

Section 114 Information Collection Request Emissions Test Report

Heidelberg Materials US Cement, LLC
Nazareth Cement Manufacturing Facility
EPA Registry ID: 110070834829
3938 Easton-Nazareth Highway
Nazareth, PA 18064
Report No. M234208E





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**Report Submittal Date:
March 4, 2024**

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TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 TEST REQUIREMENTS	2
3.0 QA SPECIFICATIONS AND PROCESS DIAGRAM	4
3-1 QA/QC Specifications.....	4
3-2 Process Flow Diagram	5
4.0 TEST PROCEDURES	6
4.1 Method 1 Sample and Velocity Traverse Determination	6
4.2 Method 2 Volumetric Flow Rate Determination	6
4.3 Method 3A Oxygen (O ₂) and Carbon Dioxide (CO ₂) Determination.....	6
4.4 Method 26A Hydrogen Fluoride (HF) and Chlorine (Cl ₂) Determination	7
4.5 Method 320 Speciated Flue Gas Concentration Determinations	7
5.0 TEST RESULTS SUMMARIES.....	9
6.0 CERTIFICATION.....	15
APPENDICES	
Appendix A – Plant Operating Data.....	17
Appendix B – Test Section Diagrams.....	26
Appendix C – Sample Train Diagrams	29
Appendix D – Calculation Nomenclature and Formulas.....	33
Appendix E – Laboratory Sample Analysis	46
Appendix F – Reference Method Test Data	61
Appendix G – Calibration Data	98
Appendix H – Gas Cylinder Certifications	137

1.0 INTRODUCTION

Mostardi Platt conducted an air emissions test program for Heidelberg Materials US Cement, LLC at the Nazareth Cement Manufacturing Facility located in Nazareth, Pennsylvania. 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.

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

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

Location	Address	Contact
Facility Representative	Heidelberg Materials US Cement, LLC Nazareth Manufacturing Facility Easton-Nazareth Highway Nazareth, PA 18064	Luis Rodriguez (610) 746-3229 luis.rodriguez@heidelbergmaterials.com
Testing Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Eric Ehlers VP, Field Operations (630) 993-2100 eehlers@mp-mail.com

2.0 TEST REQUIREMENTS

Testing was performed at main kiln stack during both “mill on” and “mill off” operation conditions. The following table presents a list of the parameters tested, the applicable methodologies utilized, and average test results:

Source	Parameter Tested	Test Results	Method/Regulation Citation
Kiln Stack <u>Mill ON</u>	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.25 ppmvd @7% O ₂	
		≤ 0.12 lb/hr	
		≤ 0.0007 lb/ton clinker	
	HF ¹	≤ 0.11 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.25 ppmvd @7% O ₂	
		≤ 0.12 lb/hr	
		≤ 0.0007 lb/ton clinker	
	Chlorine (Cl ₂) ¹	≤ 0.03 ppmvd	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.07 ppmvd @7% O ₂	
		≤ 0.12 lb/hr	
		≤ 0.0007 lb/ton clinker	
	Hydrogen Cyanide (HCN)	1.03 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		2.58 ppmvd @7% O ₂	
		1.63 lb/hr	
		0.0099 lb/ton clinker	
	Oxygen (O ₂)	14.7 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO ₂)	9.6 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H ₂ O)	10.2 %	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 Cl₂ Method 26A results are reported as the average from Train A and Train B.

Source	Parameter Tested	Test Results	Method/Regulation Citation
Kiln Stack <u>Mill OFF</u>	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.20 ppmvd @7% O ₂	
		≤ 0.09 lb/hr	
		≤ 0.0006 lb/ton clinker	
	HF ²	≤ 0.15 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.25 ppmvd @7% O ₂	
		≤ 0.11 lb/hr	
		≤ 0.0007 lb/ton clinker	
	Chlorine (Cl ₂) ¹	≤ 0.04 ppmvd	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.07 ppmvd @7% O ₂	
		≤ 0.12 lb/hr	
		≤ 0.0007 lb/ton clinker	
	Hydrogen Cyanide (HCN)	1.04 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		2.12 ppmvd @7% O ₂	
		1.29 lb/hr	
		0.0078 lb/ton clinker	
	Oxygen (O ₂)	12.9 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO ₂)	11.8 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H ₂ O)	14.5 %	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

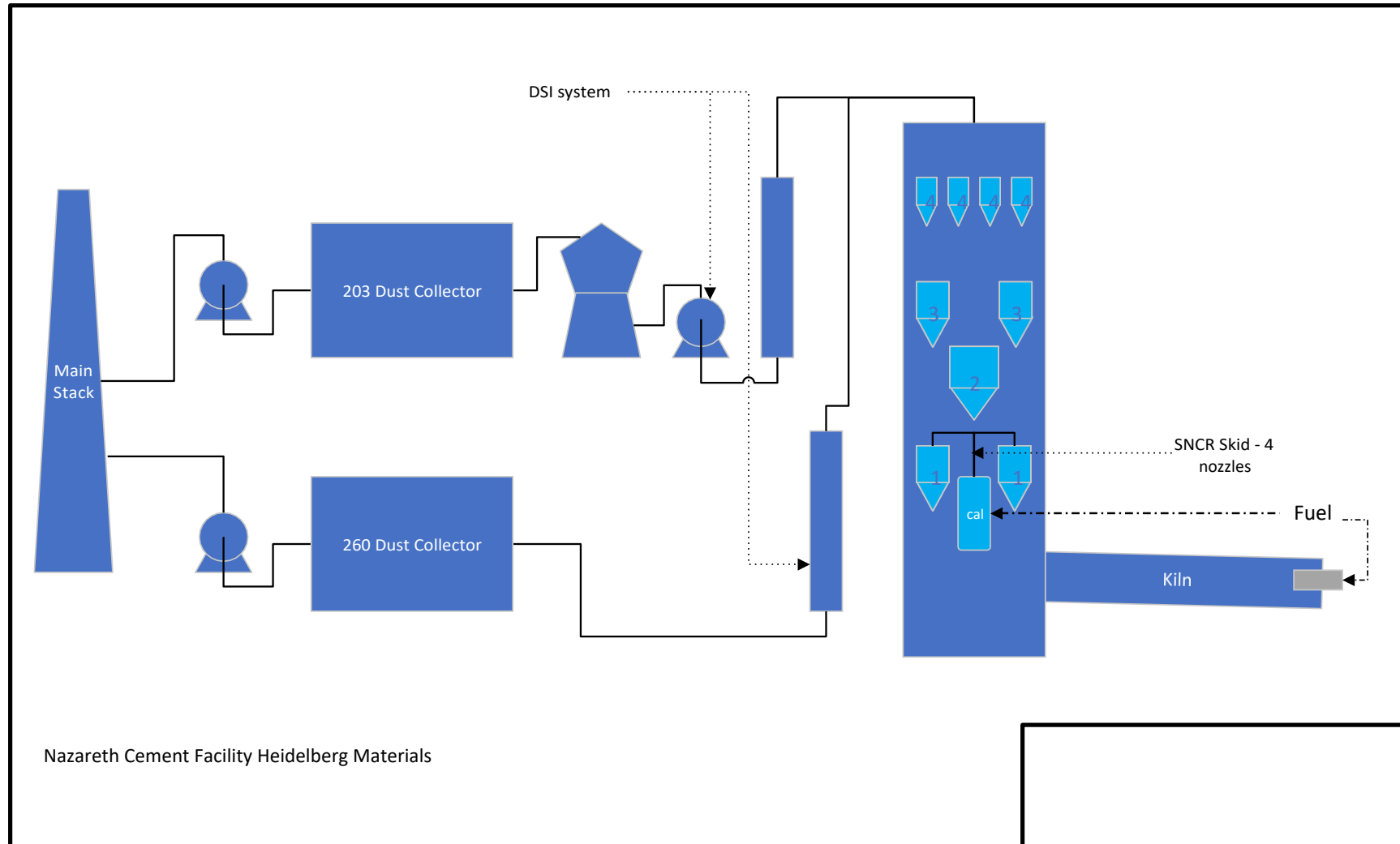
² HF and Cl₂ Method 26A results are reported as the average from Train A and Train B.

3.0 QA SPECIFICATIONS AND PROCESS DIAGRAM

3-1 QA/QC Specifications

Parameter	Method	QA/QC Specification	Acceptance Criteria	Actual Result
HCN	320	Method Detection Limit	0.5 ppm	0.3 ppmvw
		SNR	>2500 at 64 scans	4680 (Run 1 Average)
		S Beam	>0.9	0.9 (Run 1 Average)
		Direct HCN Analysis	±5% of tag value	-0.4%
		Dynamic Spike Analysis	≤10% of total sample volume	<10% for all spikes
			Spike gas ~twice native concentration or 3-4 ppm addition to native concentration	+4.2 ppm
			≤±20% of expected value or ≤±0.5 ppm, whichever is less restrictive	≤±20% of expected value
HF/Cl ₂	26A	Residuals	≤±0.3 ppm, or ≤±5% of measured value, whichever is less restrictive	≤0.3 ppm
		Method Detection Limit	300 µg	150 µg
		Paired Train Agreement	≤10% Relative Deviation or ≤0.2 ppm, whichever is less restrictive.	≤0.2 ppm

3-2 Process Flow Diagram



4.0 TEST PROCEDURES

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

4.1 Method 1 Sample and Velocity Traverse Determination

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

Sample Point Selection

Test Location	Stack Diameter	Port Length	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points
Kiln Stack	12.25 Feet	16.0 Inches	7.1 Diameters	7.1 Diameters	HF/Cl ₂ (26A)	16
					O ₂ (3A)	3 (stratification)
					HCN/HF/CO ₂ (320/3A)	1

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

4.2 Method 2 Volumetric Flow Rate Determination

The gas velocity and volumetric flowrate were determined using Method 2, 40CFR60, Appendix A, as an integrated part of the HF/Cl₂ 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 (O₂) and Carbon Dioxide (CO₂) Determination

O₂ and CO₂ concentrations were determined in accordance with Method 3A, 40CFR60, Appendix A and Method 320, 40CFR63, Appendix A, respectively. A Servomex analyzer was used to determine O₂ concentrations while the MKS 2030 analyzer was used to determine CO₂ concentrations. The O₂ 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 (Cl₂) Determination

HF and Cl₂ 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 sixteen (16) test points were sampled per run on the Kiln Stack. The sample was extracted isokinetically from the gas stream and passed through dilute sulfuric acid (0.1N H₂SO₄). HF was collected in the dilute acid. Cl₂ 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 H₂SO₄, 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 H₂SO₄ impinger catch samples were analyzed for HF while the 0.1N NaOH impinger catch samples were analyzed for Cl₂. The method detection limit (MDL) was determined for both HF and Cl₂ using the "Definition and Procedure for the Determination of the Method Detection Limit, Revision 2". A value of 150ug was used for both compounds. All equipment used was calibrated in accordance with the specifications of the method. Calibration data is appended.

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

4.5 Method 320 Speciated Flue Gas Concentration Determinations

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

The average gas effluent concentrations were determined from the average gas concentration displayed by the MKS 2030 analyzer. The Method 320 sampling system vaporizes water droplets similar to Method 26A. The difference is that Method 320 is an extractive method that calculates concentration based on compounds continuously flowing through the FTIR gas cell where the Method 26A captures water vapor in an impinger train. Calculating Method 320 concentrations on a dry basis uses the water vapor contained in the FTIR gas cell. In order to calculate lb/hr, the dry FTIR concentration is used in combination with the dry stack gas volumetric flow rate.

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

FTIR technology works on the principle that most gases absorb infrared light. This is true for all compounds except for homonuclear diatomic molecules and noble gases such as: N₂, O₂, H₂, 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: Heidelberg Materials US Cement, LLC

Facility: Nazareth Cement Plant

Test Location: Main Kiln Stack

Test Method: 26A - Combined Results

Source Condition	Mill On	Mill On	Mill On	
Date	12/5/23	12/5/23	12/5/23	
Start Time	11:50	13:25	15:00	
End Time	13:06	14:41	16:16	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Velocity, ft/sec	71.123	71.175	70.812	71.037
Gas Volumetric Flow Rate, acfm	502,942	503,316	500,748	502,335
Gas Volumetric Flow Rate, dscfm	341,437	335,283	335,355	337,358
Gas Volumetric Flow Rate, scfm	375,026	374,283	372,828	374,046
Average %CO ₂ by volume, dry basis	9.6	9.6	9.5	9.6
Average %O ₂ by volume, dry basis	14.9	14.6	14.6	14.7
Clinker production, ton/hr	164.9	164.9	164.9	164.9
Chlorine (Cl₂) Emissions				
ppm ≤	0.03	≤ 0.03	≤ 0.03	≤ 0.03
ppm@7%O ₂ ≤	0.07	≤ 0.07	≤ 0.07	≤ 0.07
lb/hr ≤	0.12	≤ 0.12	≤ 0.12	≤ 0.12
lb/ton of clinker ≤	0.0007	≤ 0.0007	≤ 0.0007	≤ 0.0007
Hydrogen Fluoride (HF) Emissions				
ppm ≤	0.11	≤ 0.11	≤ 0.11	≤ 0.11
ppm@7%O ₂ ≤	0.26	≤ 0.25	≤ 0.25	≤ 0.25
lb/hr ≤	0.12	≤ 0.12	≤ 0.12	≤ 0.12
lb/ton of clinker ≤	0.0007	≤ 0.0007	≤ 0.0007	≤ 0.0007

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Test Method: 26A - A Train

Source Condition	Mill On	Mill On	Mill On	
Date	12/5/23	12/5/23	12/5/23	
Start Time	11:50	13:25	15:00	
End Time	13:06	14:41	16:16	
	Run 1A	Run 2A	Run 3A	Average
Stack Conditions				
Average Gas Temperature, °F	230.4	232.3	233.3	232.0
Flue Gas Moisture, percent by volume	8.6%	10.3%	11.0%	10.0%
Average Flue Pressure, in. Hg	29.24	29.24	29.24	29.24
Gas Sample Volume, dscf	58.774	57.978	57.846	58.199
Average Gas Velocity, ft/sec	71.477	70.917	71.276	71.223
Gas Volumetric Flow Rate, acfm	505,448	501,495	504,032	503,658
Gas Volumetric Flow Rate, dscfm	345,255	335,428	333,859	338,181
Gas Volumetric Flow Rate, scfm	377,792	373,822	375,205	375,606
Average %CO ₂ by volume, dry basis	9.6	9.6	9.5	9.6
Average %O ₂ by volume, dry basis	14.9	14.6	14.6	14.7
Isokinetic Variance	100.7	102.2	102.5	101.8
Chlorine (Cl₂) Emissions				
ug of sample collected ≤	150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm ≤	0.03	≤ 0.03	≤ 0.03	≤ 0.03
Hydrogen Fluoride (HF) Emissions				
ug of sample collected ≤	150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm ≤	0.11	≤ 0.11	≤ 0.11	≤ 0.11

Client: Heidelberg Materials US Cement, LLC
Facility: Nazareth Cement Plant
Test Location: Main Kiln Stack
Test Method: 26A - B Train

Source Condition	Mill On	Mill On	Mill On	
Date	12/5/23	12/5/23	12/5/23	
Start Time	11:50	13:25	15:00	
End Time	13:06	14:41	16:16	
	Run 1B	Run 2B	Run 3B	Average
Stack Conditions				
Average Gas Temperature, °F	233.8	235.6	233.0	234.1
Flue Gas Moisture, percent by volume	9.3%	10.6%	9.1%	9.7%
Average Flue Pressure, in. Hg	29.24	29.24	29.24	29.24
Gas Sample Volume, dscf	55.865	56.034	55.580	55.826
Average Gas Velocity, ft/sec	70.768	71.433	70.347	70.849
Gas Volumetric Flow Rate, acfm	500,436	505,137	497,464	501,012
Gas Volumetric Flow Rate, dscfm	337,619	335,137	336,851	336,536
Gas Volumetric Flow Rate, scfm	372,260	374,744	370,450	372,485
Average %CO ₂ by volume, dry basis	9.6	9.6	9.5	9.6
Average %O ₂ by volume, dry basis	14.9	14.6	14.6	14.7
Isokinetic Variance	101.2	102.3	100.9	101.5
Chlorine (Cl₂) Emissions				
ug of sample collected	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03
Hydrogen Fluoride (HF) Emissions				
ug of sample collected	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm	≤ 0.11	≤ 0.11	≤ 0.11	≤ 0.11

Heidelberg Materials US Cement, Inc. Nazareth Cement Plant Main Kiln Stack Mill On Reference Method Test Data									
Test No.	Date	Start Time	End Time	O ₂ % (dry)	Moisture %	HCN ppmvw	HCN ppmvd @ 7% O ₂	HF ppmvw	HF ppmvd @ 7% O ₂
1	12/5/2023	11:50	12:48	14.9	10.2%	0.97	2.50	≤ 0.10	≤ 0.26
2	12/5/2023	13:25	14:24	14.6	10.1%	1.12	2.76	≤ 0.10	≤ 0.25
3	12/5/2023	15:00	15:59	14.6	10.4%	1.00	2.47	≤ 0.10	≤ 0.25
Average				14.7	10.2%	1.03	2.58	≤ 0.10	≤ 0.25

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	12/5/2023	11:50	12:48	341,437	164.9	1.55	0.0094	≤ 0.12	≤ 0.0007
2	12/5/2023	13:25	14:24	335,283	164.9	1.76	0.0107	≤ 0.12	≤ 0.0007
3	12/5/2023	15:00	15:59	335,355	164.9	1.58	0.0096	≤ 0.12	≤ 0.0007
Average				337,358	164.9	1.63	0.0099	≤ 0.12	≤ 0.0007

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Test Method: 26A - Combined Results

Source Condition	Mill Off	Mill Off	Mill Off	
Date	12/6/23	12/6/23	12/6/23	
Start Time	8:18	9:55	11:30	
End Time	9:34	11:11	12:46	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Velocity, ft/sec	56.624	59.759	60.254	58.879
Gas Volumetric Flow Rate, acfm	400,416	422,582	426,087	416,361
Gas Volumetric Flow Rate, dscfm	242,419	256,367	258,073	252,286
Gas Volumetric Flow Rate, scfm	282,323	297,984	300,773	293,693
Average %CO ₂ by volume, dry basis	12.1	11.5	11.7	11.8
Average %O ₂ by volume, dry basis	12.7	13.1	13.0	12.9
Clinker production, ton/hr	164.9	164.9	164.9	164.9
Chlorine (Cl₂) Emissions				
ppm ≤	0.04	≤ 0.04	≤ 0.04	≤ 0.04
ppm@7%O ₂ ≤	0.07	≤ 0.07	≤ 0.07	≤ 0.07
lb/hr ≤	0.12	≤ 0.11	≤ 0.12	≤ 0.12
lb/ton of clinker ≤	0.0007	≤ 0.0007	≤ 0.0007	≤ 0.0007
Hydrogen Fluoride (HF) Emissions				
ppm ≤	0.15	≤ 0.14	≤ 0.14	≤ 0.15
ppm@7%O ₂ ≤	0.25	≤ 0.25	≤ 0.25	≤ 0.25
lb/hr ≤	0.11	≤ 0.11	≤ 0.11	≤ 0.11
lb/ton of clinker ≤	0.0007	≤ 0.0007	≤ 0.0007	≤ 0.0007

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Test Method: 26A - Train A

Source Condition	Mill Off	Mill Off	Mill Off	
Date	12/6/23	12/6/23	12/6/23	
Start Time	8:18	9:55	11:30	
End Time	9:34	11:11	12:46	
	Run 1A	Run 2A	Run 3A	Average
Stack Conditions				
Average Gas Temperature, °F	272.2	272.7	272.8	272.6
Flue Gas Moisture, percent by volume	13.7%	13.7%	14.2%	13.9%
Average Flue Pressure, in. Hg	29.34	29.34	29.34	29.34
Gas Sample Volume, dscf	42.925	45.709	46.559	45.064
Average Gas Velocity, ft/sec	56.516	60.381	61.501	59.466
Gas Volumetric Flow Rate, acfm	399,656	426,985	434,903	420,515
Gas Volumetric Flow Rate, dscfm	243,997	260,493	263,771	256,087
Gas Volumetric Flow Rate, scfm	282,604	301,722	307,265	297,197
Average %CO ₂ by volume, dry basis	12.1	11.5	11.7	11.8
Average %O ₂ by volume, dry basis	12.7	13.1	13.0	12.9
Isokinetic Variance	104.1	103.8	104.4	104.1
Chlorine (Cl₂) Emissions				
ug of sample collected ≤	150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm ≤	0.04	≤ 0.04	≤ 0.04	≤ 0.04
Hydrogen Fluoride (HF) Emissions				
ug of sample collected ≤	150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm ≤	0.15	≤ 0.14	≤ 0.14	≤ 0.14

Client: Heidelberg Materials US Cement, LLC
Facility: Nazareth Cement Plant
Test Location: Main Kiln Stack
Test Method: 26A - B Train

Source Condition	Mill Off	Mill Off	Mill Off	
Date	12/6/23	12/6/23	12/6/23	
Start Time	8:18	9:55	11:30	
End Time	9:34	11:11	12:46	
	Run 1B	Run 2B	Run 3B	Average
Stack Conditions				
Average Gas Temperature, °F	276.4	275.8	274.1	275.4
Flue Gas Moisture, percent by volume	14.6%	14.3%	14.2%	14.4%
Average Flue Pressure, in. Hg	29.34	29.34	29.34	29.34
Gas Sample Volume, dscf	42.042	43.926	43.030	42.999
Average Gas Velocity, ft/sec	56.731	59.136	59.007	58.291
Gas Volumetric Flow Rate, acfm	401,175	418,179	417,270	412,208
Gas Volumetric Flow Rate, dscfm	240,840	252,241	252,374	248,485
Gas Volumetric Flow Rate, scfm	282,041	294,245	294,280	290,189
Average %CO ₂ by volume, dry basis	12.1	11.5	11.7	11.8
Average %O ₂ by volume, dry basis	12.7	13.1	13.0	12.9
Isokinetic Variance	106.8	106.5	104.3	105.9
Chlorine (Cl₂) Emissions				
ug of sample collected	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.04
Hydrogen Fluoride (HF) Emissions				
ug of sample collected	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm	≤ 0.15	≤ 0.15	≤ 0.15	≤ 0.15

Heidelberg Materials US Cement, Inc. Nazareth Cement Plant Main Kiln Stack Mill Off Reference Method Test Data									
Test No.	Date	Start Time	End Time	O ₂ % (dry)	Moisture %	HCN ppmvw	HCN ppmvd @ 7% O ₂	HF ppmvw	HF ppmvd @ 7% O ₂
1	12/6/2023	8:18	9:16	12.7	14.2%	1.01	1.99	≤ 0.10	≤ 0.20
2	12/6/2023	9:50	10:49	13.1	14.6%	1.06	2.21	≤ 0.10	≤ 0.21
3	12/6/2023	11:30	12:29	13.0	14.7%	1.05	2.15	≤ 0.10	≤ 0.21
Average				12.9	14.5%	1.04	2.12	≤ 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	12/6/2023	8:18	9:16	242,419	164.9	1.20	0.0073	≤ 0.09	≤ 0.0005
2	12/6/2023	9:50	10:49	256,367	164.9	1.34	0.0081	≤ 0.09	≤ 0.0006
3	12/6/2023	11:30	12:29	258,073	164.9	1.33	0.0081	≤ 0.09	≤ 0.0006
Average				252,286	164.9	1.29	0.0078	≤ 0.09	≤ 0.0006

6.0 CERTIFICATION

Mostardi Platt is pleased to have been of service to Heidelberg Materials US Cement, LLC. 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 (TNHR) Expression Value
12/05/2023 11:50	164.9
12/05/2023 11:51	164.9
12/05/2023 11:52	164.9
12/05/2023 11:53	164.9
12/05/2023 11:54	164.9
12/05/2023 11:55	164.9
12/05/2023 11:56	164.9
12/05/2023 11:57	164.9
12/05/2023 11:58	164.9
12/05/2023 11:59	164.9
12/05/2023 12:00	164.9
12/05/2023 12:01	164.9
12/05/2023 12:02	164.9
12/05/2023 12:03	164.9
12/05/2023 12:04	164.9
12/05/2023 12:05	164.9
12/05/2023 12:06	164.9
12/05/2023 12:07	164.9
12/05/2023 12:08	164.9
12/05/2023 12:09	164.9
12/05/2023 12:10	164.9
12/05/2023 12:11	164.9
12/05/2023 12:12	164.9
12/05/2023 12:13	164.9
12/05/2023 12:14	164.9
12/05/2023 12:15	164.9
12/05/2023 12:16	164.9
12/05/2023 12:17	164.9
12/05/2023 12:18	164.9
12/05/2023 12:19	164.9
12/05/2023 12:20	164.9
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12/05/2023 12:34	164.9

Date/Time	Kiln: Clinker (TNHR) Expression Value
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Date/Time	Kiln: Clinker (TNHR) Expression Value
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12/05/2023 15:14	164.9

Date/Time	Kiln: Clinker (TNHR) Expression Value
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12/06/2023 08:26	164.9
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12/06/2023 08:34	164.9
12/06/2023 08:35	164.9
12/06/2023 08:36	164.9
12/06/2023 08:37	164.9
12/06/2023 08:38	164.9
12/06/2023 08:39	164.9
12/06/2023 08:40	164.9
12/06/2023 08:41	164.9
12/06/2023 08:42	164.9
12/06/2023 08:43	164.9
12/06/2023 08:44	164.9
12/06/2023 08:45	164.9
12/06/2023 08:46	164.9
12/06/2023 08:47	164.9
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12/06/2023 08:54	164.9
12/06/2023 08:55	164.9
12/06/2023 08:56	164.9
12/06/2023 08:57	164.9
12/06/2023 08:58	164.9
12/06/2023 08:59	164.9
12/06/2023 09:00	164.9
12/06/2023 09:01	164.9
12/06/2023 09:02	164.9

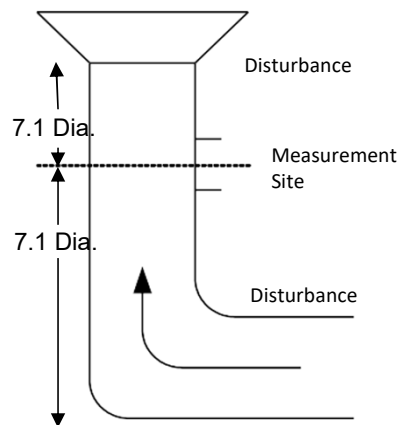
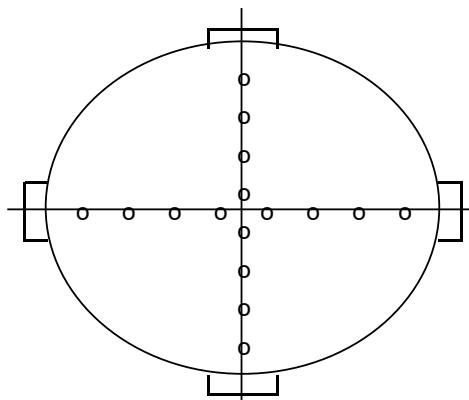
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12/06/2023 09:12	164.9
12/06/2023 09:13	164.9
12/06/2023 09:14	164.9
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12/06/2023 09:59	164.9
12/06/2023 10:00	164.9
12/06/2023 10:01	164.9
12/06/2023 10:02	164.9
12/06/2023 10:03	164.9
12/06/2023 10:04	164.9
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12/06/2023 10:11	164.9
12/06/2023 10:12	164.9
12/06/2023 10:13	164.9
12/06/2023 10:14	164.9
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12/06/2023 10:16	164.9
12/06/2023 10:17	164.9
12/06/2023 10:18	164.9
12/06/2023 10:19	164.9

Date/Time	Kiln: Clinker (TNHR) Expression Value
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12/06/2023 10:27	164.9
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12/06/2023 10:30	164.9
12/06/2023 10:31	164.9
12/06/2023 10:32	164.9
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12/06/2023 10:40	164.9
12/06/2023 10:41	164.9
12/06/2023 10:42	164.9
12/06/2023 10:43	164.9
12/06/2023 10:44	164.9
12/06/2023 10:45	164.9
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12/06/2023 10:47	164.9
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Date/Time	Kiln: Clinker (TNHR) Expression Value
12/06/2023 11:45	164.9
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12/06/2023 11:59	164.9
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12/06/2023 12:29	164.9

Appendix B – Test Section Diagrams

EQUAL AREA TRAVERSE FOR ROUND DUCTS



Client: Heidelberg Materials US Cement, LLC

Facility: Nazareth Cement Plant

Test Location: Main Kiln Stack

Date: 12/05/23 and 12/06/23

Diameter (Feet): 12.250

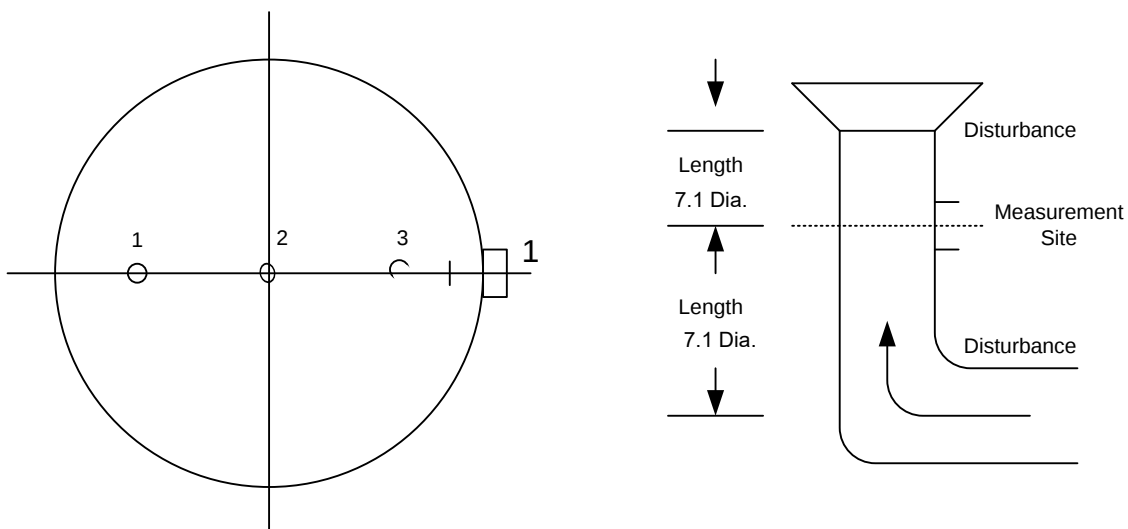
Port Length (In): 16.00

Ports Sampled: 4

Points/Port: 4

Point Markings		
	From inside wall (in.)	% of Diameter
1	4.70	3.20
2	15.44	10.50
3	28.52	19.40
4	47.48	32.30

GASEOUS TRAVERSE FOR ROUND DUCTS (Stratification Test)



Job: Heidelberg Materials
Nazareth Cement Plant

Date: 12/5/2023 and 12/6/2023

Test Location: Kiln Stack

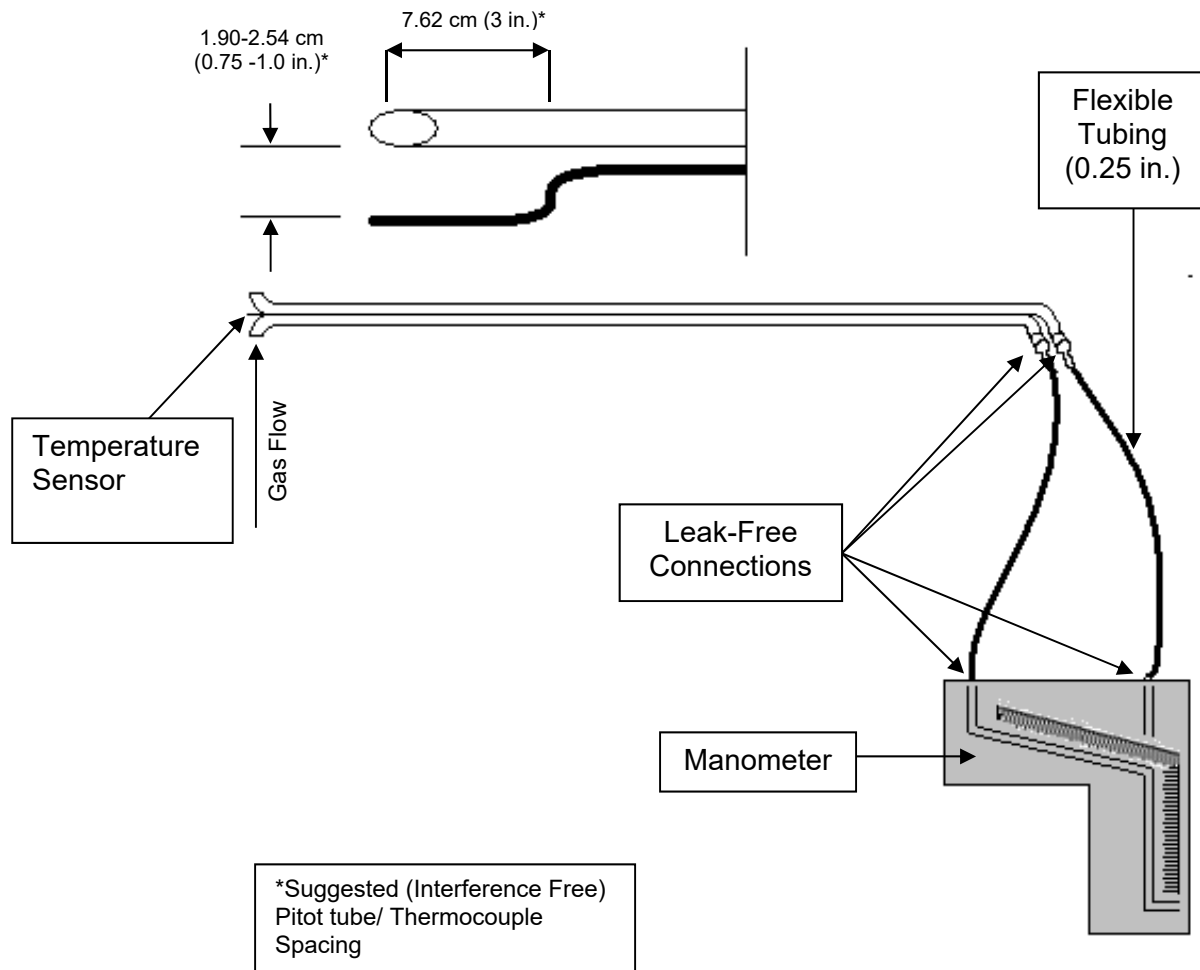
Duct Diameter: 12.25 Feet

Duct Area: 117.86 Square Feet

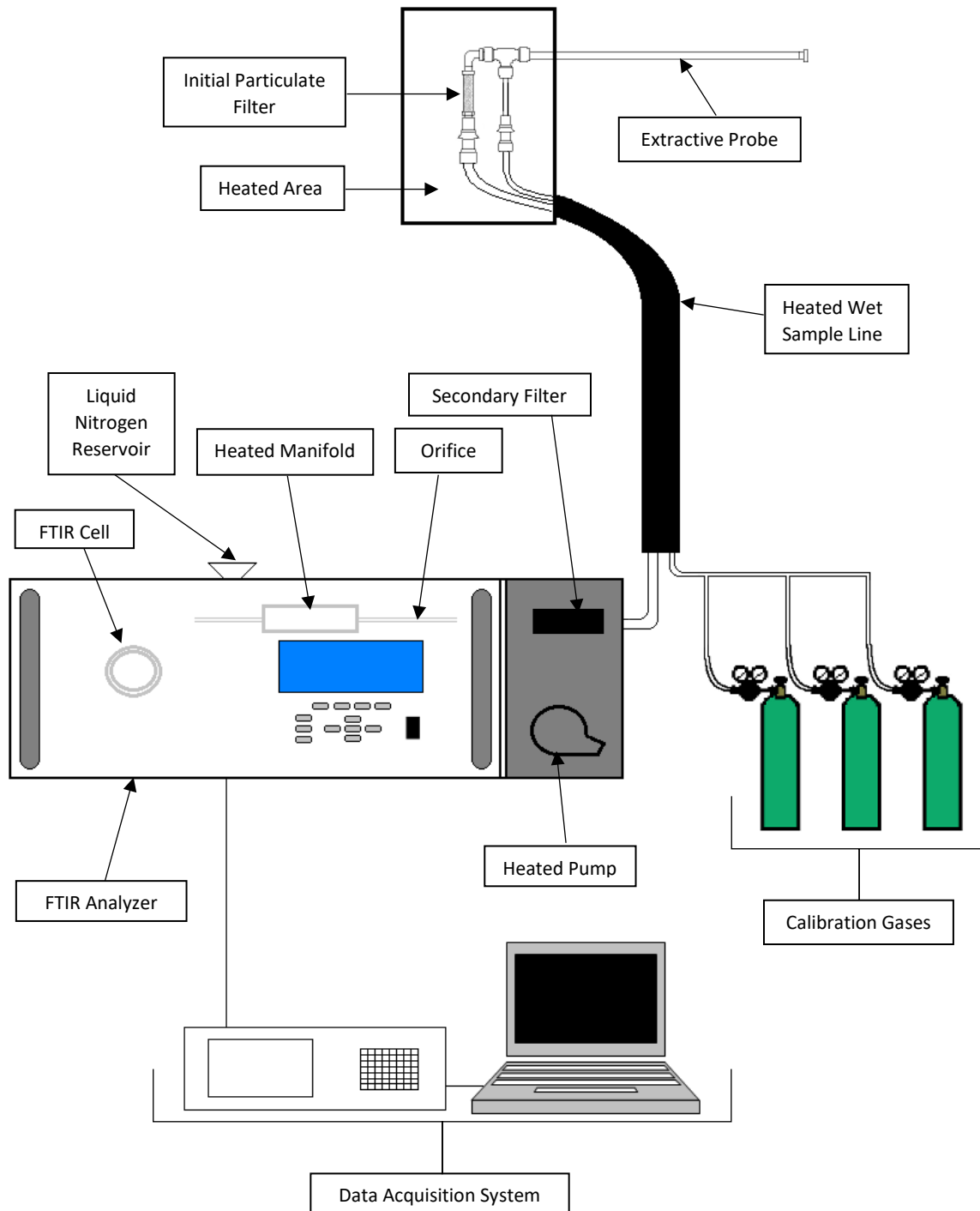
No. Sample Points: 3

Appendix C – Sample Train Diagrams

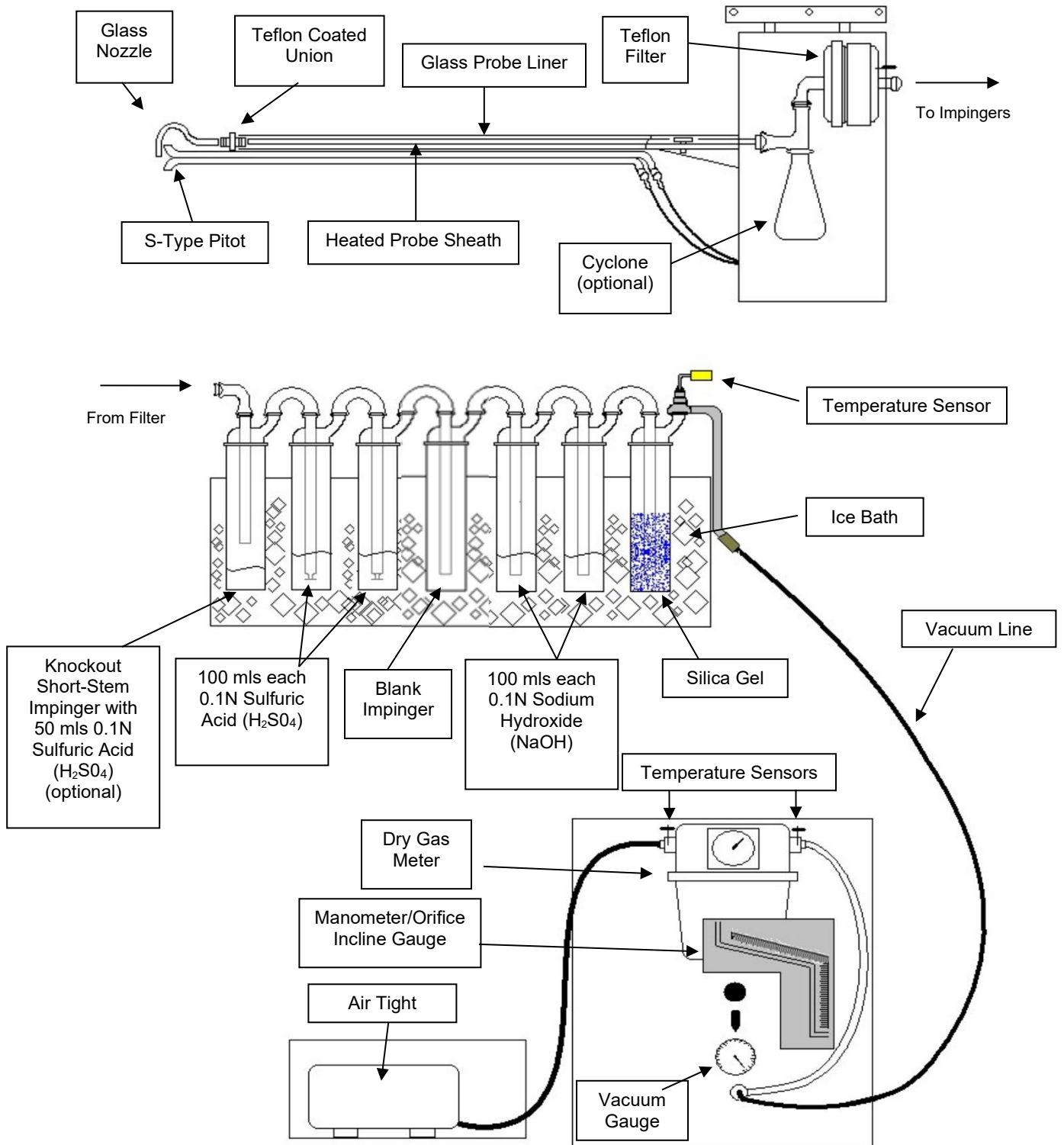
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



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



USEPA Method 26A – HF and Cl₂ Sample Train Diagram



Appendix D – Calculation Nomenclature and Formulas

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Run: 1
 Date: 12/5/2023
 Method: 26A
 Source Condition: Mill On

Dry Molecular Weight

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

$$\%CO_2 = \underline{9.6} \qquad \%O_2 = \underline{14.9} \qquad \%N_2 = \underline{75.5}$$

$$Md = \underline{30.130}$$

Wet Molecular Weight

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

$$Md = \underline{30.130} \qquad Bws = \underline{0.086}$$

$$Ms = \underline{29.085}$$

Meter Volume at Standard Conditions

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

$$Y = \frac{1.004}{2.0} \qquad Vm = \frac{57.924}{52.0} \qquad Pbar = \underline{29.2}$$

$$Vm(std) = \underline{58.774}$$

Volume of Water Vapor Condensed

$$Vw(std) = 0.0471 \times (\text{net H}_2\text{O gain})$$

$$\text{Net H}_2\text{O} = \underline{117.6}$$

$$Vw(std) = \underline{5.539}$$

Moisture Content

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

$$Vw(std) = \underline{5.539} \qquad Vm(std) = \underline{58.774}$$

$$Bws = \underline{0.086}$$

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Run: 1
 Date: 12/5/2023
 Method: 26A
 Source Condition: Mill On

Average Duct Velocity

$$V_s = 85.49 \times C_p \times \sqrt{DP \text{ (avg)}} \times (T_s \text{ (avg)} + 460 / (P_s \times M_s))^{1/2}$$

$C_p = \frac{0.839}{29.24}$	$T_s \text{ (avg)} = \frac{230.4}{29.085}$	$\sqrt{DP \text{ (avg)}} = 1.106$
$P_s = 29.24$	$M_s = 29.085$	
$V_s = 71.477$		

Volumetric Flow Rate (Actual Basis)

$$Q = V_s \times A \times 60$$

$V_s = 71.477$	$A = 117.859$
$Q = 505,448$	

Volumetric Flow Rate (Standard Basis)

$$Q_{std} = 17.647 \times Q \times \frac{P_s}{T_s \text{ (avg)} + 460}$$

$Q = 505,448$	$P_s = 29.24$	$T_s \text{ (avg)} = 230.4$
$Q_{std} = 377,792$		

Volumetric Flow Rate (Standard Dry Basis)

$$Q_{std(dry)} = Q_{std} \times (1 - Bws)$$

$Q_{std} = 377,792$	$Bws = 0.086$
$Q_{std(dry)} = 345,255$	

Isokinetic Variation:

$$\%ISO = \frac{0.0945 \times (T_s + 460) \times V_m(std)}{V_s \times \theta \times A_n \times P_s \times (1 - Bws)}$$

$T_s = 230.4$	$V_m(std) = 58.774$	$V_s = 71.477$
$A_n = 0.0003115$	$\theta = 64$	$P_s = 29.24$
$Bws = 0.086$		
$\%ISO = 100.7$		

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Run: 1
 Date: 12/5/2023
 Method: 26A
 Source Condition: Mill On

Chloride (Cl₂) Concentration:

$$\begin{aligned}
 \text{mg/m}^3 &= \frac{\text{mg of Chloride (Cl}_2\text{)}}{\text{Vm(std)} \times 0.02832 \text{ m}^3/\text{ft}^3} \\
 \text{mg} &= \underline{0.15} \quad \text{Vm(std)} = \underline{58.774} \\
 \text{mg/m}^3 &= \underline{0.09}
 \end{aligned}$$

Chloride (Cl₂) Emission Rate:

$$\begin{aligned}
 \text{lb of Chloride (Cl}_2\text{)} &= \frac{\mu\text{g of sample} \times 10^6 \text{ grams}/\mu\text{g}}{453.6 \text{ grams/lb}} \\
 \text{Emission Rate lb/hr} &= \frac{\text{lb of Chloride (Cl}_2\text{)}}{\text{Vm(std)}} \times \text{dscfm} \times 60 \text{ min/hr} \\
 \text{lb of Chloride (Cl}_2\text{)} &= \underline{3.31\text{E-}10} \quad \text{dscfm} = \underline{345,255} \\
 \text{Emission Rate lb/hr} &= \underline{0.1166}
 \end{aligned}$$

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Test Location: Main Kiln Stack
Date: 12/5/23

Sample Calculations

$$(14.45 \% - 0.02 \%) \times \frac{\text{O2 \% (dry)} \quad 10.10 \%}{9.79 \% - 0.02 \%} = 14.92 \%$$

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

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 initial 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: Heidelberg Materials US Cement, Inc.
 Facility: Nazareth Cement Plant
 Project #: M234208
 Test Location: Main Kiln Stack
 Date: 12/5/23

FTIR Sample Calculations

Direct Recovery % of Calibration Transfer Standard

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

$$Cma = \underline{100.1}$$

$$D_{cts} = \underline{99.9}$$

$$DR_{cts} = \underline{99.8\%}$$

Recovery % with Calibration Transfer Standard System Purge

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

$$Sys_{cts} = \underline{99.3}$$

$$D_{cts} = \underline{99.9}$$

$$R_{cts} = \underline{99\%}$$

Direct Recovery % of Analyte Spike Gas

SF6

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

$$Cma = \underline{5.0}$$

$$D_{sf6} = \underline{5.1}$$

$$DR_{sf6} = \underline{101\%}$$

HCN

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

$$Cma = \underline{49.7}$$

$$D_{asg} = \underline{49.5}$$

$$DR_{asg} = \underline{99.6\%}$$

Dilution Factor for Analyte Spiking

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

$$Spk_{sf6} = \underline{0.385}$$

$$D_{sf6} = \underline{5.066}$$

$$DF = \underline{0.076}$$

Recovery % for Analyte Spike With HCN

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

$$Spk_x = \underline{4.2}$$

$$N_x = \underline{0.9}$$

$$DF = \underline{0.076}$$

$$D_{asg} = \underline{49.5}$$

$$R_x = \underline{92.3} \quad \%$$

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

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

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

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

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

Where:

B_{ws} = Water vapor in gas stream, proportion by volume

M_w = Molecular weight of water, 18.015 lb/lb-mole

P_{bar} = Barometric pressure at the testing site, in. Hg

P_{std} = Standard absolute pressure, 29.92 in. Hg

R = Ideal gas constant, $0.048137 \text{ (in. Hg)(ft}^3\text{)/(g-mole)(}^\circ\text{R)} =$
 $[21.8348 \text{ (in. Hg)(ft}^3\text{)/(lb-mole)(}^\circ\text{R)}]/453.592 \text{ g-mole/lb-mole}$

T_m = Absolute average dry gas meter temperature, $^\circ\text{R}$

T_{std} = Standard absolute temperature, 528 $^\circ\text{R}$

V_f = Final volume of condenser water, ml

V_i = Initial volume of condenser water, ml

V_m = Dry gas volume measured by dry gas meter, dcf

$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, scf

$V_{wc(std)}$ = Volume of condensed water vapor, corrected to standard conditions, scf

$V_{wsg(std)}$ = Volume of water vapor collected in silica gel, corrected to standard conditions, scf

W_f = Final weight of silica gel, g

W_i = Initial weight of silica gel, g

Y = Dry gas meter calibration factor

ΔH = Average pressure exerted on dry gas meter outlet by gas sample bag, in. H_2O

ρ_w = Density of water, 0.9982 g/ml

13.6 = Specific gravity of mercury (Hg)

17.64 = T_{std}/P_{std}

0.04707 = ft^3/ml 0.04715 = ft^3/g

MOSTARDI PLATT

Volumetric Flow Nomenclature

- A = Cross-sectional area of stack or duct, ft²
- Bws = Water vapor in gas stream, proportion by volume
- Cp = Pitot tube coefficient, dimensionless
- Md = Dry molecular weight of gas, lb/lb-mole
- Ms = Molecular weight of gas, wet basis, lb/lb-mole
- Mw = Molecular weight of water, 18.0 lb/lb-mole
- Pbar = Barometric pressure at testing site, in. Hg
- Pg = Static pressure of gas, in. Hg (in. H₂O/13.6)
- DH = Static pressure of gas, in. H₂O
- Ps = Absolute pressure of gas, in. Hg = Pbar + Pg
- Pstd = Standard absolute pressure, 29.92 in. Hg
- Acfm = Actual volumetric gas flow rate
- Scfm = Volumetric gas flow rate, corrected to standard conditions
- Dscfm = Standard volumetric flow rate, corrected to dry conditions
- R = Ideal gas constant, 21.85 in. Hg-ft³/°R-lb-mole
- Ts = Average stack gas temperature, °F
- Tm = Average dry gas meter temperature, °F
- 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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

MOSTARDI PLATT

Isokinetic Nomenclature

- A = Cross-sectional area of stack or duct, square feet
A_n = Cross-sectional area of nozzle, square feet
B_{ws} = Water vapor in gas stream, by volume
C_a = Acetone blank residue concentration, g/g
C_{act} = 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
K₁ = 17.647 °R/in. Hg
K₂ = 0.04707 ft³/ml
K₄ = 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
%CO₂ = Percent carbon dioxide by volume, dry basis
%O₂ = Percent oxygen by volume, dry basis
%CO = Percent carbon monoxide by volume, dry basis
%N₂ = Percent nitrogen by volume, dry basis
0.264 = Ratio of O₂ to N₂ in air, v/v
28 = Molecular weight of N₂ or CO
32 = Molecular weight of O₂
44 = Molecular weight of CO₂
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

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

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

$$\text{lbs HF /dscf} \times \text{dscfm} \times 60 \text{ min/hr} = \text{lbs/hr HF}$$

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

Chain-of-Custody Form						
Project Number: M234208-04				Date Results Required:		
Client: Heidelberg – Nazareth				TAT Required:		
Plant/Test Location: Main Kiln				Project Supervisor: ELE		
Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
001	12/5/23	#1A 26A Mill on 0.1N H2SO4	1		M26A (HF)	
002	12/5/23	#1A 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
003	12/5/23	#2A 26A Mill on 0.1N H2SO4	1		M26A (HF)	
004	12/5/23	#2A 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
005	12/5/23	#3A 26A Mill on 0.1N H2SO4	1		M26A (HF)	
006	12/5/23	#3A 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
007	12/5/23	#1B 26A Mill on 0.1N H2SO4	1		M26A (HF)	
008	12/5/23	#1B 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
009	12/5/23	#2B 26A Mill on 0.1N H2SO4	1		M26A (HF)	
010	12/5/23	#2B 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
011	12/5/23	#3B 26A Mill on 0.1N H2SO4	1		M26A (HF)	
012	12/5/23	#3B 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
013	12/6/23	#1A 26A Mill off 0.1N H2SO4	1		M26A (HF)	
014	12/6/23	#1A 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
015	12/6/23	#2A 26A Mill off 0.1N H2SO4	1		M26A (HF)	
016	12/6/23	#2A 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
017	12/6/23	#3A 26A Mill off 0.1N H2SO4	1		M26A (HF)	
018	12/6/23	#3A 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
019	12/6/23	#1B 26A Mill off 0.1N H2SO4	1		M26A (HF)	
020	12/6/23	#1B 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
021	12/6/23	#2B 26A Mill off 0.1N H2SO4	1		M26A (HF)	
022	12/6/23	#2B 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
023	12/6/23	#3B 26A Mill off 0.1N H2SO4	1		M26A (HF)	
024	12/6/23	#3B 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	

025	12/5/23	A Train Field Blank 0.1N H ₂ SO ₄	1		M26A (HF)	
026	12/5/23	A Train Field Blank 0.1N NaOH	1		M26A (Cl ₂)	
027	12/6/23	B Train Field Blank 0.1N H ₂ SO ₄	1		M26A (HF)	
028	12/6/23	B Train Field Blank 0.1N NaOH	1		M26A (Cl ₂)	
029	12/6/23	0.1N H ₂ SO ₄ Reagent Blank	1		M26A (HF)	
030	12/6/23	0.1N NaOH Reagent Blank	1		M26A (Cl ₂)	
031	12/6/23	DI Water Reagent Blank	1		M26A (HF and Cl ₂)	
Delivered to Lab by: Date/Time:			Received by: Date/Time:		Processed by: Date/Time:	

Laboratory Notes:

Kiln Stack

Client: Heidelberg	Analysis Date: 12/15/2023
Facility: Nazareth	Analysis Location: Elmhurst
Test Location: Kiln Stack	Analyst: JMG
Project Number: M234208	
Method: 26A	
Date Samples Received: 12/8/2023	

Train A

Sampling Date		12/5/2023	12/5/2023	12/5/2023	12/5/2023		
	UNITS	M26A DI Blank	M26A H2SO4 Blank	M26A H2SO4-R1	M26A H2SO4-R1 Dup	RDL	MDL
Sulfuric Acid Volume	ml	225	200	322	322		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		12/5/2023	12/5/2023	12/5/2023			
	UNITS	M26A- H2SO4 R2	M26A- H2SO4 R3	Train A Field Blank		RDL	MDL
Sulfuric Acid Volume	ml	276	294	252			
Hydrofluoric Acid	ug	<150	<150	<150		150	15

Train B

Sampling Date		12/5/2023	12/5/2023	12/5/2023	12/5/2023		
	UNITS	M26A DI Blank	M26A H2SO4 Blank	M26A H2SO4-R1	M26A H2SO4-R1 Dup	RDL	MDL
Sulfuric Acid Volume	ml	225	200	257	257		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		12/5/2023	12/5/2023	12/5/2023			
	UNITS	M26A- H2SO4 R2	M26A- H2SO4 R3	Train b Field Blank		RDL	MDL
Sulfuric Acid Volume	ml	373	260	239			
Hydrofluoric Acid	ug	<150	<150	<150		150	15

Client: Heidelberg		Analysis Date: 12/15/2023											
Facility: Nazareth		Analysis Location: Elmhurst											
Test Location: Kiln Stack		Analyst: JMG											
Project Number: M234208													
Method: 26A													
Date Samples Received: 12/8/2023													
Standard ppm HF	Area	Response Factor	Calculated Value	Slope of Regression Curve									
1	0.2118	0.2118	0.94	0.2253									
2	0.4406	0.2203	1.96										
5	1.1289	0.2258	5.01	Response Factor Ave									
8	1.8566	0.2321	8.24	0.2252									
10	2.3617	0.2362	10.48										
Lot Number	Ricca 8209004												
	R ²	0.9997											
Sample Number	Sample Date	Sample ID	Sample Area	PPM F	PPM X Dilution Factor	Dilution Factor	Total ml	mg F in soln	mg HF in soln	mg HF in soln avg	ug HF in soln		
031	12/5/2023	DI Reagent Blank	0.0067	0.0297	0.0297	1	225	0.0067	0.0070				
031	12/5/2023	DI Reagent Blank	0.0076	0.0337	0.0337	1	225	0.0076	0.0080	0.0075	7.520753234		
029	12/5/2023	H2SO4 Reagent Blank	0.0266	0.1181	0.1181	1	200	0.0236	0.0249				
029	12/5/2023	H2SO4 Reagent Blank	0.0266	0.1181	0.1181	1	200	0.0236	0.0249	0.0249	24.87049399		
001	12/5/2023	Test 1A H2SO4 Imp	0.0403	0.1789	0.1789	1	322	0.0576	0.0607				
001	12/5/2023	Test 1A H2SO4 Imp	0.0331	0.1469	0.1469	1	322	0.0473	0.0498				
001	12/5/2023	Test 1A H2SO4 Imp	0.0338	0.1500	0.1500	1	322	0.0483	0.0509	0.0552	55.24522099		
001	12/5/2023	Test 1A H2SO4 Imp	0.0346	0.1536	0.1536	1	322	0.0494	0.0521	0.0515	51.48192256		
003	12/5/2023	Test 2A H2SO4 Imp	0.0322	0.1429	0.1429	1	276	0.0394	0.0415				
003	12/5/2023	Test 2A H2SO4 Imp	0.0292	0.1296	0.1296	1	276	0.0358	0.0377	0.0396	39.61140407		
005	12/5/2023	Test 3A H2SO4 Imp	0.0433	0.1922	0.1922	1	294	0.0565	0.0595				
005	12/5/2023	Test 3A H2SO4 Imp	0.0454	0.2015	0.2015	1	294	0.0592	0.0624	0.0610	60.95561731		
025	12/5/2023	Train Blank A	0.0298	0.1323	0.1323	1	252	0.0333	0.0343				
025	12/5/2023	Train Blank A	0.0259	0.1150	0.1150	1	252	0.0290	0.0298	0.0320	32.02879556		
					Expected Value	% Difference							
		Run 1 H2SO4 Spike W/ 2ppm	0.2431	1.0790	1.0592								
Lot Number: Thermo 21-191JKS		Run 1 H2SO4 Spike W/ 2ppm	0.2543	1.1287	1.0592	4.21%							
CCV ppm F	Area	PPM F											
1 ppm ICV	0.2385	1.0586											
5 ppm CCV	1.1164	4.9551											
5 ppm CCV	1.1409	5.0639											
5 ppm CCV	1.1331	5.0292											
Standard ppm F	Area	Difference											
1	0.2120	0.05%											
2	0.4355	0.59%											
5	1.1564	1.19%											
8	1.9170	1.58%											
10	2.4216	1.24%											

Client:	Heidelberg	Analysis Date:	12/15/2023										
Facility:	Nazareth	Analysis Location:	Elmhurst										
Test Location:	Kiln Stack	Analyst:	JMG										
Project Number:	M234208												
Method:	26A												
Date Samples Received:	12/8/2023												
Standard ppm HF	Area	Response Factor	Calculated Value	Slope of Regression Curve									
1	0.2118	0.2118	0.94	0.2253									
2	0.4406	0.2203	1.96										
5	1.1289	0.2258	5.01	Response Factor Ave									
8	1.8566	0.2321	8.24	0.2252									
10	2.3617	0.2362	10.48										
Lot Number	Ricca 8209004												
	R ²	0.9997											
Sample Number	Sample Date	Sample ID	Sample Area	PPM F	PPM X Dilution Factor	Dilution Factor	Total ml	mg F in soln	mg HF in soln	mg HF in soln avg	ug HF in soln		
031	12/5/2023	DI Reagent Blank	0.0067	0.0297	0.0297	1	225	0.0067	0.0070				
031	12/5/2023	DI Reagent Blank	0.0076	0.0337	0.0337	1	225	0.0076	0.0080	0.0075	7.520753234		
029	12/5/2023	H2SO4 Reagent Blank	0.0266	0.1181	0.1181	1	200	0.0236	0.0249				
029	12/5/2023	H2SO4 Reagent Blank	0.0266	0.1181	0.1181	1	200	0.0236	0.0249	0.0249	24.87049399		
007	12/5/2023	Test 1B H2SO4 Imp	0.0304	0.1349	0.1349	1	257	0.0347	0.0365				
007	12/5/2023	Test 1B H2SO4 Imp	0.0237	0.1052	0.1052	1	257	0.0270	0.0285	0.0325	32.49923753		
007	12/5/2023	Test 1B H2SO4 Imp	0.0294	0.1305	0.1305	1	257	0.0335	0.0353				
007	12/5/2023	Test 1B H2SO4 Imp	0.0351	0.1558	0.1558	1	257	0.0400	0.0422	0.0387	38.74678041		
009	12/5/2023	Test 2B H2SO4 Imp	0.0282	0.1252	0.1252	1	373	0.0467	0.0492				
009	12/5/2023	Test 2B H2SO4 Imp	0.0242	0.1074	0.1074	1	373	0.0401	0.0422	0.0457	45.68597548		
011	12/5/2023	Test 3B H2SO4 Imp	0.0308	0.1367	0.1367	1	260	0.0355	0.0374				
011	12/5/2023	Test 3B H2SO4 Imp	0.0340	0.1509	0.1509	1	260	0.0392	0.0413	0.0394	39.38139875		
027	12/5/2023	Train Blank B	0.0234	0.1039	0.1039	1	239	0.0248	0.0261				
027	12/5/2023	Train Blank B	0.0244	0.1083	0.1083	1	239	0.0259	0.0273	0.0267	26.70352419		
CCV ppm F	Area	PPM F											
1 ppm ICV	0.2385	1.0586											
5 ppm CCV	1.1164	4.9551											
5 ppm CCV	1.1409	5.0639											
5 ppm CCV	1.1331	5.0292											
Standard ppm F	Area	Difference											
1	0.2120	0.05%											
2	0.4355	0.59%											
5	1.1564	1.19%											
8	1.9170	1.58%											
10	2.4216	1.24%											

Kiln Stack

Client: Heidelberg	Analysis Date: 12/15/2023
Facility: Nazareth	Analysis Location: Elmhurst
Test Location: Kiln Stack	Analyst: JMG
Project Number: M234208	
Method: 26A	
Date Samples Received: 12/8/2023	

Train A

Sampling Date		12/5/2023	12/5/2023	12/5/2023	12/5/2023		
	UNITS	M26A DI Blank	M26A NaOH Blank	M26A NaOH-R1	M26A NaOH-R1 Dup	RDL	MDL
Sodium Hydroxide Volume	ml	225	165	249	249		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		12/5/2023	12/5/2023	12/5/2023			
	UNITS	M26A- NaOH R2	M26A- NaOH R3	Train A Field Blank		RDL	MDL
Sodium Hydroxide Volume	ml	253	240	214			
Chlorine	ug	<150	<150	<150		150	15

Train B

Sampling Date		12/5/2023	12/5/2023	12/5/2023	12/5/2023		
	UNITS	M26A DI Blank	M26A NaOH Blank	M26A NaOH-R1	M26A NaOH-R1 Dup	RDL	MDL
Sodium Hydroxide Volume	ml	225	165	266	266		
Chlorine	ug	<150	<150	306.8197569	297.1480409	150	15

Sampling Date		12/5/2023	12/5/2023	12/5/2023			
	UNITS	M26A- NaOH R2	M26A- NaOH R3	Train B Field Blank		RDL	MDL
Sodium Hydroxide Volume	ml	235	269	237			
Chlorine	ug	<150	<150	<150		150	15

Client: Heidelberg		Analysis Date: 12/15/2023								
Facility: Nazareth		Analysis Location: Elmhurst Lab								
Test Location: Kiln Stack		Analyst: JMG								
Project Number: M234208										
Method: 26A										
Date Samples Received: 12/8/2023										
Standard ppm Cl	Area	Response Factor	Calculated Value	Slope of Regression Curve						
1	0.1278	0.1278	0.99	0.1293						
2	0.2497	0.1249	1.93							
5	0.6554	0.1311	5.07	Response Factor Ave						
8	1.0439	0.1305	8.08	0.1292						
10	1.3202	0.1320	10.21							
Lot Number	Ricca 8209004									
	R ²		0.9999							
Sample Number	Sample Date	Sample ID	Sample Area	PPM Cl	PPM X Dilution Factor	Dilution Factor	Total ml	mg Cl in soln	ug Cl2 in soln	ug Cl2 in soln
031	12/5/2023	DI Reagent Blank	0.0016	0.0124	0.0124	1	225	0.0028		
031	12/5/2023	DI Reagent Blank	0.0000	0.0000	0.0000	1	225	0.0000	0.0014	1.392504305
030	12/5/2023	NaOH Reagent Blank	0.0067	0.0518	0.0518	1	165	0.0086		
030	12/5/2023	NaOH Reagent Blank	0.0103	0.0797	0.0797	1	165	0.0131	0.0108	10.84992938
002	12/5/2023	Test 1A NaOH Imp	0.0176	0.1362	0.1362	1	249	0.0339		
002	12/5/2023	Test 1A NaOH Imp	0.0161	0.1246	0.1246	1	249	0.0310	0.0325	32.45811493
002	12/5/2023	Test 1A NaOH Imp	0.0162	0.1253	0.1253	1	249	0.0312		
002	12/5/2023	Test 1A NaOH Imp	0.0171	0.1323	0.1323	1	249	0.0329	0.0321	32.07285541
004	12/5/2023	Test 2A NaOH Imp	0.0008	0.0062	0.0062	1	253	0.0016		
004	12/5/2023	Test 2A NaOH Imp	0.0006	0.0046	0.0046	1	253	0.0012	0.0014	1.370069513
006	12/5/2023	Test 3A NaOH Imp	0.0042	0.0325	0.0325	1	240	0.0078		
006	12/5/2023	Test 3A NaOH Imp	0.0036	0.0279	0.0279	1	240	0.0067	0.0072	7.241022386
026	12/5/2023	Train Blank	0.0005	0.0039	0.0039	1	214	0.0008		
026	12/5/2023	Train Blank	0.0011	0.0085	0.0085	1	214	0.0018	0.0013	1.324426317
				Expected Value	% Difference					
		Run 1 H2SO4 Spike W/ 2ppm	0.1456	1.1264	1.0310					
		Run 1 H2SO4 Spike W/ 2ppm	0.1313	1.0158	1.0310	3.88%				
CCV ppm Cl	Area	PPM Cl								
5 ppm ICV	0.6608	5.1120								
5 ppm CCV	0.6716	5.1956								
5 ppm CCV	0.6577	5.0881								
5 ppm CCV	0.645	4.9898								
Standard ppm Cl	Area	Difference								
1	0.1318	1.52%								
2	0.2299	4.31%								
5	0.6492	0.48%								
8	0.9795	3.29%								
10	1.2018	4.93%								

Client: Heidelberg		Analysis Date: 12/15/2023									
Facility: Nazareth		Analysis Location: Elmhurst Lab									
Test Location: Kiln Stack		Analyst: JMG									
Project Number: M234208											
Method: 26A											
Date Samples Received: 12/8/2023											
Standard ppm Cl	Area	Response Factor	Calculated Value	Slope of Regression Curve							
1	0.1278	0.1278	0.99	0.1293							
2	0.2497	0.1249	1.93								
5	0.6554	0.1311	5.07	Response Factor Ave							
8	1.0439	0.1305	8.08	0.1292							
10	1.3202	0.1320	10.21								
Lot Number	Ricca 8209004										
	R ²	0.9999									
Sample Number	Sample Date	Sample ID	Sample Area	PPM Cl	PPM X Dilution Factor	Dilution Factor	Total ml	mg Cl in soln	mg Cl2 in soln avg	ug Cl2 in soln	
031	12/5/2023	DI Reagent Blank	0.0016	0.0124	0.0124	1	225	0.0028			
031	12/5/2023	DI Reagent Blank	0.0000	0.0000	0.0000	1	225	0.0000	0.0014	1.392504305	
030	12/5/2023	NaOH Reagent Blank	0.0067	0.0518	0.0518	1	165	0.0086			
030	12/5/2023	NaOH Reagent Blank	0.0103	0.0797	0.0797	1	165	0.0131	0.0108	10.84992938	
008	12/5/2023	Test 1B NaOH Imp	0.1540	1.1914	1.1914	1	266	0.3169			
008	12/5/2023	Test 1B NaOH Imp	0.1442	1.1156	1.1156	1	266	0.2967	0.3068	306.8197569	
008	12/5/2023	Test 1B NaOH Imp	0.1532	1.1852	1.1852	1	266	0.3153			
008	12/5/2023	Test 1B NaOH Imp	0.1356	1.0490	1.0490	1	266	0.2790	0.2971	297.1480409	
010	12/5/2023	Test 2B NaOH Imp	0.0080	0.0619	0.0619	1	235	0.0145			
010	12/5/2023	Test 2B NaOH Imp	0.0077	0.0596	0.0596	1	235	0.0140	0.0143	14.27123509	
012	12/5/2023	Test 3B NaOH Imp	0.0118	0.0913	0.0913	1	269	0.0246			
012	12/5/2023	Test 3B NaOH Imp	0.0111	0.0859	0.0859	1	269	0.0231	0.0238	23.82768269	
028	12/5/2023	Train B Train Blank	0.0048	0.0371	0.0371	1	237	0.0088			
028	12/5/2023	Train B Train Blank	0.0051	0.0395	0.0395	1	237	0.0094	0.0091	9.075646808	
CCV ppm Cl	Area	PPM Cl									
5 ppm ICV	0.6608	5.1120									
5 ppm CCV	0.6716	5.1956									
5 ppm CCV	0.6577	5.0881									
5 ppm CCV	0.645	4.9898									
Standard ppm Cl	Area	Difference									
1	0.1318	1.52%									
2	0.2299	4.31%									
5	0.6492	0.48%									
8	0.9795	3.29%									
10	1.2018	4.93%									

Kiln

Client: Heidelberg	Analysis Date: 12/15/2023
Facility: Nazareth	Analysis Location: Elmhurst
Test Location: Kiln	Analyst: JMG
Project Number: M234208	
Method: 26A-Mill Off	
Date Samples Received: 12/8/2023	

Train A

Sampling Date		12/5/2023	12/5/2023	12/6/2023	12/6/2023		
	UNITS	M26A DI Blank	M26A H2SO4 Blank	M26A H2SO4-R1	M26A H2SO4-R1 Dup	RDL	MDL
Sulfuric Acid Volume	ml	225	200	414	414		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		12/6/2023	12/6/2023				
	UNITS	M26A- H2SO4 R2	M26A- H2SO4 R3			RDL	MDL
Sulfuric Acid Volume	ml	404	386				
Hydrofluoric Acid	ug	<150	<150			150	15

Train B

Sampling Date		12/5/2023	12/5/2023	12/5/2023	12/6/2023		
	UNITS	M26A DI Blank	M26A H2SO4 Blank	M26A H2SO4-R1	M26A H2SO4-R1 Dup	RDL	MDL
Sulfuric Acid Volume	ml	225	200	395	395		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		12/6/2023	12/6/2023				
	UNITS	M26A- H2SO4 R2	M26A- H2SO4 R3			RDL	MDL
Sulfuric Acid Volume	ml	421	400				
Hydrofluoric Acid	ug	<150	<150			150	15

Client: Heidelberg		Analysis Date: 12/15/2023											
Facility: Nazareth		Analysis Location: Elmhurst											
Test Location: Kiln		Analyst: JMG											
Project Number: M234208													
Method: 26A-Mill Off													
Date Samples Received: 12/8/2023													
Standard ppm HF	Area	Response Factor	Calculated Value	Slope of Regression Curve									
1	0.2118	0.2118	0.94	0.2253									
2	0.4406	0.2203	1.96										
5	1.1289	0.2258	5.01	Response Factor Ave									
8	1.8566	0.2321	8.24	0.2252									
10	2.3617	0.2362	10.48										
Lot Number	Ricca 8209004												
	R ²	0.9997											
Sample Number	Sample Date	Sample ID	Sample Area	PPM F	PPM X Dilution Factor	Dilution Factor	Total ml	mg F in soln	mg HF in soln	mg HF in soln avg	ug HF in soln		
031	12/5/2023	DI Reagent Blank	0.0067	0.0297	0.0297	1	225	0.0067	0.0070				
031	12/5/2023	DI Reagent Blank	0.0076	0.0337	0.0337	1	225	0.0076	0.0080	0.0075	7.520753234		
029	12/5/2023	H2SO4 Reagent Blank	0.0266	0.1181	0.1181	1	200	0.0236	0.0249				
029	12/5/2023	H2SO4 Reagent Blank	0.0266	0.1181	0.1181	1	200	0.0236	0.0249	0.0249	24.87049399		
013	12/6/2023	Test 1A H2SO4 Imp	0.0211	0.0937	0.0937	1	414	0.0388	0.0408				
013	12/6/2023	Test 1A H2SO4 Imp	0.0158	0.0701	0.0701	1	414	0.0290	0.0306	0.0357	35.70832598		
013	12/6/2023	Test 1A H2SO4 Imp	0.0196	0.0870	0.0870	1	414	0.0360	0.0379				
013	12/6/2023	Test 1A H2SO4 Imp	0.0241	0.1070	0.1070	1	414	0.0443	0.0466	0.0423	42.2887221		
015	12/6/2023	Test 2A H2SO4 Imp	0.0450	0.1997	0.1997	1	404	0.0807	0.0850				
015	12/6/2023	Test 2A H2SO4 Imp	0.0460	0.2042	0.2042	1	404	0.0825	0.0869	0.0859	85.9341016		
017	12/6/2023	Test 3A H2SO4 Imp	0.0244	0.1083	0.1083	1	386	0.0418	0.0440				
017	12/6/2023	Test 3A H2SO4 Imp	0.0234	0.1039	0.1039	1	386	0.0401	0.0422	0.0431	43.12786753		
025	12/5/2023	Train Blank A	0.0298	0.1323	0.1323	1	252	0.0333	0.0343				
025	12/5/2023	Train Blank A	0.0259	0.1150	0.1150	1	252	0.0290	0.0298	0.0320	32.02879556		
					Expected Value	% Difference							
		Run 1 H2SO4 Spike W/ 2ppm	0.2373	1.0532	1.0187								
Lot Number: Thermo 211-191JKS		Run 1 H2SO4 Spike W/ 2ppm	0.2354	1.0448	1.0187	2.97%							
CCV ppm F	Area	PPM F											
1 ppm ICV	0.2385	1.0586											
5 ppm CCV	1.1331	5.0292											
5 ppm CCV	1.1441	5.0781											
Standard ppm F	Area	Difference											
1	0.2120	0.05%											
2	0.4355	0.59%											
5	1.1564	1.19%											
8	1.9170	1.58%											
10	2.4216	1.24%											

Client:	Heidelberg	Analysis Date:	12/15/2023									
Facility:	Nazareth	Analysis Location:	Elmhurst									
Test Location:	Kiln	Analyst:	JMG									
Project Number:	M234208											
Method:	26A-Mill Off											
Date Samples Received:	12/8/2023											
Standard ppm HF	Area	Response Factor	Calculated Value	Slope of Regression Curve								
1	0.2118	0.2118	0.94	0.2253								
2	0.4406	0.2203	1.96									
5	1.1289	0.2258	5.01	Response Factor Ave								
8	1.8566	0.2321	8.24	0.2252								
10	2.3617	0.2362	10.48									
Lot Number	Ricca 8209004											
	R ²	0.9997										
Sample Number	Sample Date	Sample ID	Sample Area	PPM F	PPM X Dilution Factor	Dilution Factor	Total ml	mg F in soln	mg HF in soln	mg HF in soln avg	ug HF in soln	
031	12/5/2023	DI Reagent Blank	0.0067	0.0297	0.0297	1	225	0.0067	0.0070			
031	12/5/2023	DI Reagent Blank	0.0076	0.0337	0.0337	1	225	0.0076	0.0080	0.0075	7.520753234	
029	12/5/2023	H2SO4 Reagent Blank	0.0266	0.1181	0.1181	1	200	0.0236	0.0249			
029	12/5/2023	H2SO4 Reagent Blank	0.0266	0.1181	0.1181	1	200	0.0236	0.0249	0.0249	24.87049399	
019	12/6/2023	Test 1B H2SO4 Imp	0.0312	0.1385	0.1385	1	395	0.0547	0.0576			
019	12/6/2023	Test 1B H2SO4 Imp	0.0294	0.1305	0.1305	1	395	0.0515	0.0543	0.0560	55.95159912	
019	12/6/2023	Test 1B H2SO4 Imp	0.0283	0.1300	0.1300	1	395	0.0514	0.0541			
019	12/6/2023	Test 1B H2SO4 Imp	0.0279	0.1238	0.1238	1	395	0.0489	0.0515	0.0528	52.81240049	
021	12/6/2023	Test 2B H2SO4 Imp	0.0454	0.2015	0.2015	1	421	0.0848	0.0894			
021	12/6/2023	Test 2B H2SO4 Imp	0.0477	0.2117	0.2117	1	421	0.0891	0.0939	0.0916	91.61668223	
023	12/6/2023	Test 3B H2SO4 Imp	0.0398	0.1767	0.1767	1	400	0.0707	0.0744			
023	12/6/2023	Test 3B H2SO4 Imp	0.0440	0.1953	0.1953	1	400	0.0781	0.0823	0.0784	78.35140588	
027	1/0/1900	Train Blank B	0.0234	0.1039	0.1039	1	239	0.0248	0.0261			
027	1/0/1900	Train Blank B	0.0244	0.1083	0.1083	1	239	0.0259	0.0273	0.0267	26.70352419	
CCV ppm F	Area	PPM F										
1 ppm ICV	0.2385	1.0586										
5 ppm CCV	1.1331	5.0292										
5 ppm CCV	1.1441	5.0781										
Standard ppm F	Area	Difference										
1	0.2120	0.05%										
2	0.4355	0.59%										
5	1.1564	1.19%										
8	1.9170	1.58%										
10	2.4216	1.24%										

Kiln

Client: Heidelberg	Analysis Date: 12/15/2023
Facility: Nazareth	Analysis Location: Elmhurst
Test Location: Kiln	Analyst: JMG
Project Number: M234208	
Method: 26A-Mill Off	
Date Samples Received: 12/8/2023	

Train A

Sampling Date		12/5/2023	12/5/2023	12/6/2023	12/6/2023		
	UNITS	M26A DI Blank	M26A NaOH Blank	M26A NaOH-R1	M26A NaOH-R1 Dup	RDL	MDL
Sodium Hydroxide Volume	ml	225	165	265	265		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		12/6/2023	12/6/2023				
	UNITS	M26A- NaOH R2	M26A- NaOH R3			RDL	MDL
Sodium Hydroxide Volume	ml	262	239				
Chlorine	ug	<150	<150			150	15

Train B

Sampling Date		12/6/2023	12/5/2023	12/6/2023	12/6/2023		
	UNITS	M26A DI Blank	M26A NaOH Blank	M26A NaOH-R1	M26A NaOH-R1 Dup	RDL	MDL
Sodium Hydroxide Volume	ml	225	165	244	244		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		12/6/2023	12/6/2023				
	UNITS	M26A- NaOH R2	M26A- NaOH R3			RDL	MDL
Sodium Hydroxide Volume	ml	223	238				
Chlorine	ug	<150	<150			150	15

Client: Heidelberg		Analysis Date: 12/15/2023								
Facility: Nazareth		Analysis Location: Elmhurst Lab								
Test Location: Kiln		Analyst: JMG								
Project Number: M234208										
Method: 26A										
Date Samples Received: 12/8/2023										
Standard ppm Cl	Area	Response Factor	Calculated Value	Slope of Regression Curve						
1	0.1278	0.1278	0.99	0.1293						
2	0.2497	0.1249	1.93							
5	0.6554	0.1311	5.07	Response Factor Ave						
8	1.0439	0.1305	8.08	0.1292						
10	1.3202	0.1320	10.21							
Lot Number	Ricca 8209004									
	R ²	0.9999								
Sample Number	Sample Date	Sample ID	Sample Area	PPM Cl	PPM X Dilution Factor	Dilution Factor	Total ml	mg Cl in soln	ug Cl2 in soln	ug Cl2 in soln
031	12/5/2023	DI Reagent Blank	0.0016	0.0124	0.0124	1	225	0.0028		
031	12/5/2023	DI Reagent Blank	0.0000	0.0000	0.0000	1	225	0.0000	0.0014	1.392504305
030	12/5/2023	NaOH Reagent Blank	0.0067	0.0518	0.0518	1	165	0.0086		
030	12/5/2023	NaOH Reagent Blank	0.0103	0.0797	0.0797	1	165	0.0131	0.0108	10.84992938
014	12/6/2023	Test 1A NaOH Imp	0.0030	0.0232	0.0232	1	265	0.0062		
014	12/6/2023	Test 1A NaOH Imp	0.0022	0.0170	0.0170	1	265	0.0045	0.0053	5.330197034
014	12/6/2023	Test 1A NaOH Imp	0.0016	0.0124	0.0124	1	265	0.0033		
014	12/6/2023	Test 1A NaOH Imp	0.0023	0.0178	0.0178	1	265	0.0047	0.0040	3.997647776
016	12/6/2023	Test 2A NaOH Imp	0.0106	0.0820	0.0820	1	262	0.0215		
016	12/6/2023	Test 2A NaOH Imp	0.0108	0.0836	0.0836	1	262	0.0219	0.0217	21.68748094
018	12/6/2023	Test 3A NaOH Imp	0.0078	0.0603	0.0603	1	239	0.0144		
018	12/6/2023	Test 3A NaOH Imp	0.0091	0.0704	0.0704	1	239	0.0168	0.0156	15.6235115
025	12/5/2023	Train Blank	0.0005	0.0039	0.0039	1	214	0.0008		
025	12/5/2023	Train Blank	0.0011	0.0085	0.0085	1	214	0.0018	0.0013	1.324426317
					Expected Value	% Difference				
		Run 1 H2SO4 Spike W/ 2ppm	0.1163	0.8997	0.9759					
		Run 1 H2SO4 Spike W/ 2ppm	0.1231	0.9523	0.9759	5.11%				
CCV ppm Cl	Area	PPM Cl								
5 ppm ICV	0.6608	5.1120								
5 ppm CCV	0.6681	5.1685								
5 ppm CCV	0.6558	5.0734								
5 ppm CCV	0.6716	5.1956								
Standard ppm Cl	Area	Difference								
1	0.1318	1.52%								
2	0.2299	4.31%								
5	0.6492	0.48%								
8	0.9795	3.29%								
10	1.2018	4.93%								

Client: Heidelberg		Analysis Date: 12/15/2023									
Facility: Nazareth		Analysis Location: Elmhurst Lab									
Test Location: Kiln		Analyst: JMG									
Project Number: M234208											
Method: 26A											
Date Samples Received: 12/8/2023											
Standard ppm Cl	Area	Response Factor	Calculated Value	Slope of Regression Curve							
1	0.1278	0.1278	0.99	0.1293							
2	0.2497	0.1249	1.93								
5	0.6554	0.1311	5.07	Response Factor Ave							
8	1.0439	0.1305	8.08	0.1292							
10	1.3202	0.1320	10.21								
Lot Number	Ricca 8209004										
	R ²	0.9999									
Sample Number	Sample Date	Sample ID	Sample Area	PPM Cl	PPM X Dilution Factor	Dilution Factor	Total ml	mg Cl in soln	mg Cl2 in soln avg	ug Cl2 in soln	
031	12/5/2023	DI Reagent Blank	0.0016	0.0124	0.0124	1	225	0.0028			
031	12/5/2023	DI Reagent Blank	0.0000	0.0000	0.0000	1	225	0.0000	0.0014	1.392504305	
030	12/5/2023	NaOH Reagent Blank	0.0067	0.0518	0.0518	1	165	0.0086			
030	12/5/2023	NaOH Reagent Blank	0.0103	0.0797	0.0797	1	165	0.0131	0.0108	10.84992938	
020	12/6/2023	Test 1B NaOH Imp	0.0008	0.0062	0.0062	1	244	0.0015			
020	12/6/2023	Test 1B NaOH Imp	0.0015	0.0116	0.0116	1	244	0.0028	0.0022	2.170759489	
020	12/6/2023	Test 1B NaOH Imp	0.0006	0.0046	0.0046	1	244	0.0011			
020	12/6/2023	Test 1B NaOH Imp	0.0007	0.0054	0.0054	1	244	0.0013	0.0012	1.226951015	
022	12/6/2023	Test 2B NaOH Imp	0.0053	0.0410	0.0410	1	223	0.0091			
022	12/6/2023	Test 2B NaOH Imp	0.0072	0.0557	0.0557	1	223	0.0124	0.0108	10.7822382	
024	12/6/2023	Test 3B NaOH Imp	0.0029	0.0224	0.0224	1	238	0.0053			
024	12/6/2023	Test 3B NaOH Imp	0.0034	0.0263	0.0263	1	238	0.0063	0.0058	5.799780431	
028	12/5/2023	Train B Train Blank	0.0048	0.0371	0.0371	1	237	0.0088			
028	12/5/2023	Train B Train Blank	0.0051	0.0395	0.0395	1	237	0.0094	0.0091	9.075646808	
CCV ppm Cl	Area	PPM Cl									
5 ppm ICV	0.6608	5.1120									
5 ppm CCV	0.6681	5.1685									
5 ppm CCV	0.6558	5.0734									
5 ppm CCV	0.6716	5.1956									
Standard ppm Cl	Area	Difference									
1	0.1318	1.52%									
2	0.2299	4.31%									
5	0.6492	0.48%									
8	0.9795	3.29%									
10	1.2018	4.93%									

Appendix F - Reference Method Test Data

Client: Heidelberg Materials US Cement, LLC
Facility: Nazareth Cement Plant
Test Location: Main Kiln Stack
Project #: M234208
Test Method: 26A
Test Engineer: MLIP
Test Technician: CLM1

	<u>Run 1A</u>	<u>Run 2A</u>	<u>Run 3A</u>
Temp ID:	CM5	CM5	CM5
Meter ID:	CM5	CM5	CM5
Pitot ID:	S8-059	S8-059	S8-059
Filter ID:	Teflon	Teflon	Teflon
Nozzle Diameter (Inches):	0.239	0.239	0.239
Meter Calibration Date:	10/13/2023	10/13/2023	10/13/2023
Meter Calibration Factor (Y):	1.004	1.004	1.004
Meter Orifice Setting (Delta H):	1.458	1.458	1.458
Nozzle Kit ID Number and Material:	Teflon 6	Teflon 6	Teflon 6

Leak Checks

Pre Pitot Leak Check	0.0	@	4.0	"H ₂ O	0.0	@	4.3	"H ₂ O	0.0	@	4.4	"H ₂ O
Post Pitot Leak Check	0.0	@	4.0	"H ₂ O	0.0	@	4.2	"H ₂ O	0.0	@	4.5	"H ₂ O
Pre Nozzle Leak Check	0.0000	@	8	"Hg	0.0000	@	10	"Hg	0.0000	@	11	"Hg
Post Nozzle Leak Check	0.0000	@	10	"Hg	0.0000	@	12	"Hg	0.0000	@	10	"Hg

Pitot Tube Coefficient: 0.839
 Probe Length (Feet): 6.0
 Probe Liner Material: Glass
 Sample Plane: Horizontal
 Port Length (Inches): 16.00
 Port Size (Diameter, Inches): 6.00
 Port Type: Nipple
 Duct Shape: Circular
 Diameter (Feet): 12.25
 Duct Area (Square Feet): 117.859
 Upstream Diameters: 7.1
 Downstream Diameters: 7.1
 Number of Ports Sampled: 4
 Number of Points per Port: 4
 Minutes per Point: 4.0
 Minutes per Reading: 4.0
 Total Number of Traverse Points: 16
 Test Length (Minutes): 64
 Train Type: Anderson Box
 Source Condition: Mill On
 Moisture Balance ID: S10-25
 # of Runs: 3

Run 1A - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill On

Date: 12/5/23
 Start Time: 11:50
 End Time: 13:06

DRY GAS METER CONDITIONS

ΔH: 2.04 in. H₂O
 Meter Temperature, Tm: 52.0 °F
 Sqrt ΔP: 1.106 in. H₂O
 Stack Temperature, Ts: 230.4 °F
 Meter Volume, Vm: 57.924 ft³
 Meter Volume, Vmstd: 58.774 dscf
 Meter Volume, Vwstd: 5.539 wscf
 Isokinetic Variance: 100.7 %I
 Test Length: 64.00 in mins.
 Nozzle Diameter: 0.239 in inches
 Barometric Pressure: 29.17 in Hg

STACK CONDITIONS

Static Pressure 1.00 in. H₂O
 Flue Pressure (Ps): 29.24 in. Hg. abs.
 Carbon Dioxide: 9.58 %
 Oxygen: 14.92 %
 Nitrogen: 75.50 %
 Gas Weight dry, Md: 30.130 lb/lb mole
 Gas Weight wet, Ms: 29.085 lb/lb mole
 Excess Air: --- %
 Gas Velocity, Vs: 71.477 fps
 Volumetric Flow: 505,448 acfm
 Volumetric Flow: 345,255 dscfm
 Volumetric Flow: 377,792 scfm

MOISTURE DETERMINATION

Initial Impinger Content: 3635.9 ml Silica Initial Wt. 736.8 grams
 Final Impinger Content: 3737.4 ml Silica Final Wt. 752.9 grams
 Impinger Difference: 101.5 ml Silica Difference: 16.1 grams
 Total Water Gain: 117.6 Moisture, Bws: 0.086

Port- Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	11:50:00	1.10	1.80	70.610	230	51	51	4	259	250	43
1-2	11:54:00	1.10	1.80	74.110	230	51	51	4	258	252	43
1-3	11:58:00	1.30	2.20	77.510	231	51	50	4	259	250	44
1-4	12:02:00	1.20	2.00	81.270	232	51	51	4	258	250	45
	12:06:00			84.730							
2-1	12:10:00	1.30	2.20	84.730	232	51	50	4	259	251	45
2	12:14:00	1.30	2.20	88.460	232	51	50	4	260	251	45
3	12:18:00	1.20	2.00	92.250	231	51	50	4	260	252	46
4	12:22:00	1.20	2.00	95.700	231	52	50	4	261	250	46
	12:26:00			99.356							
3-1	12:30:00	1.40	2.30	99.356	232	53	51	6	260	250	46
2	12:34:00	1.30	2.20	103.300	231	54	52	5	261	251	47
3	12:38:00	1.20	2.00	106.980	231	54	52	5	260	250	47
4	12:42:00	1.10	1.80	110.540	230	54	52	5	259	252	47
	12:46:00			113.989							
4-1	12:50:00	1.30	2.20	113.989	229	54	53	6	259	252	48
2	12:54:00	1.30	2.20	117.850	229	54	53	6	258	253	49
3	12:58:00	1.20	2.00	121.590	228	54	53	5	259	251	50
4	13:02:00	1.10	1.80	125.142	228	55	53	5	258	252	50
	13:06:00			128.534							
Total	1:04:00			57.924		52.6	51.4				
Average			2.04		230.4	52.0		5			
Min			1.80		228.0	50.0		4			
Max			2.30		232.0	55.0		6			

Impinger Weight Sheet - Run 1A

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/5/2023 Test Method: 26A Weighed/Measured By: EE Balance ID: S10-25	Scale Calibration Check Date: <u>12/5/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: center; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: center; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	755.3	737.2	18.1
0.1N H2SO4	794.6	746.3	48.3
Empty	672.2	664.8	7.4
0.1N NaOH	765.9	746.2	19.7
0.1N NaOH	749.4	741.4	8.0
Silica Gel	752.9	736.8	16.1

<u>3,737.4</u> Liquid Final	<u>3,635.9</u> Liquid Initial	<u>101.5</u> Liquid Gain
<u>752.9</u> Silica Final	<u>736.8</u> Silica Initial	<u>16.1</u> Silica Gain

Run 2A - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill On

Date: 12/5/23
 Start Time: 13:25
 End Time: 14:41

DRY GAS METER CONDITIONS				STACK CONDITIONS			
ΔH:	1.99	In. H ₂ O		Static Pressure	1.00	in. H ₂ O	
Meter Temperature, Tm:	54.3	°F		Flue Pressure (Ps):	29.24	in. Hg. abs.	
Sqrt ΔP:	1.092	In. H ₂ O		Carbon Dioxide:	9.59	%	
Stack Temperature, Ts:	232.3	°F		Oxygen:	14.62	%	
Meter Volume, Vm:	57.413	ft ³		Nitrogen:	75.8	%	
Meter Volume, Vmstd:	57.978	dscf		Gas Weight dry, Md:	30.119	lb/lb mole	
Meter Volume, Vwstd:	6.636	wscf		Gas Weight wet, Ms:	28.874	lb/lb mole	
Isokinetic Variance:	102.2	%I		Excess Air:	---	%	
Test Length:	64.00	in mins.		Gas Velocity, Vs:	70.917	fps	
Nozzle Diameter:	0.239	in inches		Volumetric Flow:	501,495	acfm	
Barometric Pressure:	29.17	in Hg		Volumetric Flow:	335,428	dscfm	
				Volumetric Flow:	373,822	scfm	

MOISTURE DETERMINATION

Initial Impinger Content:	3551.6	ml	Silica Initial Wt.	897.0	grams
Final Impinger Content:	3681.9	ml	Silica Final Wt.	907.6	grams
Impinger Difference:	130.3	ml	Silica Difference:	10.6	grams
Total Water Gain:	140.9		Moisture, Bws:	0.103	

Port-Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	13:25:00	1.30	2.20	30.707	229	53	53	5	252	250	45
1-2	13:29:00	1.30	2.20	34.520	229	54	53	5	256	250	42
1-3	13:33:00	1.20	2.00	38.230	229	54	53	6	254	251	43
1-4	13:37:00	1.10	1.80	41.830	230	55	53	6	252	252	44
	13:41:00			45.228							
2-1	13:45:00	1.30	2.20	45.228	230	55	53	6	254	250	45
2	13:49:00	1.30	2.20	49.050	231	55	53	6	257	250	46
3	13:53:00	1.20	2.00	52.770	231	55	53	6	258	251	46
4	13:57:00	1.10	1.80	56.300	230	55	54	5	258	250	47
	14:01:00			59.711							
3-1	14:05:00	1.30	2.20	59.711	233	55	53	6	254	252	48
2	14:09:00	1.20	2.00	63.530	235	55	53	6	254	254	48
3	14:13:00	1.10	1.80	67.120	236	56	54	7	255	253	49
4	14:17:00	1.10	1.80	70.510	236	56	54	7	256	250	49
	14:21:00			73.968							
4-1	14:25:00	1.20	2.00	73.963	234	56	54	7	255	250	49
2	14:29:00	1.20	2.00	77.650	234	56	54	7	257	251	49
3	14:33:00	1.10	1.80	81.240	235	57	54	7	269	252	49
4	14:37:00	1.10	1.80	84.600	235	57	54	7	260	251	49
	14:41:00			88.114							
Total	1:04:00			57.413		55.3	53.4				
Average			1.99		232.3	54.3		6			
Min			1.80		229.0	53.0		5			
Max			2.20		236.0	57.0		7			

Impinger Weight Sheet - Run 2A

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/5/2023 Test Method: 26A Weighed/Measured By: EE Balance ID: S10-25	Scale Calibration Check Date: <u>12/5/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	836.1	768.8	67.3
0.1N H2SO4	686.3	641.8	44.5
Empty	685.5	674.7	10.8
0.1N NaOH	719.0	713.5	5.5
0.1N NaOH	755.0	752.8	2.2
Silica Gel	907.6	897.0	10.6

<u>3,681.9</u> Liquid Final	<u>3,551.6</u> Liquid Initial	<u>130.3</u> Liquid Gain
<u>907.6</u> Silica Final	<u>897.0</u> Silica Initial	<u>10.6</u> Silica Gain

Run 3A - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill On

Date: 12/5/23
 Start Time: 15:00
 End Time: 16:16

DRY GAS METER CONDITIONS				STACK CONDITIONS			
ΔH:	2.00	In. H ₂ O		Static Pressure	1.00	in. H ₂ O	
Meter Temperature, Tm:	57.7	°F		Flue Pressure (Ps):	29.24	in. Hg. abs.	
Sqrt ΔP:	1.095	In. H ₂ O		Carbon Dioxide:	9.54	%	
Stack Temperature, Ts:	233.3	°F		Oxygen:	14.61	%	
Meter Volume, Vm:	57.652	ft ³		Nitrogen:	75.85	%	
Meter Volume, Vmstd:	57.846	dscf		Gas Weight dry, Md:	30.111	lb/lb mole	
Meter Volume, Vwstd:	7.164	wscf		Gas Weight wet, Ms:	28.776	lb/lb mole	
Isokinetic Variance:	102.5	%I		Excess Air:	---	%	
Test Length:	64.00	in mins.		Gas Velocity, Vs:	71.276	fps	
Nozzle Diameter:	0.239	in inches		Volumetric Flow:	504,032	acfm	
Barometric Pressure:	29.17	in Hg		Volumetric Flow:	333,859	dscfm	
				Volumetric Flow:	375,205	scfm	

MOISTURE DETERMINATION					
Initial Impinger Content:	3680.9	ml	Silica Initial Wt.	752.9	grams
Final Impinger Content:	3822.2	ml	Silica Final Wt.	763.7	grams
Impinger Difference:	141.3	ml	Silica Difference:	10.8	grams
Total Water Gain:	152.1		Moisture, Bws:	0.110	

Port- Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	15:00:00	1.30	2.20	88.700	234	57	56	6	250	250	45
1-2	15:04:00	1.20	2.00	92.540	234	57	56	6	252	251	46
1-3	15:08:00	1.10	1.80	96.190	233	58	56	6	253	251	46
1-4	15:12:00	1.10	1.80	99.590	233	58	56	6	253	250	47
	15:16:00			102.875							
2-1	15:20:00	1.30	2.20	102.875	233	58	56	5	253	250	47
2	15:24:00	1.30	2.20	106.250	233	58	56	5	252	251	47
3	15:28:00	1.20	2.00	110.480	234	59	56	5	256	250	48
4	15:32:00	1.10	1.80	113.860	233	59	56	5	258	253	48
	15:36:00			117.407							
3-1	15:40:00	1.20	2.00	117.407	234	59	56	5	258	251	48
2	15:44:00	1.20	2.00	121.100	234	60	57	5	259	252	48
3	15:48:00	1.10	1.80	124.690	233	60	57	5	257	251	49
4	15:52:00	1.10	1.80	128.150	233	60	57	5	258	250	49
	15:56:00			131.552							
4-1	16:00:00	1.30	2.20	131.552	233	60	57	6	259	250	49
2	16:04:00	1.30	2.20	135.390	233	60	57	5	260	251	49
3	16:08:00	1.20	2.00	139.170	233	60	57	5	260	252	50
4	16:12:00	1.20	2.00	142.820	232	60	57	5	269	250	50
	16:16:00			146.352							
Total		1:04:00		57.652		58.9	56.4				
Average			2.00		233.3	57.7		5			
Min			1.80		232.0	56.0		5			
Max			2.20		234.0	60.0		6			

Impinger Weight Sheet - Run 3A

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/5/2023 Test Method: 26A Weighed/Measured By: EE Balance ID: S10-25	Scale Calibration Check Date: <u>12/5/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	832.3	751.2	81.1
0.1N H2SO4	801.3	762.7	38.6
Empty	681.1	664.4	16.7
0.1N NaOH	765.0	760.5	4.5
0.1N NaOH	742.5	742.1	0.4
Silica Gel	763.7	752.9	10.8

<u>3,822.2</u> Liquid Final	<u>3,680.9</u> Liquid Initial	<u>141.3</u> Liquid Gain
<u>763.7</u> Silica Final	<u>752.9</u> Silica Initial	<u>10.8</u> Silica Gain

Client: Heidelberg Materials US Cement, LLC
Facility: Nazareth Cement Plant
Test Location: Main Kiln Stack
Project #: M234208
Test Method: 26A
Test Engineer: PPP
Test Technician: CLM1

	<u>Run 1B</u>	<u>Run 2B</u>	<u>Run 3B</u>
Temp ID:	CM 49	CM 49	CM 49
Meter ID:	CM 49	CM 49	CM 49
Pitot ID:	S8-058	S8-058	S8-058
Nozzle Diameter (Inches):	0.235	0.235	0.235
Meter Calibration Date:	10/24/2023	10/24/2023	10/24/2023
Meter Calibration Factor (Y):	1.007	1.007	1.007
Meter Orifice Setting (Delta H):	1.732	1.732	1.732

Leak Checks

Pre Pitot Leak Check	0.0	@	3.5	"H ₂ O	0.0	@	3.3	"H ₂ O	0.0	@	3.4	"H ₂ O
Post Pitot Leak Check	0.0	@	3.4	"H ₂ O	0.0	@	3.4	"H ₂ O	0.0	@	3.3	"H ₂ O
Pre Nozzle Leak Check	0.0000	@	14	"Hg	0.0010	@	14	"Hg	0.0000	@	14	"Hg
Post Nozzle Leak Check	0.0000	@	13	"Hg	0.0000	@	12	"Hg	0.0000	@	13	"Hg
Pitot Tube Coefficient:	0.834											
Probe Length (Feet):	6.0											
Probe Liner Material:	Glass											
Sample Plane:	Horizontal											
Port Length (Inches):	16.00											
Port Size (Diameter, Inches):	6.00											
Port Type:	Nipple											
Duct Shape:	Circular											
Diameter (Feet):	12.25											
Duct Area (Square Feet):	117.859											
Upstream Diameters:	7.1											
Downstream Diameters:	7.1											
Number of Ports Sampled:	4											
Number of Points per Port:	4											
Minutes per Point:	4.0											
Minutes per Reading:	4.0											
Total Number of Traverse Points:	16											
Test Length (Minutes):	64											
Train Type:	Anderson Box											
Source Condition:	Mill On											
Moisture Balance ID:	S10-25											
# of Runs	3											

Run 1B - Method 26A

Client: Heidelberg Materials US Cement, LLC

Facility: Nazareth Cement Plant

Test Location: Main Kiln Stack

Source Condition: Mill On

Date: 12/5/23

Start Time: 11:50

End Time: 13:06

DRY GAS METER CONDITIONS

ΔH : 2.27 in. H₂O
 Meter Temperature, T_m: 52.4 °F
 $\sqrt{\Delta P}$: 1.097 in. H₂O
 Stack Temperature, T_s: 233.8 °F
 Meter Volume, V_m: 54.912 ft³
 Meter Volume, V_{mstd}: 55.865 dscf
 Meter Volume, V_{wstd}: 5.732 wscf
 Isokinetic Variance: 101.2 %I

 Test Length: 64.00 in mins.
 Nozzle Diameter: 0.235 in inches
 Barometric Pressure: 29.17 in Hg

STACK CONDITIONS

Static Pressure: 1.00 in. H₂O
 Flue Pressure (Ps): 29.24 in. Hg. abs.
 Carbon Dioxide: 9.58 %
 Oxygen: 14.92 %
 Nitrogen: 75.50 %
 Gas Weight dry, M_d: 30.130 lb/lb mole
 Gas Weight wet, M_s: 29.001 lb/lb mole
 Excess Air: --- %
 Gas Velocity, V_s: 70.768 fps
 Volumetric Flow: 500,436 acfm
 Volumetric Flow: 337,619 dscfm
 Volumetric Flow: 372,260 scfm

MOISTURE DETERMINATION

Initial Impinger Content: 3691.9 ml
 Final Impinger Content: 3797.9 ml
 Impinger Difference: 106.0 ml

 Silica Initial Wt. 853.1 grams
 Silica Final Wt. 868.8 grams
 Silica Difference: 15.7 grams

Total Water Gain: 121.7 Moisture, Bws: 0.093

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Pump	Probe	Filter	Impinger	
		Head ΔP in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Vacuum "Hg	Temp °F	Exit Temp °F	Exit Temp °F	
1-1	11:50:00	1.10	2.10	743.850	233	50	50	5	264	259	53	
1-2	11:54:00	1.40	2.60	747.320	237	51	51	5	260	260	55	
1-3	11:58:00	1.30	2.40	750.910	237	51	51	5	255	259	54	
1-4	12:02:00	1.10	2.00	754.530	239	51	51	5	256	259	50	
	12:06:00			757.615								
2-1	12:10:00	1.20	2.20	757.615	236	52	52	5	271	259	52	
2-2	12:14:00	1.30	2.40	761.240	233	52	52	5	265	259	51	
2-3	12:18:00	1.30	2.40	764.770	233	52	52	5	263	260	51	
2-4	12:22:00	1.10	2.10	768.150	233	52	52	5	260	261	52	
	12:26:00			771.410								
3-1	12:30:00	1.10	2.10	771.410	233	53	53	5	258	261	54	
3-2	12:34:00	1.30	2.40	774.810	233	53	53	5	259	260	54	
3-3	12:38:00	1.20	2.30	778.240	233	53	53	5	261	260	54	
3-4	12:42:00	1.10	2.10	781.620	233	53	53	5	261	260	55	
	12:46:00			784.994								
4-1	12:50:00	1.20	2.30	784.994	232	54	54	5	260	260	54	
4-2	12:54:00	1.20	2.30	788.660	232	54	54	5	260	260	55	
4-3	12:58:00	1.30	2.50	791.910	232	54	54	5	260	260	54	
4-4	13:02:00	1.10	2.10	795.320	231	54	54	5	260	260	54	
	13:06:00			798.762								
Total		1:04:00		54.912		52.4	52.4					
Average			2.27		233.8			5				
Min			2.00		231.0			5				
Max			2.60		239.0			5				

Impinger Weight Sheet - Run 1B

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/5/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S10-25	Scale Calibration Check Date: <u>12/5/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	794.6	760.8	33.8
0.1N H2SO4	778.8	734.8	44.0
Empty	663.8	639.8	24.0
0.1N NaOH	799.9	798.8	1.1
0.1N NaOH	760.8	757.7	3.1
Silica Gel	868.8	853.1	15.7

<u>3,797.9</u> Liquid Final	<u>3,691.9</u> Liquid Initial	<u>106.0</u> Liquid Gain
<u>868.8</u> Silica Final	<u>853.1</u> Silica Initial	<u>15.7</u> Silica Gain

Run 2B - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill On

Date: 12/5/23
 Start Time: 13:25
 End Time: 14:41

DRY GAS METER CONDITIONS				STACK CONDITIONS			
ΔH:	2.28	In. H ₂ O		Static Pressure	1.00	in. H ₂ O	
Meter Temperature, Tm:	54.3	°F		Flue Pressure (Ps):	29.24	in. Hg. abs.	
Sqrt ΔP:	1.103	In. H ₂ O		Carbon Dioxide:	9.59	%	
Stack Temperature, Ts:	235.6	°F		Oxygen:	14.62	%	
Meter Volume, Vm:	55.271	ft ³		Nitrogen:	75.8	%	
Meter Volume, Vmstd:	56.034	dscf		Gas Weight dry, Md:	30.119	lb/lb mole	
Meter Volume, Vwstd:	6.622	wscf		Gas Weight wet, Ms:	28.838	lb/lb mole	
Isokinetic Variance:	102.3	%I		Excess Air:	---	%	
Test Length:	64.00	in mins.		Gas Velocity, Vs:	71.433	fps	
Nozzle Diameter:	0.235	in inches		Volumetric Flow:	505,137	acfm	
Barometric Pressure:	29.17	in Hg		Volumetric Flow:	335,137	dscfm	
				Volumetric Flow:	374,744	scfm	

MOISTURE DETERMINATION

Initial Impinger Content:	3593.0	ml	Silica Initial Wt.	873.8	grams
Final Impinger Content:	3721.3	ml	Silica Final Wt.	886.1	grams
Impinger Difference:	128.3	ml	Silica Difference:	12.3	grams
Total Water Gain:	140.6		Moisture, Bws:	0.106	

Port-Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	13:25:00	1.20	2.30	799.320	231	52	52	5	260	260	41
1-2	13:29:00	1.30	2.40	802.820	233	53	53	5	261	261	43
1-3	13:33:00	1.30	2.40	806.510	234	53	53	5	260	260	45
1-4	13:37:00	1.10	2.10	809.860	234	53	53	5	259	259	45
	13:41:00			813.160							
2-1	13:45:00	1.10	2.00	813.160	238	53	53	5	260	260	49
2-2	13:49:00	1.20	2.20	816.620	238	53	53	5	260	260	49
2-3	13:53:00	1.30	2.40	819.860	236	54	54	5	260	260	49
2-4	13:57:00	1.10	2.10	823.310	238	54	54	5	260	260	50
	14:01:00			826.685							
3-1	14:05:00	1.10	2.10	826.685	236	55	55	5	260	261	53
3-2	14:09:00	1.30	2.40	830.120	237	55	55	5	258	260	54
3-3	14:13:00	1.40	2.60	833.630	236	55	55	5	259	260	53
3-4	14:17:00	1.10	2.10	837.320	237	55	55	5	261	260	54
	14:21:00			840.545							
4-1	14:25:00	1.20	2.30	840.545	235	55	55	5	259	261	54
4-2	14:29:00	1.30	2.40	844.140	235	56	56	5	259	260	54
4-3	14:33:00	1.30	2.40	847.620	236	56	56	5	261	260	55
4-4	14:37:00	1.20	2.30	851.120	236	56	56	5	261	260	55
	14:41:00			854.591							

Total	1:04:00			55.271		54.3	54.3				
Average			2.28		235.6	54.3		5			
Min			2.00		231.0	52.0		5			
Max			2.60		238.0	56.0		5			

Impinger Weight Sheet - Run 2B

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/5/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S10-25	Scale Calibration Check Date: <u>12/5/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	807.3	740.2	67.1
0.1N H2SO4	789.1	751.1	38.0
Empty	665.5	651.6	13.9
0.1N NaOH	766.8	761.1	5.7
0.1N NaOH	692.6	689.0	3.6
Silica Gel	886.1	873.8	12.3

<u>3,721.3</u> Liquid Final	<u>3,593.0</u> Liquid Initial	<u>128.3</u> Liquid Gain
<u>886.1</u> Silica Final	<u>873.8</u> Silica Initial	<u>12.3</u> Silica Gain

Run 3B - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill On

Date: 12/5/23
 Start Time: 15:00
 End Time: 16:16

DRY GAS METER CONDITIONS				STACK CONDITIONS			
ΔH:	2.29	In. H ₂ O		Static Pressure	1.00	in. H ₂ O	
Meter Temperature, Tm:	58.4	°F		Flue Pressure (Ps):	29.24	in. Hg. abs.	
Sqrt ΔP:	1.092	In. H ₂ O		Carbon Dioxide:	9.54	%	
Stack Temperature, Ts:	233.0	°F		Oxygen:	14.61	%	
Meter Volume, Vm:	55.269	ft ³		Nitrogen:	75.85	%	
Meter Volume, Vmstd:	55.580	dscf		Gas Weight dry, Md:	30.111	lb/lb mole	
Meter Volume, Vwstd:	5.544	wscf		Gas Weight wet, Ms:	29.012	lb/lb mole	
Isokinetic Variance:	100.9	%I		Excess Air:	---	%	
Test Length:	64.00	in mins.		Gas Velocity, Vs:	70.347	fps	
Nozzle Diameter:	0.235	in inches		Volumetric Flow:	497,464	acfm	
Barometric Pressure:	29.17	in Hg		Volumetric Flow:	336,851	dscfm	
				Volumetric Flow:	370,450	scfm	

MOISTURE DETERMINATION

Initial Impinger Content:	3690.3	ml	Silica Initial Wt.	868.8	grams
Final Impinger Content:	3802.0	ml	Silica Final Wt.	874.8	grams
Impinger Difference:	111.7	ml	Silica Difference:	6.0	grams
Total Water Gain:	117.7		Moisture, Bws:	0.091	

Port- Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	15:00:00	1.20	2.30	854.876	234	56	56	5	260	260	47
1-2	15:04:00	1.30	2.50	858.520	234	57	57	5	260	259	48
1-3	15:08:00	1.30	2.50	862.160	234	57	57	5	259	261	50
1-4	15:12:00	1.10	2.10	865.520	234	57	57	5	260	261	50
	15:16:00			868.820							
2-1	15:20:00	1.10	2.10	868.820	230	58	58	5	259	259	54
2-2	15:24:00	1.20	2.30	872.320	229	58	58	5	259	259	54
2-3	15:28:00	1.30	2.50	875.750	229	58	58	5	259	260	53
2-4	15:32:00	1.10	2.10	879.310	229	58	58	5	259	260	54
	15:36:00			882.555							
3-1	15:40:00	1.10	2.10	882.555	234	60	60	5	260	260	56
3-2	15:44:00	1.30	2.50	885.920	234	60	60	5	261	260	57
3-3	15:48:00	1.40	2.70	889.640	234	60	60	5	261	260	57
3-4	15:52:00	1.10	2.10	893.260	233	60	60	5	260	260	56
	15:56:00			896.575							
4-1	16:00:00	1.10	2.10	896.575	235	59	59	5	259	259	54
4-2	16:04:00	1.20	2.30	899.930	235	59	59	5	258	260	55
4-3	16:08:00	1.20	2.30	903.540	235	59	59	5	259	260	55
4-4	16:12:00	1.10	2.10	906.760	235	59	59	5	259	260	55
	16:16:00			910.145							

Total	1:04:00			55.269		58.4	58.4				
Average			2.29		233.0	58.4		5			
Min			2.10		229.0	56.0		5			
Max			2.70		235.0	60.0		5			

Impinger Weight Sheet - Run 3B

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/5/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S10-25	Scale Calibration Check Date: <u>12/5/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	803.4	753.3	50.1
0.1N H2SO4	781.8	737.1	44.7
Empty	653.8	638.2	15.6
0.1N NaOH	801.1	798.6	2.5
0.1N NaOH	761.9	763.1	-1.2
Silica Gel	874.8	868.8	6.0

<u>3,802.0</u> Liquid Final	<u>3,690.3</u> Liquid Initial	<u>111.7</u> Liquid Gain
<u>874.8</u> Silica Final	<u>868.8</u> Silica Initial	<u>6.0</u> Silica Gain

Client: Heidelberg Materials US Cement, Inc.
 Facility: Nazareth Cement Plant
 Project #: M234208
 Test Location: Main Kiln Stack
 Date: 12/5/23

Run 1								
FTIR Data								
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	Analyzer Data O2 % (dry)
RUN 1_018212.LAB	11:50	9.51	8.66	1.08	≤ 0.10	190.95	0.98	14.32
RUN 1_018213.LAB	11:51	10.68	8.50	0.84	≤ 0.10	191.04	0.98	14.32
RUN 1_018214.LAB	11:52	9.87	8.68	0.88	≤ 0.10	191.04	0.98	14.32
RUN 1_018215.LAB	11:53	9.81	8.61	0.96	≤ 0.10	191.03	0.98	14.33
RUN 1_018216.LAB	11:54	10.76	8.58	0.92	≤ 0.10	191.04	0.98	14.31
RUN 1_018217.LAB	11:55	9.55	8.73	1.11	≤ 0.10	191.01	0.98	14.34
RUN 1_018218.LAB	11:56	9.58	8.75	0.92	≤ 0.10	190.98	0.98	14.31
RUN 1_018219.LAB	11:57	9.81	8.71	0.91	≤ 0.10	191.04	0.98	14.34
RUN 1_018220.LAB	11:58	10.44	8.56	0.87	≤ 0.10	191.04	0.98	14.33
RUN 1_018221.LAB	11:59	9.85	8.57	0.85	≤ 0.10	190.99	0.98	14.36
RUN 1_018222.LAB	12:00	9.52	8.56	0.96	≤ 0.10	191.01	0.98	14.41
RUN 1_018223.LAB	12:01	10.69	8.49	0.84	≤ 0.10	191.05	0.98	14.39
RUN 1_018224.LAB	12:02	9.76	8.56	0.91	≤ 0.10	191.03	0.98	14.42
RUN 1_018225.LAB	12:03	9.37	8.62	0.99	≤ 0.10	191.00	0.98	14.39
RUN 1_018226.LAB	12:04	9.77	8.55	0.89	≤ 0.10	191.00	0.98	14.42
RUN 1_018227.LAB	12:05	9.77	8.61	0.97	≤ 0.10	191.01	0.98	14.35
RUN 1_018228.LAB	12:06	11.10	8.50	0.75	≤ 0.10	190.99	0.98	14.32
RUN 1_018229.LAB	12:07	10.06	8.60	0.93	≤ 0.10	191.01	0.98	14.28
RUN 1_018230.LAB	12:08	10.08	8.58	0.93	≤ 0.10	190.98	0.98	14.29
RUN 1_018231.LAB	12:09	10.23	8.55	0.99	≤ 0.10	190.98	0.98	14.27
RUN 1_018232.LAB	12:10	10.33	8.53	0.94	≤ 0.10	191.01	0.98	14.27
RUN 1_018233.LAB	12:11	10.57	8.50	0.83	≤ 0.10	191.02	0.98	14.33
RUN 1_018234.LAB	12:12	10.10	8.55	1.06	≤ 0.10	191.00	0.98	14.29
RUN 1_018235.LAB	12:13	11.01	8.51	1.02	≤ 0.10	190.95	0.98	14.30
RUN 1_018236.LAB	12:14	9.78	8.62	1.04	≤ 0.10	191.12	0.98	14.28
RUN 1_018237.LAB	12:15	9.56	8.61	1.06	≤ 0.10	191.20	0.98	14.34
RUN 1_018238.LAB	12:16	10.80	8.54	0.96	≤ 0.10	191.02	0.98	14.35
RUN 1_018239.LAB	12:17	9.47	8.71	1.07	≤ 0.10	190.94	0.98	14.36
RUN 1_018240.LAB	12:18	9.89	8.69	0.97	≤ 0.10	190.97	0.98	14.38
RUN 1_018241.LAB	12:19	10.06	8.62	1.05	≤ 0.10	190.95	0.98	14.36
RUN 1_018242.LAB	12:20	10.12	8.69	0.96	≤ 0.10	190.97	0.98	14.40
RUN 1_018243.LAB	12:21	10.33	8.62	1.03	≤ 0.10	190.93	0.98	14.40
RUN 1_018244.LAB	12:22	10.65	8.57	0.99	≤ 0.10	190.97	0.98	14.45
RUN 1_018245.LAB	12:23	9.62	8.67	1.04	≤ 0.10	191.03	0.98	14.45
RUN 1_018246.LAB	12:24	10.16	8.65	1.04	≤ 0.10	191.04	0.98	14.51
RUN 1_018247.LAB	12:25	10.36	8.61	1.11	≤ 0.10	190.93	0.98	14.53
RUN 1_018248.LAB	12:26	10.65	8.63	0.90	≤ 0.10	190.84	0.98	14.51
RUN 1_018249.LAB	12:27	9.65	8.70	1.10	≤ 0.10	190.84	0.98	14.55
RUN 1_018250.LAB	12:28	10.27	8.67	0.95	≤ 0.10	191.00	0.98	14.56
RUN 1_018251.LAB	12:29	9.54	8.76	1.08	≤ 0.10	191.14	0.98	14.61
RUN 1_018252.LAB	12:30	10.37	8.69	0.96	≤ 0.10	191.05	0.98	14.59
RUN 1_018253.LAB	12:31	11.04	8.61	0.85	≤ 0.10	191.02	0.98	14.59
RUN 1_018254.LAB	12:32	9.93	8.70	0.99	≤ 0.10	191.04	0.98	14.56
RUN 1_018255.LAB	12:33	10.19	8.66	1.01	≤ 0.10	191.03	0.98	14.57
RUN 1_018256.LAB	12:34	10.92	8.58	0.92	≤ 0.10	191.01	0.98	14.59
RUN 1_018257.LAB	12:35	10.06	8.65	1.07	≤ 0.10	191.01	0.98	14.61
RUN 1_018258.LAB	12:36	9.97	8.62	1.01	≤ 0.10	191.01	0.98	14.62
RUN 1_018259.LAB	12:37	10.42	8.63	1.05	≤ 0.10	191.02	0.98	14.62
RUN 1_018260.LAB	12:38	9.79	8.62	0.98	≤ 0.10	190.98	0.98	14.67
RUN 1_018261.LAB	12:39	11.22	8.50	0.88	≤ 0.10	190.99	0.98	14.64
RUN 1_018262.LAB	12:40	9.98	8.64	0.90	≤ 0.10	191.04	0.98	14.65
RUN 1_018263.LAB	12:41	9.96	8.67	1.01	≤ 0.10	191.00	0.98	14.68
RUN 1_018264.LAB	12:42	10.43	8.55	0.91	≤ 0.10	190.97	0.98	14.67
RUN 1_018265.LAB	12:43	10.06	8.66	1.10	≤ 0.10	191.05	0.98	14.66
RUN 1_018266.LAB	12:44	10.66	8.47	1.01	≤ 0.10	191.02	0.98	14.65
RUN 1_018267.LAB	12:45	10.67	8.51	0.84	≤ 0.10	190.99	0.98	14.70
RUN 1_018268.LAB	12:46	9.92	8.55	0.92	≤ 0.10	191.00	0.98	14.62
RUN 1_018269.LAB	12:47	9.98	8.60	0.95	≤ 0.10	191.00	0.98	14.42
RUN 1_018270.LAB	12:48	9.84	8.57	1.05	≤ 0.10	191.00	0.98	14.42
RUN 1_018271.LAB	12:49	11.10	8.47	0.85	≤ 0.10	190.97	0.98	14.46
Average		10.16	8.61	0.97	≤ 0.10	191.01	0.98	14.45

Client: Heidelberg Materials US Cement, Inc.
 Facility: Nazareth Cement Plant
 Project #: M234208
 Test Location: Main Kiln Stack
 Date: 12/5/23

Run 2								
FTIR Data								
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	Analyzer Data O2 % (dry)
RUN 2_018351.LAB	13:25	10.26	8.5	1.23	≤ 0.10	191.0	0.98	14.15
RUN 2_018352.LAB	13:26	9.42	8.6	1.32	≤ 0.10	191.0	0.98	14.15
RUN 2_018353.LAB	13:27	9.38	8.7	1.16	≤ 0.10	191.0	0.98	14.16
RUN 2_018354.LAB	13:28	9.53	8.7	1.20	≤ 0.10	191.0	0.98	14.15
RUN 2_018355.LAB	13:29	9.64	8.7	1.17	≤ 0.10	191.0	0.98	14.16
RUN 2_018356.LAB	13:30	11.17	8.4	1.11	≤ 0.10	191.0	0.98	14.13
RUN 2_018357.LAB	13:31	9.41	8.7	1.37	≤ 0.10	191.1	0.98	14.16
RUN 2_018358.LAB	13:32	9.71	8.7	1.29	≤ 0.10	191.0	0.98	14.12
RUN 2_018359.LAB	13:33	9.58	8.7	1.30	≤ 0.10	191.1	0.98	14.15
RUN 2_018360.LAB	13:34	10.66	8.6	1.09	≤ 0.10	191.2	0.98	14.15
RUN 2_018361.LAB	13:35	9.15	8.8	1.33	≤ 0.10	191.0	0.98	14.14
RUN 2_018362.LAB	13:36	9.65	8.7	1.21	≤ 0.10	191.0	0.98	14.15
RUN 2_018363.LAB	13:37	10.60	8.7	1.17	≤ 0.10	191.0	0.98	14.14
RUN 2_018364.LAB	13:38	9.50	8.8	1.21	≤ 0.10	191.0	0.98	14.18
RUN 2_018365.LAB	13:39	9.49	8.8	1.32	≤ 0.10	191.0	0.98	14.15
RUN 2_018366.LAB	13:40	11.13	8.5	0.92	≤ 0.10	191.0	0.98	14.16
RUN 2_018367.LAB	13:41	9.54	8.7	1.24	≤ 0.10	191.0	0.98	14.15
RUN 2_018368.LAB	13:42	9.90	8.7	1.08	≤ 0.10	190.9	0.98	14.20
RUN 2_018369.LAB	13:43	10.09	8.7	1.10	≤ 0.10	190.9	0.98	14.17
RUN 2_018370.LAB	13:44	9.94	8.6	1.10	≤ 0.10	190.9	0.98	14.19
RUN 2_018371.LAB	13:45	10.00	8.6	1.02	≤ 0.10	191.0	0.98	14.15
RUN 2_018372.LAB	13:46	9.88	8.6	1.22	≤ 0.10	191.0	0.98	14.15
RUN 2_018373.LAB	13:47	11.07	8.6	0.95	≤ 0.10	191.0	0.98	14.17
RUN 2_018374.LAB	13:48	9.72	8.7	1.07	≤ 0.10	191.1	0.98	14.17
RUN 2_018375.LAB	13:49	9.85	8.6	1.16	≤ 0.10	191.0	0.98	14.18
RUN 2_018376.LAB	13:50	9.88	8.6	1.12	≤ 0.10	191.0	0.98	14.16
RUN 2_018377.LAB	13:51	11.03	8.5	0.94	≤ 0.10	191.0	0.98	14.17
RUN 2_018378.LAB	13:52	9.86	8.7	1.00	≤ 0.10	191.0	0.98	14.15
RUN 2_018379.LAB	13:53	9.56	8.7	1.12	≤ 0.10	191.0	0.98	14.16
RUN 2_018380.LAB	13:54	9.99	8.6	1.03	≤ 0.10	191.0	0.98	14.15
RUN 2_018381.LAB	13:55	9.87	8.6	1.17	≤ 0.10	191.0	0.98	14.18
RUN 2_018382.LAB	13:56	10.62	8.5	1.04	≤ 0.10	191.0	0.98	14.16
RUN 2_018383.LAB	13:57	10.41	8.5	1.17	≤ 0.10	191.0	0.98	14.18
RUN 2_018384.LAB	13:58	9.51	8.6	1.04	≤ 0.10	191.0	0.98	14.21
RUN 2_018385.LAB	13:59	10.16	8.5	1.06	≤ 0.10	191.0	0.98	14.20
RUN 2_018386.LAB	14:00	10.06	8.5	0.99	≤ 0.10	191.0	0.98	14.20
RUN 2_018387.LAB	14:01	9.88	8.5	1.10	≤ 0.10	191.0	0.98	14.16
RUN 2_018388.LAB	14:02	11.16	8.5	0.99	≤ 0.10	191.0	0.98	14.17
RUN 2_018389.LAB	14:03	9.81	8.6	1.01	≤ 0.10	191.0	0.98	14.13
RUN 2_018390.LAB	14:04	9.85	8.7	1.15	≤ 0.10	191.0	0.98	14.15
RUN 2_018391.LAB	14:05	10.12	8.6	1.14	≤ 0.10	191.0	0.98	14.14
RUN 2_018392.LAB	14:06	9.92	8.7	1.18	≤ 0.10	191.0	0.98	14.10
RUN 2_018393.LAB	14:07	11.07	8.5	0.98	≤ 0.10	191.0	0.98	14.14
RUN 2_018394.LAB	14:08	9.71	8.7	1.16	≤ 0.10	191.0	0.98	14.11
RUN 2_018395.LAB	14:09	10.19	8.6	1.10	≤ 0.10	191.0	0.98	14.14
RUN 2_018396.LAB	14:10	10.05	8.6	1.14	≤ 0.10	191.0	0.98	14.12
RUN 2_018397.LAB	14:11	9.92	8.6	1.12	≤ 0.10	191.0	0.98	14.15
RUN 2_018398.LAB	14:12	10.06	8.6	1.15	≤ 0.10	191.2	0.98	14.15
RUN 2_018399.LAB	14:13	10.51	8.5	1.12	≤ 0.10	191.0	0.98	14.14
RUN 2_018400.LAB	14:14	10.33	8.6	1.05	≤ 0.10	191.0	0.98	14.18
RUN 2_018401.LAB	14:15	10.48	8.6	1.04	≤ 0.10	191.0	0.98	14.14
RUN 2_018402.LAB	14:16	10.30	8.6	1.04	≤ 0.10	191.0	0.98	14.19
RUN 2_018403.LAB	14:17	10.31	8.6	1.05	≤ 0.10	191.0	0.98	14.16
RUN 2_018404.LAB	14:18	11.33	8.5	1.09	≤ 0.10	191.0	0.98	14.14
RUN 2_018405.LAB	14:19	9.88	8.6	1.16	≤ 0.10	191.0	0.98	14.19
RUN 2_018406.LAB	14:20	10.17	8.7	1.03	≤ 0.10	191.0	0.98	14.19
RUN 2_018407.LAB	14:21	10.12	8.7	1.02	≤ 0.10	191.0	0.98	14.16
RUN 2_018408.LAB	14:22	10.09	8.7	1.10	≤ 0.10	190.9	0.98	14.15
RUN 2_018409.LAB	14:23	9.98	8.7	1.16	≤ 0.10	190.8	0.98	14.23
RUN 2_018410.LAB	14:24	10.31	8.6	1.06	≤ 0.10	190.8	0.98	14.17
Average		10.08	8.62	1.12	≤ 0.10	191.00	0.98	14.16

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Test Location: Main Kiln Stack
Date: 12/5/23

Run 3								Analyzer Data O2 % (dry)
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	
RUN 3_018514.LAB	15:00	10.63	8.5	0.72	≤ 0.10	190.8	0.98	14.30
RUN 3_018515.LAB	15:01	10.48	8.5	0.79	≤ 0.10	190.8	0.98	14.26
RUN 3_018516.LAB	15:02	10.82	8.5	0.90	≤ 0.10	190.8	0.98	14.25
RUN 3_018517.LAB	15:03	10.46	8.6	0.95	≤ 0.10	190.9	0.98	14.28
RUN 3_018518.LAB	15:04	10.50	8.6	0.95	≤ 0.10	190.9	0.98	14.25
RUN 3_018519.LAB	15:05	10.12	8.6	0.99	≤ 0.10	191.0	0.98	14.25
RUN 3_018520.LAB	15:06	11.66	8.4	0.83	≤ 0.10	191.1	0.98	14.28
RUN 3_018521.LAB	15:07	10.53	8.5	1.03	≤ 0.10	191.1	0.98	14.21
RUN 3_018522.LAB	15:08	10.33	8.6	1.02	≤ 0.10	191.0	0.98	14.24
RUN 3_018523.LAB	15:09	10.41	8.5	1.00	≤ 0.10	191.0	0.98	14.22
RUN 3_018524.LAB	15:10	10.27	8.5	1.07	≤ 0.10	191.0	0.98	14.22
RUN 3_018525.LAB	15:11	10.17	8.6	0.99	≤ 0.10	191.0	0.98	14.20
RUN 3_018526.LAB	15:12	10.59	8.5	0.98	≤ 0.10	191.0	0.98	14.22
RUN 3_018527.LAB	15:13	10.45	8.5	1.14	≤ 0.10	191.0	0.98	14.20
RUN 3_018528.LAB	15:14	10.43	8.5	1.14	≤ 0.10	191.0	0.98	14.15
RUN 3_018529.LAB	15:15	10.44	8.5	0.99	≤ 0.10	191.0	0.98	14.18
RUN 3_018530.LAB	15:16	10.31	8.5	1.03	≤ 0.10	190.9	0.98	14.16
RUN 3_018531.LAB	15:17	10.32	8.6	1.01	≤ 0.10	191.0	0.98	14.17
RUN 3_018532.LAB	15:18	10.38	8.6	1.00	≤ 0.10	191.0	0.98	14.21
RUN 3_018533.LAB	15:19	10.44	8.5	1.04	≤ 0.10	191.0	0.98	14.18
RUN 3_018534.LAB	15:20	10.65	8.6	1.03	≤ 0.10	191.0	0.98	14.22
RUN 3_018535.LAB	15:21	10.03	8.5	0.96	≤ 0.10	191.0	0.98	14.23
RUN 3_018536.LAB	15:22	10.14	8.5	1.03	≤ 0.10	191.0	0.98	14.25
RUN 3_018537.LAB	15:23	9.95	8.5	1.10	≤ 0.10	190.9	0.98	14.26
RUN 3_018538.LAB	15:24	10.62	8.5	1.05	≤ 0.10	191.0	0.98	14.23
RUN 3_018539.LAB	15:25	10.17	8.6	1.03	≤ 0.10	191.0	0.98	14.32
RUN 3_018540.LAB	15:26	10.35	8.5	1.02	≤ 0.10	191.0	0.98	14.29
RUN 3_018541.LAB	15:27	10.22	8.7	1.05	≤ 0.10	191.0	0.98	14.28
RUN 3_018542.LAB	15:28	9.86	8.6	1.10	≤ 0.10	191.0	0.98	14.27
RUN 3_018543.LAB	15:29	10.61	8.6	1.08	≤ 0.10	191.0	0.98	14.25
RUN 3_018544.LAB	15:30	9.75	8.7	1.09	≤ 0.10	191.0	0.98	14.26
RUN 3_018545.LAB	15:31	10.38	8.5	1.02	≤ 0.10	190.9	0.98	14.25
RUN 3_018546.LAB	15:32	10.35	8.6	1.03	≤ 0.10	191.0	0.98	14.29
RUN 3_018547.LAB	15:33	10.02	8.6	1.00	≤ 0.10	191.0	0.98	14.28
RUN 3_018548.LAB	15:34	10.59	8.5	0.98	≤ 0.10	190.9	0.98	14.28
RUN 3_018549.LAB	15:35	10.53	8.6	1.00	≤ 0.10	191.0	0.98	14.32
RUN 3_018550.LAB	15:36	10.40	8.6	1.14	≤ 0.10	191.0	0.98	14.30
RUN 3_018551.LAB	15:37	10.48	8.6	1.13	≤ 0.10	191.1	0.98	14.33
RUN 3_018552.LAB	15:38	10.22	8.6	1.05	≤ 0.10	191.0	0.98	14.29
RUN 3_018553.LAB	15:39	10.40	8.6	1.09	≤ 0.10	190.9	0.98	14.32
RUN 3_018554.LAB	15:40	10.32	8.6	1.07	≤ 0.10	191.0	0.98	14.33
RUN 3_018555.LAB	15:41	10.34	8.6	1.01	≤ 0.10	191.0	0.98	14.29
RUN 3_018556.LAB	15:42	10.52	8.5	1.06	≤ 0.10	191.0	0.98	14.29
RUN 3_018557.LAB	15:43	9.93	8.6	1.01	≤ 0.10	190.9	0.98	14.22
RUN 3_018558.LAB	15:44	10.26	8.6	1.02	≤ 0.10	191.0	0.98	14.30
RUN 3_018559.LAB	15:45	10.27	8.6	1.06	≤ 0.10	191.0	0.98	14.30
RUN 3_018560.LAB	15:46	10.66	8.6	1.07	≤ 0.10	191.0	0.98	14.27
RUN 3_018561.LAB	15:47	10.20	8.6	1.06	≤ 0.10	191.1	0.98	14.31
RUN 3_018562.LAB	15:48	10.21	8.5	0.97	≤ 0.10	191.0	0.98	14.30
RUN 3_018563.LAB	15:49	10.37	8.5	0.94	≤ 0.10	191.0	0.98	14.31
RUN 3_018564.LAB	15:50	10.15	8.6	0.96	≤ 0.10	191.0	0.98	14.31
RUN 3_018565.LAB	15:51	10.56	8.5	0.91	≤ 0.10	190.9	0.98	14.28
RUN 3_018566.LAB	15:52	9.94	8.5	1.03	≤ 0.10	190.9	0.98	14.31
RUN 3_018567.LAB	15:53	10.90	8.4	0.85	≤ 0.10	191.0	0.98	14.27
RUN 3_018568.LAB	15:54	10.62	8.6	0.88	≤ 0.10	191.0	0.98	14.31
RUN 3_018569.LAB	15:55	11.30	8.4	0.83	≤ 0.10	191.0	0.98	14.27
RUN 3_018570.LAB	15:56	10.65	8.5	0.94	≤ 0.10	191.0	0.98	14.29
RUN 3_018571.LAB	15:57	10.55	8.5	0.94	≤ 0.10	191.0	0.98	14.31
RUN 3_018572.LAB	15:58	10.50	8.5	1.01	≤ 0.10	191.0	0.98	14.28
RUN 3_018573.LAB	15:59	10.15	8.5	1.00	≤ 0.10	191.1	0.98	14.32
Average		10.40	8.55	1.00	≤ 0.10	191.00	0.98	14.26

Client: Heidelberg Materials US Cement, LLC
Facility: Nazareth Cement Plant
Test Location: Main Kiln Stack
Project #: M234208
Test Method: 26A
Test Engineer: MLIP
Test Technician: CLM1

	<u>Run 1A</u>	<u>Run 2A</u>	<u>Run 3A</u>
Temp ID:	CM5	CM5	CM5
Meter ID:	CM5	CM5	CM5
Pitot ID:	S8-059	S8-059	S8-059
Filter ID:	Teflon	Teflon	Teflon
Nozzle Diameter (Inches):	0.239	0.239	0.239
Meter Calibration Date:	10/13/2023	10/13/2023	10/13/2023
Meter Calibration Factor (Y):	1.004	1.004	1.004
Meter Orifice Setting (Delta H):	1.458	1.458	1.458
Nozzle Kit ID Number and Material:	Teflon 6	Teflon 6	Teflon 6

Leak Checks

Pre Pitot Leak Check	0.0	@	4.0	"H ₂ O	0.0	@	4.2	"H ₂ O	0.0	@	4.0	"H ₂ O
Post Pitot Leak Check	0.0	@	4.1	"H ₂ O	0.0	@	4.1	"H ₂ O	0.0	@	4.0	"H ₂ O
Pre Nozzle Leak Check	0.0000	@	10	"Hg	0.0000	@	11	"Hg	0.0000	@	11	"Hg
Post Nozzle Leak Check	0.0000	@	10	"Hg	0.0000	@	10	"Hg	0.0000	@	12	"Hg

Pitot Tube Coefficient: 0.839
 Probe Length (Feet): 6.0
 Probe Liner Material: Glass
 Sample Plane: Horizontal
 Port Length (Inches): 16.00
 Port Size (Diameter, Inches): 6.00
 Port Type: Nipple
 Duct Shape: Circular
 Diameter (Feet): 12.25
 Duct Area (Square Feet): 117.859
 Upstream Diameters: 7.1
 Downstream Diameters: 7.1
 Number of Ports Sampled: 4
 Number of Points per Port: 4
 Minutes per Point: 4.0
 Minutes per Reading: 4.0
 Total Number of Traverse Points: 16
 Test Length (Minutes): 64
 Train Type: Anderson Box
 Source Condition: Mill Off
 Moisture Balance ID: S10-25
 # of Runs: 3

Run 1A - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill Off

Date: 12/6/23
 Start Time: 8:18
 End Time: 9:34

DRY GAS METER CONDITIONS

ΔH : 1.04 in. H₂O
 Meter Temperature, Tm: 45.6 °F
 Sqrt ΔP : 0.846 in. H₂O
 Stack Temperature, Ts: 272.2 °F
 Meter Volume, Vm: 41.723 ft³
 Meter Volume, Vmstd: 42.925 dscf
 Meter Volume, Vwstd: 6.792 wscf
 Isokinetic Variance: 104.1 %I
 Test Length: 64.00 in mins.
 Nozzle Diameter: 0.239 in inches
 Barometric Pressure: 29.28 in Hg

STACK CONDITIONS

Static Pressure 0.80 in. H₂O
 Flue Pressure (Ps): 29.34 in. Hg. abs.
 Carbon Dioxide: 12.05 %
 Oxygen: 12.69 %
 Nitrogen: 75.26 %
 Gas Weight dry, Md: 30.436 lb/lb mole
 Gas Weight wet, Ms: 28.737 lb/lb mole
 Excess Air: --- %
 Gas Velocity, Vs: 56.516 fps
 Volumetric Flow: 399,656 acfm
 Volumetric Flow: 243,997 dscfm
 Volumetric Flow: 282,604 scfm

MOISTURE DETERMINATION

Initial Impinger Content: 3583.3 ml Silica Initial Wt. 907.6 grams
 Final Impinger Content: 3712.9 ml Silica Final Wt. 922.2 grams
 Impinger Difference: 129.6 ml Silica Difference: 14.6 grams
 Total Water Gain: 144.2 Moisture, Bws: 0.137

Port- Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	8:18:00	0.75	1.20	50.745	272	44	43	4	254	251	39
2	8:22:00	0.74	1.10	53.420	273	44	43	4	255	252	40
3	8:26:00	0.72	1.00	56.080	273	45	43	4	254	253	40
4	8:30:00	0.72	1.00	58.670	272	45	43	4	256	251	40
	8:34:00			61.357							
2-1	8:38:00	0.72	1.10	61.357	271	45	43	4	253	251	40
2	8:42:00	0.71	1.00	63.990	272	46	43	4	254	252	41
3	8:46:00	0.70	1.00	66.580	271	46	44	4	255	251	42
4	8:50:00	0.70	1.00	69.240	271	47	44	4	255	250	42
	8:54:00			71.705							
3-1	8:58:00	0.73	1.10	71.705	273	48	44	4	252	250	42
2	9:02:00	0.72	1.00	74.480	273	48	44	4	253	251	43
3	9:06:00	0.72	1.00	76.980	272	49	44	4	253	250	43
4	9:10:00	0.71	1.00	79.550	272	49	45	4	258	252	43
	9:14:00			82.124							
4-1	9:18:00	0.72	1.10	82.124	272	49	45	4	259	251	43
2	9:22:00	0.70	1.00	84.850	273	49	45	4	258	252	44
3	9:26:00	0.69	1.00	87.360	273	50	45	4	259	250	45
4	9:30:00	0.69	1.00	89.370	272	50	46	4	255	251	46
	9:34:00			92.468							
Total	1:04:00			41.723		47.1	44.0				
Average			1.04		272.2	45.6		4			
Min			1.00		271.0	43.0		4			
Max			1.20		273.0	50.0		4			

Impinger Weight Sheet - Run 1A

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/6/2023 Test Method: 26A Weighed/Measured By: EE Balance ID: S10-25	Scale Calibration Check Date: <u>12/6/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	828.8	771.6	57.2
0.1N H2SO4	714.8	660.3	54.5
Empty	687.1	679.7	7.4
0.1N NaOH	732.9	724.7	8.2
0.1N NaOH	749.3	747.0	2.3
Silica Gel	922.2	907.6	14.6

<u>3,712.9</u> Liquid Final	<u>3,583.3</u> Liquid Initial	<u>129.6</u> Liquid Gain
<u>922.2</u> Silica Final	<u>907.6</u> Silica Initial	<u>14.6</u> Silica Gain

Run 2A - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill Off

Date: 12/6/23
 Start Time: 9:55
 End Time: 11:11

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	1.24	In. H ₂ O		Static Pressure	0.80	in. H ₂ O
Meter Temperature, Tm:	49.5	°F		Flue Pressure (Ps):	29.34	in. Hg. abs.
Sqrt ΔP :	0.902	In. H ₂ O		Carbon Dioxide:	11.48	%
Stack Temperature, Ts:	272.7	°F		Oxygen:	13.09	%
Meter Volume, Vm:	44.752	ft ³		Nitrogen:	75.4	%
Meter Volume, Vmstd:	45.709	dscf		Gas Weight dry, Md:	30.360	lb/lb mole
Meter Volume, Vwstd:	7.235	wscf		Gas Weight wet, Ms:	28.671	lb/lb mole
Isokinetic Variance:	103.8	%I		Excess Air:	---	%
Test Length:	64.00	in mins.		Gas Velocity, Vs:	60.381	fps
Nozzle Diameter:	0.239	in inches		Volumetric Flow:	426,985	acfm
Barometric Pressure:	29.28	in Hg		Volumetric Flow:	260,493	dscfm
				Volumetric Flow:	301,722	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3693.2	ml	Silica Initial Wt.	907.5	grams
Final Impinger Content:	3833.2	ml	Silica Final Wt.	921.1	grams
Impinger Difference:	140.0	ml	Silica Difference:	13.6	grams
Total Water Gain:	153.6		Moisture, Bws:	0.137	

Port- Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	0.78	1.20	97.200	273	48	47	4	256	252	43
2	9:59:00	0.79	1.20	99.940	273	48	47	4	257	253	44
3	10:03:00	0.79	1.20	102.750	274	49	47	4	258	252	44
4	10:07:00	0.77	1.20	105.430	271	50	47	4	258	251	45
	10:11:00			108.171							
2-1	10:15:00	0.80	1.20	108.171	271	50	47	4	250	250	45
2	10:19:00	0.81	1.20	110.900	272	50	47	4	251	251	45
3	10:23:00	0.82	1.20	113.760	271	51	48	4	252	251	46
4	10:27:00	0.81	1.20	116.520	272	51	48	4	252	251	46
	10:31:00			119.355							
3-1	10:35:00	0.82	1.20	119.355	273	52	48	4	252	252	46
2	10:39:00	0.83	1.30	122.220	273	52	48	4	253	253	47
3	10:43:00	0.83	1.30	124.980	272	52	48	4	255	251	47
4	10:47:00	0.83	1.30	127.820	273	53	48	4	259	251	48
	10:51:00			130.658							
4-1	10:55:00	0.83	1.30	130.658	275	53	48	4	259	252	48
2	10:59:00	0.83	1.30	133.570	274	54	48	4	258	251	48
3	11:03:00	0.84	1.30	136.350	274	54	48	4	258	252	49
4	11:07:00	0.84	1.30	139.140	272	54	49	4	257	251	49
	11:11:00			141.952							
Total	1:04:00			44.752		51.3	47.7				
Average			1.24		272.7	49.5		4			
Min			1.20		271.0	47.0		4			
Max			1.30		275.0	54.0		4			

Impinger Weight Sheet - Run 2A

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/6/2023 Test Method: 26A Weighed/Measured By: EE Balance ID: S10-25	Scale Calibration Check Date: <u>12/6/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	839.7	757.8	81.9
0.1N H2SO4	800.9	748.9	52.0
Empty	665.3	666.7	-1.4
0.1N NaOH	773.2	767.5	5.7
0.1N NaOH	754.1	752.3	1.8
Silica Gel	921.1	907.5	13.6

<u>3,833.2</u> Liquid Final	<u>3,693.2</u> Liquid Initial	<u>140.0</u> Liquid Gain
<u>921.1</u> Silica Final	<u>907.5</u> Silica Initial	<u>13.6</u> Silica Gain

Run 3A - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill Off

Date: 12/6/23
 Start Time: 11:30
 End Time: 12:46

DRY GAS METER CONDITIONS				STACK CONDITIONS			
ΔH:	1.30	In. H ₂ O		Static Pressure	0.80	in. H ₂ O	
Meter Temperature, Tm:	52.6	°F		Flue Pressure (Ps):	29.34	in. Hg. abs.	
Sqrt ΔP:	0.918	In. H ₂ O		Carbon Dioxide:	11.74	%	
Stack Temperature, Ts:	272.8	°F		Oxygen:	12.97	%	
Meter Volume, Vm:	45.858	ft ³		Nitrogen:	75.29	%	
Meter Volume, Vmstd:	46.559	dscf		Gas Weight dry, Md:	30.397	lb/lb mole	
Meter Volume, Vwstd:	7.677	wscf		Gas Weight wet, Ms:	28.642	lb/lb mole	
Isokinetic Variance:	104.4	%I		Excess Air:	---	%	
Test Length:	64.00	in mins.		Gas Velocity, Vs:	61.501	fps	
Nozzle Diameter:	0.239	in inches		Volumetric Flow:	434,903	acfm	
Barometric Pressure:	29.28	in Hg		Volumetric Flow:	263,771	dscfm	
				Volumetric Flow:	307,265	scfm	

MOISTURE DETERMINATION

Initial Impinger Content:	3535.0	ml	Silica Initial Wt.	826.0	grams
Final Impinger Content:	3691.2	ml	Silica Final Wt.	832.8	grams
Impinger Difference:	156.2	ml	Silica Difference:	6.8	grams
Total Water Gain:	163.0		Moisture, Bws:	0.142	

Port- Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	11:30:00	0.83	1.30	42.928	274	51	50	4	265	252	45
2	11:34:00	0.83	1.30	45.860	274	51	50	4	262	252	45
3	11:38:00	0.84	1.30	48.680	273	52	51	4	261	251	45
4	11:42:00	0.85	1.30	51.440	273	53	51	4	260	251	46
	11:46:00			54.297							
2-1	11:50:00	0.85	1.30	54.297	273	53	51	4	260	251	46
2	11:54:00	0.85	1.30	57.240	274	54	51	4	261	250	46
3	11:58:00	0.84	1.30	60.100	274	54	51	4	265	250	47
4	12:02:00	0.82	1.30	62.970	272	54	51	4	264	251	47
	12:06:00			65.741							
3-1	12:10:00	0.82	1.30	65.741	273	54	51	4	265	251	47
2	12:14:00	0.84	1.30	68.880	273	54	52	4	264	252	47
3	12:18:00	0.85	1.30	71.490	272	55	52	4	264	252	48
4	12:22:00	0.83	1.30	74.300	271	56	52	4	262	251	48
	12:26:00			77.166							
4-1	12:30:00	0.85	1.30	77.166	273	56	52	4	262	252	48
2	12:34:00	0.86	1.30	80.140	272	56	52	4	261	253	48
3	12:38:00	0.86	1.30	83.060	272	56	51	4	263	252	49
4	12:42:00	0.87	1.30	85.850	272	56	51	4	262	251	49
	12:46:00			88.786							
Total	1:04:00			45.858		54.1	51.2				
Average			1.30		272.8	52.6		4			
Min			1.30		271.0	50.0		4			
Max			1.30		274.0	56.0		4			

Impinger Weight Sheet - Run 3A

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/6/2023 Test Method: 26A Weighed/Measured By: EE Balance ID: S10-25	Scale Calibration Check Date: <u>12/6/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	803.1	747.8	55.3
0.1N H2SO4	708.8	644.2	64.6
Empty	704.5	682.6	21.9
0.1N NaOH	717.0	706.6	10.4
0.1N NaOH	757.8	753.8	4.0
Silica Gel	832.8	826.0	6.8

<u>3,691.2</u> Liquid Final	<u>3,535.0</u> Liquid Initial	<u>156.2</u> Liquid Gain
<u>832.8</u> Silica Final	<u>826.0</u> Silica Initial	<u>6.8</u> Silica Gain

Client: Heidelberg Materials US Cement, LLC
Facility: Nazareth Cement Plant
Test Location: Main Kiln Stack
Project #: M234208
Test Method: 26A
Test Engineer: PPP
Test Technician: CLM1

	<u>Run 1B</u>	<u>Run 2B</u>	<u>Run 3B</u>
Temp ID:	CM 49	CM 49	CM 49
Meter ID:	CM 49	CM 49	CM 49
Pitot ID:	S8-058	S8-058	S8-058
Nozzle Diameter (Inches):	0.235	0.235	0.235
Meter Calibration Date:	10/24/2023	10/24/2023	10/24/2023
Meter Calibration Factor (Y):	1.007	1.007	1.007
Meter Orifice Setting (Delta H):	1.732	1.732	1.732

Leak Checks

Pre Pitot Leak Check	0.0	@	3.4	"H ₂ O	0.0	@	3.2	"H ₂ O	0.0	@	3.3	"H ₂ O
Post Pitot Leak Check	0.0	@	3.2	"H ₂ O	0.0	@	3.4	"H ₂ O	0.0	@	3.2	"H ₂ O
Pre Nozzle Leak Check	0.0010	@	15	"Hg	0.0000	@	13	"Hg	0.0000	@	13	"Hg
Post Nozzle Leak Check	0.0000	@	12	"Hg	0.0000	@	13	"Hg	0.0000	@	12	"Hg

Pitot Tube Coefficient: 0.834
 Probe Length (Feet): 6.0
 Probe Liner Material: Glass
 Sample Plane: Horizontal
 Port Length (Inches): 16.00
 Port Size (Diameter, Inches): 6.00
 Port Type: Nipple
 Duct Shape: Circular
 Diameter (Feet): 12.25
 Duct Area (Square Feet): 117.859
 Upstream Diameters: 7.1
 Downstream Diameters: 7.1
 Number of Ports Sampled: 4
 Number of Points per Port: 4
 Minutes per Point: 4.0
 Minutes per Reading: 4.0
 Total Number of Traverse Points: 16
 Test Length (Minutes): 64
 Train Type: Anderson Box
 Source Condition: Mill OFF
 Moisture Balance ID: S10-25
 # of Runs: 3

Run 1B - Method 26A

Client: Heidelberg Materials US Cement, LLC

Facility: Nazareth Cement Plant

Test Location: Main Kiln Stack

Source Condition: Mill OFF

Date: 12/6/23

Start Time: 8:18

End Time: 9:34

DRY GAS METER CONDITIONS

ΔH : 1.26 in. H₂O
 Meter Temperature, T_m: 44.0 °F
 $\sqrt{\Delta P}$: 0.850 in. H₂O
 Stack Temperature, T_s: 276.4 °F
 Meter Volume, V_m: 40.595 ft³
 Meter Volume, V_{mstd}: 42.042 dscf
 Meter Volume, V_{wstd}: 7.192 wscf
 Isokinetic Variance: 106.8 %I

 Test Length: 64.00 in mins.
 Nozzle Diameter: 0.235 in inches
 Barometric Pressure: 29.28 in Hg

STACK CONDITIONS

Static Pressure: 0.80 in. H₂O
 Flue Pressure (Ps): 29.34 in. Hg. abs.
 Carbon Dioxide: 12.05 %
 Oxygen: 12.69 %
 Nitrogen: 75.26 %
 Gas Weight dry, M_d: 30.436 lb/lb mole
 Gas Weight wet, M_s: 28.619 lb/lb mole
 Excess Air: --- %
 Gas Velocity, V_s: 56.731 fps
 Volumetric Flow: 401,175 acfm
 Volumetric Flow: 240,840 dscfm
 Volumetric Flow: 282,041 scfm

MOISTURE DETERMINATION

Initial Impinger Content: 3646.0 ml
 Final Impinger Content: 3791.4 ml
 Impinger Difference: 145.4 ml

 Silica Initial Wt. 886.1 grams
 Silica Final Wt. 893.4 grams
 Silica Difference: 7.3 grams

Total Water Gain: 152.7 Moisture, Bws: 0.146

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Pump	Probe	Filter	Impinger	
		Head ΔP in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Vacuum "Hg	Temp °F	Exit Temp °F	Exit Temp °F	
1-1	8:18:00	0.73	1.30	910.462	277	40	40	5	260	260	41	
1-2	8:22:00	0.74	1.30	913.240	276	41	41	5	268	258	43	
1-3	8:26:00	0.74	1.30	915.730	276	41	41	5	268	260	43	
1-4	8:30:00	0.72	1.20	918.110	275	41	41	4	268	260	43	
	8:34:00			920.630								
2-1	8:38:00	0.71	1.20	920.630	276	42	42	4	266	260	42	
2-2	8:42:00	0.73	1.30	923.340	276	42	42	5	265	260	42	
2-3	8:46:00	0.73	1.30	925.710	275	43	43	5	266	261	42	
2-4	8:50:00	0.72	1.30	928.190	275	43	43	4	264	261	42	
	8:54:00			930.745								
3-1	8:58:00	0.71	1.20	930.745	276	45	45	4	265	259	40	
3-2	9:02:00	0.72	1.30	933.450	275	46	46	4	266	260	40	
3-3	9:06:00	0.73	1.30	935.910	276	46	46	5	266	261	39	
3-4	9:10:00	0.72	1.30	938.320	276	46	46	4	266	260	39	
	9:14:00			940.920								
4-1	9:18:00	0.71	1.20	940.920	279	47	47	4	267	259	40	
4-2	9:22:00	0.71	1.20	943.640	278	47	47	4	267	261	39	
4-3	9:26:00	0.72	1.30	945.990	278	47	47	4	267	261	39	
4-4	9:30:00	0.71	1.20	948.550	279	47	47	4	269	259	40	
	9:34:00			951.057								
Total		1:04:00		40.595		44.0	44.0					
Average			1.26		276.4	44.0		4				
Min			1.20		275.0	40.0		4				
Max			1.30		279.0	47.0		5				

Impinger Weight Sheet - Run 1B

Client:	Heidelberg Materials US Cement, LLC	Scale Calibration Check Date: <u>12/6/2023</u>
Facility:	Nazareth Cement Plant	<u>Scale Calibration Check (see QS-6.05C for procedure)</u>
Test Location:	Main Kiln Stack	must be within $\pm 0.5g$ of certified mass
Project #:	M234208	<u>Certified Weight, grams</u> <u>Result, grams</u>
Date:	12/6/2023	200 200.0
Test Method:	26A	
Weighed/Measured By:	ELE	500 500.0
Balance ID:	S10-25	700 700.0

IMPINGER		FINAL		INITIAL		GAIN	
CONTENTS		MLS / GRAMS		MLS / GRAMS		MLS / GRAMS	
0.1N H2SO4		861.3		747.9		113.4	
0.1N H2SO4		781.1		757.1		24.0	
Empty		661.8		657.3		4.5	
0.1N NaOH		766.8		764.2		2.6	
0.1N NaOH		720.4		719.5		0.9	
Silica Gel		893.4		886.1		7.3	

<u>3,791.4</u> Liquid Final	<u>3,646.0</u> Liquid Initial	<u>145.4</u> Liquid Gain
<u>893.4</u> Silica Final	<u>886.1</u> Silica Initial	<u>7.3</u> Silica Gain

Run 2B - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill OFF

Date: 12/6/23
 Start Time: 9:55
 End Time: 11:11

DRY GAS METER CONDITIONS				STACK CONDITIONS			
ΔH:	1.40	In. H ₂ O		Static Pressure	0.80	in. H ₂ O	
Meter Temperature, Tm:	51.1	°F		Flue Pressure (Ps):	29.34	in. Hg. abs.	
Sqrt ΔP:	0.886	In. H ₂ O		Carbon Dioxide:	11.48	%	
Stack Temperature, Ts:	275.8	°F		Oxygen:	13.09	%	
Meter Volume, Vm:	42.993	ft ³		Nitrogen:	75.4	%	
Meter Volume, Vmstd:	43.926	dscf		Gas Weight dry, Md:	30.360	lb/lb mole	
Meter Volume, Vwstd:	7.315	wscf		Gas Weight wet, Ms:	28.596	lb/lb mole	
Isokinetic Variance:	106.5	%I		Excess Air:	---	%	
Test Length:	64.00	in mins.		Gas Velocity, Vs:	59.136	fps	
Nozzle Diameter:	0.235	in inches		Volumetric Flow:	418,179	acfm	
Barometric Pressure:	29.28	in Hg		Volumetric Flow:	252,241	dscfm	
				Volumetric Flow:	294,245	scfm	

MOISTURE DETERMINATION

Initial Impinger Content:	3695.8	ml	Silica Initial Wt.	874.8	grams
Final Impinger Content:	3845.5	ml	Silica Final Wt.	880.4	grams
Impinger Difference:	149.7	ml	Silica Difference:	5.6	grams
Total Water Gain:	155.3		Moisture, Bws:	0.143	

Port- Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	0.78	1.40	952.132	276	47	47	5	271	260	43
1-2	9:59:00	0.79	1.40	954.840	276	48	48	5	271	260	47
1-3	10:03:00	0.79	1.40	957.430	277	48	48	5	270	261	45
1-4	10:07:00	0.78	1.40	960.250	277	49	49	5	270	261	47
	10:11:00			962.780							
2-1	10:15:00	0.78	1.40	962.780	277	50	50	5	269	260	47
2-2	10:19:00	0.79	1.40	965.650	278	50	50	5	269	260	49
2-3	10:23:00	0.80	1.40	968.230	277	51	51	5	269	260	50
2-4	10:27:00	0.78	1.40	970.760	277	51	51	5	269	260	49
	10:31:00			973.520							
3-1	10:35:00	0.78	1.40	973.520	274	52	52	5	260	253	51
3-2	10:39:00	0.79	1.40	976.340	274	53	53	5	261	256	50
3-3	10:43:00	0.79	1.40	978.930	275	53	53	5	265	260	50
3-4	10:47:00	0.78	1.40	981.480	274	53	53	5	264	261	52
	10:51:00			984.285							
4-1	10:55:00	0.77	1.40	984.285	275	53	53	4	270	261	49
4-2	10:59:00	0.78	1.40	987.140	275	53	53	5	265	261	53
4-3	11:03:00	0.79	1.40	989.750	275	53	53	5	264	261	53
4-4	11:07:00	0.78	1.40	992.330	276	53	53	5	273	260	54
	11:11:00			995.125							

Total	1:04:00			42.993		51.1	51.1				
Average			1.40		275.8	51.1		5			
Min			1.40		274.0	47.0		4			
Max			1.40		278.0	53.0		5			

Impinger Weight Sheet - Run 2B

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/6/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S10-25	Scale Calibration Check Date: <u>12/6/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	860.9	780.0	80.9
0.1N H2SO4	793.8	741.1	52.7
Empty	651.6	637.8	13.8
0.1N NaOH	786.2	784.4	1.8
0.1N NaOH	753.0	752.5	0.5
Silica Gel	880.4	874.8	5.6

<u>3,845.5</u> Liquid Final	<u>3,695.8</u> Liquid Initial	<u>149.7</u> Liquid Gain
<u>880.4</u> Silica Final	<u>874.8</u> Silica Initial	<u>5.6</u> Silica Gain

Run 3B - Method 26A

Client: Heidelberg Materials US Cement, LLC
 Facility: Nazareth Cement Plant
 Test Location: Main Kiln Stack
 Source Condition: Mill OFF

Date: 12/6/23
 Start Time: 11:30
 End Time: 12:46

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH:	1.35	In. H ₂ O		Static Pressure	0.80	in. H ₂ O
Meter Temperature, Tm:	55.6	°F		Flue Pressure (Ps):	29.34	in. Hg. abs.
Sqrt ΔP:	0.885	In. H ₂ O		Carbon Dioxide:	11.74	%
Stack Temperature, Ts:	274.1	°F		Oxygen:	12.97	%
Meter Volume, Vm:	42.498	ft ³		Nitrogen:	75.29	%
Meter Volume, Vmstd:	43.030	dscf		Gas Weight dry, Md:	30.397	lb/lb mole
Meter Volume, Vwstd:	7.145	wscf		Gas Weight wet, Ms:	28.632	lb/lb mole
Isokinetic Variance:	104.3	%I		Excess Air:	---	%
Test Length:	64.00	in mins.		Gas Velocity, Vs:	59.007	fps
Nozzle Diameter:	0.235	in inches		Volumetric Flow:	417,270	acfm
Barometric Pressure:	29.28	in Hg		Volumetric Flow:	252,374	dscfm
				Volumetric Flow:	294,280	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3604.8	ml	Silica Initial Wt.	893.4	grams
Final Impinger Content:	3750.1	ml	Silica Final Wt.	899.8	grams
Impinger Difference:	145.3	ml	Silica Difference:	6.4	grams
Total Water Gain:	151.7		Moisture, Bws:	0.142	

Port-Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	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	11:30:00	0.78	1.30	0.199	271	53	53	5	260	260	53
1-2	11:34:00	0.79	1.40	2.950	271	53	53	5	264	260	55
1-3	11:38:00	0.79	1.40	5.510	272	53	53	5	263	262	54
1-4	11:42:00	0.78	1.30	8.155	272	54	54	5	261	262	53
	11:46:00			10.810							
2-1	11:50:00	0.78	1.40	10.810	274	55	55	5	260	259	52
2-2	11:54:00	0.80	1.40	13.640	274	55	55	5	261	256	51
2-3	11:58:00	0.79	1.40	16.230	275	55	55	5	262	260	51
2-4	12:02:00	0.78	1.30	18.730	275	55	55	5	263	261	52
	12:06:00			21.437							
3-1	12:10:00	0.79	1.40	21.437	276	56	56	5	264	261	50
3-2	12:14:00	0.79	1.40	24.240	275	56	56	5	265	260	51
3-3	12:18:00	0.78	1.30	26.910	276	57	57	5	264	260	52
3-4	12:22:00	0.78	1.30	29.470	274	57	57	5	265	260	53
	12:26:00			32.084							
4-1	12:30:00	0.77	1.30	32.084	274	57	57	4	266	259	54
4-2	12:34:00	0.78	1.30	34.860	275	58	58	5	267	261	54
4-3	12:38:00	0.79	1.40	37.510	276	58	58	5	267	261	53
4-4	12:42:00	0.77	1.30	40.160	276	58	58	4	266	259	52
	12:46:00			42.697							

Total	1:04:00			42.498		55.6	55.6				
Average			1.35		274.1	55.6		5			
Min			1.30		271.0	53.0		4			
Max			1.40		276.0	58.0		5			

Impinger Weight Sheet - Run 3B

Client: Heidelberg Materials US Cement, LLC Facility: Nazareth Cement Plant Test Location: Main Kiln Stack Project #: M234208 Date: 12/6/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S10-25	Scale Calibration Check Date: <u>12/6/2023</u> <u>Scale Calibration Check (see QS-6.05C for procedure)</u> must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center; border-bottom: 1px solid black;">200.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">700</td> <td style="text-align: center; border-bottom: 1px solid black;">700.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	200	200.0	500	500.0	700	700.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
200	200.0								
500	500.0								
700	700.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	823.8	742.9	80.9
0.1N H2SO4	788.6	743.2	45.4
Empty	670.3	658.4	11.9
0.1N NaOH	768.6	763.1	5.5
0.1N NaOH	698.8	697.2	1.6
Silica Gel	899.8	893.4	6.4

<u>3,750.1</u> Liquid Final	<u>3,604.8</u> Liquid Initial	<u>145.3</u> Liquid Gain
<u>899.8</u> Silica Final	<u>893.4</u> Silica Initial	<u>6.4</u> Silica Gain

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Test Location: Main Kiln Stack
Date: 12/6/23

Run 1								Analyzer Data O2 % (dry)
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	
RUN 1_018982.LAB	8:18	14.20	10.24	0.93	≤ 0.10	190.99	0.98	12.71
RUN 1_018983.LAB	8:19	15.38	10.14	1.06	≤ 0.10	190.99	0.98	12.74
RUN 1_018984.LAB	8:20	14.15	10.29	0.90	≤ 0.10	191.05	0.98	12.71
RUN 1_018985.LAB	8:21	13.82	10.35	1.10	≤ 0.10	191.01	0.98	12.78
RUN 1_018986.LAB	8:22	14.59	10.30	1.03	≤ 0.10	191.01	0.98	12.77
RUN 1_018987.LAB	8:23	14.08	10.44	1.07	≤ 0.10	191.00	0.98	12.71
RUN 1_018988.LAB	8:24	14.50	10.38	0.95	≤ 0.10	191.04	0.98	12.75
RUN 1_018989.LAB	8:25	13.53	10.63	1.02	≤ 0.10	191.02	0.98	12.69
RUN 1_018990.LAB	8:26	14.70	10.46	0.99	≤ 0.10	190.98	0.98	12.72
RUN 1_018991.LAB	8:27	13.84	10.56	1.03	≤ 0.10	191.02	0.98	12.74
RUN 1_018992.LAB	8:28	14.10	10.57	0.98	≤ 0.10	191.01	0.98	12.70
RUN 1_018993.LAB	8:29	14.32	10.52	0.97	≤ 0.10	191.04	0.98	12.70
RUN 1_018994.LAB	8:30	13.93	10.56	0.93	≤ 0.10	191.03	0.98	12.69
RUN 1_018995.LAB	8:31	14.57	10.37	0.93	≤ 0.10	191.03	0.98	12.72
RUN 1_018996.LAB	8:32	14.69	10.39	0.88	≤ 0.10	191.00	0.98	12.74
RUN 1_018997.LAB	8:33	14.31	10.32	0.84	≤ 0.10	191.02	0.98	12.71
RUN 1_018998.LAB	8:34	14.03	10.40	0.95	≤ 0.10	190.98	0.98	12.79
RUN 1_018999.LAB	8:35	14.11	10.36	0.94	≤ 0.10	191.02	0.98	12.73
RUN 1_019000.LAB	8:36	14.39	10.31	0.91	≤ 0.10	191.00	0.98	12.75
RUN 1_019001.LAB	8:37	13.99	10.37	0.95	≤ 0.10	191.01	0.98	12.73
RUN 1_019002.LAB	8:38	14.33	10.37	0.94	≤ 0.10	191.00	0.98	12.69
RUN 1_019003.LAB	8:39	14.24	10.37	0.95	≤ 0.10	190.98	0.98	12.69
RUN 1_019004.LAB	8:40	14.10	10.34	0.98	≤ 0.10	190.97	0.98	12.65
RUN 1_019005.LAB	8:41	14.65	10.36	0.92	≤ 0.10	191.01	0.98	12.74
RUN 1_019006.LAB	8:42	14.13	10.37	0.98	≤ 0.10	191.05	0.98	12.70
RUN 1_019007.LAB	8:43	14.11	10.42	0.97	≤ 0.10	191.01	0.98	12.72
RUN 1_019008.LAB	8:44	14.81	10.28	1.00	≤ 0.10	191.02	0.98	12.70
RUN 1_019009.LAB	8:45	14.22	10.36	0.95	≤ 0.10	190.98	0.98	12.68
RUN 1_019010.LAB	8:46	14.41	10.31	1.04	≤ 0.10	191.00	0.98	12.75
RUN 1_019011.LAB	8:47	14.09	10.34	0.95	≤ 0.10	190.99	0.98	12.69
RUN 1_019012.LAB	8:48	13.84	10.34	1.00	≤ 0.10	191.05	0.98	12.72
RUN 1_019013.LAB	8:49	14.37	10.34	1.07	≤ 0.10	191.02	0.98	12.74
RUN 1_019014.LAB	8:50	14.41	10.22	0.94	≤ 0.10	191.04	0.98	12.76
RUN 1_019015.LAB	8:51	14.32	10.02	1.03	≤ 0.10	190.96	0.98	12.72
RUN 1_019016.LAB	8:52	13.81	10.13	1.05	≤ 0.10	191.02	0.98	12.73
RUN 1_019017.LAB	8:53	14.32	10.10	1.06	≤ 0.10	190.98	0.98	12.82
RUN 1_019018.LAB	8:54	14.24	10.14	1.05	≤ 0.10	190.99	0.98	12.82
RUN 1_019019.LAB	8:55	13.90	10.20	1.02	≤ 0.10	191.02	0.98	12.82
RUN 1_019020.LAB	8:56	13.49	10.27	1.10	≤ 0.10	191.00	0.98	12.80
RUN 1_019021.LAB	8:57	14.71	10.20	0.95	≤ 0.10	191.04	0.98	12.76
RUN 1_019022.LAB	8:58	14.73	10.12	1.10	≤ 0.10	191.05	0.98	12.82
RUN 1_019023.LAB	8:59	13.57	10.34	1.01	≤ 0.10	191.05	0.98	12.74
RUN 1_019024.LAB	9:00	13.70	10.31	1.09	≤ 0.10	191.05	0.98	12.77
RUN 1_019025.LAB	9:01	14.51	10.24	1.05	≤ 0.10	191.09	0.98	12.77
RUN 1_019026.LAB	9:02	13.93	10.40	0.99	≤ 0.10	190.98	0.98	12.74
RUN 1_019027.LAB	9:03	13.94	10.45	1.12	≤ 0.10	190.97	0.98	12.80
RUN 1_019028.LAB	9:04	13.90	10.31	1.09	≤ 0.10	190.97	0.98	12.72
RUN 1_019029.LAB	9:05	14.22	10.26	1.02	≤ 0.10	190.94	0.98	12.75
RUN 1_019030.LAB	9:06	13.67	10.35	1.02	≤ 0.10	191.03	0.98	12.71
RUN 1_019031.LAB	9:07	14.14	10.34	0.97	≤ 0.10	191.03	0.98	12.78
RUN 1_019032.LAB	9:08	14.57	10.32	1.09	≤ 0.10	191.04	0.98	12.78
RUN 1_019033.LAB	9:09	13.99	10.41	1.03	≤ 0.10	191.02	0.98	12.75
RUN 1_019034.LAB	9:10	13.82	10.49	1.08	≤ 0.10	191.05	0.98	12.80
RUN 1_019035.LAB	9:11	14.17	10.44	1.14	≤ 0.10	191.12	0.98	12.72
RUN 1_019036.LAB	9:12	13.79	10.49	1.01	≤ 0.10	191.05	0.98	12.77
RUN 1_019037.LAB	9:13	14.79	10.32	1.06	≤ 0.10	190.99	0.98	12.72
RUN 1_019038.LAB	9:14	13.66	10.48	1.05	≤ 0.10	190.99	0.98	12.74
RUN 1_019039.LAB	9:15	14.42	10.30	1.08	≤ 0.10	190.97	0.98	12.75
RUN 1_019040.LAB	9:16	13.75	10.42	1.03	≤ 0.10	190.96	0.98	12.71
RUN 1_019041.LAB	9:17	14.59	10.22	1.08	≤ 0.10	190.97	0.98	12.77
Average		14.19	10.34	1.01	≤ 0.10	191.01	0.98	12.74

Client: Heidelberg Materials US Cement, Inc.
 Facility: Nazareth Cement Plant
 Project #: M234208
 Test Location: Main Kiln Stack
 Date: 12/6/23

Run 2								
FTIR Data								
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	Analyzer Data O2 % (dry)
RUN 2_019144.LAB	9:50	13.35	10.0	1.04	≤ 0.10	191.0	0.98	12.97
RUN 2_019145.LAB	9:51	14.04	9.9	1.04	≤ 0.10	191.0	0.98	12.94
RUN 2_019146.LAB	9:52	14.26	9.9	0.91	≤ 0.10	191.0	0.98	12.97
RUN 2_019147.LAB	9:53	14.96	9.8	1.20	≤ 0.10	191.0	0.98	12.93
RUN 2_019148.LAB	9:54	14.52	9.9	1.05	≤ 0.10	191.0	0.98	12.92
RUN 2_019149.LAB	9:55	14.60	10.0	1.07	≤ 0.10	191.0	0.98	12.89
RUN 2_019150.LAB	9:56	14.39	10.1	1.01	≤ 0.10	190.9	0.98	12.83
RUN 2_019151.LAB	9:57	14.70	10.0	1.04	≤ 0.10	190.9	0.98	12.83
RUN 2_019152.LAB	9:58	14.19	10.0	1.05	≤ 0.10	191.0	0.98	12.87
RUN 2_019153.LAB	9:59	14.53	9.9	1.02	≤ 0.10	191.1	0.98	12.89
RUN 2_019154.LAB	10:00	14.64	10.0	1.06	≤ 0.10	191.0	0.98	12.87
RUN 2_019155.LAB	10:01	14.33	10.0	1.02	≤ 0.10	191.0	0.98	12.91
RUN 2_019156.LAB	10:02	14.29	9.9	1.00	≤ 0.10	190.9	0.98	12.90
RUN 2_019157.LAB	10:03	15.06	9.8	1.07	≤ 0.10	190.8	0.98	12.93
RUN 2_019158.LAB	10:04	13.82	10.0	1.04	≤ 0.10	190.8	0.98	12.90
RUN 2_019159.LAB	10:05	14.57	9.8	1.14	≤ 0.10	190.8	0.98	12.94
RUN 2_019160.LAB	10:06	14.80	9.7	1.03	≤ 0.10	191.0	0.98	12.95
RUN 2_019161.LAB	10:07	14.51	9.7	1.07	≤ 0.10	191.1	0.98	12.99
RUN 2_019162.LAB	10:08	14.46	9.7	1.10	≤ 0.10	191.1	0.98	12.95
RUN 2_019163.LAB	10:09	15.02	9.6	1.18	≤ 0.10	191.0	0.98	12.96
RUN 2_019164.LAB	10:10	14.19	9.7	1.04	≤ 0.10	191.0	0.98	13.00
RUN 2_019165.LAB	10:11	14.78	9.7	1.13	≤ 0.10	191.0	0.98	12.97
RUN 2_019166.LAB	10:12	14.84	9.7	1.02	≤ 0.10	191.0	0.98	12.99
RUN 2_019167.LAB	10:13	13.95	9.8	1.13	≤ 0.10	191.0	0.98	12.96
RUN 2_019168.LAB	10:14	13.70	9.9	1.06	≤ 0.10	191.0	0.98	12.94
RUN 2_019169.LAB	10:15	15.36	9.7	1.14	≤ 0.10	191.0	0.98	12.94
RUN 2_019170.LAB	10:16	14.60	9.8	0.99	≤ 0.10	191.0	0.98	12.94
RUN 2_019171.LAB	10:17	15.13	9.8	1.15	≤ 0.10	191.0	0.98	12.92
RUN 2_019172.LAB	10:18	15.23	9.8	1.11	≤ 0.10	191.0	0.98	12.93
RUN 2_019173.LAB	10:19	14.41	9.9	1.08	≤ 0.10	191.0	0.98	12.93
RUN 2_019174.LAB	10:20	14.97	9.7	0.96	≤ 0.10	191.0	0.98	12.92
RUN 2_019175.LAB	10:21	15.39	9.7	1.09	≤ 0.10	191.0	0.98	12.95
RUN 2_019176.LAB	10:22	14.88	9.8	1.02	≤ 0.10	191.0	0.98	12.97
RUN 2_019177.LAB	10:23	15.29	9.7	1.03	≤ 0.10	191.0	0.98	12.94
RUN 2_019178.LAB	10:24	14.85	9.9	1.03	≤ 0.10	191.0	0.98	12.89
RUN 2_019179.LAB	10:25	14.65	9.9	1.03	≤ 0.10	191.0	0.98	12.91
RUN 2_019180.LAB	10:26	14.75	9.7	0.88	≤ 0.10	191.0	0.98	12.91
RUN 2_019181.LAB	10:27	14.48	9.7	1.06	≤ 0.10	191.0	0.98	12.97
RUN 2_019182.LAB	10:28	15.80	9.5	1.09	≤ 0.10	191.0	0.98	12.99
RUN 2_019183.LAB	10:29	14.79	9.6	1.05	≤ 0.10	191.0	0.98	13.00
RUN 2_019184.LAB	10:30	14.54	9.6	1.02	≤ 0.10	191.0	0.98	13.03
RUN 2_019185.LAB	10:31	14.59	9.7	1.11	≤ 0.10	191.0	0.98	12.99
RUN 2_019186.LAB	10:32	14.53	9.7	1.05	≤ 0.10	191.0	0.98	13.03
RUN 2_019187.LAB	10:33	15.30	9.6	1.09	≤ 0.10	191.1	0.98	13.00
RUN 2_019188.LAB	10:34	14.31	9.7	1.04	≤ 0.10	191.1	0.98	13.01
RUN 2_019189.LAB	10:35	14.25	9.8	1.06	≤ 0.10	191.0	0.98	13.00
RUN 2_019190.LAB	10:36	14.13	9.7	1.08	≤ 0.10	191.0	0.98	12.99
RUN 2_019191.LAB	10:37	14.96	9.7	1.06	≤ 0.10	191.0	0.98	13.00
RUN 2_019192.LAB	10:38	14.15	9.8	1.14	≤ 0.10	191.0	0.98	13.00
RUN 2_019193.LAB	10:39	14.80	9.8	1.10	≤ 0.10	191.0	0.98	12.97
RUN 2_019194.LAB	10:40	14.43	9.9	1.03	≤ 0.10	191.0	0.98	12.97
RUN 2_019195.LAB	10:41	14.29	9.8	1.07	≤ 0.10	191.0	0.98	12.95
RUN 2_019196.LAB	10:42	14.11	9.9	1.10	≤ 0.10	191.0	0.98	12.91
RUN 2_019197.LAB	10:43	14.48	10.0	1.23	≤ 0.10	191.0	0.98	12.90
RUN 2_019198.LAB	10:44	14.46	10.0	1.06	≤ 0.10	191.0	0.98	12.89
RUN 2_019199.LAB	10:45	15.10	9.9	1.07	≤ 0.10	190.9	0.98	12.91
RUN 2_019200.LAB	10:46	14.73	9.8	1.05	≤ 0.10	190.8	0.98	12.89
RUN 2_019201.LAB	10:47	14.49	9.8	0.99	≤ 0.10	190.9	0.98	12.86
RUN 2_019202.LAB	10:48	14.61	9.8	1.03	≤ 0.10	191.0	0.98	12.86
RUN 2_019203.LAB	10:49	14.63	9.7	1.12	≤ 0.10	191.0	0.98	12.92
Average		14.60	9.81	1.06	≤ 0.10	191.00	0.98	12.94

Client: Heidelberg Materials US Cement, Inc.
 Facility: Nazareth Cement Plant
 Project #: M234208
 Test Location: Main Kiln Stack
 Date: 12/6/23

Run 3								
FTIR Data								
Spectrum	Time	H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw	Cell Temp	Pressure	Analyzer Data O2 % (dry)
RUN 3_019297.LAB	11:30	13.86	10.0	1.06	≤ 0.10	191.0	0.98	12.84
RUN 3_019298.LAB	11:31	14.53	9.9	0.97	≤ 0.10	191.0	0.98	12.80
RUN 3_019299.LAB	11:32	15.47	9.9	1.11	≤ 0.10	191.1	0.98	12.86
RUN 3_019300.LAB	11:33	15.51	9.8	1.05	≤ 0.10	191.0	0.98	12.86
RUN 3_019301.LAB	11:34	14.69	9.9	1.01	≤ 0.10	191.0	0.98	12.89
RUN 3_019302.LAB	11:35	15.18	9.9	1.04	≤ 0.10	191.0	0.98	12.88
RUN 3_019303.LAB	11:36	15.29	9.8	1.13	≤ 0.10	191.0	0.98	12.85
RUN 3_019304.LAB	11:37	14.77	9.9	1.13	≤ 0.10	191.0	0.98	12.82
RUN 3_019305.LAB	11:38	14.78	9.9	0.99	≤ 0.10	190.9	0.98	12.84
RUN 3_019306.LAB	11:39	15.37	9.8	0.98	≤ 0.10	190.9	0.98	12.86
RUN 3_019307.LAB	11:40	15.00	9.9	1.10	≤ 0.10	190.9	0.98	12.84
RUN 3_019308.LAB	11:41	14.84	10.0	1.06	≤ 0.10	190.8	0.98	12.84
RUN 3_019309.LAB	11:42	15.52	9.9	1.15	≤ 0.10	190.9	0.98	12.83
RUN 3_019310.LAB	11:43	15.00	10.0	1.15	≤ 0.10	191.1	0.98	12.82
RUN 3_019311.LAB	11:44	15.12	10.1	1.20	≤ 0.10	191.1	0.98	12.75
RUN 3_019312.LAB	11:45	15.20	9.9	1.07	≤ 0.10	191.0	0.98	12.82
RUN 3_019313.LAB	11:46	14.60	10.0	1.11	≤ 0.10	191.0	0.98	12.81
RUN 3_019314.LAB	11:47	14.59	10.0	1.07	≤ 0.10	191.0	0.98	12.83
RUN 3_019315.LAB	11:48	15.11	9.9	1.10	≤ 0.10	191.0	0.98	12.84
RUN 3_019316.LAB	11:49	14.76	10.0	1.02	≤ 0.10	191.0	0.98	12.83
RUN 3_019317.LAB	11:50	15.16	9.8	1.07	≤ 0.10	191.0	0.98	12.85
RUN 3_019318.LAB	11:51	14.53	10.0	1.01	≤ 0.10	191.1	0.98	12.82
RUN 3_019319.LAB	11:52	14.56	10.0	1.11	≤ 0.10	191.0	0.98	12.84
RUN 3_019320.LAB	11:53	14.45	10.0	1.09	≤ 0.10	191.0	0.98	12.82
RUN 3_019321.LAB	11:54	15.22	9.9	1.08	≤ 0.10	191.0	0.98	12.86
RUN 3_019322.LAB	11:55	14.31	10.0	1.11	≤ 0.10	191.0	0.98	12.84
RUN 3_019323.LAB	11:56	14.43	10.0	0.99	≤ 0.10	191.0	0.98	12.88
RUN 3_019324.LAB	11:57	14.52	10.0	0.99	≤ 0.10	191.0	0.98	12.85
RUN 3_019325.LAB	11:58	14.39	10.0	1.04	≤ 0.10	191.0	0.98	12.82
RUN 3_019326.LAB	11:59	13.95	10.1	1.02	≤ 0.10	191.0	0.98	12.85
RUN 3_019327.LAB	12:00	15.52	10.0	1.05	≤ 0.10	191.0	0.98	12.82
RUN 3_019328.LAB	12:01	14.10	10.2	1.02	≤ 0.10	191.0	0.98	12.78
RUN 3_019329.LAB	12:02	14.30	10.2	1.00	≤ 0.10	191.0	0.98	12.78
RUN 3_019330.LAB	12:03	14.48	10.3	1.03	≤ 0.10	191.0	0.98	12.75
RUN 3_019331.LAB	12:04	14.05	10.2	1.12	≤ 0.10	191.0	0.98	12.69
RUN 3_019332.LAB	12:05	15.15	10.2	1.14	≤ 0.10	191.0	0.98	12.78
RUN 3_019333.LAB	12:06	15.04	10.2	1.10	≤ 0.10	191.0	0.98	12.75
RUN 3_019334.LAB	12:07	14.25	10.2	1.07	≤ 0.10	191.0	0.98	12.73
RUN 3_019335.LAB	12:08	14.63	10.2	1.07	≤ 0.10	191.0	0.98	12.72
RUN 3_019336.LAB	12:09	14.70	10.2	0.96	≤ 0.10	191.0	0.98	12.73
RUN 3_019337.LAB	12:10	14.22	10.2	0.97	≤ 0.10	191.0	0.98	12.75
RUN 3_019338.LAB	12:11	14.22	10.3	1.05	≤ 0.10	191.0	0.98	12.74
RUN 3_019339.LAB	12:12	14.75	10.1	1.11	≤ 0.10	191.0	0.98	12.77
RUN 3_019340.LAB	12:13	14.66	10.1	1.06	≤ 0.10	190.9	0.98	12.71
RUN 3_019341.LAB	12:14	14.63	10.0	1.02	≤ 0.10	191.0	0.98	12.74
RUN 3_019342.LAB	12:15	13.88	10.1	0.92	≤ 0.10	191.0	0.98	12.77
RUN 3_019343.LAB	12:16	14.19	10.1	1.04	≤ 0.10	191.0	0.98	12.80
RUN 3_019344.LAB	12:17	14.65	10.1	1.00	≤ 0.10	191.0	0.98	12.77
RUN 3_019345.LAB	12:18	14.14	10.2	0.98	≤ 0.10	190.9	0.98	12.76
RUN 3_019346.LAB	12:19	14.62	10.1	1.04	≤ 0.10	191.0	0.98	12.79
RUN 3_019347.LAB	12:20	15.02	10.1	1.07	≤ 0.10	191.0	0.98	12.73
RUN 3_019348.LAB	12:21	14.17	10.1	1.06	≤ 0.10	191.0	0.98	12.74
RUN 3_019349.LAB	12:22	14.34	10.1	0.91	≤ 0.10	191.0	0.98	12.79
RUN 3_019350.LAB	12:23	14.58	10.0	0.96	≤ 0.10	191.0	0.98	12.73
RUN 3_019351.LAB	12:24	14.52	9.9	1.01	≤ 0.10	191.0	0.98	12.66
RUN 3_019352.LAB	12:25	14.07	10.0	1.05	≤ 0.10	191.0	0.98	12.75
RUN 3_019353.LAB	12:26	14.68	9.9	0.95	≤ 0.10	191.0	0.98	12.72
RUN 3_019354.LAB	12:27	14.48	9.9	0.94	≤ 0.10	191.0	0.98	12.74
RUN 3_019355.LAB	12:28	14.63	10.0	1.12	≤ 0.10	191.0	0.98	12.81
RUN 3_019356.LAB	12:29	14.30	10.0	0.97	≤ 0.10	191.0	0.98	12.76
Average		14.66	10.02	1.05	≤ 0.10	191.00	0.98	12.80

Method 1 and 2 Cyclonic Flow Check Data

Project Number: M234208
Client: Heidelberg Materials US Cement, LLC
Facility: Nazareth Cement Plant
Location: Main Kiln Stack
Pitot ID: S8-058
Pitot Coefficient: 0.839
Probe Length: 6

Source Condition: Mill On
Run No.: 1
Date: 12/5/2023
Start Time: 11:16
End Time: 11:27
RM Testers: MLIP
Port Length: 16.00

Port	Point	DP (in. H ₂ O)	Sqrt. DP	Temp (°F)	Yaw Angle (°)	DP (in. H ₂ O) at Null Point Angle	Velocity (V)	Port	Point	DP (in. H ₂ O)	Sqrt. DP	Temp (°F)	Yaw Angle (°)	DP (in. H ₂ O) at Null Point Angle	Velocity (V)
A	1	1.20	1.0954	230.0	4.0	0.00	70.77	C	1	1.20	1.0954	229.0	7.0	0.00	70.72
A	2	1.20	1.0954	230.0	6.0	0.00	70.77	C	2	1.30	1.1402	230.0	9.0	0.00	73.66
A	3	1.10	1.0488	230.0	7.0	0.00	67.76	C	3	1.20	1.0954	231.0	5.0	0.00	70.82
A	4	1.00	1.0000	229.0	5.0	0.00	64.56	C	4	1.10	1.0488	230.0	3.0	0.00	67.76
B	1	1.30	1.1402	229.0	6.0	0.00	73.61	D	1	1.20	1.0954	232.0	3.0	0.00	70.87
B	2	1.20	1.0954	229.0	3.0	0.00	70.72	D	2	1.20	1.0954	231.0	2.0	0.00	70.82
B	3	1.20	1.0954	230.0	3.0	0.00	70.77	D	3	1.10	1.0488	230.0	4.0	0.00	67.76
B	4	1.10	1.0488	229.0	7.0	0.00	67.71	D	4	1.10	1.0488	230.0	1.0	0.00	67.76

Stratification Test Results Summary
Heidelberg Materials US Cement, Inc.
Nazareth Cement Plant
Main Kiln Stack
December 5, 2023

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

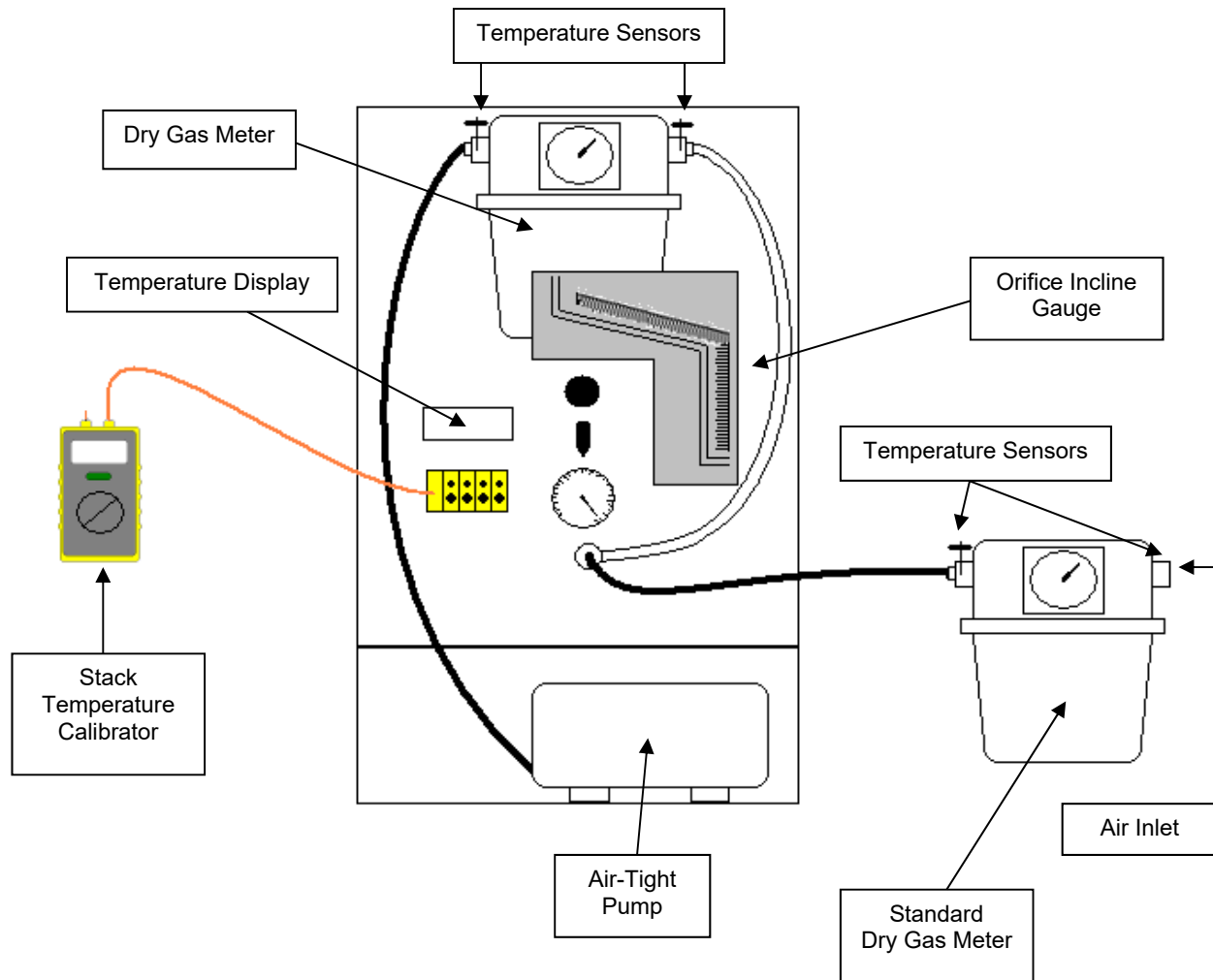
Port No.	Point No.	Time	O ₂ %	Actual % Difference O ₂ %	Mean Difference O ₂ %
1	1	11:50	14.32	0.26	0.04
	2	12:05	14.35	0.05	0.01
	3	12:20	14.40	0.30	0.04
Average			14.36		

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

One point traverse (<0.3% mean difference) 
Three point traverse (0.4, 1.2, and 2.0 meters), < 0.5% mean difference for O₂ 
Twelve point traverse (Method 1 points) >0.5% mean difference for O₂ 

Appendix G - Calibration Data

Dry Gas Meter/Control Module Calibration Diagram



Meter Box Calibration

Dry Gas Meter Calibration Data

Dry Gas Meter No. CM5
Standard Meter No. 4319699
Standard Meter (Y) 1.00620

Date: October 13, 2023
Calibrated By: Vincent Vang
Barometric Pressure: 28.94

Run Number	Orifice Setting in H ₂ O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final		85.018	50.332	68	74	72					
Initial		79.837	45.106	68	74	71					
Difference	1 0.20	5.181	5.226	68	74	72	73	17	40	1.006	1.323
Final		90.896	56.379	69	76	74					
Initial		85.570	50.904	68	74	73					
Difference	2 0.50	5.326	5.475	69	75	74	74	11	50	0.988	1.403
Final		96.279	61.714	69	77	75					
Initial		91.179	56.571	69	75	74					
Difference	3 0.70	5.100	5.143	69	76	75	75	9	45	1.008	1.454
Final		101.957	67.474	69	76	75					
Initial		96.721	62.179	69	76	75					
Difference	4 0.90	5.236	5.295	69	76	75	76	8	55	1.005	1.483
Final		107.891	73.464								
Initial		102.634	68.157	69	75	75					
Difference	5 1.20	5.257	5.307	69	75	75	75	7	50	1.005	1.515
Final		79.535	44.801	68	74	72					
Initial		74.384	39.668	68	74	71					
Difference	6 2.00	5.151	5.133	68	74	72	73	6	3	1.014	1.570

Average **1.004** **1.458**

Stack Temperature Sensor Calibration			
Temperature ID :	T-249465	Name :	Vincent Vang
Ambient Temperature, °F :	70	Date :	October 13, 2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	December 14, 2022
Serial # :	T-249465	Expiration Date:	December 14, 2023

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

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	3	0.7
250	252	0.3
600	599	0.1
1200	1198	0.1

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

Meter Box Calibration

Dry Gas Meter Calibration Data

Dry Gas Meter No. CM 5
Standard Meter No. 16541852
Standard Meter (Y) 1.00440

Date: January 4, 2024
Calibrated By: HH
Barometric Pressure: 29.54

Run Number	Orifice Setting in H ₂ O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final		78.564	99.676	64	65	65					
Initial		73.520	94.531	63	63	62					
Difference	1 0.20	5.044	5.145	64	64	64	64	18	50	0.985	1.560
Final		84.075	105.279	64	70	70					
Initial		78.654	99.776	64	65	65					
Difference	2 0.50	5.421	5.503	64	68	68	68	12	22	0.995	1.448
Final		89.087	10.368	64	70	69					
Initial		84.075	5.279	64	68	67					
Difference	3 0.70	5.012	5.089	64	69	68	69	9	25	0.996	1.372
Final		94.096	15.455	64	70	70					
Initial		89.087	10.368	64	70	69					
Difference	4 0.90	5.009	5.087	64	70	70	70	8	32	0.998	1.447
Final		99.516	20.942	65	72	70					
Initial		94.096	15.455	64	70	70					
Difference	5 1.20	5.420	5.487	65	71	70	71	8	0	1.000	1.449
Final		73.520	94.531	63	63	62					
Initial		68.409	89.456	63	62	62					
Difference	6 2.00	5.111	5.075	63	63	62	62	6	8	1.005	1.612

Average **0.996** **1.481**

Stack Temperature Sensor Calibration			
Temperature ID :		Name :	
Ambient Temperature, °F :	61.6	Date :	

Temperature Calibrator			
Model # :		Certification Date:	
Serial # :		Expiration Date:	

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	599	0.1
1200	1202	0.1

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

Meter Box Calibration

Dry Gas Meter Calibration Data

Dry Gas Meter No. CM49
 Standard Meter No. 16541852
 Standard Meter (Y) 1.00440

Date: October 24, 2023
 Calibrated By: try
 Barometric Pressure: 29.28

Run Number	Orifice Setting in H ₂ O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final		99.317	104.541	66	70	70					
Initial		93.389	98.578	65	69	69					
Difference	1 0.20	5.928	5.963	66	70	70	70	22	37	1.006	1.637
Final		105.237	110.485	66	70	70					
Initial		99.424	104.644	66	70	70					
Difference	2 0.50	5.813	5.841	66	70	70	70	14	43	1.006	1.804
Final		112.223	117.514	66	69	69					
Initial		105.383	110.635	66	70	70					
Difference	3 0.70	6.840	6.879	66	70	70	70	14	8	1.004	1.684
Final		121.290	126.598	66	70	70					
Initial		112.363	117.645	66	68	69					
Difference	4 0.90	8.927	8.953	66	69	70	69	16	13	1.005	1.674
Final		126.421	131.731	66	70	70					
Initial		121.363	126.672	66	70	70					
Difference	5 1.20	5.058	5.059	66	70	70	70	8	4	1.009	1.718
Final		93.292	98.475	65	68	68					
Initial		85.768	91.004	65	67	67					
Difference	6 2.00	7.524	7.471	65	68	68	68	9	42	1.011	1.873

Average **1.007** **1.732**

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	try
Ambient Temperature, °F :	65.9	Date :	October 24, 2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	May 2, 2023
Serial # :	T-285688	Expiration Date:	May 1, 2024

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

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	2	0.4
250	252	0.3
600	602	0.2
1200	1206	0.4

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

Ref. Temp., °F + 460

Meter Box Calibration

Dry Gas Meter Calibration Data

Dry Gas Meter No. CM 49
Standard Meter No. 366118
Standard Meter (Y) 0.99950

Date: January 4, 2024
Calibrated By: HH
Barometric Pressure: 29.59

Run Number	Orifice Setting in H ₂ O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final		25.717	99.534	63	62	62					
Initial		20.659	94.516	62	60	60					
Difference	1 0.20	5.058	5.018	63	61	61	61	20	28	1.004	1.849
Final		30.855	104.621	63	64	64					
Initial		25.717	99.534	63	62	62					
Difference	2 0.50	5.138	5.087	63	63	63	63	12	50	1.008	1.758
Final		35.944	109.715	63	65	65					
Initial		30.855	104.621	63	64	64					
Difference	3 0.70	5.089	5.094	63	65	65	65	10	56	1.000	1.816
Final		41.055	114.821	63	65	65					
Initial		35.944	109.715	63	65	65					
Difference	4 0.90	5.111	5.106	63	65	65	65	9	38	1.002	1.795
Final		46.150	119.916	64	66	66					
Initial		41.055	114.821	63	65	65					
Difference	5 1.20	5.095	5.095	64	66	66	66	8	18	1.000	1.790
Final		20.659	94.516	62	60	60					
Initial		15.575	89.503	62	60	60					
Difference	6 2.00	5.084	5.013	62	60	60	60	6	38	1.005	1.923

Average **1.003** **1.822**

Stack Temperature Sensor Calibration			
Temperature ID :	285668	Name :	HH
Ambient Temperature, °F :	61.6	Date :	January 4, 2024

Temperature Calibrator			
Model # :	CL23A	Certification Date:	May 2, 2023
Serial # :	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	2	0.4
250	253	0.4
600	602	0.2
1200	1206	0.4

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



Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date: 9/21/2023
Temperature (°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 (°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 (°F): 72.6
 Barometric Pressure ("Hg): 29.48

Repetition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (°)	
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

Repetition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	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

$$\% \text{ Difference} = \frac{C_{p(\text{avg-low})} - C_{p(\text{avg-high})}}{C_{p(\text{avg-low})}} \times 100\% = \underline{-0.67\%} \quad \text{Pass}$$

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

$$C_p = \underline{0.834}$$



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 (°F): 72.6
 Barometric Pressure ("Hg): 29.48

Repetition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (°)	
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

Repetition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	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

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

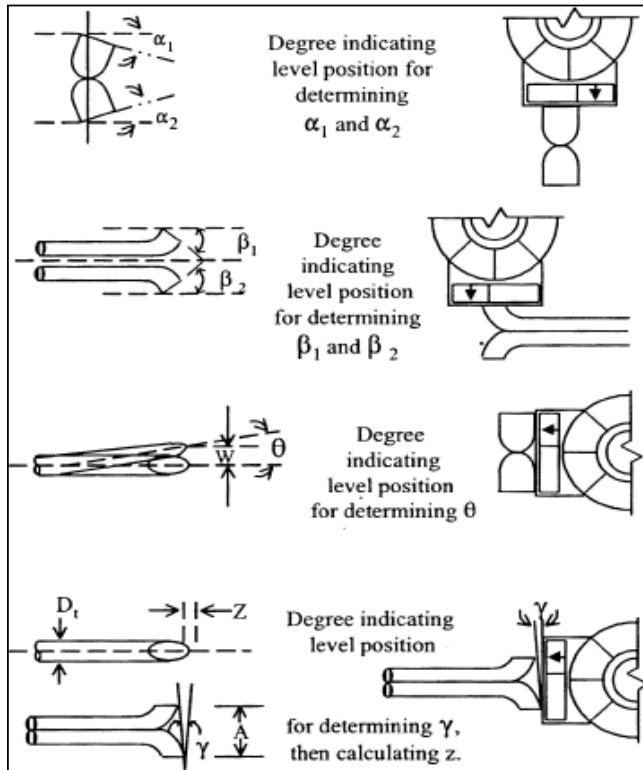
Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
 (2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

$$C_p = \underline{0.834}$$

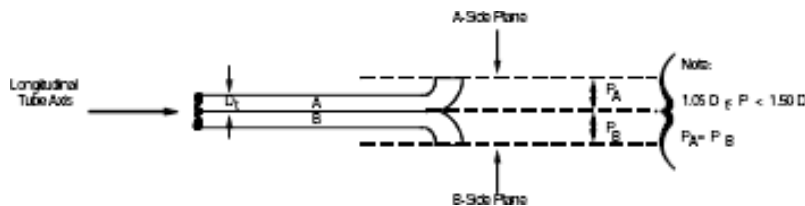


Airflow Sciences Corporation

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 (°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 (°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 (°F): 72.8
 Barometric Pressure ("Hg): 29.48

Repetition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (°)	
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

Repetition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	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

$$\% \text{ Difference} = \frac{C_{p(\text{avg-low})} - C_{p(\text{avg-high})}}{C_{p(\text{avg-low})}} \times 100\% = \underline{-0.30\%} \quad \text{Pass}$$

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

$$C_p = \underline{0.839}$$



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 (°F): 73.1
 Barometric Pressure ("Hg): 29.47

Repetition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (°)	
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

Repetition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	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

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

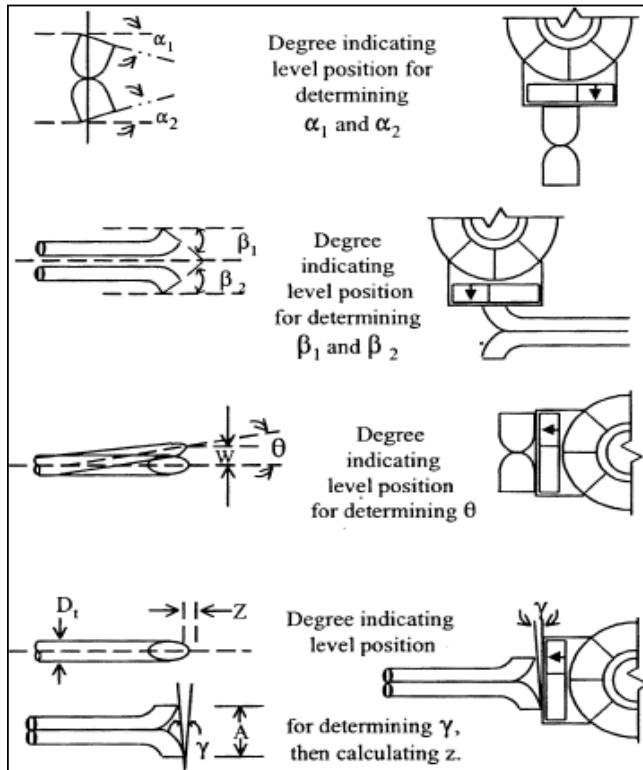
Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
 (2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

$$C_p = \underline{0.829}$$

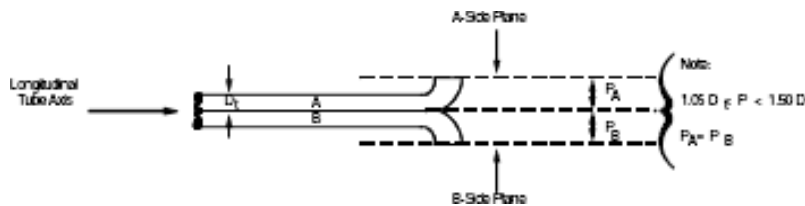


Airflow Sciences Corporation

Probe Inspection for Method 2G



α_1	0.9 ($^\circ$)	Pass
α_2	0.5 ($^\circ$)	Pass
β_1	0.7 ($^\circ$)	Pass
β_2	0.9 ($^\circ$)	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

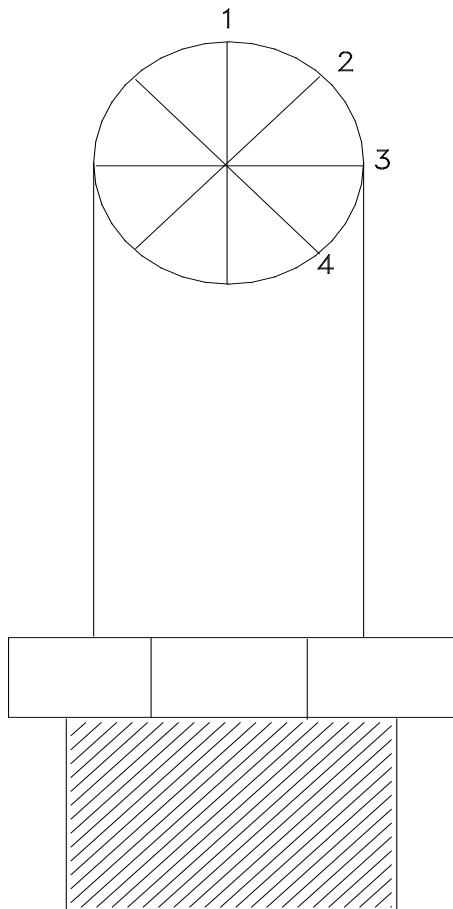
Nozzle Calibration

Date: 12/26/2019

Nozzle ID No.: 862

Analyst: JRK

Material/Type: Glass



0.235 1

0.236 2

0.234 3

0.235 4

Valid Data

Average

0.235

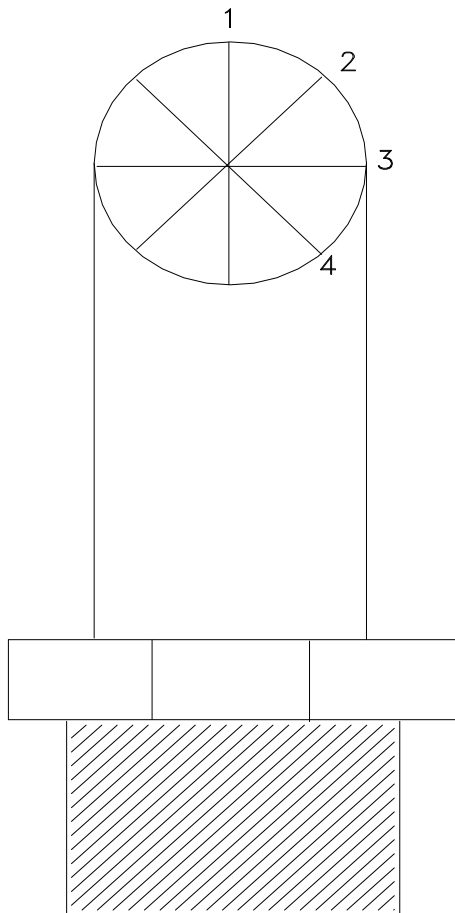
Nozzle Calibration

Date: 10/11/2023

Nozzle ID No.: 8Y

Analyst: RMF

Material/Type: Teflon



<u>0.239</u>	1
<u>0.238</u>	2
<u>0.240</u>	3
<u>0.239</u>	4

Valid Data

Average
<u>0.239</u>

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Test Location: Main Kiln Stack
Date: 12/5/2023
Operator: E. Ehlers
Operating Condition Mill On

Sample System:	FTIR		
Probe Length:	12.0	ft	
Probe Type:	FTIR		
Sample Plane:	Horizontal		
Port Type:	Flange		
Duct Shape:	Circular		
Diameter:	12.25	ft	
Duct Area:	117.86	Sq. Ft.	
Upstream Diameters:	7.10		Minimum Upstream Distance 6.1 Feet
Downstream Diameters:	7.10		Minimum Downstream Distance 24.5 Feet
Number of Ports Sampled:	1		Ideal Upstream Distance 24.5 Feet
Number of Points per Port:	1		Ideal Downstream Distance 98.0 Feet
Total Number of Traverse Points:	1		

Calibration Gases

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder	Final Bottle Pressure, PSI
O2 % (dry)	Zero	Zero Nitrogen	0.0	0.04	-0.21%	N/A		1700
	Mid	ALM039009	10.10	10.19	-0.47%	10/26/2031	52.20%	600
	High	CC743660	19.35	19.49	-0.72%	6/18/2029		1000

Type	Compound	Cylinder ID	Cylinder Value	Expiration Date	Final Bottle Pressure, PSI
Zero Gas	Nitrogen	Zero Nitrogen	0.0	N/A	1700
Calibration Transfer Standard	Ethylene	EB0153603	100.1	9/6/2031	1000
Analyte Spike Gas	HCN	CC768243	49.70	2/29/2024	1600
	SF6		5.000		

Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
O2 % (dry)	Servomex 1440	4662	25	19.35
HF ppmvw	MKS 2030	000583	10	N/A
HCN ppmvw	MKS 2030	000583	200	N/A

Client: Heidelberg Materials US Cement, Inc.
 Facility: Nazareth Cement Plant
 Project #: M234208
 Diluent: O2 %

Test Location: Main Kiln Stack
 Date: 12/5/23
 Operator: E. Ehlers
 O2 % Correction: 7

O2 % (dry) Correction Data

Run #	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
1	10.10	9.82	9.76	0.04	0.00	0.02	9.79	14.45	14.9	2.22	-0.31	0.21	-0.21
2	10.1	9.76	9.80	0.00	-0.01	-0.01	9.78	14.16	14.6	2.02	0.21	0.26	-0.05
3	10.1	9.80	9.97	-0.01	0.15	0.07	9.89	14.26	14.6	1.14	0.88	-0.57	0.83

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

Calibration Corrected and Calculated Data

Run #	Run Date	Start Time	End Time	Moisture %	O2 % (dry)	CO2 % (wet)	CO2 % (dry)	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2
1	12/5/23	11:50	12:48	10.16%	14.92	8.61	9.58	0.97	2.50	0.10	0.26
2	12/5/23	13:25	14:24	10.08%	14.62	8.62	9.59	1.12	2.76	0.10	0.25
3	12/5/23	15:00	15:59	10.40%	14.61	8.55	9.54	1.00	2.47	0.10	0.25

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Test Location: Main Kiln Stack
Date: 12/5/23
Project #: M234208

Linearity Cal/Pre 1 Cal		
<u>Time</u>	<u>O2 % (dry)</u>	
9:52	0.03	
9:53	0.04	
9:54	0.04	iz
9:55	2.12	
9:56	18.38	
9:57	19.61	
9:58	19.49	ih
9:59	15.16	
10:00	0.76	
10:01	0.08	
10:02	0.06	
10:03	2.53	
10:04	16.31	
10:05	10.52	
10:06	10.18	
10:07	10.19	
10:08	10.19	
10:09	10.19	im
11:21	0.03	
11:22	0.04	z
11:23	0.62	
11:24	11.36	
11:25	9.96	
11:26	9.83	
11:27	9.82	m

Client: Heidelberg Materials US Cement, Inc.

Facility: Nazareth Cement Plant

Project #: M234208

Test Location: Main Kiln Stack

Date: 12/5/23

Post 1/Pre 2			Post 2/Pre 3		
<u>Time</u>	<u>O2 % (dry)</u>		<u>Time</u>	<u>O2 % (dry)</u>	
13:13	0.00	z	14:53	0.02	
13:14	-0.05		14:54	-0.01	z
13:15	5.33		14:55	5.13	
13:16	9.67		14:56	9.69	
13:17	9.75		14:57	9.80	
13:18	9.76	m	14:58	9.80	m

Post 3		
<u>Time</u>	<u>O2 % (dry)</u>	
16:44	0.15	z
16:45	1.66	
16:46	10.12	
16:47	9.95	
16:48	9.97	m

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Operating Condition: Mill On

Test Location: Main Kiln Stack
Date: 12/5/2023
Operator: E. Ehlers
FTIR s/n: 000583

System Leak Check: 0.0 mL/min

Nitrogen (Zero) Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
N2 DIR_017809.LAB	12/5/23	9:48:24	0.0	0.0	0.1	191.0	0.98	-0.1	-0.1	0.004
N2 DIR_017810.LAB	12/5/23	9:48:32	0.0	0.0	0.0	191.0	0.98	0.1	-0.1	0.000
N2 DIR_017811.LAB	12/5/23	9:48:40	0.0	0.0	0.0	191.0	0.98	-0.2	0.0	-0.001
N2 DIR_017812.LAB	12/5/23	9:48:48	0.0	0.0	-0.1	191.0	0.98	0.0	0.2	0.003
N2 DIR_017813.LAB	12/5/23	9:48:57	0.0	0.0	0.0	191.0	0.98	0.0	-0.1	0.011
N2 DIR_017814.LAB	12/5/23	9:49:05	0.0	0.0	0.0	191.0	0.98	-0.3	0.0	-0.002
N2 DIR_017815.LAB	12/5/23	9:49:13	0.0	0.0	0.0	191.0	0.98	-0.2	0.0	0.000
N2 DIR_017816.LAB	12/5/23	9:49:22	0.0	0.0	0.0	191.0	0.98	0.0	-0.3	-0.001
N2 DIR_017817.LAB	12/5/23	9:49:30	0.0	0.0	0.0	191.0	0.98	-0.2	-0.3	0.004

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_017893.LAB	12/5/23	10:00:40	0.0	0.0	0.1	191.0	0.98	100.0	-0.1	0.002	99.9%
CTS DIR_017894.LAB	12/5/23	10:00:48	0.0	0.0	0.0	191.0	0.98	99.8	0.2	0.000	99.7%
CTS DIR_017895.LAB	12/5/23	10:00:56	0.0	0.0	0.1	191.0	0.98	99.8	-0.1	-0.004	99.7%
CTS DIR_017896.LAB	12/5/23	10:01:05	0.0	0.0	0.0	191.0	0.98	100.0	-0.2	0.000	99.9%
CTS DIR_017897.LAB	12/5/23	10:01:13	0.0	0.0	0.0	190.9	0.98	100.1	-0.1	-0.002	100.0%
CTS DIR_017898.LAB	12/5/23	10:01:21	0.0	0.0	0.0	190.9	0.98	100.1	0.0	0.005	100.0%
CTS DIR_017899.LAB	12/5/23	10:01:29	0.0	0.0	0.0	190.9	0.98	99.8	0.2	-0.004	99.7%
Average								99.9			99.8%

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_017947.LAB	12/5/23	10:12:51	0.0	0.0	-0.1	191.0	0.98	-0.3	49.6	5.072	99.8%
HCN DIR_017948.LAB	12/5/23	10:12:59	0.0	0.0	0.0	191.0	0.98	-0.3	49.4	5.071	99.5%
HCN DIR_017949.LAB	12/5/23	10:13:07	0.0	0.0	0.0	191.0	0.98	-0.4	49.3	5.054	99.2%
HCN DIR_017950.LAB	12/5/23	10:13:16	0.0	0.0	0.0	191.0	0.98	-0.1	49.4	5.054	99.5%
HCN DIR_017951.LAB	12/5/23	10:13:24	0.0	0.0	0.0	191.0	0.98	-0.2	49.5	5.065	99.5%
HCN DIR_017952.LAB	12/5/23	10:13:32	0.0	0.0	0.0	191.0	0.98	-0.3	49.5	5.064	99.5%
HCN DIR_017953.LAB	12/5/23	10:13:40	0.0	0.0	0.0	191.0	0.98	-0.4	49.7	5.079	100.0%
HCN DIR_017954.LAB	12/5/23	10:13:49	0.0	0.0	0.0	191.0	0.98	-0.4	49.5	5.068	99.5%
Average									49.5	5.066	99.6%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS REMOTE_018125.LAB	12/5/23	11:29:48	0.3	0.0	0.0	190.9	0.98	98.8	0.0	0.030	98.7%
CTS REMOTE_018126.LAB	12/5/23	11:29:56	0.3	0.0	0.0	191.0	0.98	99.2	-0.1	0.027	99.1%
CTS REMOTE_018127.LAB	12/5/23	11:30:04	0.3	0.0	0.0	191.0	0.98	99.3	-0.1	0.031	99.4%
CTS REMOTE_018128.LAB	12/5/23	11:30:12	0.3	0.0	0.0	191.0	0.98	99.2	0.4	0.026	99.2%
CTS REMOTE_018129.LAB	12/5/23	11:30:21	0.3	0.0	0.0	191.0	0.98	99.3	0.2	0.023	99.3%
CTS REMOTE_018130.LAB	12/5/23	11:30:29	0.3	0.0	-0.1	191.0	0.98	99.3	0.0	0.028	99.3%
CTS REMOTE_018131.LAB	12/5/23	11:30:37	0.2	0.0	0.0	190.9	0.98	99.4	0.2	0.044	99.4%
CTS REMOTE_018132.LAB	12/5/23	11:30:46	0.2	0.0	0.0	190.9	0.98	99.3	0.2	0.035	99.3%

Response Time Test

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Response Time (sec)
CTS REMOTE_018119.LAB	12/5/23	11:28:58	1.6	0.2	0.1	191.0	0.98	96.5	0.4	0.036	-
CTS REMOTE_018120.LAB	12/5/23	11:29:06	1.2	0.1	0.0	191.0	0.98	97.6	0.2	0.021	16.248
CTS REMOTE_018121.LAB	12/5/23	11:29:15	0.8	0.1	0.0	191.0	0.98	98.6	0.0	0.027	24.248
CTS REMOTE_018122.LAB	12/5/23	11:29:23	0.6	0.1	0.1	191.0	0.98	98.7	0.1	0.026	
CTS REMOTE_018123.LAB	12/5/23	11:29:31	0.3	0.0	0.0	191.0	0.98	99.1	0.1	0.035	
CTS REMOTE_018124.LAB	12/5/23	11:29:39	0.3	0.0	0.1	191.0	0.98	99.2	0.2	0.027	
CTS REMOTE_018125.LAB	12/5/23	11:29:48	0.3	0.0	0.0	190.9	0.98	98.8	0.0	0.030	
CTS REMOTE_018126.LAB	12/5/23	11:29:56	0.3	0.0	0.0	191.0	0.98	99.2	-0.1	0.027	
CTS REMOTE_018127.LAB	12/5/23	11:30:04	0.3	0.0	0.0	191.0	0.98	99.3	-0.1	0.031	

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Operating Condition: Mill On

Test Location: Main Kiln Stack
Date: 12/5/2023
Operator: E. Ehlers
FTIR s/n: 000583

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_018147.LAB	12/5/23	11:33:11	8.5	8.8	0.0	191.0	0.98	-0.6	1.1	0.027
NATIVE_018148.LAB	12/5/23	11:33:19	8.5	8.8	-0.1	191.0	0.98	-0.4	0.7	0.017
NATIVE_018149.LAB	12/5/23	11:33:28	8.5	8.8	0.0	191.0	0.98	-0.4	0.9	0.018
									0.9	0.021

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_018170.LAB	12/5/23	11:36:40	8.8	8.0	0.0	191.0	0.98	-0.5	4.2	0.385	0.076	92.3%
PRE 1 SPIKE_018171.LAB	12/5/23	11:36:48	8.5	8.0	0.0	191.0	0.98	-0.3	4.4	0.385	0.076	95.8%
PRE 1 SPIKE_018172.LAB	12/5/23	11:36:57	8.4	8.1	-0.1	191.0	0.98	-0.4	4.2	0.386	0.076	92.1%
PRE 1 SPIKE_018173.LAB	12/5/23	11:37:05	8.9	8.1	0.0	191.0	0.98	-0.4	4.2	0.378	0.075	92.4%
PRE 1 SPIKE_018174.LAB	12/5/23	11:37:13	11.4	7.8	0.0	191.0	0.98	-0.3	3.9	0.373	0.074	88.3%
PRE 1 SPIKE_018175.LAB	12/5/23	11:37:21	9.6	8.0	-0.1	191.0	0.98	-0.3	4.4	0.386	0.076	96.6%
PRE 1 SPIKE_018176.LAB	12/5/23	11:37:30	9.0	7.9	-0.1	191.0	0.98	-0.4	4.1	0.385	0.076	89.3%
PRE 1 SPIKE_018177.LAB	12/5/23	11:37:38	8.8	8.0	0.0	191.0	0.98	-0.5	4.5	0.381	0.075	99.6%

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_018281.LAB	12/5/23	13:03:39	10.2	8.6	-0.1	191.0	0.98	1.4	1.1	-0.008
RUN 1_018282.LAB	12/5/23	13:04:43	11.0	8.5	0.0	191.0	0.98	1.0	0.9	-0.010
RUN 1_018283.LAB	12/5/23	13:05:47	9.6	8.7	-0.1	191.0	0.98	1.1	1.1	-0.007
									1.1	-0.008

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
POST 1 SPIKE_018309.LAB	12/5/23	13:10:05	8.2	7.8	0.0	190.9	0.98	0.8	5.4	0.481	0.095	95.4%
POST 1 SPIKE_018310.LAB	12/5/23	13:10:14	8.2	7.8	-0.1	191.0	0.98	0.7	5.5	0.482	0.095	97.7%
POST 1 SPIKE_018311.LAB	12/5/23	13:10:22	8.2	7.9	-0.1	191.0	0.98	0.9	5.7	0.486	0.096	99.5%
POST 1 SPIKE_018312.LAB	12/5/23	13:10:30	8.2	8.0	-0.1	191.0	0.98	0.9	5.6	0.481	0.095	98.3%
POST 1 SPIKE_018313.LAB	12/5/23	13:10:38	9.8	7.8	-0.1	191.0	0.98	0.8	5.6	0.470	0.093	100.0%
POST 1 SPIKE_018314.LAB	12/5/23	13:10:47	9.0	7.8	0.0	191.0	0.98	1.1	5.8	0.481	0.095	101.8%
POST 1 SPIKE_018315.LAB	12/5/23	13:10:55	8.4	7.7	-0.1	190.9	0.98	0.7	5.5	0.486	0.096	95.6%
POST 1 SPIKE_018316.LAB	12/5/23	13:11:03	9.3	7.8	-0.1	190.9	0.98	1.0	5.4	0.475	0.094	96.2%

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 1 CTS_018332.LAB	12/5/23	13:13:35	1.0	0.0	0.0	191.0	0.98	100.2	0.2	0.002	100.2%
POST 1 CTS_018333.LAB	12/5/23	13:13:44	0.9	0.0	0.0	191.0	0.98	100.0	0.2	0.003	100.1%
POST 1 CTS_018334.LAB	12/5/23	13:13:52	0.9	0.0	0.0	191.0	0.98	100.1	0.2	0.006	100.1%
POST 1 CTS_018335.LAB	12/5/23	13:14:00	0.8	0.0	0.0	191.0	0.98	100.6	0.1	0.005	100.6%
POST 1 CTS_018336.LAB	12/5/23	13:14:08	0.8	0.0	0.0	191.0	0.98	100.9	0.5	0.001	100.9%
POST 1 CTS_018337.LAB	12/5/23	13:14:17	0.7	0.0	0.0	190.9	0.98	100.5	-0.1	0.008	100.5%
POST 1 CTS_018338.LAB	12/5/23	13:14:25	0.6	0.0	0.0	190.9	0.98	100.6	0.0	0.008	100.6%
POST 1 CTS_018339.LAB	12/5/23	13:14:33	0.4	0.0	-0.1	190.9	0.98	100.7	0.1	0.006	100.8%

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Operating Condition: Mill On

Test Location: Main Kiln Stack
Date: 12/5/2023
Operator: E. Ehlers
FTIR s/n: 000583

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_018425.LAB	12/5/23	14:42:18	10.2	8.6	-0.1	191.0	0.98	0.9	1.1	-0.009
RUN 2_018426.LAB	12/5/23	14:43:21	10.5	8.6	-0.1	191.0	0.98	0.9	1.0	-0.010
RUN 2_018427.LAB	12/5/23	14:44:25	10.1	8.5	-0.1	191.0	0.98	1.0	1.1	-0.010
									1.1	-0.010

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 2 SPIKE_018455.LAB	12/5/23	14:49:31	11.3	7.6	-0.1	191.0	0.98	1.2	5.5	0.466	0.092	99.6%
POST 2 SPIKE_018456.LAB	12/5/23	14:49:39	10.3	7.7	-0.1	191.0	0.98	2.1	5.8	0.488	0.096	100.6%
POST 2 SPIKE_018457.LAB	12/5/23	14:49:47	9.7	7.6	-0.1	190.9	0.98	2.1	5.6	0.475	0.094	100.1%
POST 2 SPIKE_018458.LAB	12/5/23	14:49:55	9.2	7.7	-0.1	190.9	0.98	1.5	5.8	0.480	0.095	102.8%
POST 2 SPIKE_018459.LAB	12/5/23	14:50:04	9.0	7.8	-0.1	190.9	0.98	1.0	5.6	0.476	0.094	99.6%
POST 2 SPIKE_018460.LAB	12/5/23	14:50:12	8.9	7.8	-0.1	190.9	0.98	0.9	5.8	0.477	0.094	103.4%
POST 2 SPIKE_018461.LAB	12/5/23	14:50:20	8.9	7.9	-0.1	191.0	0.98	0.9	5.7	0.479	0.095	100.2%
POST 2 SPIKE_018462.LAB	12/5/23	14:50:29	8.8	7.9	-0.1	191.0	0.98	0.8	5.8	0.482	0.095	103.0%

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 2 CTS_018477.LAB	12/5/23	14:52:53	1.1	0.0	-0.1	191.0	0.98	100.1	0.3	0.008	100.1%
POST 2 CTS_018478.LAB	12/5/23	14:53:01	1.0	0.0	0.1	191.0	0.98	100.2	0.1	0.008	100.2%
POST 2 CTS_018479.LAB	12/5/23	14:53:09	0.9	0.0	0.0	191.0	0.98	100.1	0.3	0.003	100.2%
POST 2 CTS_018480.LAB	12/5/23	14:53:18	0.9	0.0	0.0	191.1	0.98	100.3	0.3	0.008	100.4%
POST 2 CTS_018481.LAB	12/5/23	14:53:26	0.9	0.0	0.0	191.1	0.98	99.9	0.3	0.009	100.0%
POST 2 CTS_018482.LAB	12/5/23	14:53:34	0.8	0.0	0.1	191.0	0.98	100.2	0.2	0.012	100.3%
POST 2 CTS_018483.LAB	12/5/23	14:53:42	0.8	0.0	0.0	191.0	0.98	100.3	0.2	0.016	100.3%
POST 2 CTS_018484.LAB	12/5/23	14:53:51	0.8	0.0	0.0	191.0	0.98	100.4	0.3	0.001	100.5%

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Operating Condition: Mill On

Test Location: Main Kiln Stack
Date: 12/5/2023
Operator: E. Ehlers
FTIR s/n: 000583

Post Test CTS, Direct Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	CH4 ppmv wet	Ethane ppmv wet	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS DIR POST ALL_018695.LAB	12/5/23	16:51:04	0.4	0.0	0.0	191.0	0.98	101.1	0.1	0.049	101.2%
CTS DIR POST ALL_018696.LAB	12/5/23	16:51:12	0.4	0.0	0.1	191.0	0.98	101.3	0.7	0.054	101.4%
CTS DIR POST ALL_018697.LAB	12/5/23	16:51:21	0.4	0.0	0.0	191.0	0.98	101.4	0.2	0.049	101.5%
CTS DIR POST ALL_018698.LAB	12/5/23	16:51:29	0.4	0.0	0.0	191.0	0.98	101.5	0.4	0.054	101.6%
CTS DIR POST ALL_018699.LAB	12/5/23	16:51:37	0.3	0.0	0.0	191.0	0.98	101.7	0.3	0.055	101.8%
CTS DIR POST ALL_018700.LAB	12/5/23	16:51:45	0.3	0.0	0.0	191.0	0.98	101.3	0.4	0.042	101.4%
CTS DIR POST ALL_018701.LAB	12/5/23	16:51:54	0.3	0.0	0.0	191.0	0.98	101.5	0.2	0.052	101.5%
CTS DIR POST ALL_018702.LAB	12/5/23	16:52:02	0.3	0.0	0.0	191.0	0.98	101.5	0.2	0.047	101.5%
Average								101.4			

Post Test N2, Direct Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	CH4 ppmv wet	Ethane ppmv wet	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
N2 DIR POST ALL_018710.LAB	12/5/23	16:55:42	0.3	0.0	0.0		0.98		0.1	0.037
N2 DIR POST ALL_018711.LAB	12/5/23	16:57:53	0.1	0.0	0.0	191.1	0.98	0.1	0.1	0.029
N2 DIR POST ALL_018712.LAB	12/5/23	17:00:05	0.0	0.0	0.0	190.9	0.98	0.0	0.1	0.022

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Test Location: Main Kiln Stack
Date: 12/6/2023
Operator: E. Ehlers
Operating Condition Mill Off

Sample System:	FTIR		
Probe Length:	12.0	ft	
Probe Type:	FTIR		
Sample Plane:	Horizontal		
Port Type:	Flange		
Duct Shape:	Circular		
Diameter:	12.25	ft	
Duct Area:	117.86	Sq. Ft.	
Upstream Diameters:	7.10		Minimum Upstream Distance
Downstream Diameters:	7.10		Minimum Downstream Distance
Number of Ports Sampled:	1		Ideal Upstream Distance
Number of Points per Port:	1		Ideal Downstream Distance
Total Number of Traverse Points:	1		

6.1 Feet
 24.5 Feet
 24.5 Feet
 98.0 Feet

Calibration Gases

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder	Final Bottle Pressure, PSI
O2 % (dry)	Zero	Zero Nitrogen	0.0	0.11	-0.57%	N/A		1700
	Mid	ALM039009	10.10	10.15	-0.26%	10/26/2031	52.20%	600
	High	CC743660	19.35	19.42	-0.36%	6/18/2029		1000

Type	Compound	Cylinder ID	Cylinder Value	Expiration Date	Final Bottle Pressure, PSI
Zero Gas	Nitrogen	Zero Nitrogen	0.0	N/A	1700
Calibration Transfer Standard	Ethylene	EB0153603	100.1	9/6/2031	1000
Analyte Spike Gas	HCN	CC768243	49.70	2/29/2024	1600
	SF6		5.000		

Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
O2 % (dry)	Servomex 1440	4662	25	19.35
HF ppmvw	MKS 2030	000583	10	N/A
HCN ppmvw	MKS 2030	000583	200	N/A

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Diluent: O₂ %

Test Location: Main Kiln Stack
Date: 12/6/23
Operator: E. Ehlers
O₂ % Correction: 7

O₂ % (dry) Correction Data

Run #	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
1	10.10	10.29	9.98	-0.02	-0.01	-0.02	10.14	12.74	12.7	0.88	-1.60	0.62	0.05
2	10.1	9.98	9.97	-0.01	-0.04	-0.03	9.98	12.94	13.1	0.93	-0.05	0.78	-0.16
3	10.1	9.97	9.95	-0.04	-0.01	-0.03	9.96	12.80	13.0	1.03	-0.10	0.62	0.16

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

Calibration Corrected and Calculated Data

Run #	Run Date	Start Time	End Time	Moisture %	O ₂ % (dry)	CO ₂ % (wet)	CO ₂ % (dry)	HCN ppmvw	HCN ppmvd @ 7% O ₂	HF ppmvw	HF ppmvd @ 7% O ₂
1	12/6/23	8:18	9:16	14.19%	12.69	10.34	12.05	1.01	1.99	0.10	0.20
2	12/6/23	9:50	10:49	14.60%	13.09	9.81	11.48	1.06	2.21	0.10	0.21
3	12/6/23	11:30	12:29	14.66%	12.97	10.02	11.74	1.05	2.15	0.10	0.21

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Test Location: Main Kiln Stack
Date: 12/6/23
Project #: M234208

Linearity Cal/Pre 1 Cal		
<u>Time</u>	<u>O2 % (dry)</u>	
7:25	0.10	
7:26	0.10	
7:27	0.11	
7:28	0.11	iz
7:29	0.11	
7:30	0.11	
7:31	4.24	
7:32	16.96	
7:33	19.20	
7:34	19.42	ih
7:35	17.40	
7:36	2.38	
7:37	0.25	
7:38	6.19	
7:39	10.15	im
7:40	10.33	
7:41	8.02	
7:42	0.67	
7:43	1.90	
7:44	7.70	
7:45	1.68	
7:46	0.50	
7:47	6.96	
7:48	10.29	m
7:49	10.46	
7:50	11.31	
7:51	4.82	
7:52	0.02	
7:53	-0.07	
7:54	-0.02	z

Client: Heidelberg Materials US Cement, Inc.

Facility: Nazareth Cement Plant

Project #: M234208

Test Location: Main Kiln Stack

Date: 12/6/23

Post 1/Pre 2			Post 2/Pre 3		
<u>Time</u>	<u>O2 % (dry)</u>		<u>Time</u>	<u>O2 % (dry)</u>	
9:39	-0.01	z	11:17	0.03	
9:40	0.03		11:18	-0.04	z
9:41	8.70		11:19	6.16	
9:42	9.97		11:20	9.91	
9:43	9.98	m	11:21	9.95	
9:44	11.27		11:22	9.97	m
9:45	5.47				
9:46	0.04				

Post 3		
<u>Time</u>	<u>O2 % (dry)</u>	
12:57	-0.01	z
12:58	-0.02	
12:59	1.33	
13:00	9.44	
13:01	9.93	
13:02	9.95	
13:03	9.95	m

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Operating Condition: Mill Off

Test Location: Main Kiln Stack
Date: 12/6/2023
Operator: E. Ehlers
FTIR s/n: 000583

System Leak Check: 0.0 mL/min

Nitrogen (Zero) Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
N2 DIR_018724.LAB	12/6/23	7:28:54	0.0	0.0	0.0	191.0	0.98	0.0	0.2	-0.006
N2 DIR_018725.LAB	12/6/23	7:29:03	0.0	0.0	0.1	191.0	0.98	0.2	0.2	0.002
N2 DIR_018726.LAB	12/6/23	7:29:11	0.0	0.0	0.0	191.0	0.98	0.0	0.3	0.000
N2 DIR_018727.LAB	12/6/23	7:29:19	0.0	0.0	0.1	191.0	0.98	0.0	0.3	0.008
N2 DIR_018728.LAB	12/6/23	7:29:28	0.0	0.0	0.0	191.0	0.98	0.1	-0.1	-0.005
N2 DIR_018729.LAB	12/6/23	7:29:36	0.0	0.0	0.0	191.0	0.98	0.1	0.0	-0.001
N2 DIR_018730.LAB	12/6/23	7:29:44	0.0	0.0	0.1	190.9	0.98	0.0	0.3	0.000
N2 DIR_018731.LAB	12/6/23	7:29:52	0.0	0.0	0.1	190.9	0.98	0.0	0.0	0.005
N2 DIR_018732.LAB	12/6/23	7:30:00	0.0	0.0	0.0	191.0	0.98	0.0	0.2	0.005

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_018773.LAB	12/6/23	7:36:27	0.0	0.0	0.1	191.0	0.98	100.2	-0.1	-0.004	100.1%
CTS DIR_018774.LAB	12/6/23	7:36:35	0.0	0.0	-0.1	191.0	0.98	100.2	0.1	-0.004	100.1%
CTS DIR_018775.LAB	12/6/23	7:36:44	0.0	0.0	0.0	191.0	0.98	100.7	0.0	-0.003	100.6%
CTS DIR_018776.LAB	12/6/23	7:36:52	0.0	0.0	0.0	191.0	0.98	100.6	-0.1	-0.007	100.5%
CTS DIR_018777.LAB	12/6/23	7:37:00	0.0	0.0	-0.1	191.0	0.98	100.0	0.1	0.001	99.9%
CTS DIR_018778.LAB	12/6/23	7:37:08	0.0	0.0	0.0	191.0	0.98	99.3	0.0	0.001	99.2%
CTS DIR_018779.LAB	12/6/23	7:37:17	0.0	0.0	0.0	191.0	0.98	99.3	-0.2	-0.004	99.2%
Average								100.0			99.9%

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_018811.LAB	12/6/23	7:42:11	0.0	0.0	-0.1	191.0	0.98	-0.4	48.8	4.981	98.2%
HCN DIR_018812.LAB	12/6/23	7:42:19	0.0	0.0	0.0	191.0	0.98	-0.4	48.6	4.978	97.8%
HCN DIR_018813.LAB	12/6/23	7:42:28	0.0	0.0	0.0	191.0	0.98	-0.2	48.5	4.969	97.6%
HCN DIR_018814.LAB	12/6/23	7:42:36	0.0	0.0	0.0	191.0	0.98	-0.2	48.9	4.967	98.5%
HCN DIR_018815.LAB	12/6/23	7:42:44	0.0	0.0	0.0	191.0	0.98	-0.3	49.2	4.983	98.9%
HCN DIR_018816.LAB	12/6/23	7:42:52	0.0	0.0	0.0	191.0	0.98	-0.4	49.0	4.977	98.5%
HCN DIR_018817.LAB	12/6/23	7:43:01	0.0	0.0	0.0	191.0	0.98	-0.3	49.0	4.979	98.6%
HCN DIR_018818.LAB	12/6/23	7:43:09	0.0	0.0	0.0	191.0	0.98	-0.4	49.2	4.983	98.9%
Average									48.9	4.977	98.4%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS REMOTE_018829.LAB	12/6/23	7:45:01	2.3	0.0	0.0	191.0	0.98	100.0	0.3	0.008	99.9%
CTS REMOTE_018830.LAB	12/6/23	7:45:10	2.0	0.0	0.0	191.0	0.98	100.2	0.5	0.002	100.1%
CTS REMOTE_018831.LAB	12/6/23	7:45:18	1.8	0.0	0.0	191.0	0.98	100.4	0.3	0.003	100.3%
CTS REMOTE_018832.LAB	12/6/23	7:45:26	1.5	0.0	0.0	191.0	0.98	101.1	0.4	0.004	101.1%
CTS REMOTE_018833.LAB	12/6/23	7:45:34	1.2	0.0	0.0	191.0	0.98	101.2	0.1	0.003	101.2%
CTS REMOTE_018834.LAB	12/6/23	7:45:43	1.1	0.0	0.0	191.0	0.98	101.5	0.2	0.003	101.5%
CTS REMOTE_018835.LAB	12/6/23	7:45:51	1.0	0.0	0.0	191.0	0.98	101.6	0.3	0.001	101.6%
CTS REMOTE_018836.LAB	12/6/23	7:45:59	0.9	0.0	0.0	190.9	0.98	101.7	0.3	-0.001	101.7%

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_018824.LAB	12/6/23	7:44:19	5.4	11.0	0.1	191.0	0.98	0.7	1.2	0.012	-
CTS REMOTE_018825.LAB	12/6/23	7:44:27	4.4	1.7	0.0	191.0	0.98	52.3	10.9	1.164	16.25
CTS REMOTE_018826.LAB	12/6/23	7:44:36	3.5	0.1	0.0	191.0	0.98	97.8	0.4	0.017	24.25
CTS REMOTE_018827.LAB	12/6/23	7:44:45	3.1	0.1	0.0	191.0	0.98	99.0	0.6	0.013	
CTS REMOTE_018828.LAB	12/6/23	7:44:53	2.7	0.0	-0.1	191.0	0.98	99.4	0.3	0.004	
CTS REMOTE_018829.LAB	12/6/23	7:45:01	2.3	0.0	0.0	191.0	0.98	100.0	0.3	0.008	
CTS REMOTE_018830.LAB	12/6/23	7:45:10	2.0	0.0	0.0	191.0	0.98	100.2	0.5	0.002	
CTS REMOTE_018831.LAB	12/6/23	7:45:18	1.8	0.0	0.0	191.0	0.98	100.4	0.3	0.003	
CTS REMOTE_018832.LAB	12/6/23	7:45:26	1.5	0.0	0.0	191.0	0.98	101.1	0.4	0.004	

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Operating Condition: Mill Off

Test Location: Main Kiln Stack
Date: 12/6/2023
Operator: E. Ehlers
FTIR s/n: 000583

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_018926.LAB	12/6/23	7:59:45	15.2	9.9	-0.1	190.9	0.98	1.0	1.1	-0.017
NATIVE_018927.LAB	12/6/23	7:59:54	15.7	9.9	0.0	190.9	0.98	0.9	1.2	-0.016
NATIVE_018928.LAB	12/6/23	8:00:02	17.0	9.6	0.0	190.9	0.98	1.0	1.3	-0.017
									1.2	-0.017

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_018957.LAB	12/6/23	8:04:59	12.6	9.1	0.0	191.0	0.98	0.9	5.5	0.478	0.096	96.1%
PRE 1 SPIKE_018958.LAB	12/6/23	8:05:08	12.9	9.0	0.0	191.0	0.98	1.0	5.2	0.484	0.097	90.0%
PRE 1 SPIKE_018959.LAB	12/6/23	8:05:16	17.4	8.5	0.0	191.0	0.98	0.8	5.0	0.464	0.093	88.3%
PRE 1 SPIKE_018960.LAB	12/6/23	8:05:24	13.7	8.8	-0.1	191.0	0.98	0.8	5.5	0.496	0.100	93.1%
PRE 1 SPIKE_018961.LAB	12/6/23	8:05:32	12.0	9.1	-0.1	191.0	0.98	0.7	5.4	0.497	0.100	90.2%
PRE 1 SPIKE_018962.LAB	12/6/23	8:05:41	11.1	9.2	0.0	191.0	0.98	0.9	5.3	0.495	0.100	89.6%
PRE 1 SPIKE_018963.LAB	12/6/23	8:05:49	13.4	9.0	0.0	191.0	0.98	1.0	5.1	0.473	0.095	88.6%
PRE 1 SPIKE_018964.LAB	12/6/23	8:05:57	12.3	9.2	-0.1	191.0	0.98	0.7	5.2	0.491	0.099	88.4%

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_019048.LAB	12/6/23	9:28:59	14.1	10.2	0.0	191.0	0.98	0.8	1.0	-0.015
RUN 1_019049.LAB	12/6/23	9:30:03	14.2	10.2	0.0	191.0	0.98	0.8	1.1	-0.014
RUN 1_019050.LAB	12/6/23	9:31:07	15.0	10.2	0.0	191.0	0.98	0.8	1.0	-0.016
									1.0	-0.015

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 1 SPIKE_019077.LAB	12/6/23	9:36:12	12.7	9.5	-0.1	190.9	0.98	0.7	5.0	0.445	0.089	94.1%
POST 1 SPIKE_019078.LAB	12/6/23	9:36:20	12.3	9.5	-0.1	191.0	0.98	0.8	5.2	0.437	0.088	99.1%
POST 1 SPIKE_019079.LAB	12/6/23	9:36:28	14.4	9.3	0.0	191.0	0.98	0.9	4.8	0.433	0.087	91.8%
POST 1 SPIKE_019080.LAB	12/6/23	9:36:36	13.6	9.4	0.0	191.0	0.98	0.9	4.9	0.439	0.088	92.3%
POST 1 SPIKE_019081.LAB	12/6/23	9:36:45	13.0	9.4	-0.1	191.0	0.98	0.7	5.2	0.435	0.087	98.9%
POST 1 SPIKE_019082.LAB	12/6/23	9:36:53	12.6	9.4	-0.1	191.0	0.98	0.9	4.9	0.434	0.087	93.4%
POST 1 SPIKE_019083.LAB	12/6/23	9:37:01	12.4	9.4	0.0	191.0	0.98	2.3	5.3	0.439	0.088	100.0%
POST 1 SPIKE_019084.LAB	12/6/23	9:37:09	13.4	9.3	-0.1	191.0	0.98	3.5	5.3	0.436	0.088	100.5%

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 1 CTS_019095.LAB	12/6/23	9:39:03	1.2	0.0	-0.1	190.9	0.98	100.3	0.2	0.006	100.3%
POST 1 CTS_019096.LAB	12/6/23	9:39:12	1.0	0.0	0.0	191.0	0.98	100.2	0.1	-0.001	100.1%
POST 1 CTS_019097.LAB	12/6/23	9:39:20	0.9	0.0	-0.1	191.0	0.98	100.3	0.2	0.010	100.2%
POST 1 CTS_019098.LAB	12/6/23	9:39:28	0.8	0.0	0.0	191.0	0.98	100.3	0.1	0.007	100.3%
POST 1 CTS_019099.LAB	12/6/23	9:39:36	0.8	0.0	0.0	190.9	0.98	100.8	0.4	0.012	100.8%
POST 1 CTS_019100.LAB	12/6/23	9:39:45	0.8	0.0	0.0	190.9	0.98	100.9	0.3	0.008	100.9%
POST 1 CTS_019101.LAB	12/6/23	9:39:53	0.7	0.0	0.0	191.0	0.98	100.6	0.4	0.011	100.6%
POST 1 CTS_019102.LAB	12/6/23	9:40:01	0.7	0.0	0.0	191.0	0.98	100.7	0.0	0.008	100.7%

Client: Heidelberg Materials US Cement, Inc.
Facility: Nazareth Cement Plant
Project #: M234208
Operating Condition: Mill Off

Test Location: Main Kiln Stack
Date: 12/6/2023
Operator: E. Ehlers
FTIR s/n: 000583

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_019218.LAB	12/6/23	11:08:50	15.0	9.8	-0.1	191.0	0.98	0.9	1.0	-0.012
RUN 2_019219.LAB	12/6/23	11:09:54	14.8	9.9	-0.1	191.0	0.98	0.9	1.0	-0.014
RUN 2_019220.LAB	12/6/23	11:10:58	14.5	9.9	0.0	191.0	0.98	0.9	1.0	-0.015
									1.0	-0.014

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_019233.LAB	12/6/23	11:14:24	14.7	8.8	-0.1	191.0	0.98	0.8	5.1	0.449	0.090	96.3%
POST RUN 2 SPIKE_019234.LAB	12/6/23	11:14:32	13.4	9.0	0.0	191.0	0.98	0.7	5.1	0.453	0.091	95.7%
POST RUN 2 SPIKE_019235.LAB	12/6/23	11:14:41	13.2	9.0	0.0	191.0	0.98	0.7	4.9	0.441	0.089	93.0%
POST RUN 2 SPIKE_019236.LAB	12/6/23	11:14:49	15.0	8.8	-0.1	191.0	0.98	0.8	4.8	0.438	0.088	92.0%
POST RUN 2 SPIKE_019237.LAB	12/6/23	11:14:57	13.5	9.0	-0.1	191.0	0.98	0.7	4.9	0.450	0.090	92.6%
POST RUN 2 SPIKE_019238.LAB	12/6/23	11:15:05	13.4	9.0	0.0	191.0	0.98	0.8	4.8	0.439	0.088	93.0%
POST RUN 2 SPIKE_019239.LAB	12/6/23	11:15:14	13.6	9.0	0.0	191.0	0.98	0.8	5.0	0.443	0.089	95.8%
POST RUN 2 SPIKE_019240.LAB	12/6/23	11:15:22	13.1	9.1	0.0	191.0	0.98	0.7	4.8	0.442	0.089	92.1%

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
POST RUN 2 CTS_019254.LAB	12/6/23	11:17:40	0.9	0.0	-0.1	191.0	0.98	100.2	0.2	0.007	100.2%
POST RUN 2 CTS_019255.LAB	12/6/23	11:17:48	0.8	0.0	0.0	191.0	0.98	100.5	0.3	0.006	100.5%
POST RUN 2 CTS_019256.LAB	12/6/23	11:17:57	0.8	0.0	0.0	191.0	0.98	100.6	0.3	0.010	100.5%
POST RUN 2 CTS_019257.LAB	12/6/23	11:18:05	0.7	0.0	-0.1	190.9	0.98	100.5	0.2	0.014	100.5%
POST RUN 2 CTS_019258.LAB	12/6/23	11:18:13	0.6	0.0	0.0	190.9	0.98	100.7	0.2	0.009	100.7%
POST RUN 2 CTS_019259.LAB	12/6/23	11:18:21	0.6	0.0	0.0	190.9	0.98	100.6	0.3	0.004	100.6%
POST RUN 2 CTS_019260.LAB	12/6/23	11:18:30	0.6	0.0	0.0	190.9	0.98	101.1	0.2	0.001	101.1%
POST RUN 2 CTS_019261.LAB	12/6/23	11:18:38	0.6	0.0	0.0	190.9	0.98	100.9	0.2	0.004	100.9%

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 3_019363.LAB	12/6/23	12:44:31	14.2	10.1	-0.1	191.0	0.98	0.9	1.0	-0.013
RUN 3_019364.LAB	12/6/23	12:45:35	14.9	10.0	0.0	191.0	0.98	0.9	0.9	-0.016
RUN 3_019365.LAB	12/6/23	12:46:39	14.3	10.1	0.0	191.0	0.98	0.8	1.0	-0.015
									1.0	-0.015

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
RUN 3 POST SPIKE_019373.LAB	12/6/23	12:48:47	12.7	9.6	-0.1	191.0	0.98	0.7	3.7	0.270	0.054	103.4%
RUN 3 POST SPIKE_019374.LAB	12/6/23	12:48:55	13.3	9.5	0.0	191.0	0.98	0.7	3.4	0.275	0.055	93.3%
RUN 3 POST SPIKE_019375.LAB	12/6/23	12:49:03	13.5	9.5	0.0	191.0	0.98	0.7	3.6	0.281	0.056	97.8%
RUN 3 POST SPIKE_019376.LAB	12/6/23	12:49:11	13.9	9.4	-0.1	191.0	0.98	0.8	3.7	0.278	0.056	101.9%
RUN 3 POST SPIKE_019377.LAB	12/6/23	12:49:20	14.0	9.4	0.0	191.0	0.98	0.7	3.6	0.281	0.056	97.8%
RUN 3 POST SPIKE_019378.LAB	12/6/23	12:49:28	14.1	9.4	0.0	191.0	0.98	0.8	3.8	0.288	0.058	100.0%
RUN 3 POST SPIKE_019379.LAB	12/6/23	12:49:36	13.8	9.4	0.0	191.0	0.98	0.8	3.4	0.278	0.056	91.8%
RUN 3 POST SPIKE_019380.LAB	12/6/23	12:49:44	13.2	9.4	-0.1	191.0	0.98	0.6	3.7	0.292	0.059	97.5%

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
RUN 3 POST CTS_019422.LAB	12/6/23	12:55:54	2.0	0.0	0.0	190.9	0.98	99.1	0.3	0.009	99.1%
RUN 3 POST CTS_019423.LAB	12/6/23	12:56:03	1.8	0.0	0.0	190.9	0.98	99.2	0.3	0.008	99.1%
RUN 3 POST CTS_019424.LAB	12/6/23	12:56:11	1.7	0.0	0.0	190.9	0.98	99.5	0.6	0.011	99.4%
RUN 3 POST CTS_019425.LAB	12/6/23	12:56:19	1.5	0.0	0.0	191.0	0.98	99.6	0.2	-0.004	99.5%
RUN 3 POST CTS_019426.LAB	12/6/23	12:56:27	1.3	0.0	0.0	191.0	0.98	99.5	-0.1	0.008	99.5%
RUN 3 POST CTS_019427.LAB	12/6/23	12:56:36	1.1	0.0	0.0	191.0	0.98	99.8	0.1	0.008	99.8%
RUN 3 POST CTS_019428.LAB	12/6/23	12:56:44	1.1	0.0	0.1	191.0	0.98	99.9	0.3	0.003	99.9%
RUN 3 POST CTS_019429.LAB	12/6/23	12:56:52	1.0	0.0	0.0	190.9	0.98	100.1	0.4	0.003	100.0%

Client: Heidelberg Materials US Cement, Inc.

Facility: Nazareth Cement Plant

Project #: M234208

Operating Condition: Mill Off

Test Location: Main Kiln Stack

Date: 12/6/2023

Operator: E. Ehlers

FTIR s/n: 000583

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 DIR POST ALL_019471.LAB	12/6/23	13:05:13	0.9	0.0	0.1	191.0	0.98	100.1	-0.1	-0.001	100.1%
CTS DIR POST ALL_019472.LAB	12/6/23	13:05:21	0.9	0.0	0.1	191.1	0.98	100.1	-0.3	-0.007	100.1%
CTS DIR POST ALL_019473.LAB	12/6/23	13:05:29	0.8	0.0	-0.1	191.1	0.98	100.0	0.1	-0.001	100.0%
CTS DIR POST ALL_019474.LAB	12/6/23	13:05:38	0.8	0.0	0.0	191.1	0.98	99.9	0.1	-0.007	99.8%
CTS DIR POST ALL_019475.LAB	12/6/23	13:05:46	0.7	0.0	0.0	191.1	0.98	100.0	-0.2	-0.009	100.0%
CTS DIR POST ALL_019476.LAB	12/6/23	13:05:54	0.6	0.0	-0.1	191.1	0.98	99.8	0.3	-0.005	99.8%
CTS DIR POST ALL_019477.LAB	12/6/23	13:06:02	0.6	0.0	0.0	191.0	0.98	100.0	0.0	-0.009	99.9%
CTS DIR POST ALL_019478.LAB	12/6/23	13:06:11	0.6	0.0	0.0	191.0	0.98	100.3	0.2	-0.008	100.2%
Average								100.0			

Post Test N2, Direct Purge											
Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	
N2 DIR POST ALL_019491.LAB	12/6/23	13:12:50	0.3	0.0	0.0	191.0	0.98	-0.1	-0.1	-0.005	
N2 DIR POST ALL_019492.LAB	12/6/23	13:15:02	0.3	0.0	0.0	191.0	0.98	-0.1	0.0	-0.006	
N2 DIR POST ALL_019493.LAB	12/6/23	13:17:14	0.2	0.0	0.0	191.0	0.98	-0.1	-0.1	-0.005	

Zero Gas and In-Stack Detection Limit Study
Heidelberg Materials US Cement, Inc.
Nazareth Cement Plant
Main Kiln Stack
12/5/2023

Time	DL summary - zero gas		Time	DL summary - in stack	
	HF ppm (10) 191C	HCN (100) 191C		HF ppm (10) 191C	HCN (100) 191C
9:51:58 AM	0.00	-0.08	12:49:47 PM	-0.08	0.92
9:52:07 AM	0.01	-0.08	12:50:51 PM	-0.07	0.95
9:52:15 AM	-0.03	-0.04	12:51:55 PM	-0.07	1.05
9:52:23 AM	-0.01	-0.10	12:52:59 PM	-0.06	0.85
9:52:32 AM	0.03	-0.13	12:54:03 PM	-0.08	1.16
9:52:40 AM	0.02	-0.04	12:55:07 PM	-0.07	0.98
9:52:48 AM	0.05	-0.11	12:56:11 PM	-0.07	0.98
Standard Deviation	0.02	0.03	Standard Deviation	0.01	0.09
3x = DL	0.07	0.09	3x = DL	0.02	0.28

Appendix H - Gas Cylinder Certifications

CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Part Number:	X02NI99P15AD524	Reference Number:	141-402838188-1
Cylinder Number:	EB0153603	Cylinder Volume:	140.0 CF
Laboratory:	124 - Stryker (SAP) - OH	Cylinder Pressure:	2015 PSIG
Analysis Date:	Sep 06, 2023	Valve Outlet:	350
Lot Number:	141-402838188-1		

Expiration Date: Sep 06, 2031

Primary Standard Gas Mixtures are traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	100.1 PPM	+/- 1%
NITROGEN	Balance		



Signature on file

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Customer:	MOSTARDI PLATT	Reference Number:	160-402841763-1
Part Number:	X03NI99C15AC0W8	Cylinder Volume:	144.4 CF
Cylinder Number:	CC768249	Cylinder Pressure:	2015 PSIG
Laboratory:	124 - Plumsteadville - PA	Valve Outlet:	350SS
Analysis Date:	Sep 11, 2023		
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		



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Grade of Product: EPA PROTOCOL STANDARD

Reference Number: 48-402876811-1
Cylinder Volume: 141.0 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 590
Certification Date: Oct 26, 2023

Expiration Date: Oct 26, 2031

Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	10.00 %	10.08 %	G1	+/- 0.6% NIST Traceable	10/26/2023
OXYGEN	10.00 %	10.10 %	G1	+/- 1.3% NIST Traceable	10/26/2023
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08010611	K005428	13.94 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 30, 2024
NTRM	98051113	SG9163010BAL	9.507 % OXYGEN/NITROGEN	+/- 0.7%	Mar 22, 2030

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS 6E CO2	NDIR	Oct 23, 2023
SIEMENS OXYMAT 6	PARAMAGNETIC	Oct 09, 2023

Triad Data Available Upon Request



Signature on file

Project No. M3882
Main Kiln Stack

140 of 142

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI62E15A3356	Reference Number:	54-402141622-1
Cylinder Number:	CC743660	Cylinder Volume:	158.6 CF
Laboratory:	124 - Chicago (SAP) - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12021	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Jun 18, 2021

Expiration Date: Jun 18, 2029

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	19.00 %	18.76 %	G1	+/- 0.6% NIST Traceable	06/18/2021
OXYGEN	19.00 %	19.35 %	G1	+/- 0.7% NIST Traceable	06/18/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	060118	K008299	23.04 % CARBON DIOXIDE/NITROGEN	+/- 0.5%	Jun 27, 2022

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO2-1 HORIBA VIA-510 V1E3H7P5	NDIR	Jun 17, 2021
O2-1 HORIBA MPA-510 3VUYL9NR	Paramagnetic	Jun 14, 2021

Triad Data Available Upon Request



Signature on file

END OF THE REPORT