressure (Ps):	29.73	in. Hg. abs.
Sqrt ΔP:	0.578	in. H_2O	Carbon Dioxide:	12.86	%
Stack Temperature, Ts:	173.7	°F	Oxygen:	12.93	%
Meter Volume, Vm:	33.630	ft^3	Nitrogen:	74.21	%
Meter Volume, Vmstd:	34.329	dscf	Gas Weight dry, Md:	30.575	lb/lb mole
Meter Volume, Vwstd:	4.644	wscf	Gas Weight wet, Ms:	29.076	lb/lb mole
Isokinetic Variance:	108.7	%I	Excess Air:	---	%
			Gas Velocity, Vs:	35.305	fps
Test Length:	60.00	in mins.	Volumetric Flow:	521,701	acfm
Nozzle Diameter:	0.250	in inches	Volumetric Flow:	380,477	dscfm
Barometric Pressure:	29.62	in Hg	Volumetric Flow:	431,948	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3641.1	ml	Silica Initial Wt.	876.2	grams
Final Impinger Content:	3734.1	ml	Silica Final Wt.	881.8	grams
Impinger Difference:	93.0	ml	Silica Difference:	5.6	grams

Total Water Gain: 98.6 | Moisture, Bws: 0.119 | **Supersaturation Value, Bws: 0.446**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	8:20:00	0.25	0.70	366.610	169	52	49	4	270	266	42
1-2	8:25:00	0.23	0.64	369.990	164	49	49	4	260	260	49
1-3	8:30:00	0.21	0.53	371.380	164	50	49	4	260	261	50
	8:35:00			373.670							
2-1	8:40:00	0.36	1.00	373.670	178	50	50	4	260	260	53
2-2	8:45:00	0.34	0.95	376.500	176	50	50	3	260	260	45
2-3	8:50:00	0.32	0.89	378.930	176	50	50	3	260	260	45
	8:55:00			381.930							
3-1	9:00:00	0.41	1.14	381.230	175	50	50	2.5	260	260	44
3-2	9:05:00	0.38	1.05	384.600	174	50	50	2.5	259	259	45
3-3	9:10:00	0.36	1.00	387.550	174	50	50	2.5	260	260	45
	9:15:00			390.520							
4-1	9:20:00	0.42	1.17	390.520	178	51	51	2.5	265	261	51
4-2	9:25:00	0.40	1.11	393.610	178	51	51	2.5	266	261	51
4-3	9:30:00	0.38	1.05	396.430	178	51	51	2.5	265	261	51
	9:35:00			399.540							
Total	1:00:00			33.630		50.3	50.0				
Average			0.94		173.7	50.2		3			
Min			0.53		164.0	49.0		3			
Max			1.17		178.0	52.0		4			

Impinger Weight Sheet - Run 1A

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/31/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/31/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	811.9	745.5	66.4
0.1N H2SO4	759.8	736.5	23.3
Empty	648.9	648.1	0.8
0.1N NaOH	759.4	757.9	1.5
0.1N NaOH	754.1	753.1	1.0
Silica Gel	881.8	876.2	5.6

3,734.1	3,641.1	93.0
Liquid Final	**Liquid Initial**	**Liquid Gain**
881.8	876.2	5.6
Silica Final	**Silica Initial**	**Silica Gain**

Run 2A - Method 26A

Client: Holcim (US) Inc. | **Date:** 1/31/24
Facility: Ravena Cement Plant | **Start Time:** 9:55
Test Location: Kiln 3 Common Stack | **End Time:** 11:10
Source Condition: Mill OFF

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.09	In. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	55.8	°F	Flue Pressure (Ps):	29.73	in. Hg. abs.
Sqrt ΔP:	0.626	In. H_2O	Carbon Dioxide:	12.85	%
Stack Temperature, Ts:	178.5	°F	Oxygen:	12.92	%
Meter Volume, Vm:	35.150	ft^3	Nitrogen:	74.2	%
Meter Volume, Vmstd:	35.506	dscf	Gas Weight dry, Md:	30.573	lb/lb mole
Meter Volume, Vwstd:	4.041	wscf	Gas Weight wet, Ms:	29.288	lb/lb mole
Isokinetic Variance:	102.7	%I	Excess Air:	---	%
			Gas Velocity, Vs:	38.209	fps
Test Length:	60.00	in mins.	Volumetric Flow:	564,608	acfm
Nozzle Diameter:	0.250	in inches	Volumetric Flow:	416,526	dscfm
Barometric Pressure:	29.62	in Hg	Volumetric Flow:	463,934	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3426.5	ml	Silica Initial Wt.	847.6	grams
Final Impinger Content:	3501.7	ml	Silica Final Wt.	858.2	grams
Impinger Difference:	75.2	ml	Silica Difference:	10.6	grams

Total Water Gain: 85.8 | Moisture, Bws: 0.102 | **Supersaturation Value, Bws: 0.497**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	9:55:00	0.37	1.03	399.711	180	55	55	2	251	260	50
1-2	10:00:00	0.35	0.98	403.000	180	55	55	2	251	259	51
1-3	10:05:00	0.33	0.92	405.890	180	55	55	2	251	260	50
	10:10:00			408.370							
2-1	10:15:00	0.42	1.17	408.370	179	56	56	1.5	262	260	52
2-2	10:20:00	0.40	1.11	411.400	179	56	56	1.5	262	260	52
2-3	10:25:00	0.38	1.06	414.290	179	56	56	1.5	262	260	52
	10:30:00			417.010							
3-1	10:35:00	0.46	1.28	417.010	178	56	56	1.5	255	259	52
3-2	10:40:00	0.44	1.23	420.060	178	56	56	1.5	255	259	52
3-3	10:45:00	0.42	1.17	422.980	178	56	56	1.5	255	259	52
	10:50:00			426.310							
4-1	10:55:00	0.40	1.11	426.310	177	56	56	1.5	255	259	52
4-2	11:00:00	0.38	1.05	429.000	177	56	56	1.5	255	259	52
4-3	11:05:00	0.36	1.00	431.920	177	56	56	1.5	255	259	52
	11:10:00			434.861							
Total	1:00:00			35.150		55.8	55.8				
Average			1.09		178.5	55.8		2			
Min			0.92		177.0	55.0		2			
Max			1.28		180.0	56.0		2			

Impinger Weight Sheet - Run 2A

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/31/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/31/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	815.7	765.7	50.0
0.1N H2SO4	683.8	663.1	20.7
Empty	603.0	599.8	3.2
0.1N NaOH	648.3	647.6	0.7
0.1N NaOH	750.9	750.3	0.6
Silica Gel	858.2	847.6	10.6
	3,501.7	3,426.5	75.2
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	858.2	847.6	10.6
	Silica Final	**Silica Initial**	**Silica Gain**

Run 3A - Method 26A

Client: Holcim (US) Inc. | **Date: 1/31/24**
Facility: Ravena Cement Plant | **Start Time: 11:40**
Test Location: Kiln 3 Common Stack | **End Time: 12:55**
Source Condition: Mill OFF

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	0.99	In. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	57.4	°F	Flue Pressure (Ps):	29.73	in. Hg. abs.
Sqrt ΔP:	0.603	In. H_2O	Carbon Dioxide:	12.89	%
Stack Temperature, Ts:	179.9	°F	Oxygen:	13.12	%
Meter Volume, Vm:	33.851	ft^3	Nitrogen:	73.99	%
Meter Volume, Vmstd:	34.075	dscf	Gas Weight dry, Md:	30.587	lb/lb mole
Meter Volume, Vwstd:	4.663	wscf	Gas Weight wet, Ms:	29.072	lb/lb mole
Isokinetic Variance:	104.2	%I	Excess Air:	---	%
			Gas Velocity, Vs:	36.968	fps
Test Length:	60.00	in mins.	Volumetric Flow:	546,272	acfm
Nozzle Diameter:	0.250	in inches	Volumetric Flow:	393,964	dscfm
Barometric Pressure:	29.62	in Hg	Volumetric Flow:	447,874	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3641.1	ml	Silica Initial Wt.	881.8	grams
Final Impinger Content:	3732.1	ml	Silica Final Wt.	889.8	grams
Impinger Difference:	91.0	ml	Silica Difference:	8.0	grams

Total Water Gain: 99.0 | Moisture, Bws: 0.120 | **Supersaturation Value, Bws: 0.513**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	11:40:00	0.36	0.98	440.010	179	55	55	2	263	257	47
1-2	11:45:00	0.33	0.90	443.010	179	56	56	2	265	258	50
1-3	11:50:00	0.31	0.84	445.960	179	56	56	2	268	261	50
	11:55:00			448.380							
2-1	12:00:00	0.40	1.09	448.380	180	58	58	2	258	260	52
2-2	12:05:00	0.38	1.04	451.520	180	58	58	2	259	260	52
2-3	12:10:00	0.36	0.98	453.990	180	58	58	2	260	260	52
	12:15:00			456.810							
3-1	12:20:00	0.44	1.20	456.810	181	59	59	1.5	265	260	55
3-2	12:25:00	0.41	1.12	459.760	181	59	59	1.5	265	260	55
3-3	12:30:00	0.39	1.06	462.940	180	59	59	1.5	266	260	55
	12:35:00			465.780							
4-1	12:40:00	0.35	0.95	465.780	180	57	57	1.5	262	260	57
4-2	12:45:00	0.33	0.90	467.950	180	57	57	1.5	263	260	57
4-3	12:50:00	0.31	0.84	471.010	180	57	57	1.5	263	260	57
	12:55:00			473.861							
Total	1:00:00			33.851		57.4	57.4				
Average			0.99		179.9	57.4		2			
Min			0.84		179.0	55.0		2			
Max			1.20		181.0	59.0		2			

Impinger Weight Sheet - Run 3A

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/31/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/31/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	794.2	736.8	57.4
0.1N H2SO4	771.5	746.6	24.9
Empty	650.5	644.7	5.8
0.1N NaOH	767.9	765.7	2.2
0.1N NaOH	748.0	747.3	0.7
Silica Gel	889.8	881.8	8.0
	3,732.1	3,641.1	91.0
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	889.8	881.8	8.0
	Silica Final	**Silica Initial**	**Silica Gain**

Client:	Holcim (US) Inc.													
Facility:	Ravena Cement Plant													
Test Location:	Kiln 3 Common Stack													
Project #:	M234506													
Test Method:	26A													
Test Engineer:	PPP													
Test Technician:	LPH													
	Run 1B				**Run 2B**				**Run 3B**					
Meter ID:	CM13				CM13				CM13					
Pitot ID:	S8-058				S8-058				S8-058					
Nozzle Diameter (Inches):	0.280				0.280				0.280					
Meter Calibration Date:	1/16/2024				1/16/2024				1/16/2024					
Meter Calibration Factor (Y):	0.987				0.987				0.987					
Meter Orifice Setting (Delta H):	1.516				1.516				1.516					
Nozzle Kit ID Number and Material:	Glass #1 822				Glass #1 822				Glass #1 822					
	Leak Checks													
Pre Pitot Leak Check	**0.0**	**@**	**3.3**	**"H_2O**	**0.0**	**@**	**3.2**	**"H_2O**	**0.0**	**@**	**3.3**	**"H_2O**		
Post Pitot Leak Check	**0.0**	**@**	**3.4**	**"H_2O**	**0.0**	**@**	**3.3**	**"H_2O**	**0.0**	**@**	**3.2**	**"H_2O**		
Pre Nozzle Leak Check	**0.0000**	**@**	**13**	**"Hg**	**0.0015**	**@**	**12**	**"Hg**	**0.0000**	**@**	**14**	**"Hg**		
Post Nozzle Leak Check	**0.0000**	**@**	**12**	**"Hg**	**0.0000**	**@**	**10**	**"Hg**	**0.0000**	**@**	**12**	**"Hg**		
Pitot Tube Coefficient:	0.834													
Probe Length (Feet):	7.0													
Probe Liner Material:	Glass													
Sample Plane:	Horizontal													
Port Length (Inches):	12.00													
Port Size (Diameter, Inches):	4.00													
Port Type:	Flange													
Duct Shape:	Circular													
Diameter (Feet):	17.708													
Duct Area (Square Feet):	246.280													
Upstream Diameters:	3.3													
Downstream Diameters:	8.8													
Number of Ports Sampled:	4													
Number of Points per Port:	3													
Minutes per Point:	5.0													
Minutes per Reading:	5.0													
Total Number of Traverse Points:	12													
Test Length (Minutes):	60													
Train Type:	Anderson Box													
Source Condition:	Mill OFF													
Moisture Balance ID:	S10-31													
# of Runs	3													

Run 1B - Method 26A

Client: Holcim (US) Inc. | **Date: 1/31/24**
Facility: Ravena Cement Plant | **Start Time: 8:20**
Test Location: Kiln 3 Common Stack | **End Time: 9:35**
Source Condition: Mill OFF

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.25	in. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	57.2	°F	Flue Pressure (Ps):	29.73	in. Hg. abs.
Sqrt ΔP:	0.573	in. H_2O	Carbon Dioxide:	12.86	%
Stack Temperature, Ts:	173.6	°F	Oxygen:	12.93	%
Meter Volume, Vm:	40.900	ft^3	Nitrogen:	74.21	%
Meter Volume, Vmstd:	40.927	dscf	Gas Weight dry, Md:	30.575	lb/lb mole
Meter Volume, Vwstd:	4.880	wscf	Gas Weight wet, Ms:	29.235	lb/lb mole
Isokinetic Variance:	103.0	%I	Excess Air:	---	%
			Gas Velocity, Vs:	34.909	fps
Test Length:	60.00	in mins.	Volumetric Flow:	515,848	acfm
Nozzle Diameter:	0.280	in inches	Volumetric Flow:	381,654	dscfm
Barometric Pressure:	29.62	in Hg	Volumetric Flow:	427,158	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3640.6	ml	Silica Initial Wt.	839.6	grams
Final Impinger Content:	3728.0	ml	Silica Final Wt.	855.8	grams
Impinger Difference:	87.4	ml	Silica Difference:	16.2	grams

Total Water Gain: 103.6 Moisture, Bws: 0.107 **Supersaturation Value, Bws: 0.446**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	8:20:00	0.27	1.00	140.712	168	52	48	4	250	250	34
1-2	8:25:00	0.25	0.94	143.840	164	55	48	4	257	261	35
1-3	8:30:00	0.22	0.83	146.930	164	58	48	4	261	260	36
	8:35:00			149.529							
2-1	8:40:00	0.37	1.40	149.529	176	60	48	4	260	261	37
2-2	8:45:00	0.35	1.30	153.340	178	63	49	4	260	262	37
2-3	8:50:00	0.30	1.10	156.850	178	63	49	4	260	261	33
	8:55:00			159.844							
3-1	9:00:00	0.40	1.50	159.844	177	64	50	4	260	260	38
3-2	9:05:00	0.36	1.30	163.720	177	64	50	4	260	259	38
3-3	9:10:00	0.33	1.30	167.360	175	65	60	4	260	259	39
	9:15:00			170.587							
4-1	9:20:00	0.43	1.60	170.587	175	65	60	4	262	260	40
4-2	9:25:00	0.37	1.40	174.630	176	65	61	4	260	261	40
4-3	9:30:00	0.33	1.30	178.340	175	66	61	4	260	261	41
	9:35:00			181.612							
Total	1:00:00			40.900		61.7	52.7				
Average			1.25		173.6	57.2		4			
Min			0.83		164.0	48.0		4			
Max			1.60		178.0	66.0		4			

Impinger Weight Sheet - Run 1B

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/31/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/31/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	784.3	743.1	41.2
0.1N H2SO4	776.7	742.6	34.1
Empty	646.1	638.5	7.6
0.1N NaOH	779.1	776.2	2.9
0.1N NaOH	741.8	740.2	1.6
Silica Gel	855.8	839.6	16.2
	3,728.0	3,640.6	87.4
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	855.8	839.6	16.2
	Silica Final	**Silica Initial**	**Silica Gain**

Run 2B - Method 26A

Client: Holcim (US) Inc. | **Date:** 1/31/24
Facility: Ravena Cement Plant | **Start Time:** 9:55
Test Location: Kiln 3 Common Stack | **End Time:** 11:10
Source Condition: Mill OFF

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.37	In. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	57.8	°F	Flue Pressure (Ps):	29.73	in. Hg. abs.
Sqrt ΔP:	0.611	In. H_2O	Carbon Dioxide:	12.85	%
Stack Temperature, Ts:	178.6	°F	Oxygen:	12.92	%
Meter Volume, Vm:	43.229	ft^3	Nitrogen:	74.2	%
Meter Volume, Vmstd:	43.214	dscf	Gas Weight dry, Md:	30.573	lb/lb mole
Meter Volume, Vwstd:	5.209	wscf	Gas Weight wet, Ms:	29.220	lb/lb mole
Isokinetic Variance:	102.6	%I	Excess Air:	---	%
			Gas Velocity, Vs:	37.324	fps
Test Length:	60.00	in mins.	Volumetric Flow:	551,528	acfm
Nozzle Diameter:	0.280	in inches	Volumetric Flow:	404,382	dscfm
Barometric Pressure:	29.62	in Hg	Volumetric Flow:	453,127	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3600.6	ml	Silica Initial Wt.	893.1	grams
Final Impinger Content:	3704.5	ml	Silica Final Wt.	899.8	grams
Impinger Difference:	103.9	ml	Silica Difference:	6.7	grams

Total Water Gain: 110.6 | Moisture, Bws: 0.108 | **Supersaturation Value, Bws: 0.498**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	9:55:00	0.36	1.30	187.416	179	59	52	4	261	259	33
1-2	10:00:00	0.34	1.30	191.120	179	59	52	4	260	259	35
1-3	10:05:00	0.30	1.10	194.560	179	60	53	4	260	253	34
	10:10:00			197.523							
2-1	10:15:00	0.43	1.60	197.523	179	61	53	4	260	251	35
2-2	10:20:00	0.40	1.50	201.410	178	61	53	4	261	253	35
2-3	10:25:00	0.35	1.30	205.340	178	61	53	4	260	254	35
	10:30:00			208.543							
3-1	10:35:00	0.45	1.60	208.543	179	63	54	4	260	250	36
3-2	10:40:00	0.42	1.50	212.620	179	64	54	4	259	254	36
3-3	10:45:00	0.39	1.40	216.530	179	64	53	4	260	258	37
	10:50:00			220.027							
4-1	10:55:00	0.39	1.40	220.027	178	64	55	4	260	259	38
4-2	11:00:00	0.35	1.30	223.810	178	65	55	4	259	260	38
4-3	11:05:00	0.31	1.10	227.470	178	65	55	4	260	261	39
	11:10:00			230.645							
Total	1:00:00			43.229		62.2	53.5				
Average			1.37		178.6	57.8		4			
Min			1.10		178.0	52.0		0			
Max			1.60		179.0	65.0		4			

Impinger Weight Sheet - Run 2B

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/31/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/31/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	815.3	745.6	69.7
0.1N H2SO4	783.1	755.3	27.8
Empty	650.5	646.3	4.2
0.1N NaOH	707.4	705.9	1.5
0.1N NaOH	748.2	747.5	0.7
Silica Gel	899.8	893.1	6.7
	3,704.5	3,600.6	103.9
	Liquid Final	**Liquid Initial**	**Liquid Gain**
	899.8	893.1	6.7
	Silica Final	**Silica Initial**	**Silica Gain**

Run 3B - Method 26A

Client: Holcim (US) Inc. | **Date: 1/31/24**
Facility: Ravena Cement Plant | **Start Time: 11:40**
Test Location: Kiln 3 Common Stack | **End Time: 12:55**
Source Condition: Mill OFF

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.28	In. H_2O	Static Pressure	1.50	in. H_2O
Meter Temperature, Tm:	60.6	°F	Flue Pressure (Ps):	29.73	in. Hg. abs.
Sqrt ΔP:	0.595	In. H_2O	Carbon Dioxide:	12.89	%
Stack Temperature, Ts:	179.3	°F	Oxygen:	13.12	%
Meter Volume, Vm:	42.115	ft^3	Nitrogen:	73.99	%
Meter Volume, Vmstd:	41.870	dscf	Gas Weight dry, Md:	30.587	lb/lb mole
Meter Volume, Vwstd:	6.198	wscf	Gas Weight wet, Ms:	28.964	lb/lb mole
Isokinetic Variance:	104.1	%I	Excess Air:	---	%
			Gas Velocity, Vs:	36.558	fps
Test Length:	60.00	in mins.	Volumetric Flow:	540,215	acfm
Nozzle Diameter:	0.280	in inches	Volumetric Flow:	386,147	dscfm
Barometric Pressure:	29.62	in Hg	Volumetric Flow:	443,312	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3573.4	ml	Silica Initial Wt.	855.8	grams
Final Impinger Content:	3694.6	ml	Silica Final Wt.	866.2	grams
Impinger Difference:	121.2	ml	Silica Difference:	10.4	grams

Total Water Gain: 131.6 | Moisture, Bws: 0.129 | **Supersaturation Value, Bws: 0.507**

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	Pump Vacuum "Hg	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	11:40:00	0.35	1.30	232.539	179	61	54	4	260	260	34
1-2	11:45:00	0.33	1.20	236.020	179	62	55	4	260	258	34
1-3	11:50:00	0.30	1.10	239.530	189	63	55	4	260	259	35
	11:55:00			242.564							
2-1	12:00:00	0.41	1.50	242.564	179	63	55	4	260	260	36
2-2	12:05:00	0.37	1.30	246.370	179	64	56	4	261	259	36
2-3	12:10:00	0.34	1.20	249.910	178	64	57	4	260	260	36
	12:15:00			253.343							
3-1	12:20:00	0.43	1.50	253.343	178	64	58	4	263	260	37
3-2	12:25:00	0.38	1.40	257.430	178	64	58	4	262	260	37
3-3	12:30:00	0.33	1.20	260.910	179	65	59	4	262	260	38
	12:35:00			264.274							
4-1	12:40:00	0.36	1.30	264.274	178	66	59	4	260	260	39
4-2	12:45:00	0.34	1.30	267.990	178	67	59	4	260	263	39
4-3	12:50:00	0.32	1.10	271.520	178	67	59	4	260	262	39
	12:55:00			274.654							
Total	1:00:00			42.115		64.2	57.0				
Average			1.28		179.3	60.6		4			
Min			1.10		178.0	54.0		4			
Max			1.50		189.0	67.0		4			

Impinger Weight Sheet - Run 3B

Client:	**Holcim (US) Inc.**
Facility:	**Ravena Cement Plant**
Test Location:	**Kiln 3 Common Stack**
Project #:	**M234506**
Date:	**1/31/2024**
Test Method:	**26A**
Weighed/Measured By:	**EE**
Balance ID:	**S10-31**

Scale Calibration Check Date: **1/31/2024**

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

Certified Weight, grams	Result, grams
200	200.0
500	500.0
700	700.0

IMPINGER CONTENTS	FINAL MLS / GRAMS	INITIAL MLS / GRAMS	GAIN MLS / GRAMS
0.1N H2SO4	757.5	696.5	61.0
0.1N H2SO4	799.0	754.1	44.9
Empty	664.9	652.7	12.2
0.1N NaOH	768.7	764.7	4.0
0.1N NaOH	704.5	705.4	-0.9
Silica Gel	866.2	855.8	10.4
	3,694.6 Liquid Final	3,573.4 Liquid Initial	121.2 Liquid Gain
	866.2 Silica Final	855.8 Silica Initial	10.4 Silica Gain

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Test Location: Kiln 3 Common Stack
Date: 1/31/24

Run 1

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 1_000373.LAB	8:20	12.54	11.15	1.55	≤	0.10	190.97	0.99	13.09
RUN 1_000374.LAB	8:21	12.67	11.39	1.49	≤	0.10	190.97	0.99	12.90
RUN 1_000375.LAB	8:22	12.76	11.37	1.50	≤	0.10	190.89	0.99	12.87
RUN 1_000376.LAB	8:23	12.92	11.33	1.47	≤	0.10	190.95	0.99	12.85
RUN 1_000377.LAB	8:24	13.08	11.49	1.37	≤	0.10	190.97	0.99	12.78
RUN 1_000378.LAB	8:25	13.22	11.47	1.42	≤	0.10	190.97	0.99	12.70
RUN 1_000379.LAB	8:26	13.13	11.69	1.43	≤	0.10	190.98	0.99	12.72
RUN 1_000380.LAB	8:27	13.27	11.55	1.45	≤	0.10	190.93	0.99	12.64
RUN 1_000381.LAB	8:28	13.09	11.64	1.41	≤	0.10	191.01	0.99	12.77
RUN 1_000382.LAB	8:29	13.17	11.25	1.47	≤	0.10	190.91	0.99	12.77
RUN 1_000383.LAB	8:30	13.14	11.30	1.48	≤	0.10	190.93	0.99	12.92
RUN 1_000384.LAB	8:31	13.10	11.33	1.50	≤	0.10	190.84	0.99	12.96
RUN 1_000385.LAB	8:32	13.05	11.10	1.37	≤	0.10	191.04	0.99	12.97
RUN 1_000386.LAB	8:33	12.99	11.06	1.33	≤	0.10	190.98	0.99	13.10
RUN 1_000387.LAB	8:34	13.01	11.05	1.47	≤	0.10	190.98	0.99	13.07
RUN 1_000388.LAB	8:35	12.89	10.95	1.35	≤	0.10	190.93	0.99	13.10
RUN 1_000389.LAB	8:36	12.83	10.78	1.57	≤	0.10	190.98	0.99	13.13
RUN 1_000390.LAB	8:37	12.78	10.76	1.32	≤	0.10	191.01	0.99	13.23
RUN 1_000391.LAB	8:38	12.60	10.99	1.49	≤	0.10	190.91	0.99	13.25
RUN 1_000392.LAB	8:39	12.66	11.14	1.42	≤	0.10	190.93	0.99	13.20
RUN 1_000393.LAB	8:40	12.55	10.99	1.23	≤	0.10	190.94	0.99	13.07
RUN 1_000394.LAB	8:41	12.45	10.88	1.31	≤	0.10	190.94	0.99	13.14
RUN 1_000395.LAB	8:42	11.78	11.12	1.27	≤	0.10	190.85	0.99	13.15
RUN 1_000396.LAB	8:43	11.91	11.12	1.41	≤	0.10	191.01	0.99	13.09
RUN 1_000397.LAB	8:44	11.85	11.28	1.38	≤	0.10	190.95	0.99	13.05
RUN 1_000398.LAB	8:45	12.26	11.14	1.44	≤	0.10	190.98	0.99	12.98
RUN 1_000399.LAB	8:46	12.13	11.36	1.48	≤	0.10	190.94	0.99	12.90
RUN 1_000400.LAB	8:47	12.20	11.43	1.30	≤	0.10	191.05	0.99	12.88
RUN 1_000401.LAB	8:48	12.87	11.40	1.48	≤	0.10	190.94	0.99	12.78
RUN 1_000402.LAB	8:49	13.01	11.30	1.41	≤	0.10	190.96	0.99	12.74
RUN 1_000403.LAB	8:50	13.12	11.65	1.49	≤	0.10	190.97	0.99	12.73
RUN 1_000404.LAB	8:51	13.21	11.48	1.50	≤	0.10	190.91	0.99	12.73
RUN 1_000405.LAB	8:52	13.15	11.46	1.44	≤	0.10	190.91	0.99	12.65
RUN 1_000406.LAB	8:53	13.19	11.33	1.38	≤	0.10	190.96	0.99	12.70
RUN 1_000407.LAB	8:54	13.05	11.33	1.35	≤	0.10	190.93	0.99	12.75
RUN 1_000408.LAB	8:55	13.18	11.22	1.58	≤	0.10	190.91	0.99	12.87
RUN 1_000409.LAB	8:56	13.09	11.28	1.55	≤	0.10	190.95	0.99	12.94
RUN 1_000410.LAB	8:57	13.25	11.19	1.39	≤	0.10	190.92	0.99	12.93
RUN 1_000411.LAB	8:58	13.19	11.17	1.47	≤	0.10	190.94	0.99	12.93
RUN 1_000412.LAB	8:59	13.17	10.98	1.52	≤	0.10	190.95	0.99	12.99
RUN 1_000413.LAB	9:00	13.07	10.98	1.37	≤	0.10	190.97	0.99	13.05
RUN 1_000414.LAB	9:01	12.94	11.02	1.47	≤	0.10	190.97	0.99	13.18
RUN 1_000415.LAB	9:02	12.88	10.87	1.43	≤	0.10	190.96	0.99	13.20
RUN 1_000416.LAB	9:03	12.84	10.93	1.38	≤	0.10	190.93	0.99	13.24
RUN 1_000417.LAB	9:04	12.79	10.96	1.46	≤	0.10	190.96	0.99	13.28
RUN 1_000418.LAB	9:05	12.77	11.08	1.60	≤	0.10	190.94	0.99	13.28
RUN 1_000419.LAB	9:06	12.80	11.05	1.48	≤	0.10	190.93	0.99	13.28
RUN 1_000420.LAB	9:07	12.81	10.95	1.46	≤	0.10	190.94	0.99	13.23
RUN 1_000421.LAB	9:08	12.84	11.01	1.41	≤	0.10	190.96	0.99	13.13
RUN 1_000422.LAB	9:09	12.82	11.04	1.48	≤	0.10	190.97	0.99	13.15
RUN 1_000423.LAB	9:10	12.77	11.14	1.57	≤	0.10	190.92	0.99	13.20
RUN 1_000424.LAB	9:11	12.82	11.08	1.53	≤	0.10	191.06	0.99	13.16
RUN 1_000425.LAB	9:12	12.82	11.33	1.51	≤	0.10	191.02	0.99	13.13
RUN 1_000426.LAB	9:13	12.81	11.24	1.60	≤	0.10	190.95	0.99	13.10
RUN 1_000427.LAB	9:14	12.87	11.35	1.64	≤	0.10	190.92	0.99	13.11
RUN 1_000428.LAB	9:15	12.90	11.44	1.55	≤	0.10	191.00	0.99	13.00
RUN 1_000429.LAB	9:16	12.98	11.42	1.62	≤	0.10	190.98	0.99	13.03
RUN 1_000430.LAB	9:17	12.95	11.31	1.59	≤	0.10	190.99	0.99	12.94
RUN 1_000431.LAB	9:18	12.96	11.31	1.61	≤	0.10	191.03	0.99	12.91
RUN 1_000432.LAB	9:19	12.89	11.25	1.52	≤	0.10	190.98	0.99	12.87
Average		**12.85**	**11.21**	**1.46**	**≤**	**0.10**	**190.96**	**0.99**	**12.99**

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Test Location: Kiln 3 Common Stack
Date: 1/31/24

Run 2

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 2_000508.LAB	9:55	12.85	11.2	1.39	≤	0.10	191.0	0.99	13.15
RUN 2_000509.LAB	9:56	12.78	11.1	1.59	≤	0.10	190.9	0.99	13.14
RUN 2_000510.LAB	9:57	12.86	11.4	1.44	≤	0.10	190.9	0.99	12.97
RUN 2_000511.LAB	9:58	12.87	11.2	1.45	≤	0.10	191.0	0.99	12.97
RUN 2_000512.LAB	9:59	12.95	11.4	1.50	≤	0.10	190.9	0.99	12.85
RUN 2_000513.LAB	10:00	12.92	11.4	1.55	≤	0.10	191.0	0.99	12.91
RUN 2_000514.LAB	10:01	12.35	11.4	1.44	≤	0.10	191.0	0.99	12.85
RUN 2_000515.LAB	10:02	12.17	11.3	1.57	≤	0.10	190.9	0.99	12.84
RUN 2_000516.LAB	10:03	12.67	11.4	1.62	≤	0.10	190.9	0.99	12.83
RUN 2_000517.LAB	10:04	12.84	11.5	1.61	≤	0.10	190.9	0.99	12.80
RUN 2_000518.LAB	10:05	12.89	11.6	1.65	≤	0.10	190.9	0.99	12.73
RUN 2_000519.LAB	10:06	12.91	11.4	1.53	≤	0.10	191.0	0.99	12.80
RUN 2_000520.LAB	10:07	12.91	11.3	1.56	≤	0.10	191.0	0.99	12.83
RUN 2_000521.LAB	10:08	12.90	11.4	1.47	≤	0.10	190.8	0.99	12.82
RUN 2_000522.LAB	10:09	12.98	11.4	1.64	≤	0.10	190.9	0.99	12.80
RUN 2_000523.LAB	10:10	13.04	11.2	1.47	≤	0.10	190.9	0.99	12.85
RUN 2_000524.LAB	10:11	13.01	11.3	1.51	≤	0.10	190.9	0.99	12.93
RUN 2_000525.LAB	10:12	12.98	11.2	1.49	≤	0.10	190.9	0.99	12.91
RUN 2_000526.LAB	10:13	12.95	11.2	1.44	≤	0.10	191.0	0.99	12.90
RUN 2_000527.LAB	10:14	12.91	11.3	1.60	≤	0.10	190.9	0.99	12.96
RUN 2_000528.LAB	10:15	12.89	11.0	1.42	≤	0.10	190.9	0.99	12.93
RUN 2_000529.LAB	10:16	12.83	10.9	1.57	≤	0.10	191.1	0.99	13.15
RUN 2_000530.LAB	10:17	12.83	10.9	1.46	≤	0.10	191.0	0.99	13.19
RUN 2_000531.LAB	10:18	12.78	10.8	1.36	≤	0.10	191.0	0.99	13.16
RUN 2_000532.LAB	10:19	12.81	11.0	1.52	≤	0.10	191.1	0.99	13.32
RUN 2_000533.LAB	10:20	12.83	10.8	1.44	≤	0.10	191.0	0.99	13.12
RUN 2_000534.LAB	10:21	12.78	10.8	1.55	≤	0.10	191.0	0.99	13.26
RUN 2_000535.LAB	10:22	12.72	11.2	1.60	≤	0.10	191.0	0.99	13.29
RUN 2_000536.LAB	10:23	12.68	11.2	1.48	≤	0.10	191.0	0.99	13.23
RUN 2_000537.LAB	10:24	12.70	11.4	1.43	≤	0.10	190.9	0.99	13.09
RUN 2_000538.LAB	10:25	12.71	11.2	1.57	≤	0.10	190.9	0.99	12.97
RUN 2_000539.LAB	10:26	12.69	11.2	1.52	≤	0.10	190.9	0.99	12.92
RUN 2_000540.LAB	10:27	12.70	11.3	1.44	≤	0.10	190.9	0.99	12.94
RUN 2_000541.LAB	10:28	12.72	11.3	1.59	≤	0.10	191.0	0.99	12.95
RUN 2_000542.LAB	10:29	12.71	11.3	1.60	≤	0.10	190.9	0.99	12.98
RUN 2_000543.LAB	10:30	12.72	11.2	1.44	≤	0.10	191.0	0.99	12.93
RUN 2_000544.LAB	10:31	12.71	11.2	1.48	≤	0.10	190.9	0.99	12.97
RUN 2_000545.LAB	10:32	12.77	11.2	1.42	≤	0.10	191.0	0.99	13.01
RUN 2_000546.LAB	10:33	12.84	11.2	1.51	≤	0.10	191.1	0.99	12.96
RUN 2_000547.LAB	10:34	12.85	11.2	1.57	≤	0.10	190.9	0.99	12.93
RUN 2_000548.LAB	10:35	12.65	11.4	1.54	≤	0.10	190.9	0.99	12.93
RUN 2_000549.LAB	10:36	12.28	11.3	1.59	≤	0.10	191.0	0.99	12.97
RUN 2_000550.LAB	10:37	12.19	11.5	1.62	≤	0.10	190.9	0.99	12.93
RUN 2_000551.LAB	10:38	12.22	11.4	1.44	≤	0.10	191.0	0.99	12.97
RUN 2_000552.LAB	10:39	12.81	11.4	1.57	≤	0.10	191.0	0.99	12.90
RUN 2_000553.LAB	10:40	12.84	11.2	1.62	≤	0.10	191.0	0.99	12.91
RUN 2_000554.LAB	10:41	12.81	11.2	1.74	≤	0.10	191.0	0.99	12.88
RUN 2_000555.LAB	10:42	12.82	11.2	1.46	≤	0.10	190.9	0.99	13.03
RUN 2_000556.LAB	10:43	12.84	11.1	1.67	≤	0.10	191.0	0.99	13.00
RUN 2_000557.LAB	10:44	12.83	11.2	1.46	≤	0.10	190.9	0.99	13.03
RUN 2_000558.LAB	10:45	12.81	11.2	1.57	≤	0.10	191.0	0.99	13.05
RUN 2_000559.LAB	10:46	12.80	11.1	1.48	≤	0.10	191.0	0.99	13.05
RUN 2_000560.LAB	10:47	12.77	11.0	1.48	≤	0.10	191.0	0.99	13.03
RUN 2_000561.LAB	10:48	12.81	11.0	1.50	≤	0.10	191.0	0.99	13.06
RUN 2_000562.LAB	10:49	12.78	11.1	1.57	≤	0.10	190.9	0.99	13.09
RUN 2_000563.LAB	10:50	12.76	11.2	1.55	≤	0.10	190.9	0.99	13.11
RUN 2_000564.LAB	10:51	12.76	11.1	1.45	≤	0.10	191.0	0.99	13.12
RUN 2_000565.LAB	10:52	12.78	11.0	1.54	≤	0.10	191.1	0.99	13.13
RUN 2_000566.LAB	10:53	12.80	11.0	1.52	≤	0.10	190.9	0.99	13.05
RUN 2_000567.LAB	10:54	12.80	11.0	1.46	≤	0.10	191.0	0.99	13.10
Average		**12.77**	**11.21**	**1.52**	**≤**	**0.10**	**190.96**	**0.99**	**12.99**

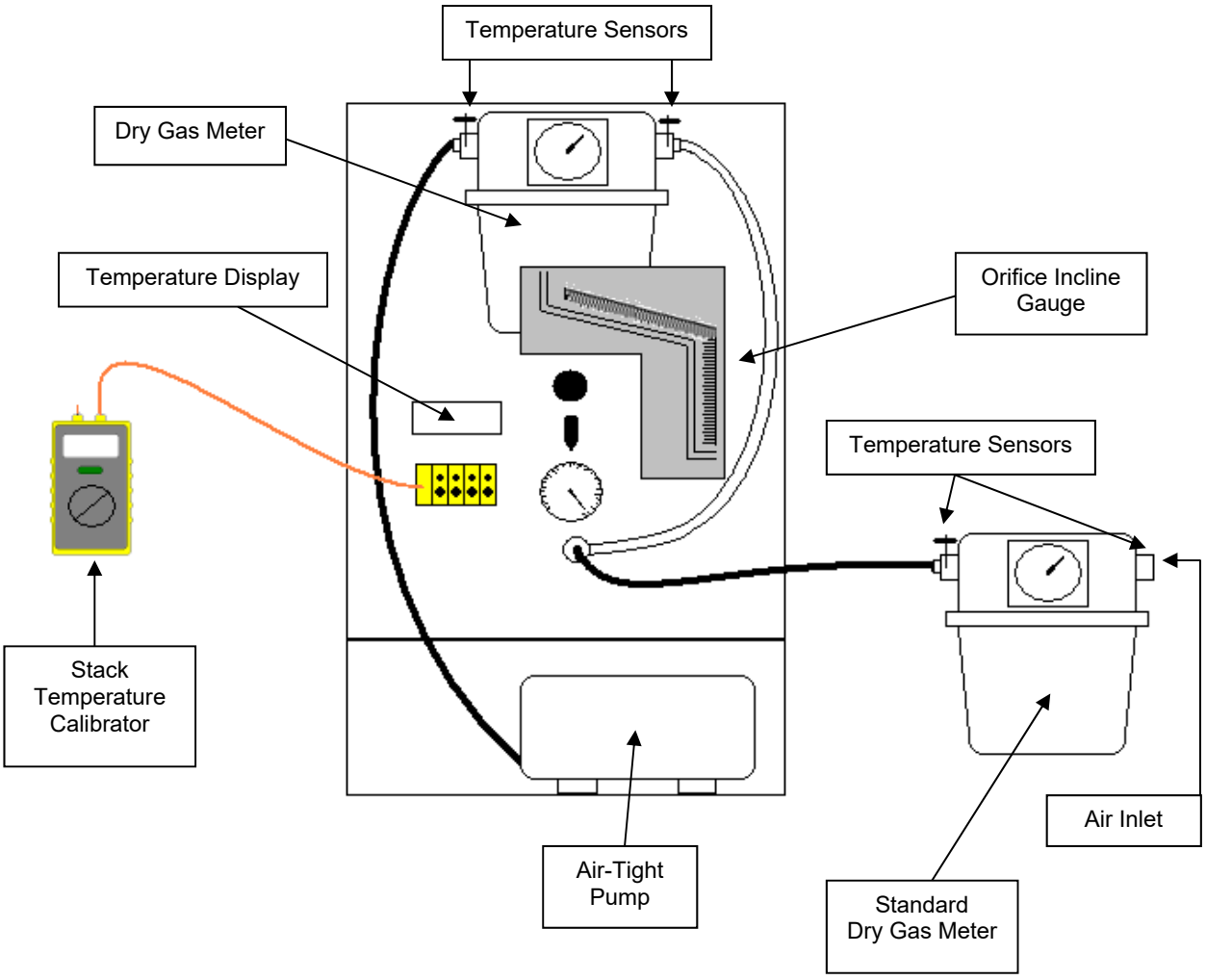
Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Test Location: Kiln 3 Common Stack
Date: 1/31/24

Run 3

		FTIR Data							Analyzer Data
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw		HF ppmvw	Cell Temp	Pressure	O2 % (dry)
RUN 3_000650.LAB	11:40	12.94	11.0	1.46	≤	0.10	190.9	0.99	13.31
RUN 3_000651.LAB	11:41	12.92	11.1	1.38	≤	0.10	190.9	0.99	13.21
RUN 3_000652.LAB	11:42	12.98	11.2	1.59	≤	0.10	191.0	0.99	13.21
RUN 3_000653.LAB	11:43	12.97	11.1	1.48	≤	0.10	191.0	0.99	13.20
RUN 3_000654.LAB	11:44	13.00	11.2	1.57	≤	0.10	191.0	0.99	13.24
RUN 3_000655.LAB	11:45	13.00	11.0	1.50	≤	0.10	191.0	0.99	13.29
RUN 3_000656.LAB	11:46	12.99	11.1	1.50	≤	0.10	191.0	0.99	13.30
RUN 3_000657.LAB	11:47	13.02	11.1	1.51	≤	0.10	191.0	0.99	13.28
RUN 3_000658.LAB	11:48	13.01	11.1	1.78	≤	0.10	190.9	0.99	13.25
RUN 3_000659.LAB	11:49	13.06	11.5	1.74	≤	0.10	191.0	0.99	13.13
RUN 3_000660.LAB	11:50	13.07	11.2	1.56	≤	0.10	191.0	0.99	13.35
RUN 3_000661.LAB	11:51	13.04	11.0	1.55	≤	0.10	191.0	0.99	13.47
RUN 3_000662.LAB	11:52	13.02	11.1	1.66	≤	0.10	190.9	0.99	13.41
RUN 3_000663.LAB	11:53	13.01	11.0	1.53	≤	0.10	190.9	0.99	13.45
RUN 3_000664.LAB	11:54	13.07	11.1	1.52	≤	0.10	191.0	0.99	13.38
RUN 3_000665.LAB	11:55	12.66	11.2	1.57	≤	0.10	191.0	0.99	13.36
RUN 3_000666.LAB	11:56	12.39	11.3	1.66	≤	0.10	190.9	0.99	13.24
RUN 3_000667.LAB	11:57	12.30	11.4	1.61	≤	0.10	190.9	0.99	13.13
RUN 3_000668.LAB	11:58	12.50	11.6	1.57	≤	0.10	190.9	0.99	13.04
RUN 3_000669.LAB	11:59	13.05	11.3	1.58	≤	0.10	191.0	0.99	13.10
RUN 3_000670.LAB	12:00	13.11	11.4	1.57	≤	0.10	191.0	0.99	13.10
RUN 3_000671.LAB	12:01	13.15	11.3	1.60	≤	0.10	190.9	0.99	13.11
RUN 3_000672.LAB	12:02	13.17	11.3	1.54	≤	0.10	190.9	0.99	13.14
RUN 3_000673.LAB	12:03	13.24	11.2	1.72	≤	0.10	191.0	0.99	13.12
RUN 3_000674.LAB	12:04	13.16	11.7	1.56	≤	0.10	190.9	0.99	13.05
RUN 3_000675.LAB	12:05	13.30	11.4	1.65	≤	0.10	191.0	0.99	13.01
RUN 3_000676.LAB	12:06	13.24	11.3	1.69	≤	0.10	190.9	0.99	13.06
RUN 3_000677.LAB	12:07	13.20	11.4	1.62	≤	0.10	190.8	0.99	13.13
RUN 3_000678.LAB	12:08	13.27	11.7	1.56	≤	0.10	190.9	0.99	13.06
RUN 3_000679.LAB	12:09	13.23	11.4	1.50	≤	0.10	190.9	0.99	12.98
RUN 3_000680.LAB	12:10	13.24	11.3	1.64	≤	0.10	190.9	0.99	13.08
RUN 3_000681.LAB	12:11	13.23	11.1	1.42	≤	0.10	190.8	0.99	13.12
RUN 3_000682.LAB	12:12	13.22	11.1	1.62	≤	0.10	190.9	0.99	13.17
RUN 3_000683.LAB	12:13	13.19	10.9	1.58	≤	0.10	190.8	0.99	13.20
RUN 3_000684.LAB	12:14	13.17	11.2	1.62	≤	0.10	190.9	0.99	13.35
RUN 3_000685.LAB	12:15	13.28	11.0	1.48	≤	0.10	190.8	0.99	13.26
RUN 3_000686.LAB	12:16	13.16	11.0	1.61	≤	0.10	190.8	0.99	13.32
RUN 3_000687.LAB	12:17	13.27	10.9	1.60	≤	0.10	190.9	0.99	13.32
RUN 3_000688.LAB	12:18	13.15	10.9	1.68	≤	0.10	190.8	0.99	13.38
RUN 3_000689.LAB	12:19	13.29	11.0	1.50	≤	0.10	190.8	0.99	13.35
RUN 3_000690.LAB	12:20	13.15	11.1	1.54	≤	0.10	190.9	0.99	13.38
RUN 3_000691.LAB	12:21	13.24	11.0	1.62	≤	0.10	190.9	0.99	13.33
RUN 3_000692.LAB	12:22	13.10	11.0	1.59	≤	0.10	190.8	0.99	13.37
RUN 3_000693.LAB	12:23	13.28	11.2	1.68	≤	0.10	190.8	0.99	13.32
RUN 3_000694.LAB	12:24	13.14	11.1	1.62	≤	0.10	190.8	0.99	13.34
RUN 3_000695.LAB	12:25	13.26	11.0	1.61	≤	0.10	190.7	0.99	13.28
RUN 3_000696.LAB	12:26	13.16	11.0	1.66	≤	0.10	190.7	0.99	13.29
RUN 3_000697.LAB	12:27	13.23	11.2	1.70	≤	0.10	190.7	0.99	13.30
RUN 3_000698.LAB	12:28	13.19	11.3	1.51	≤	0.10	190.8	0.99	13.27
RUN 3_000699.LAB	12:29	13.21	11.1	1.70	≤	0.10	190.7	0.99	13.24
RUN 3_000700.LAB	12:30	13.21	11.5	1.70	≤	0.10	190.8	0.99	13.19
RUN 3_000701.LAB	12:31	13.07	11.1	1.69	≤	0.10	190.8	0.99	13.23
RUN 3_000702.LAB	12:32	12.78	11.5	1.54	≤	0.10	190.8	0.99	13.14
RUN 3_000703.LAB	12:33	12.75	11.3	1.46	≤	0.10	190.8	0.99	13.24
RUN 3_000704.LAB	12:34	13.23	11.4	1.74	≤	0.10	190.8	0.99	13.13
RUN 3_000705.LAB	12:35	13.27	11.2	1.55	≤	0.10	190.8	0.99	13.18
RUN 3_000706.LAB	12:36	13.20	11.3	1.65	≤	0.10	190.8	0.99	13.11
RUN 3_000707.LAB	12:37	13.20	11.3	1.58	≤	0.10	190.9	0.99	13.17
RUN 3_000708.LAB	12:38	13.22	11.3	1.55	≤	0.10	190.8	0.99	13.17
RUN 3_000709.LAB	12:39	13.26	11.3	1.65	≤	0.10	190.8	0.99	13.14
Average		**13.09**	**11.20**	**1.59**	**≤**	**0.10**	**190.87**	**0.99**	**13.22**

Appendix G - Calibration Data

Dry Gas Meter/Control Module Calibration Diagram



Dry Gas Meter Calibration Data

Dry Gas Meter No.	CM13	Date:	January 16, 2024
Standard Meter No.	366118	Calibrated By:	HH
Standard Meter (Y)	0.99950	Barometric Pressure:	29.37

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			66.921	85.720	59	60	58					
Initial			61.879	80.657	60	59	55					
Difference	1	0.20	5.042	5.063	60	60	57	58	18	4	0.992	1.453
Final			71.948	90.840	59	64	60					
Initial			66.921	85.720	59	60	58					
Difference	2	0.50	5.027	5.120	59	62	59	61	11	23	0.983	1.440
Final			77.048	96.032	60	63	63					
Initial			71.948	90.840	59	64	60					
Difference	3	0.70	5.100	5.192	60	64	62	63	9	57	0.986	1.494
Final			82.130	101.215	60	64	63					
Initial			77.048	96.032	60	63	63					
Difference	4	0.90	5.082	5.183	60	64	63	63	8	48	0.984	1.514
Final			87.381	106.580	60	67	63					
Initial			82.130	101.215	60	64	63					
Difference	5	1.20	5.251	5.365	60	66	63	64	7	57	0.983	1.540
Final			61.879	80.657	60	59	55					
Initial			56.788	75.623	61	55	54					
Difference	6	2.00	5.091	5.034	61	57	55	56	6	8	0.997	1.655
										Average	**0.987**	**1.516**

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	HH
Ambient Temperature, °F :	56.3	Date :	January 16, 2024

Temperature Calibrator			
Model # :	CL23A	Certification Date:	May 2, 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	598	0.2
1200	1201	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.	CM13	Date:	February 3, 2024
Standard Meter No.	16541852	Calibrated By:	JVC
Standard Meter (Y)	1.00440	Barometric Pressure:	29.41

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			103.544	11.599	53	65	61					
Initial			97.210	5.118	52	61	59					
Difference	1	0.20	6.334	6.481	53	63	60	62	23	1	0.998	1.428
Final			11.744	20.042	53	68	63					
Initial			3.845	11.921	53	63	61					
Difference	2	0.50	7.899	8.121	53	66	62	64	18	32	0.996	1.485
Final			20.124	28.690	54	66	63					
Initial			11.970	20.280	54	65	63					
Difference	3	0.70	8.154	8.410	54	66	63	64	16	24	0.992	1.532
Final			28.044	36.872	54	69	63					
Initial			20.465	29.049	54	64	63					
Difference	4	0.90	7.579	7.823	54	67	63	65	13	39	0.991	1.578
Final			35.394	44.458	55	73	64					
Initial			28.164	36.992	54	65	63					
Difference	5	1.20	7.230	7.466	55	69	64	66	10	58	0.992	1.491
Final			97.158	105.061	52	69	59					
Initial			90.142	97.927	53	60	58					
Difference	6	2.00	7.016	7.134	53	65	59	62	8	40	1.000	1.650
										Average	**0.995**	**1.527**

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	JVC
Ambient Temperature, °F :	57	Date :	February 3, 2024

Temperature Calibrator			
Model # :	CL23A	Certification Date:	May 2, 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	598	0.2
1200	1201	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.	*CM43*	*Date:*	*January 19, 2024*
Standard Meter No.	*366118*	*Calibrated By:*	*HGS1*
Standard Meter (Y)	*0.99950*	*Barometric Pressure:*	*29.49*

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			*15.578*	*31.760*	*62*	*64*	*64*					
Initial			*10.302*	*26.451*	*61*	*63*	*63*					
Difference	*1*	*0.20*	*5.276*	*5.309*	*62*	*64*	*64*	*64*	*20*	*37*	*0.997*	*1.715*
Final			*36.955*	*53.349*	*62*	*64*	*64*					
Initial			*31.225*	*47.562*	*61*	*64*	*64*					
Difference	*2*	*0.50*	*5.730*	*5.787*	*62*	*64*	*64*	*64*	*14*	*17*	*0.993*	*1.744*
Final			*31.225*	*47.562*	*61*	*64*	*64*					
Initial			*25.945*	*42.230*	*62*	*64*	*64*					
Difference	*3*	*0.70*	*5.280*	*5.332*	*62*	*64*	*64*	*64*	*11*	*15*	*0.993*	*1.783*
Final			*20.763*	*37.005*	*62*	*64*	*64*					
Initial			*15.578*	*31.760*	*62*	*64*	*64*					
Difference	*4*	*0.90*	*5.185*	*5.245*	*62*	*64*	*64*	*64*	*9*	*46*	*0.990*	*1.795*
Final			*25.945*	*42.230*	*62*	*65*	*65*					
Initial			*20.763*	*37.005*	*62*	*64*	*64*					
Difference	*5*	*1.20*	*5.182*	*5.225*	*62*	*65*	*65*	*65*	*8*	*34*	*0.993*	*1.842*
Final			*10.302*	*26.451*	*61*	*63*	*63*					
Initial			*5.012*	*21.152*	*61*	*63*	*63*					
Difference	*6*	*2.00*	*5.290*	*5.299*	*61*	*63*	*63*	*63*	*6*	*47*	*0.997*	*1.845*
										Average	***0.994***	***1.788***

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	HGS1
Ambient Temperature, °F :	57.9	Date :	January 19, 2024

Temperature Calibrator			
Model # :	CL23A	Certification Date:	May 2, 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	0.2
250	251	0.1
600	601	0.1
1200	1205	0.3

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

Dry Gas Meter Calibration Data

Dry Gas Meter No.	*CM43*	*Date:*	*February 3, 2024*
Standard Meter No.	*366118*	*Calibrated By:*	*JVC*
Standard Meter (Y)	*0.99950*	*Barometric Pressure:*	*29.41*

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			*103.672*	*8.128*	*55*	*60*	*60*					
Initial			*98.279*	*2.724*	*55*	*58*	*58*					
Difference	*1*	*0.20*	*5.393*	*5.404*	*55*	*59*	*59*	*59*	*22*	*46*	*1.005*	*1.975*
Final			*11.028*	*15.533*	*55*	*61*	*61*					
Initial			*3.872*	*8.342*	*55*	*60*	*60*					
Difference	*2*	*0.50*	*7.156*	*7.191*	*55*	*61*	*61*	*61*	*18*	*22*	*1.004*	*1.820*
Final			*18.446*	*22.978*	*55*	*61*	*61*					
Initial			*11.196*	*15.708*	*55*	*61*	*61*					
Difference	*3*	*0.70*	*7.250*	*7.270*	*55*	*61*	*61*	*61*	*15*	*45*	*1.007*	*1.823*
Final			*26.100*	*30.672*	*56*	*62*	*62*					
Initial			*18.674*	*23.209*	*55*	*62*	*62*					
Difference	*4*	*0.90*	*7.426*	*7.463*	*56*	*62*	*62*	*62*	*14*	*14*	*1.005*	*1.825*
Final			*32.989*	*37.605*	*56*	*63*	*63*					
Initial			*26.246*	*30.819*	*56*	*62*	*62*					
Difference	*5*	*1.20*	*6.743*	*6.786*	*56*	*63*	*63*	*63*	*10*	*59*	*1.003*	*1.759*
Final			*98.230*	*102.664*	*55*	*58*	*58*					
Initial			*91.299*	*95.755*	*55*	*57*	*57*					
Difference	*6*	*2.00*	*6.931*	*6.909*	*55*	*58*	*58*	*58*	*8*	*58*	*1.003*	*1.860*

Average ***1.004*** ***1.844***

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	JVC
Ambient Temperature, °F :	57	Date :	February 3, 2024

Temperature Calibrator			
Model # :	CL23A	Certification Date:	May 2, 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	0.2
250	252	0.3
600	602	0.2
1200	1206	0.4

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

Airflow Sciences Corporation

Probe Calibration for Method 2

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

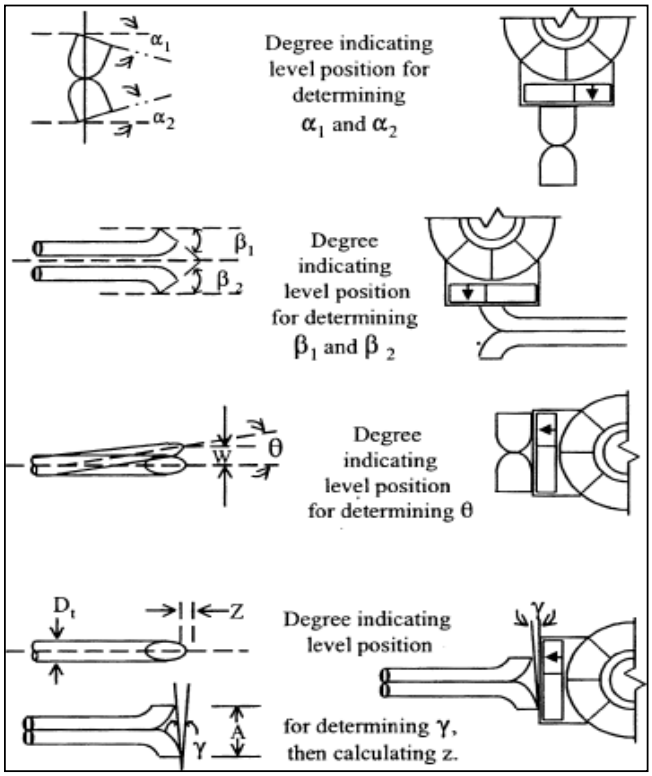
$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.37\%}$$ **Pass**

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.

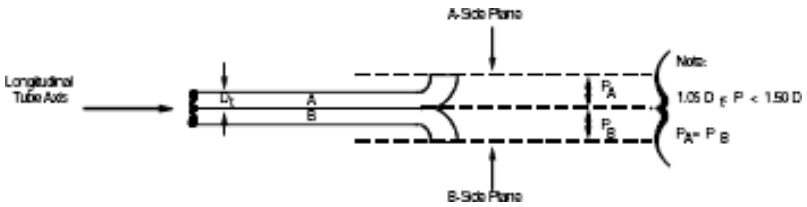
C_p = 0.834

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

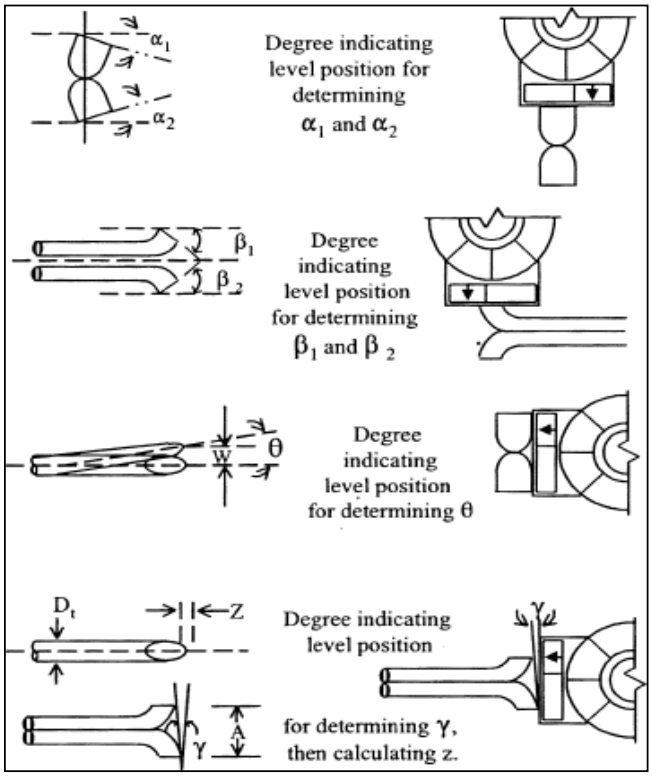
$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \textbf{-0.17\%}$$ **Pass**

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.

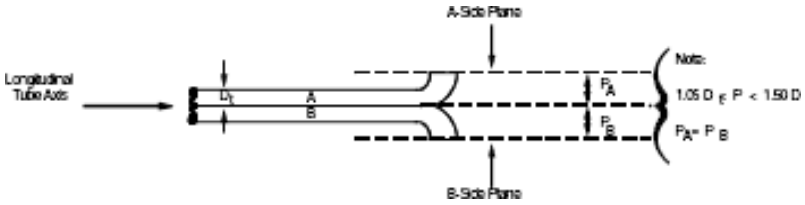
C_p = 0.829

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

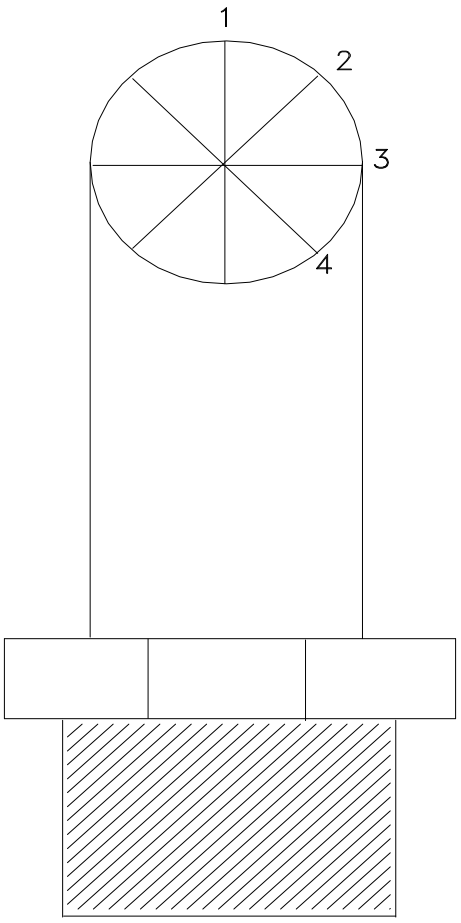
Nozzle Calibration

Date: 2/22024

Nozzle ID No.: 201

Analyst: RB

Material/Type: Glass



0.281	1
0.280	2
0.279	3
0.280	4

Valid Data

Average
0.280

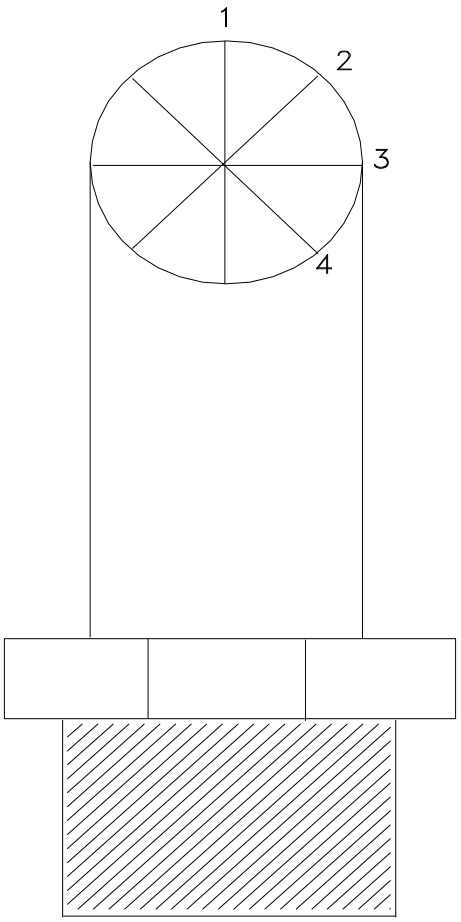
Nozzle Calibration

Date: 12/26/2019

Nozzle ID No.: 865

Analyst: JRK

Material/Type: Glass



0.251	1
0.252	2
0.251	3
0.252	4

Valid Data

Average
0.251

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Operating Condition: Mill On

Test Location: Kiln 3 Common Stack
Date: 1/30/2024
Operator: A. Benninghoff
FTIR s/n: 00612

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_000002.LAB	1/30/24	7:12:45	0.0	0.0	0.0	191.2	0.99	0.1	0.0	-0.002
N2_000003.LAB	1/30/24	7:12:53	0.0	0.0	0.0	191.2	0.99	0.1	0.0	-0.002
N2_000004.LAB	1/30/24	7:13:01	0.0	0.0	-0.1	191.2	0.99	0.0	0.2	-0.003
N2_000005.LAB	1/30/24	7:13:09	0.0	0.0	0.0	191.2	0.99	0.0	-0.4	-0.001
N2_000006.LAB	1/30/24	7:13:16	0.0	0.0	0.0	191.2	0.99	0.1	-0.3	0.001
N2_000007.LAB	1/30/24	7:13:24	0.0	0.0	-0.2	191.3	0.99	0.0	0.2	0.003
N2_000008.LAB	1/30/24	7:13:32	0.0	0.0	-0.1	191.3	0.99	0.1	0.2	-0.004
N2_000009.LAB	1/30/24	7:13:40	0.0	0.0	0.0	191.3	0.99	0.1	-0.2	-0.001

Calibration Transfer Standard (CTS), Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS DIR_000043.LAB	1/30/24	7:18:59	0.0	0.0	-0.3	191.2	0.99	97.4	0.0	-0.002	**97.4%**
CTS DIR_000044.LAB	1/30/24	7:19:06	0.0	0.0	-0.2	191.2	0.99	97.4	0.3	-0.005	**97.4%**
CTS DIR_000045.LAB	1/30/24	7:19:14	0.0	0.0	0.0	191.2	0.99	97.6	0.3	-0.018	**97.6%**
CTS DIR_000046.LAB	1/30/24	7:19:22	0.0	0.0	0.0	191.2	0.99	97.9	1.1	-0.016	**97.9%**
CTS DIR_000047.LAB	1/30/24	7:19:30	0.0	0.0	-0.2	191.2	0.99	97.5	0.0	-0.013	**97.6%**
CTS DIR_000048.LAB	1/30/24	7:19:38	0.0	0.0	-0.1	191.2	0.99	97.3	-0.1	-0.014	**97.3%**
CTS DIR_000049.LAB	1/30/24	7:19:46	0.0	0.0	0.0	191.2	0.99	97.6	-0.2	-0.010	**97.6%**
	Average							**97.5**			**97.5%**

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_000084.LAB	1/30/24	7:25:12	0.0	0.0	0.0	191.0	0.99	-0.5	49.6	4.875	**99.8%**
HCN DIR_000085.LAB	1/30/24	7:25:20	0.0	0.0	-0.1	191.0	0.99	0.0	49.8	4.858	**100.2%**
HCN DIR_000086.LAB	1/30/24	7:25:28	0.0	0.0	0.0	191.0	0.99	-0.4	50.4	4.864	**101.3%**
HCN DIR_000087.LAB	1/30/24	7:25:36	0.0	0.0	-0.2	191.0	0.99	-0.2	50.0	4.858	**100.5%**
HCN DIR_000088.LAB	1/30/24	7:25:44	0.0	0.0	-0.2	191.0	0.99	-0.3	49.7	4.842	**100.0%**
HCN DIR_000089.LAB	1/30/24	7:25:51	0.0	0.0	-0.1	191.0	0.99	-0.2	49.3	4.866	**99.2%**
HCN DIR_000090.LAB	1/30/24	7:25:59	0.0	0.0	0.1	191.0	0.99	-0.3	49.6	4.861	**99.7%**
HCN DIR_000091.LAB	1/30/24	7:26:07	0.0	0.0	-0.2	191.0	0.99	-0.1	49.6	4.853	**99.8%**
	Average								**49.8**	**4.860**	**100.1%**

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
ETHYLENE REMOTE_000100.LAB	1/30/24	7:27:52	0.1	0.0	-0.1	191.0	0.99	97.4	0.4	-0.009	**97.5%**
ETHYLENE REMOTE_000101.LAB	1/30/24	7:27:59	0.0	0.0	-0.2	191.0	0.99	97.3	0.3	-0.001	**97.3%**
ETHYLENE REMOTE_000102.LAB	1/30/24	7:28:07	0.0	0.0	0.0	191.1	0.99	97.8	0.4	-0.007	**97.8%**
ETHYLENE REMOTE_000103.LAB	1/30/24	7:28:15	0.0	0.0	-0.2	191.1	0.99	97.6	0.2	-0.006	**97.6%**
ETHYLENE REMOTE_000104.LAB	1/30/24	7:28:23	0.0	0.0	-0.1	191.1	0.99	97.7	0.5	-0.005	**97.7%**
ETHYLENE REMOTE_000105.LAB	1/30/24	7:28:31	0.0	0.0	0.1	191.1	0.99	97.8	0.3	-0.016	**97.8%**
ETHYLENE REMOTE_000106.LAB	1/30/24	7:28:39	0.0	0.0	0.0	191.1	0.99	97.5	-0.1	-0.014	**97.5%**
ETHYLENE REMOTE_000107.LAB	1/30/24	7:28:47	0.0	0.0	0.0	191.1	0.99	97.4	0.0	-0.005	**97.4%**

Response Time Test

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Response Time (sec)
ETHYLENE REMOTE_000097.LAB	1/30/24	7:27:28	1.7	0.1	-0.1	191.1	0.99	11.2	13.1	-0.050	-
ETHYLENE REMOTE_000098.LAB	1/30/24	7:27:36	0.3	0.0	-0.1	191.1	0.99	93.8	0.9	-0.003	**15.687**
ETHYLENE REMOTE_000099.LAB	1/30/24	7:27:44	0.1	0.0	0.2	191.0	0.99	97.3	0.3	-0.016	**23.687**
ETHYLENE REMOTE_000100.LAB	1/30/24	7:27:52	0.1	0.0	-0.1	191.0	0.99	97.4	0.4	-0.009	
ETHYLENE REMOTE_000101.LAB	1/30/24	7:27:59	0.0	0.0	-0.2	191.0	0.99	97.3	0.3	-0.001	
ETHYLENE REMOTE_000102.LAB	1/30/24	7:28:07	0.0	0.0	0.0	191.1	0.99	97.8	0.4	-0.007	
ETHYLENE REMOTE_000103.LAB	1/30/24	7:28:15	0.0	0.0	-0.2	191.1	0.99	97.6	0.2	-0.006	
ETHYLENE REMOTE_000104.LAB	1/30/24	7:28:23	0.0	0.0	-0.1	191.1	0.99	97.7	0.5	-0.005	
ETHYLENE REMOTE_000105.LAB	1/30/24	7:28:31	0.0	0.0	0.1	191.1	0.99	97.8	0.3	-0.016	

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Operating Condition: Mill On

Test Location: Kiln 3 Common Stack
Date: 1/30/2024
Operator: A. Benninghoff
FTIR s/n: 00612

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_000160.LAB	1/30/24	7:38:19	9.0	7.8	0.0	191.0	0.99	0.3	1.1	0.003
NATIVE_000161.LAB	1/30/24	7:38:26	9.1	7.8	-0.2	191.0	0.99	0.3	1.4	-0.007
NATIVE_000162.LAB	1/30/24	7:38:34	9.0	7.8	-0.3	191.0	0.99	0.5	1.4	0.003
									1.3	**-0.001**

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
PRE 1 SPIKE_000192.LAB	1/30/24	7:43:02	8.1	7.2	-0.1	190.9	0.99	0.4	5.7	0.486	**0.100**	**93.8%**
PRE 1 SPIKE_000193.LAB	1/30/24	7:43:10	8.1	7.2	-0.2	190.9	0.99	0.1	5.8	0.482	**0.099**	**94.9%**
PRE 1 SPIKE_000194.LAB	1/30/24	7:43:18	8.1	7.2	-0.1	190.9	0.99	0.3	5.7	0.488	**0.100**	**92.4%**
PRE 1 SPIKE_000195.LAB	1/30/24	7:43:26	8.1	7.3	-0.1	190.9	0.99	0.1	6.1	0.481	**0.099**	**101.1%**
PRE 1 SPIKE_000196.LAB	1/30/24	7:43:34	8.1	7.3	-0.2	191.0	0.99	0.2	5.6	0.487	**0.100**	**90.8%**
PRE 1 SPIKE_000197.LAB	1/30/24	7:43:41	8.1	7.3	-0.3	191.0	0.99	0.3	5.8	0.471	**0.097**	**96.6%**
PRE 1 SPIKE_000198.LAB	1/30/24	7:43:49	8.1	7.3	-0.2	191.0	0.99	0.2	5.8	0.481	**0.099**	**95.9%**
PRE 1 SPIKE_000199.LAB	1/30/24	7:43:57	8.2	7.2	-0.2	191.0	0.99	0.3	6.0	0.485	**0.100**	**99.1%**

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
RUN 1_000302.LAB	1/30/24	9:27:49	9.1	8.0	-0.2	190.8	0.99	0.3	1.2	0.000
RUN 1_000303.LAB	1/30/24	9:28:52	9.1	7.8	-0.2	190.9	0.99	0.3	1.1	0.001
RUN 1_000304.LAB	1/30/24	9:29:55	9.1	8.0	-0.2	190.7	0.99	0.3	1.1	-0.004
									1.1	**-0.001**

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
P RUN 1 SPIKE_000322.LAB	1/30/24	9:33:59	8.3	7.2	-0.1	190.7	0.99	0.1	5.8	0.473	**0.097**	**98.1%**
P RUN 1 SPIKE_000323.LAB	1/30/24	9:34:06	8.2	7.2	-0.1	190.7	0.99	0.2	5.4	0.467	**0.096**	**93.4%**
P RUN 1 SPIKE_000324.LAB	1/30/24	9:34:14	8.3	7.2	-0.1	190.7	0.99	0.1	6.0	0.461	**0.095**	**105.0%**
P RUN 1 SPIKE_000325.LAB	1/30/24	9:34:22	8.2	7.3	-0.1	190.7	0.99	0.2	5.7	0.468	**0.096**	**97.8%**
P RUN 1 SPIKE_000326.LAB	1/30/24	9:34:30	8.2	7.3	-0.1	190.7	0.99	0.2	5.6	0.467	**0.096**	**96.7%**
P RUN 1 SPIKE_000327.LAB	1/30/24	9:34:38	8.2	7.2	-0.3	190.7	0.99	0.1	5.3	0.475	**0.098**	**89.5%**
P RUN 1 SPIKE_000328.LAB	1/30/24	9:34:45	8.2	7.2	-0.1	190.6	0.99	0.3	6.1	0.473	**0.097**	**103.1%**
P RUN 1 SPIKE_000329.LAB	1/30/24	9:34:53	8.2	7.2	-0.2	190.7	0.99	0.1	5.9	0.457	**0.094**	**102.7%**

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
P RUN 1 CTS_000337.LAB	1/30/24	9:36:47	0.1	0.0	-0.1	190.7	0.99	97.6	0.3	-0.014	**97.6%**
P RUN 1 CTS_000338.LAB	1/30/24	9:36:55	0.1	0.0	-0.1	190.7	0.99	97.4	0.4	-0.008	**97.4%**
P RUN 1 CTS_000339.LAB	1/30/24	9:37:03	0.0	0.0	0.1	190.7	0.99	97.5	0.5	-0.016	**97.5%**
P RUN 1 CTS_000340.LAB	1/30/24	9:37:11	0.1	0.0	0.1	190.7	0.99	97.4	0.2	-0.010	**97.4%**
P RUN 1 CTS_000341.LAB	1/30/24	9:37:19	0.0	0.0	0.0	190.7	0.99	97.7	0.8	-0.012	**97.7%**
P RUN 1 CTS_000342.LAB	1/30/24	9:37:26	0.0	0.0	-0.1	190.7	0.99	97.2	0.4	-0.013	**97.2%**
P RUN 1 CTS_000343.LAB	1/30/24	9:37:34	0.0	0.0	-0.1	190.7	0.99	97.6	0.2	-0.019	**97.6%**
P RUN 1 CTS_000344.LAB	1/30/24	9:37:42	0.0	0.0	-0.1	190.7	0.99	97.4	0.2	-0.017	**97.4%**

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Operating Condition: Mill On

Test Location: Kiln 3 Common Stack
Date: 1/30/2024
Operator: A. Benninghoff
FTIR s/n: 00612

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_000445.LAB	1/30/24	11:02:39	9.0	8.0	-0.2	190.4	0.99	0.5	0.1	-0.006
RUN 2_000446.LAB	1/30/24	11:03:41	9.0	8.1	-0.1	190.4	0.99	0.4	-0.1	-0.007
RUN 2_000447.LAB	1/30/24	11:04:45	9.0	8.1	-0.2	190.5	0.99	0.5	0.1	-0.004
									0.0	**-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
POST RUN 2 SPIKE_000460.LAB	1/30/24	11:08:00	8.2	7.4	-0.2	190.5	0.99	0.3	4.4	0.438	**0.090**	**97.4%**
POST RUN 2 SPIKE_000461.LAB	1/30/24	11:08:08	8.2	7.5	-0.1	190.4	0.99	0.3	4.6	0.434	**0.089**	**102.9%**
POST RUN 2 SPIKE_000462.LAB	1/30/24	11:08:15	8.2	7.4	-0.2	190.4	0.99	0.6	4.5	0.444	**0.091**	**98.0%**
POST RUN 2 SPIKE_000463.LAB	1/30/24	11:08:23	8.2	7.4	-0.1	190.4	0.99	0.5	4.6	0.439	**0.090**	**101.7%**
POST RUN 2 SPIKE_000464.LAB	1/30/24	11:08:31	8.2	7.5	-0.1	190.4	0.99	0.5	4.5	0.444	**0.091**	**99.7%**
POST RUN 2 SPIKE_000465.LAB	1/30/24	11:08:39	8.2	7.5	-0.1	190.5	0.99	0.5	4.1	0.443	**0.091**	**90.1%**
POST RUN 2 SPIKE_000466.LAB	1/30/24	11:08:47	8.2	7.4	-0.2	190.5	0.99	0.5	4.1	0.440	**0.091**	**90.0%**
POST RUN 2 SPIKE_000467.LAB	1/30/24	11:08:55	8.2	7.4	-0.3	190.5	0.99	0.5	4.4	0.449	**0.092**	**95.5%**

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
POST RUN 2 CTS_000474.LAB	1/30/24	11:10:34	0.1	0.0	-0.1	190.4	0.99	97.3	-0.9	-0.019	**99.7%**
POST RUN 2 CTS_000475.LAB	1/30/24	11:10:42	0.1	0.0	0.0	190.4	0.99	97.3	-1.1	-0.005	**99.8%**
POST RUN 2 CTS_000476.LAB	1/30/24	11:10:50	0.1	0.0	0.0	190.5	0.99	97.6	-0.8	-0.011	**100.1%**
POST RUN 2 CTS_000477.LAB	1/30/24	11:10:57	0.0	0.0	0.1	190.5	0.99	97.9	-0.6	-0.009	**100.4%**
POST RUN 2 CTS_000478.LAB	1/30/24	11:11:05	0.1	0.0	-0.1	190.5	0.99	97.4	-0.5	-0.019	**99.9%**
POST RUN 2 CTS_000479.LAB	1/30/24	11:11:13	0.0	0.0	0.0	190.6	0.99	98.2	-0.9	-0.006	**100.6%**
POST RUN 2 CTS_000480.LAB	1/30/24	11:11:21	0.0	0.0	0.0	190.7	0.99	97.6	-1.1	-0.019	**100.0%**
POST RUN 2 CTS_000481.LAB	1/30/24	11:11:29	0.0	0.0	0.0	190.7	0.99	97.7	-0.7	-0.020	**100.2%**

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_000523.LAB	1/30/24	11:39:26	8.9	8.0	-0.2	190.4	0.99	0.6	0.2	-0.002
RUN 3_000524.LAB	1/30/24	11:40:28	8.9	8.1	-0.1	190.4	0.99	0.6	0.2	-0.005
RUN 3_000525.LAB	1/30/24	11:41:31	8.9	8.0	-0.1	190.6	0.99	0.5	0.2	-0.005
									0.2	**-0.004**

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 3 SPIKE_000591.LAB	1/30/24	12:42:29	8.2	7.3	-0.1	190.7	0.99	0.6	4.9	0.477	**0.098**	**96.3%**
POST RUN 3 SPIKE_000592.LAB	1/30/24	12:42:37	8.2	7.2	-0.3	190.7	0.99	0.6	4.9	0.478	**0.098**	**97.2%**
POST RUN 3 SPIKE_000593.LAB	1/30/24	12:42:45	8.2	7.3	-0.2	190.7	0.99	0.3	4.7	0.486	**0.100**	**90.9%**
POST RUN 3 SPIKE_000594.LAB	1/30/24	12:42:53	8.1	7.2	-0.1	190.7	0.99	0.3	5.2	0.484	**0.100**	**101.7%**
POST RUN 3 SPIKE_000595.LAB	1/30/24	12:43:01	8.1	7.2	-0.3	190.8	0.99	0.3	5.0	0.468	**0.096**	**101.2%**
POST RUN 3 SPIKE_000596.LAB	1/30/24	12:43:09	8.1	7.2	-0.2	190.7	0.99	0.5	4.2	0.480	**0.099**	**82.7%**
POST RUN 3 SPIKE_000597.LAB	1/30/24	12:43:16	8.1	7.3	-0.1	190.7	0.99	0.5	5.1	0.493	**0.101**	**97.6%**
POST RUN 3 SPIKE_000598.LAB	1/30/24	12:43:24	8.1	7.3	-0.1	190.6	0.99	0.5	5.0	0.481	**0.099**	**98.8%**

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 3 CTS_000603.LAB	1/30/24	12:44:53	0.1	0.0	0.0	190.8	0.99	97.7	-0.9	-0.010	**100.1%**
POST RUN 3 CTS_000604.LAB	1/30/24	12:45:01	0.1	0.0	0.0	190.8	0.99	97.5	-1.1	-0.011	**100.0%**
POST RUN 3 CTS_000605.LAB	1/30/24	12:45:09	0.1	0.0	0.0	190.8	0.99	97.9	-0.8	-0.010	**100.3%**
POST RUN 3 CTS_000606.LAB	1/30/24	12:45:17	0.1	0.0	-0.1	190.8	0.99	97.4	-0.9	-0.011	**99.9%**
POST RUN 3 CTS_000607.LAB	1/30/24	12:45:25	0.0	0.0	-0.1	190.8	0.99	97.4	-0.7	-0.006	**99.8%**
POST RUN 3 CTS_000608.LAB	1/30/24	12:45:32	0.0	0.0	0.0	190.8	0.99	97.5	-1.0	-0.023	**100.0%**
POST RUN 3 CTS_000609.LAB	1/30/24	12:45:40	0.0	0.0	0.0	190.8	0.99	97.6	-0.7	-0.006	**100.1%**
POST RUN 3 CTS_000610.LAB	1/30/24	12:45:48	0.0	0.0	0.1	190.8	0.99	98.1	-0.8	-0.014	**100.6%**

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Operating Condition: Mill On

Test Location: Kiln 3 Common Stack
Date: 1/30/2024
Operator: A. Benninghoff
FTIR s/n: 00612

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
CTS DIRECT_000778.LAB	1/30/24	15:01:11	0.0	0.0	0.0	190.9	0.99	97.1	-1.0	-0.008	**99.5%**
CTS DIRECT_000779.LAB	1/30/24	15:01:19	0.0	0.0	0.0	190.9	0.99	97.1	-0.7	-0.009	**99.6%**
CTS DIRECT_000780.LAB	1/30/24	15:01:28	0.0	0.0	-0.1	190.9	0.99	97.3	-0.5	-0.020	**99.8%**
CTS DIRECT_000781.LAB	1/30/24	15:01:35	0.0	0.0	0.1	190.9	0.99	97.3	-1.0	-0.023	**99.8%**
CTS DIRECT_000782.LAB	1/30/24	15:01:43	0.0	0.0	0.0	190.9	0.99	97.4	-0.5	-0.024	**99.9%**
CTS DIRECT_000783.LAB	1/30/24	15:01:51	0.0	0.0	-0.1	190.9	0.99	96.9	-0.5	-0.009	**99.4%**
CTS DIRECT_000784.LAB	1/30/24	15:01:59	0.0	0.0	0.0	190.8	0.99	97.3	-1.0	-0.009	**99.7%**
CTS DIRECT_000785.LAB	1/30/24	15:02:06	0.0	0.0	0.0	190.8	0.99	97.3	-0.9	-0.018	**99.8%**
	Average							**97.2**			

Post Test N2, Direct Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
ZERO GAS 126 DIR_000786.LAB	1/30/24	15:05:28	0.0	0.0	-0.1	190.8	0.99	0.2	-0.7	0.002
ZERO GAS 126 DIR_000787.LAB	1/30/24	15:07:34	0.0	0.0	0.0	190.7	0.99	0.1	-0.9	0.000
ZERO GAS 126 DIR_000788.LAB	1/30/24	15:09:39	0.0	0.0	0.0	190.9	0.99	0.1	-0.9	0.002

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Operating Condition: Mill Off

Test Location: Kiln 3 Common Stack
Date: 1/31/2024
Operator: A. Benninghoff
FTIR s/n: 612

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
BACKGROUND_000023.LAB	1/31/24	6:51:56	0.1	0.0	0.0	191.0	0.99	0.1	-0.1	-0.002
BACKGROUND_000024.LAB	1/31/24	6:52:04	0.1	0.0	-0.1	190.9	0.99	0.3	0.1	0.006
BACKGROUND_000025.LAB	1/31/24	6:52:11	0.1	0.0	-0.1	191.0	0.99	0.1	0.2	0.004
BACKGROUND_000026.LAB	1/31/24	6:52:19	0.1	0.0	0.0	191.0	0.99	0.3	-0.4	-0.008
BACKGROUND_000027.LAB	1/31/24	6:52:27	0.1	0.0	0.0	191.0	0.99	0.2	-0.3	0.012
BACKGROUND_000028.LAB	1/31/24	6:52:35	0.1	0.0	0.0	190.9	0.99	0.1	0.2	-0.005
BACKGROUND_000029.LAB	1/31/24	6:52:43	0.1	0.0	0.0	191.0	0.99	0.2	-0.2	0.007
BACKGROUND_000030.LAB	1/31/24	6:52:51	0.1	0.0	0.0	191.0	0.99	0.0	0.1	-0.008
BACKGROUND_000031BKG.LAB	1/31/24	6:55:10	0.0	0.0	0.0	191.0	0.99	0.0	0.0	0.000

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 DIRECT_000033.LAB	1/31/24	6:56:09	0.0	0.0	0.0	191.0	0.99	97.0	-0.1	-0.016	**97.0%**
CTS DIRECT_000034.LAB	1/31/24	6:56:17	0.0	0.0	0.0	191.0	0.99	96.8	0.4	-0.017	**96.8%**
CTS DIRECT_000035.LAB	1/31/24	6:56:25	0.0	0.0	0.0	191.1	0.99	97.2	0.0	-0.013	**97.2%**
CTS DIRECT_000036.LAB	1/31/24	6:56:33	0.0	0.0	0.0	191.0	0.99	97.3	-0.3	-0.021	**97.3%**
CTS DIRECT_000037.LAB	1/31/24	6:56:41	0.0	0.0	0.1	191.0	0.99	97.1	0.1	-0.020	**97.1%**
CTS DIRECT_000038.LAB	1/31/24	6:56:49	0.0	0.0	-0.1	191.0	0.99	97.2	-0.2	-0.010	**97.2%**
CTS DIRECT_000039.LAB	1/31/24	6:56:57	0.0	0.0	0.0	191.0	0.99	97.2	0.3	-0.007	**97.2%**
	Average							**97.1**			**97.1%**

Analyte Spike Gas (HCN) Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % HCN
HCN DIRECT_000046.LAB	1/31/24	6:58:14	0.0	0.0	0.0	191.0	0.99	-0.5	49.0	4.818	**98.6%**
HCN DIRECT_000047.LAB	1/31/24	6:58:21	0.0	0.0	-0.2	190.9	0.99	-0.3	49.1	4.829	**98.8%**
HCN DIRECT_000048.LAB	1/31/24	6:58:29	0.0	0.0	0.0	190.9	0.99	-0.3	49.5	4.818	**99.5%**
HCN DIRECT_000049.LAB	1/31/24	6:58:37	0.0	0.0	-0.1	191.0	0.99	-0.2	49.3	4.808	**99.1%**
HCN DIRECT_000050.LAB	1/31/24	6:58:45	0.0	0.0	-0.1	190.9	0.99	-0.3	49.4	4.841	**99.4%**
HCN DIRECT_000051.LAB	1/31/24	6:58:53	0.0	0.0	0.0	191.0	0.99	-0.2	49.5	4.821	**99.5%**
HCN DIRECT_000052.LAB	1/31/24	6:59:01	0.0	0.0	0.0	191.0	0.99	-0.3	49.1	4.831	**98.7%**
HCN DIRECT_000053.LAB	1/31/24	6:59:09	0.0	0.0	0.1	191.0	0.99	-0.5	49.6	4.823	**99.8%**
	Average								**49.3**	**4.824**	**99.2%**

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_000280.LAB	1/31/24	7:35:05	0.1	0.0	-0.1	190.9	0.99	97.1	0.5	-0.012	**97.1%**
CTS REMOTE_000281.LAB	1/31/24	7:35:14	0.1	0.0	0.0	190.9	0.99	97.2	-0.1	-0.018	**97.2%**
CTS REMOTE_000282.LAB	1/31/24	7:35:21	0.1	0.0	0.0	190.9	0.99	97.1	0.4	-0.020	**97.1%**
CTS REMOTE_000283.LAB	1/31/24	7:35:29	0.1	0.0	-0.1	190.9	0.99	97.1	0.4	-0.007	**97.1%**
CTS REMOTE_000284.LAB	1/31/24	7:35:37	0.1	0.0	0.0	190.9	0.99	97.0	0.0	-0.009	**97.0%**
CTS REMOTE_000285.LAB	1/31/24	7:35:45	0.1	0.0	0.0	191.0	0.99	97.3	0.2	-0.008	**97.3%**
CTS REMOTE_000286.LAB	1/31/24	7:35:53	0.1	0.0	0.0	191.0	0.99	97.1	0.1	-0.011	**97.1%**
CTS REMOTE_000287.LAB	1/31/24	7:36:01	0.1	0.0	-0.1	191.0	0.99	97.6	0.5	-0.004	**97.6%**

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_000276.LAB	1/31/24	7:34:34	0.6	0.1	-0.1	190.9	0.99	0.6	0.2	-0.006	-
CTS REMOTE_000277.LAB	1/31/24	7:34:42	0.3	0.0	0.1	190.9	0.99	79.7	0.3	-0.023	**15.859**
CTS REMOTE_000278.LAB	1/31/24	7:34:50	0.2	0.0	0.0	190.9	0.99	97.0	0.3	-0.022	**23.859**
CTS REMOTE_000279.LAB	1/31/24	7:34:58	0.1	0.0	0.0	190.9	0.99	97.0	0.2	-0.011	
CTS REMOTE_000280.LAB	1/31/24	7:35:05	0.1	0.0	-0.1	190.9	0.99	97.1	0.5	-0.012	
CTS REMOTE_000281.LAB	1/31/24	7:35:14	0.1	0.0	0.0	190.9	0.99	97.2	-0.1	-0.018	
CTS REMOTE_000282.LAB	1/31/24	7:35:21	0.1	0.0	0.0	190.9	0.99	97.1	0.4	-0.020	
CTS REMOTE_000283.LAB	1/31/24	7:35:29	0.1	0.0	-0.1	190.9	0.99	97.1	0.4	-0.007	
CTS REMOTE_000284.LAB	1/31/24	7:35:37	0.1	0.0	0.0	190.9	0.99	97.0	0.0	-0.009	

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Operating Condition: Mill Off

Test Location: Kiln 3 Common Stack
Date: 1/31/2024
Operator: A. Benninghoff
FTIR s/n: 612

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_000314.LAB	1/31/24	7:41:23	12.6	11.4	-0.2	190.9	0.99	0.4	1.5	-0.011
NATIVE_000315.LAB	1/31/24	7:41:30	12.5	11.3	-0.2	191.0	0.99	0.6	1.4	-0.008
NATIVE_000316.LAB	1/31/24	7:41:38	12.5	11.2	-0.1	191.0	0.99	0.7	1.3	0.001
									1.4	**-0.006**

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
PRE 1 SPIKE_000325.LAB	1/31/24	7:43:29	11.1	9.8	-0.2	191.0	0.99	0.4	5.5	0.463	**0.096**	**90.7%**
PRE 1 SPIKE_000326.LAB	1/31/24	7:43:37	11.1	9.8	-0.2	191.0	0.99	0.4	6.1	0.470	**0.097**	**99.6%**
PRE 1 SPIKE_000327.LAB	1/31/24	7:43:45	11.0	9.9	-0.1	191.0	0.99	0.7	5.8	0.468	**0.097**	**94.9%**
PRE 1 SPIKE_000328.LAB	1/31/24	7:43:53	11.1	9.9	-0.2	191.0	0.99	0.4	5.3	0.469	**0.097**	**87.9%**
PRE 1 SPIKE_000329.LAB	1/31/24	7:44:01	11.1	9.8	-0.2	191.0	0.99	0.4	5.9	0.470	**0.097**	**97.5%**
PRE 1 SPIKE_000330.LAB	1/31/24	7:44:08	11.1	9.8	-0.2	190.9	0.99	0.5	5.5	0.471	**0.098**	**90.3%**
PRE 1 SPIKE_000331.LAB	1/31/24	7:44:16	11.0	9.8	-0.2	190.9	0.99	0.4	5.8	0.476	**0.099**	**93.8%**
PRE 1 SPIKE_000332.LAB	1/31/24	7:44:24	11.0	9.9	-0.2	190.9	0.99	0.4	5.5	0.475	**0.098**	**89.1%**

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
RUN 1_000442.LAB	1/31/24	9:32:58	12.7	11.0	-0.2	190.9	0.99	0.5	1.4	-0.003
RUN 1_000443.LAB	1/31/24	9:34:01	12.7	11.0	-0.1	191.0	0.99	0.5	1.5	-0.009
RUN 1_000444.LAB	1/31/24	9:35:03	12.7	10.9	-0.2	190.9	0.99	0.5	1.5	-0.004
									1.5	**-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
POST RUN 1 SPIKE_000459.LAB	1/31/24	9:37:53	11.5	10.1	-0.1	190.9	0.99	0.3	6.0	0.443	**0.092**	**101.9%**
POST RUN 1 SPIKE_000460.LAB	1/31/24	9:38:01	11.5	10.1	-0.2	190.9	0.99	0.6	5.4	0.452	**0.094**	**91.3%**
POST RUN 1 SPIKE_000461.LAB	1/31/24	9:38:08	11.5	10.2	-0.2	190.9	0.99	0.5	5.8	0.451	**0.094**	**98.0%**
POST RUN 1 SPIKE_000462.LAB	1/31/24	9:38:16	11.6	10.3	-0.2	191.0	0.99	0.3	5.6	0.442	**0.092**	**95.3%**
POST RUN 1 SPIKE_000463.LAB	1/31/24	9:38:24	11.5	10.3	-0.2	191.0	0.99	0.3	5.6	0.442	**0.092**	**95.7%**
POST RUN 1 SPIKE_000464.LAB	1/31/24	9:38:32	11.5	10.3	-0.2	191.0	0.99	0.3	5.9	0.449	**0.093**	**99.1%**
POST RUN 1 SPIKE_000465.LAB	1/31/24	9:38:40	11.5	10.2	-0.2	190.9	0.99	0.5	5.3	0.446	**0.092**	**90.1%**
POST RUN 1 SPIKE_000466.LAB	1/31/24	9:38:48	11.5	10.2	-0.2	191.0	0.99	0.4	5.8	0.453	**0.094**	**97.8%**

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_000473.LAB	1/31/24	9:40:34	0.0	0.0	0.1	191.0	0.99	96.9	-0.1	-0.004	**97.0%**
POST RUN 1 CTS_000474.LAB	1/31/24	9:40:42	0.0	0.1	0.0	191.0	0.99	96.8	0.3	-0.011	**96.8%**
POST RUN 1 CTS_000475.LAB	1/31/24	9:40:50	0.0	0.0	0.0	191.0	0.99	96.7	0.4	-0.019	**96.7%**
POST RUN 1 CTS_000476.LAB	1/31/24	9:40:58	0.0	0.0	0.1	191.0	0.99	97.6	0.1	-0.015	**97.6%**
POST RUN 1 CTS_000477.LAB	1/31/24	9:41:06	0.0	0.0	0.0	191.0	0.99	97.0	0.3	-0.019	**97.0%**
POST RUN 1 CTS_000478.LAB	1/31/24	9:41:13	0.0	0.0	0.0	191.0	0.99	97.0	0.5	-0.020	**97.0%**
POST RUN 1 CTS_000479.LAB	1/31/24	9:41:21	0.0	0.0	-0.1	190.9	0.99	97.2	0.1	-0.016	**97.2%**
POST RUN 1 CTS_000480.LAB	1/31/24	9:41:29	0.0	0.0	0.0	191.0	0.99	97.3	0.5	-0.015	**97.3%**

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Operating Condition: Mill Off

Test Location: Kiln 3 Common Stack
Date: 1/31/2024
Operator: A. Benninghoff
FTIR s/n: 612

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_000578.LAB	1/31/24	11:08:47	12.9	11.2	-0.1	191.0	0.99	0.5	0.4	-0.006
RUN 2_000579.LAB	1/31/24	11:09:50	12.9	11.2	-0.2	191.0	0.99	0.5	0.5	-0.003
RUN 2_000580.LAB	1/31/24	11:10:53	12.9	11.3	-0.2	191.1	0.99	0.5	0.3	-0.006
									0.4	**-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 2 SPIKE_000588.LAB	1/31/24	11:12:45	11.8	10.2	-0.2	191.0	0.99	0.6	4.9	0.489	**0.101**	**92.4%**
POST RUN 2 SPIKE_000589.LAB	1/31/24	11:12:53	11.8	10.2	-0.2	191.0	0.99	0.4	4.6	0.490	**0.102**	**85.8%**
POST RUN 2 SPIKE_000590.LAB	1/31/24	11:13:00	11.7	10.3	-0.2	190.9	0.99	0.3	4.8	0.494	**0.102**	**89.6%**
POST RUN 2 SPIKE_000591.LAB	1/31/24	11:13:08	11.7	10.2	-0.1	191.0	0.99	0.3	5.0	0.486	**0.101**	**94.2%**
POST RUN 2 SPIKE_000592.LAB	1/31/24	11:13:16	11.7	10.0	-0.1	190.9	0.99	0.5	5.2	0.486	**0.101**	**97.2%**
POST RUN 2 SPIKE_000593.LAB	1/31/24	11:13:24	11.6	10.0	-0.2	190.9	0.99	0.4	4.8	0.484	**0.100**	**91.5%**
POST RUN 2 SPIKE_000594.LAB	1/31/24	11:13:32	11.6	10.2	-0.2	190.9	0.99	0.3	4.7	0.495	**0.103**	**87.8%**
POST RUN 2 SPIKE_000595.LAB	1/31/24	11:13:40	11.6	10.3	-0.1	190.9	0.99	0.4	5.0	0.486	**0.101**	**95.2%**

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 2 CTS_000603.LAB	1/31/24	11:15:05	0.1	0.0	0.0	191.0	0.99	96.7	-0.5	-0.012	**99.5%**
POST RUN 2 CTS_000604.LAB	1/31/24	11:15:13	0.1	0.1	0.1	190.9	0.99	97.0	-0.5	-0.003	**99.9%**
POST RUN 2 CTS_000605.LAB	1/31/24	11:15:21	0.0	0.1	0.0	190.9	0.99	97.1	-0.5	-0.014	**100.0%**
POST RUN 2 CTS_000606.LAB	1/31/24	11:15:29	0.0	0.0	-0.1	190.9	0.99	97.1	-1.1	-0.020	**100.0%**
POST RUN 2 CTS_000607.LAB	1/31/24	11:15:36	0.0	0.1	0.0	191.0	0.99	97.2	-1.0	-0.011	**100.1%**
POST RUN 2 CTS_000608.LAB	1/31/24	11:15:45	0.0	0.0	-0.1	191.0	0.99	97.0	-1.3	-0.014	**99.9%**
POST RUN 2 CTS_000609.LAB	1/31/24	11:15:52	0.0	0.0	0.0	190.9	0.99	97.3	-1.1	-0.020	**100.2%**
POST RUN 2 CTS_000610.LAB	1/31/24	11:16:00	0.0	0.0	0.1	190.9	0.99	97.1	-0.9	-0.018	**100.0%**

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 3_000720.LAB	1/31/24	12:53:15	13.3	11.1	-0.2	190.8	0.99	0.5	0.6	-0.004
RUN 3_000721.LAB	1/31/24	12:54:18	13.1	11.0	-0.2	190.9	0.99	0.4	0.5	-0.003
RUN 3_000722.LAB	1/31/24	12:55:21	13.2	11.1	-0.2	190.9	0.99	0.4	0.5	-0.004
									0.5	**-0.004**

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 3 SPIKE_000733.LAB	1/31/24	12:57:22	11.9	10.0	-0.2	190.9	0.99	0.5	5.0	0.475	**0.098**	**93.9%**
POST RUN 3 SPIKE_000734.LAB	1/31/24	12:57:30	11.8	10.0	-0.2	190.9	0.99	0.2	5.1	0.477	**0.099**	**95.1%**
POST RUN 3 SPIKE_000735.LAB	1/31/24	12:57:38	11.8	10.0	-0.2	190.9	0.99	0.4	4.8	0.471	**0.098**	**89.9%**
POST RUN 3 SPIKE_000736.LAB	1/31/24	12:57:45	11.8	10.0	-0.2	190.9	0.99	0.0	4.9	0.472	**0.098**	**92.9%**
POST RUN 3 SPIKE_000737.LAB	1/31/24	12:57:54	11.8	10.1	-0.1	190.9	0.99	0.5	5.0	0.476	**0.099**	**93.3%**
POST RUN 3 SPIKE_000738.LAB	1/31/24	12:58:01	11.9	10.1	-0.2	190.9	0.99	0.6	5.5	0.462	**0.096**	**105.0%**
POST RUN 3 SPIKE_000739.LAB	1/31/24	12:58:09	11.8	10.1	-0.1	190.9	0.99	0.5	5.2	0.468	**0.097**	**98.3%**
POST RUN 3 SPIKE_000740.LAB	1/31/24	12:58:17	11.8	9.9	-0.3	190.9	0.99	0.3	5.2	0.465	**0.096**	**99.4%**

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
POST RUN 3 CTS_000747.LAB	1/31/24	12:59:34	0.1	0.1	0.0	190.7	0.99	96.8	-0.5	-0.009	**99.7%**
POST RUN 3 CTS_000748.LAB	1/31/24	12:59:42	0.1	0.0	0.0	190.7	0.99	97.0	-0.4	-0.005	**99.8%**
POST RUN 3 CTS_000749.LAB	1/31/24	12:59:50	0.0	0.0	0.1	190.8	0.99	97.1	-0.7	-0.017	**100.0%**
POST RUN 3 CTS_000750.LAB	1/31/24	12:59:57	0.0	0.0	0.0	190.8	0.99	97.2	-0.4	-0.027	**100.1%**
POST RUN 3 CTS_000751.LAB	1/31/24	13:00:05	0.0	0.0	0.1	190.8	0.99	97.4	-0.5	-0.006	**100.3%**
POST RUN 3 CTS_000752.LAB	1/31/24	13:00:14	0.0	0.0	-0.1	190.8	0.99	97.1	-0.5	-0.014	**100.0%**
POST RUN 3 CTS_000753.LAB	1/31/24	13:00:21	0.0	0.0	0.0	190.8	0.99	97.2	-0.9	-0.016	**100.1%**
POST RUN 3 CTS_000754.LAB	1/31/24	13:00:29	0.0	0.0	0.0	190.8	0.99	97.1	-0.5	-0.017	**100.0%**

Client: Holcim (US) Inc.
Facility: Ravena Cement Plant
Project #: M234506
Operating Condition: Mill Off

Test Location: Kiln 3 Common Stack
Date: 1/31/2024
Operator: A. Benninghoff
FTIR s/n: 612

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
POST RUN 3 CTS DIRECT_000777.LAB	1/31/24	13:05:42	0.0	0.0	-0.1	190.8	0.99	97.7	-0.5	-0.022	**100.6%**
POST RUN 3 CTS DIRECT_000778.LAB	1/31/24	13:05:50	0.0	0.0	0.0	190.8	0.99	97.6	-1.2	-0.017	**100.5%**
POST RUN 3 CTS DIRECT_000779.LAB	1/31/24	13:05:58	0.0	0.0	-0.2	190.8	0.99	97.7	-1.3	-0.004	**100.6%**
POST RUN 3 CTS DIRECT_000780.LAB	1/31/24	13:06:06	0.0	0.0	0.0	190.8	0.99	97.6	-0.2	-0.013	**100.6%**
POST RUN 3 CTS DIRECT_000781.LAB	1/31/24	13:06:13	0.0	0.0	-0.1	190.8	0.99	97.7	-0.7	-0.007	**100.6%**
POST RUN 3 CTS DIRECT_000782.LAB	1/31/24	13:06:21	-0.1	0.0	-0.1	190.9	0.99	97.5	-0.6	-0.015	**100.4%**
POST RUN 3 CTS DIRECT_000783.LAB	1/31/24	13:06:29	-0.1	0.0	0.0	190.9	0.99	97.8	-0.9	-0.012	**100.7%**
POST RUN 3 CTS DIRECT_000784.LAB	1/31/24	13:06:37	-0.1	0.0	0.0	190.8	0.99	97.7	-0.7	-0.013	**100.6%**
	Average							**97.7**			

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
128 SCAN N2_000786.LAB	1/31/24	13:12:09	-0.1	0.0	0.0	190.7	0.99	0.1	-0.8	0.001
128 SCAN N2_000787.LAB	1/31/24	13:14:15	-0.1	0.0	0.0	190.7	0.99	0.0	-0.9	0.001
128 SCAN N2_000788.LAB	1/31/24	13:16:20	-0.1	0.0	0.0	190.8	0.99	0.0	-0.8	-0.001

Appendix H - 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:	E02NI88E15A3424	Reference Number:	54-402837999-1
Cylinder Number:	CC400459	Cylinder Volume:	146.0 CF
Laboratory:	124 - Chicago (SAP) - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12023	Valve Outlet:	590
Gas Code:	O2,BALN	Certification Date:	Sep 12, 2023

Expiration Date: Sep 12, 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
OXYGEN	12.00 %	11.92 %	G1	+/- 0.5% NIST Traceable	09/12/2023
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11060620	CC340439	14.93 % OXYGEN/NITROGEN	+/- 0.2%	Nov 02, 2028

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
O2-1 HORIBA MPA-510 3VUYL9NR	Paramagnetic	Aug 31, 2023

Triad Data Available Upon Request

Signature on file
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:	141-402876934-1
Cylinder Number:	CC497358	Cylinder Volume:	144.4 CF
Laboratory:	124 - Stryker (SAP) - OH	Cylinder Pressure:	2015 PSIG
Analysis Date:	Oct 24, 2023	Valve Outlet:	350
Lot Number:	141-402876934-1		

Expiration Date: Oct 24, 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	99.99 PPM	+/- 1%
NITROGEN	Balance		

Signature on file
Approved for Release

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

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:	E02NI78E15A0124	Reference Number:	54-402139852-1
Cylinder Number:	EB0061546	Cylinder Volume:	146.3 CF
Laboratory:	124 - Chicago (SAP) - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12021	Valve Outlet:	590
Gas Code:	O2,BALN	Certification Date:	Jun 22, 2021

Expiration Date: Jun 22, 2029

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	22.00 %	22.57 %	G1	+/- 1.0% NIST Traceable	06/22/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
O2-1 HORIBA MPA-510 3VUYL9NR	Paramagnetic	Jun 14, 2021

Triad Data Available Upon Request

Signature on file
Approved for Release

END OF THE REPORT