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Hydrogen Cyanide, Hydrogen Fluoride and Diatomic Chlorine from a Portland Cement Plant

Holcim Inc.
Joppa IL Facility

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TEST DATES: December 8, 2023

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The United States Environmental Protection Agency (US EPA) has directed the portland cement industry (SIC 3241) to conduct emissions testing as part of the US EPA Risk and Technology Review (RTR). This document provides the emission test results and supporting quality assurance/quality control (QA/QC) measures used to produce standardized data having known precision and accuracy. Collection of accurate, representative, and standardized data for facilities with low emissions is necessary especially in view of MACT standard setting procedures.

The Holcim Inc. facility located near Joppa IL has been included in this request. The process tested at the Joppa facility is a "long dry" cement kiln. It produces portland cement without an external preheater/precalciner. There is no inline raw mill. There are two kilns located on-site, however one is used. As of this writing, Kiln System #2 is idled, with gases from Kiln System #1 exhausted through the Kiln #2 stack. Kiln System #2 has been idle all of 2023 and there are no plans to bring the kiln up therefore it will not be tested.

The Holcim Joppa facility operates a number of air pollution control devices which help control and lower stack emissions. Those air pollution control devices include an Electrostatic Precipitator (ESP), Low-NO_x Burners, Selective Catalytic Reduction (SCR), Dry Absorbent Addition (DAA) System and the Kiln #2 Baghouse. A more detailed description of the processes is provided in Section 2 of the RTR Sampling and Analytical Protocol reproduced in Appendix G.

The Holcim Inc. retained DEECO Inc. (DEECO) to conduct emission tests for for hydrogen cyanide (HCN), hydrogen fluoride (HF), and diatomic chlorine (Cl_2). All sampling runs were be one hour long. Concurrent measurements to determine volumetric flow rate were made.

A summary of the test results is shown in Table 1.1.

TABLE 1.1 SUMMARY OF HYDROGEN CYANIDE, HYDROGEN FLUORIDE, AND DIATOMIC CHLORINE EMISSIONS; HOLCIM INC., JOPPA, IL FACILITY; KILN 1; DECEMBER 8, 2023

Test Parameters	Main Stack
Hydrogen Cyanide (FTIR)	
parts-per-million, dry basis corrected to 7% O_2	1.9
pounds-per-hour	0.55
pounds-per-ton of clinker	0.008
Hydrogen Fluoride (FTIR)	
parts-per-million, dry basis corrected to 7% O_2	<0.06
pounds-per-hour	<0.013
pounds-per-ton of clinker	<0.0002
Hydrogen Fluoride (Method 26A)	
parts-per-million, dry basis corrected to 7% O_2	<0.42
pounds-per-hour	<0.093
pounds-per-ton of clinker	<0.0014
Diatomic Chlorine (Method 26A)	
parts-per-million, dry basis corrected to 7% O_2	<0.087
pounds-per-hour	<0.069
pounds-per-ton of clinker	<0.0011

The sampling and analytical procedures followed are summarized in Table 1.2 and discussed in detail in Section 3.

Testing was performed on the Kiln 1 under one conditions on December 8, 2023.

Sampling was conducted by personnel from DEECO, Inc. of Raleigh, North Carolina. All questions regarding sampling and analytical data should be directed to Dr. Scott Steinsberger of DEECO at (800) 733-3261. The field sampling was completed by Lee Harris, Gage Mayer, Michael Powell, and Scott Steinsberger of DEECO.

The remainder of this document summarizes the results, procedures and quality control measures followed for this program. Section 2 contains tabulated air emission results for each parameter of interest. Section 3 summarizes the air emission sampling and analytical procedures performed by DEECO, with a brief description and/or reference to the applicable methodologies. Section 4 discusses the basic quality control elements in place for this program to assure the collection of representative, accurate air emission data.

The appendices provided in this document contain all of the necessary information to verify the reported results. Included as Appendices are: Appendix A - Emission Summary Tables; Appendix B - Field Data and CEM/FTIR Data; Appendix C - Ion Chromatography Analytical Report Data; Appendix D - Plant Process Data; Appendix E - Calibration Documents; Appendix F - Test Participants; Appendix G - RTR Sampling and Analytical Protocol

TABLE 1.2 SUMMARY OF SAMPLING AND ANALYTICAL PROTOCOLS FOR HOLCIM INC, JOPPA , ILLINOIS FACILITY

Location and Frequency	Test Parameter	Sampling Method	Sampling Procedure	Analysis Method	Analysis Procedure
Kiln 1 Main Stack	Volumetric Flow Rate and cyclonic check	EPA Methods 1 and 2	Velocity and temperature traverses	EPA Methods 1 and 2	Manometer for differential pressure and thermocouple for temperature
	Oxygen and Carbon Dioxide and Stratification Check	EPA Method 3A	Continuous; extractive sample	EPA Method 3A	Paramagnetic for O_2 and NDIR for CO_2
	Moisture	EPA Method 4	Condensation	EPA Method 4	Gravimetric
	Hydrogen Fluoride and Diatomic Chlorine (Cl_2)	EPA Method 26A	Isokinetic integrated sample	EPA Method 26A	Ion chromatography
	Hydrogen Fluoride and Hydrogen Cyanide	EPA Method 320	Continuous; extractive sample	EPA Method 320	Fourier Transform Infrared (FTIR) Spectroscopy

2. SUMMARY OF RESULTS

Emissions sampling was conducted at the Holcim Joppa facility. Sampling was conducted for stack gas flow rate (EPA Methods 1 and 2), stack gas oxygen and carbon dioxide (EPA Method 3A), stack gas moisture (EPA Method 4), stack gas hydrogen fluoride and diatomic chlorine (EPA Method 26A) and stack gas hydrogen cyanide and hydrogen fluoride (EPA Method 320).

Testing was conducted on the Kiln 1 main stack under one condition and the results are summarized in Table 2.1.

TABLE 2.1 HOLCIM INC., JOPPA, IL FACILITY; KILN 1 MAIN STACK HYDROGEN CYANIDE, HYDROGEN FLUORIDE, AND DIATOMIC CHLORINE EMISSIONS; DECEMBER 8, 2023

Test Parameter	Kiln 1 Main Stack Run 1	Kiln 1 Main Stack Run 2	Kiln 1 Main Stack Run 3	Kiln 1 Main Stack Average
Time	13:24-14:34	14:53-16:02	16:20-17:26	December 8, 2023
Flow Rate (dscfm)	120,250	123,750	123,500	122,520
Oxygen	12.9%	12.9%	12.6%	12.8%
Carbon Dioxide	14.2%	13.5%	13.7%	13.8%
Moisture	7.8%	7.9%	7.9%	7.9%
Hydrogen Cyanide (FTIR)				
ppm_{dry} at 7% O_2	2.0	1.8	1.7	1.9
pounds-per-hour	0.59	0.54	0.54	0.55
pounds-per-ton of clinker	0.009	0.008	0.008	0.008
Hydrogen Fluoride (FTIR)				
ppm_{dry} at 7% O_2	<0.06	<0.06	<0.06	<0.06
pounds-per-hour	<0.013	<0.013	<0.013	<0.013
pounds-per-ton of clinker	<0.0002	<0.0002	<0.0002	<0.0002
Hydrogen Fluoride (Method 26A)				
ppm_{dry} at 7% O_2	<0.41	<0.44	<0.41	<0.42
pounds-per-hour	<0.088	<0.097	<0.094	<0.093
pounds-per-ton of clinker	<0.0014	<0.0015	<0.0015	<0.0014
Diatomic Chlorine (Method 26A)				
ppm_{dry} at 7% O_2	<0.09	<0.09	<0.08	<0.09
pounds-per-hour	<0.069	<0.071	<0.066	<0.069
pounds-per-ton of clinker	<0.0011	<0.0011	<0.0010	<0.0011

3. SAMPLING AND ANALYTICAL PROCEDURES

Table 1.2 presents a summary of the overall sampling and analytical protocols used for the test program for the Kiln 1 main stack at Holcim's Joppa, IL facility. All sampling and analytical methods employed for this test program were performed in accordance with the procedures outlined in the Reference Test Methods contained in the Code of Federal Regulations, Title 40, Part 60, Appendix A (40 CFR 60, Appendix A) and 40 CFR 63, Appendix A.

3.1 Sampling Point Determination - EPA Method 1

The Kiln 1 Stack 2 (which is the same stack formerly used for Kiln #2) is vertically-oriented and circular with an inside diameter of 102". The stack gas sampling ports are located more than 7.5 diameters above the ID fan breaching and more than 0.5 diameters below the stack outlet. The location meets the minimum specifications for a measurement site under EPA Method 1. Cyclonic flow checks, as described in EPA Method 1 Section 2.4, using the Type-S pitot null procedure and angle measurements were conducted at the stack test location.

A twelve (12) point sampling traverse was made using three (3) point traverses in each of 4 sampling ports) at the stack. Each traverse were made at each sampling location using a type-S pitot tube in accordance with EPA Methods 2 procedures. Gas temperatures were measured using calibrated Type K thermocouples and digital readout devices. All measurements were performed in accordance with the procedures in EPA Methods 2, and 26A.

A schematic of the Kiln 1 main stack is provided in Figure 3.1.

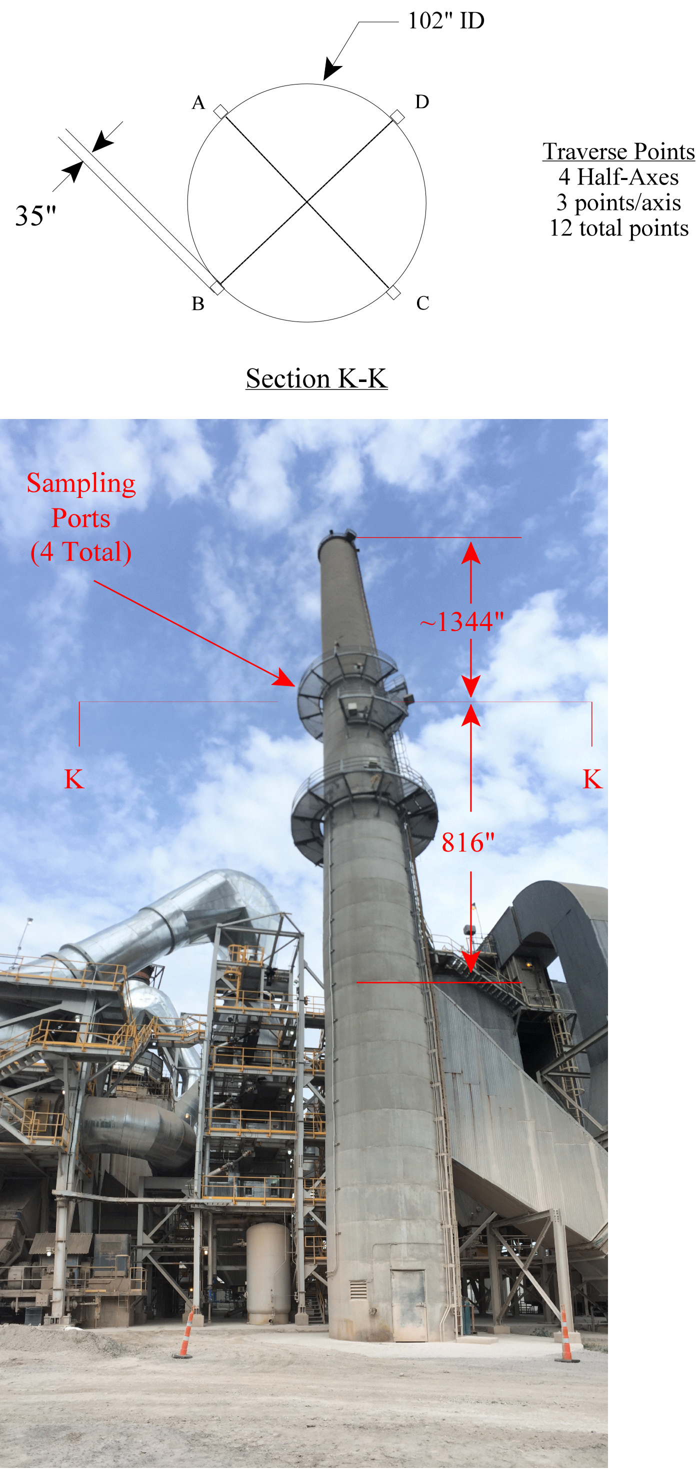


Figure 3.1 Schematic of the Kiln 1 Stack Sampling Location

The number and location of the sampling or traverse points were determined according to the procedures outlined in EPA Method 1. All points were at least 1.0 inches from the stack wall, per Method 1.

3.2 Flue Gas Velocity and Volumetric Flow Rate - EPA Method 2

The flue gas velocity and volumetric flow rate were determined according to the procedures outlined in EPA Method 2. Velocity measurements were using type S pitot tubes conforming to the calibration specifications outlined in EPA Method 2, Section 10.1. Each Type-S pitot tube, calibrated according to these standards, had an assigned coefficient. Differential pressures were measured with fluid manometers. Effluent gas temperatures were measured with chromel-alumel thermocouples equipped with digital readouts.

3.3 Outlet Flue Gas Composition - EPA Method 3A

Outlet flue gas analysis for oxygen (O_2) and carbon dioxide (CO_2) concentrations, and the calculation of percent excess air and flue gas dry molecular weight was performed in accordance with EPA Method 3A.

To evaluate the sampling location and points for FTIR and O_2 sampling, a three-point O_2 concentration stratification test on a line passing through the centroidal area at (for stacks is greater than 2.4 meters) at 0.4, 1.2 and 2.0 meters from the stack or duct wall. The procedures in Section 8.1.2 of Method 7E were followed, using oxygen as allowed by fourth sentence in Section 8.1.2. The plant O_2 CEMS was used as a control. A criteria of <5% variation from combined mean for each point was used as indication of non-stratification to allow single point sampling at the point closest to the mean.

Per EPA Method 3A for determining molecular weight, continuous extractive sampling was obtained using the same Method 320 sampling system described in Section 3.6.

A portion of the hot , wet gas sample was sent through a condensing system to remove the stack moisture. A portion of the moisture-free gas sample was sent to an O_2/CO_2 analyzer.

Calibration procedures were be performed in accordance with EPA methodology. Analyzers were calibrated before and after each test and a calibration check between each test run.

The pretest calibrations consisted of the following steps:

- Internal (direct) calibration of each analyzer to adjust calibration and check linearity.
- External (through the entire sampling system) calibration to check the system bias on zero and span gases.

The post test calibration consisted of an external system bias calibration check.

The analyzer calibrated using a certified zero and span (mid or high range) gas. Zero and span gases were directed to each analyzer through the appropriate plumbing, the calibration gas flow rates were adjusted to the correct flow rate and the analyzer was adjusted with the appropriate span pot.

After the analyzer was properly adjusted the linearity was checked using a low and high range calibration gas. The maximum allowable limit for linearity is 2% of the analyzer range and all analyzers were shown to be linear within these limits before proceeding.

The external calibration bias check were performed by placing the CEM system in sampling mode and injecting a zero and span gas into the sample line at the probe exit. This check showed if there is any sampling system related bias, and also checks the integrity of the sample line.

3.3.1 Calibration Gases

DEECO useed EPA Protocol and/or ±2% NIST Traceable gases for calibration as required by the various reference methods employed in this test program. Calibration gases were selected from previous experience with similar sources and/or from information obtained from the facility engineer prior to sampling. In some cases if the gases that are selected are out of the optimum range of operation then no significant impact of data quality is expected due to the linear nature of the analyzers that were used.

Specific HCN gases were manufactured for this test program in the range of 50-100 ppm to provide spikes in the 5-10 ppm range, or lower; with an SF_6 or appropriate tracer used to calculate the exact spike gas dilution ratio of 10% or less.

No audit gases from a federal or a state agency were provided.

3.3.2 Sampling Procedures

At the completion of the pretest calibration routine, the CEM system was ready for operation. No further adjustments of sample flow rates, analyzer zero or span adjustments, or other critical CEM operating parameters were made until testing and post test calibration were complete.

Each sampling run was one hour. At the completion for each test run, calibration gases were used to check between test runs. A zero and the upscale calibration gas closest to the actual emission concentrations were used for the pretest and post test calibrations.

3.4 Flue Gas Moisture Content - EPA Method 4

The flue gas moisture content was determined in conjunction with the EPA Method 26A trains according to the sampling and analytical procedures outlined in EPA Method 4. (**NOTE:** In order to maintain isokinetic sampling, the sampling rate used may have been required to temporarily exceed the EPA Method 4-specified maximum sampling rate of 0.75 CFM, based on observed stack gas pitot readings.) The impingers were connected in series and contained reagents as described below. The impingers were contained in an ice bath in order to assure condensation of the moisture in the flue gas stream. Any moisture that is not condensed in the impingers was captured in the silica gel, therefore all moisture was weighed and entered into moisture content calculations.

3.5 Hydrogen Fluoride and Diatomic Chlorine - EPA Method 26A

Sampling and analytical procedures were those outlined in EPA Method 26A to determine primarily diatomic chlorine (Cl_2) emissions and hydrogen fluoride (HF) emissions at main stack outlet sampling locations. Duplicate simultaneous trains (a.k.a "paired trains") for each test run were used to determine precision.

Sample was collected through a heated glass probe, followed by a heated Teflon filter, where stack gas HF and Cl_2 were collected in a series of chilled impingers. The sampling train impingers contained 100 ml of 0.1N sulfuric acid in the first and second, an empty third impinger, 100 ml of 0.1N NaOH in the fourth and fifth and 200 grams of silica gel in the last impinger

Sampling was conducted isokinetically (±10%) with readings of flue gas parameters recorded at traverse points selected according to EPA Method 1. Leak-checks on the Method 26A sampling train were performed before and after each sampling run and optionally for any port change. The sampling train leak-checks and leakage rate (where applicable) were documented on the field test data sheet for each respective run. All leak checks were acceptable.

The glass button hook nozzle and probe liner was constructed of borosilicate glass. The filter holder was constructed of borosilicate glass with a Teflon frit filter support and a sealing gasket. A PTFE-bonded glass fiber filter was used. The probe and filter housing were heated to above 248°F and not exceed an upper boundary of 273°F. Probe liners and filter holders were cleaned thoroughly prior to testing.

The Method 26A trains was operated isokinetically for a minimum of 60 minutes and collected a minimum of 1 dry, standard cubic meter (DSCM). Pretest preparations, preliminary determinations, and leak check procedures were those outlined in EPA Method 5.

After completion of sampling the train was leak checked and transferred to the sample recovery trailer. All leak checks were acceptable. The impingers were weighed to determine moisture gain in accordance with EPA Method 4.

Sample recovery involved quantitative recovery of the sulfuric acid impinger contents and the NaOH impinger contents into separate tare-weighed, precleaned polyethylene sample containers.

The nozzle, probe, filter and filter housing were not recovered.

The contents of sulfuric acid impingers, including the contents if any of the empty (2nd knockout or third) impinger were quantitatively transferred to the tare-weighed, precleaned polyethylene sample container, followed by three rinses with deionized (DI) water of the impingers and all connecting glassware (including the connecting glassware to the first impinger) placed in the same H_2SO_4 container. The container was labeled and weighed to determine the final sample volume.

The contents NaOH impingers were quantitatively transferred to a second tare-weighed, precleaned polyethylene sample container, followed by three rinses with DI water of the impingers and all connecting glassware placed in the same NaOH container. The container was labeled and weighed to determine the final sample volume.

Sample recovery from each train included:

1. Container No. 1 - Contents of H_2SO_4 impingers and knockout impinger and, and DI rinse of impingers and connecting glassware; and
2. Container No. 2 - Contents NaOH impingers, and DI rinse of impingers and connecting glassware.

Additional quality control consisted of collecting and analyzing a field blank train for every three test runs. The blank train was assembled from a used train, leak checked and sat for a period equal to the sampling time (i.e, 1-hr). The blank train data was to be used to determine the method detection limit for the test program target analytes (ie. The lowest number that could be detected), and compared to stack emissions.

Reagent blanks of 0.1 N H_2SO_4, 0.1N NaOH, and DI water were collected and archived for later analysis should there be any issues with the field blank train samples

The H_2SO_4 impinger solutions were analyzed using ion chromatography techniques for fluoride ions (F^-) (EPA SW-9057). Duplicate analyses performed on the samples and field blanks. Precision was demonstrated by duplicate injection of each sample, the results of each individual analysis being within 5% of their mean to be acceptable.

The NaOH impinger solutions was treated with sodium thiosulfate to ensure complete conversion of hypochlorous acid (HClO) to chloride ions (Cl^-). The resulting solution was analyzed using ion chromatography techniques for chloride ions (EPA SW-9057). Duplicate analyses was performed on the samples and field blanks. Precision was demonstrated by duplicate injection of each sample, the results of each individual analysis being within 5% of their mean to be acceptable

All EPA Method 26A HF/Cl_2 samples were analyzed by Element One of Wilmington NC. Refer to Section 1, Figure 1.1 of the RTR Sampling and Analytical Protocol for contact information.

For this test program, the relative deviation (RD) was to be calculated as described in EPA Method 30B between the Cl_2 concentrations measured with the paired trains. A criteria of a less than 10% relative deviation or 0.2 ppm absolute difference was required.

The absolute differences between the Cl_2 concentrations measured with the paired trains is summarized in Table 3.1. For each paired run, Cl_2 concentrations met the 0.2 ppm absolute difference criteria.

TABLE 3.1 PAIRED METHOD 26A SAMPLING TRAIN DIATOMIC CHLORINE CONCENTRATION COMPARISON RESULTS FOR THE KILN 1 MAIN STACK; DECEMBER 8, 2023

Run	Time	Train A Diatomic Chlorine Concentration (ppm,dry)	Train B Diatomic Chlorine Concentration (ppm,dry)	Absolute Difference (ppm,dry)
Run 1	13:24-14:34	<0.05	<0.05	0.00
Run 2	14:53-16:02	<0.06	<0.05	0.01
Run 3	16:20-17:26	<0.05	<0.05	0.00

3.6 Hydrogen Cyanide and Hydrogen Fluoride - EPA Method 320

EPA Method 320 was performed to determine emissions of concentrations of HCN and HF. Three, 1-hour sampling runs were conducted under each representative process and control system operating conditions.

The gas sample was extracted from the stack through a glass-lined probe and filter heated to 375° F. For external calibration checks and analyte spikes, the gases were introduced in front of the heated filter. Any excess calibration gas was diverted through the sample probes into the source. Outflow of gas from the heated filter enclosure was transported through a Teflon sample line heated to 375° F. For these sources approximately 300’ of sample line was required. The heated sample line was connected directly to the FTIR sample cell. Using heat-traced Teflon tubing the exit of the FTIR cell was connected to a sample pump with a heated stainless steel pump head. The pump discharge was directed to a proprietary chiller-type gas conditioner to remove moisture prior to delivery sample gas to the O_2/CO_2 monitor.

The distribution of the gas sample to the monitors was accomplished using a panel equipped with valves and rotometers. The gas sample was then divided and directed to the O_2/CO_2 analyzer.

FTIR sample cell was maintained at 191°C and connected to a MKS Instruments Multigas 2030 Fourier Transform Infrared Spectrometer and Detector.

The FTIR spectrometer measured vapor phase organic or inorganic compounds which absorb energy in the mid-infrared spectral region, about 400 to 4000 cm^{-1} (25 to 2.5 µm). Continuous measurement were made by matching sample absorbance bands with bands in reference spectra, and comparing sample band intensities with reference band intensities.

The principle limitation to FTIR spectroscopy are the presence of interfering compounds that also absorb energy in the mid-infrared spectral region. In a cement kiln stack gas matrix, water vapor (H_2O) and carbon dioxide (CO_2) are the primary interferents that must be incorporated into the identification and quantitation method.

The FTIR software performs the computation for a single compound by subtracting all the other compounds (interferants and target) from the absorbance spectra and quantifies the single compound based on the remain absorbance. The FTIR software provides a Standard Error Calculation (SEC) value that is an indication of how well the identification and quantitation has been performed. A high SEC indicates that other interferants have not been accounted for in the analysis method, and a low SEC is indicative of greater confidence measurement.

The instrument is operated with a resolution of 0.5 cm^{-1} with 4x zero filling. Beer-Norton Medium apodization is used with amplitude phase correction.

For this RTR test program, following specific QA/QC activities for EPA Method 320 were performed and are summarized in Table 3.2

3.6.1 Laboratory QA/QC Activities Before Field Test Program

Before field testing occurs, the following QA/QC activities were conducted;

1) Seven consecutive samples of dry nitrogen through the sampling system was acquired and used to calculate the standard deviation for each of the test program target analytes multiplied by a factor of 3. These data were considered representative of detection limits (DL) for this test program and were below the 0.5 ppm required DL for both HCN and HF;

2) From these seven dry nitrogen samples, the results for the Signal-to-Noise Ratio (SNR) @ 2500 cm^{-1} was >2500, at 64 scans and the results for single beam intensity @ 2500 cm^{-1} was >0.9; and

3) The HCN calibration gases was analyzed directly and the FTIR responses agreed with tag value within 5%

3.6.2 QA/QCActivities During Field Test Program

During the field test program, following QA/QC activities were be performed and criterium met;

1) On each test day prior to any testing, an instrument background was collected using dry nitrogen directed to the gas cell. The background was collected with at least 128 scans;

2) The probe, filter, sample line and all sample system components in contact with effluent were be maintained at or above 375ºF or 191ºC (consistent with FTIR calibration temperature) to avoid any possible "cold spots;"

3) A system zero with all sampling system components at operating temperature was performed by injecting nitrogen at the sample probe and through sample filter and entire measurement system. After zero equilibration was achieved, all measurement components were quantified for at least 128 scans;

4) The sample probe was position at effluent measurement point and sampling was continue until equilibration of the measurement system has been achieved. At this point, the effluent concentrations was quantified with two consecutive 64-scan samples as the initial native concentration for the dynamic spike;

5) Analyte spiking was conducted for HCN before the first test run, and after each successive test run for a minimum of 4 spikes per test condition. These results were used to determine accuracy and are summarized in Table 3.3;

6) The spike gas injections was maintained at 10% or less of total sample volume. The spike gas concentration and flow rate was be selected to approximately double the native effluent concentration. Spike recovery results were within ±20% of the expected value. An SF_6 tracer was used to calculate the exact spike gas dilution ratio of 10% or less;

TABLE 3.2 FTIR PRETEST AND FIELD TEST QA/QC SUMMARY

Spectrum	HCN	SF6	HF	SNR 2500	sBeam @2500
Seven consecutive samples of dry nitrogen for detection limit					
SPC__000837.LAB	-0.051		-0.002	6223.51	1.42
SPC__000838.LAB	-0.032		-0.000	5809.30	1.42
SPC__000839.LAB	0.046		-0.017	3759.60	1.42
SPC__000840.LAB	-0.011		0.016	4373.66	1.42
SPC__000841.LAB	0.080		0.002	5347.95	1.42
SPC__000842.LAB	0.059		-0.012	5012.46	1.42
SPC__000843.LAB	-0.029		-0.006	4706.13	1.42
Standard Deviation X 3	**0.156**		**0.032**		
Averages				**5033.23**	**1.42**
HCN Standard (CC768222; 49.9 ppm HCN/5.0 ppm SF6)					
SPC__005757.LAB	49.24	4.86			
SPC__005758.LAB	49.31	4.85			
SPC__005759.LAB	49.13	4.85			
Averages	49.23	4.85			
Residuals for Post HCN analyte spike native scans					
SPC_005798.LAB					
Concentration	1.27		-0.02		
MDC3	0.22		0.14		
MDC3%	NA		NA		
SPC_005799.LAB					
Concentration	1.22		-0.02		
MDC3	0.18		0.15		
MDC3%	NA		NA		
Final SNR @ 2500 cm^{-1} and single beam intensity @ 2500 cm^{-1}					
SPC__006044.LAB				5643.1	1.02

7) After the dynamic spike, nitrogen was sent through the sampling system until all traces of spike gas removed and lines proven below DL for target analytes;

8) The nitrogen purge was discontinued and the sampling system was allowed to equilibrate with stack gas before starting a test run. The first two consecutive 64-scan samples of a sample run was used for the final native concentration. Residual results for HCN and HF were verified to be less than 0.2-0.3 ppm for data acceptance, or less than 5% of the measured value, whichever was least restrictive.

9) The final SNR @ 2500 cm^{-1}, at 64 scans, and the results for single beam intensity @ 2500 cm^{-1} were verified to met the >2500 and >0.9 criterium; respectively.

TABLE 3.3 ETHYLENE CALIBRATION TRANSFER STANDARD (CTS) AND HYDROGEN CYANIDE ANALYTE SPIKING TEST RESULTS FOR THE KILN 1 MAIN STACK; DECEMBER 8, 2023

Run	Time	Average Native Hydrogen Cyanide Concentration (ppm,wet)	Spike plus Average Hydrogen Cyanide Native Concentration (ppm,wet)	Hydrogen Cyanide Spike Recovery	CTS Error
Pre Run 1	13:05-13:16	1.16	4.75	85.1%	-2.0%
Post Run 1	14:23-14:43	1.12	4.34	83.8%	
Post Run 2	15:56-16:12	1.24	4.12	82.1%	
Post Run 3	17:38-17:54	1.00	3.71	83.3%	-2.5%

4. QA/QC PROCEDURES AND RESULTS

The objective of a quality assurance/quality control (QA/QC) program is to assure that the precision and accuracy of all environmental data generated by DEECO for clients are commensurate with data quality objectives (DQO's). DQO's are based on a common understanding of the intended end use(s) of the data, the measurement process, and the availability of resources. Once DQO's are established, formally or informally, QC protocol can be defined for the measurements.

In this project, the final data user is Holcim. The data quality objectives in this project are to generate scientifically sound data to be used for compliance purposes.

4.1 Sampling Equipment

All of the sampling equipment used was calibrated according to the procedures outlined in the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, EPA-600/4-77-027b.

4.1.1 Manual Sampling Equipment Calibrations

For sampling Methods 1, 2, and 4 the procedures and equipment used to measure stack gas velocity and temperature measurements and the metering system used to maintain constant rate sampling conditions and to determine the sample gas volume were subjected to pretest and posttest calibrations and/or inspections as required by the appropriate EPA methods.

Barometer - Barometric pressure values were obtained from a calibrated barometer, verified by phone call to a local airport, and corrected for elevation to sample port level (0.01 inches Hg per 10 ft. elevation).

Pitot Tubes - Each pitot tube used in sampling meets the design specifications for type-S pitot tubes in EPA Method 2. Therefore, a maximum value baseline coefficient (C_p) of 0.84 is assigned to each pitot tube. Calibration by the manufacturer for pitot face-opening alignment included measuring the external tubing diameter (dimension D_t), the base-to-opening plane distance (dimensions P_a and P_b), and the face opening misalignment angles, with all terms as described in EPA Method 2. Pitot tubes were visually inspected for structural integrity at the completion of each test. Inspection sheets for pitot tubes are included in Appendix E.

Calibration Meter and Metering System - The secondary reference meter equipment arrangement for calibration is shown in Figure 5.7 of EPA Method 5. The prescribed procedures were followed. A wet test meter with a 1 ft^3/rev capacity and $\pm$ 1 percent accuracy is used as the primary calibrant. The dry gas meter's pump is run for a minimum of 5 minutes at a flow rate of 0.35 cfm to condition the interior surface of the wet test meter. Leak checks are performed and if satisfactory, triplicate runs at each of no less than five different flow rates are done. A calibration curve is prepared and the meter is recalibrated after 200 hours of operation or annually, whichever comes first.

The calibration set-up for the dry gas metering system using the secondary reference meter in lieu of the wet test meter is given in Figure 5.5 of EPA Method 5. A leak check of the metering system before calibration was performed as shown in Figure 5.4 of EPA Method 5. The metering systems's pump is operated for 5 minutes at an orifice manometer setting of 0.5 inches H_20 to heat up the pump and system to stabilize the meter inlet and outlet temperatures. Values for the orifice setting (delta H), wet test meter volume (V_w), corresponding dry test meter volume (V_d), dry test meter inlet and outlet gas temperatures (t_{di} and t_{dn}), and time are recorded for the initial calibration. Then the ratio of the wet test meter to the dry test meter (gamma) and the orifice pressure differential that equates to 0.75 cfm at standard conditions (delta H@) are calculated.

A post-test meter calibration was made on the dry gas meter used during the test to check its accuracy against the pre-test calibration. This post-test calibration check was made using the average orifice setting obtained during each test run and setting the vacuum at the maximum value obtained during each test run. These test runs were made against DEECO's secondary reference dry gas meter which was calibrated against a wet test meter. The calibration data sheets for the dry gas meters are included in Appendix E.

Thermocouples and Digital Indicators - Thermocouples were calibrated by comparing them against an ASTM-3F mercury-in-glass thermometer at approximately 32°F (ice water), ambient temperature, and at approximately 220°F. Each thermocouple was calibrated against temperature ranges to which it is typically exposed during test conditions, and they agreed within 1.5 percent (expressed in °R) of the reference thermometer throughout the entire calibration range. Also, thermocouples were checked at ambient temperature at the test site to verify calibration. The calibration data sheets for the thermocouples are included in Appendix E.

Pretest and Posttest Leak Checks of Sampling Trains - Each Method 4 sampling train was subjected to pretest leak checks and posttest leak checks. For all sampling runs the posttest leak checks were acceptable (less than 4% of the sampling rate at the highest vacuum recorded during the test run).

4.2 Analytical QA/QC Results

Analytical measurements of precision and accuracy were made on stack gas samples, and are summarized in a separate report.

Appendix A

Emission Summary Tables

Company: **Holcim Joppa IL**
Source: **Kiln 1 Main Stack**
Job ID: **23-3318**
Train Type: **M26A**

	1A 12/08/23 1324-1434	1B 12/08/23 1324-1434	2A 12/08/23 1453-1602	2B 12/08/23 1453-1602	3A 12/08/23 1620-1726	3B 12/08/23 1620-1726	Average
Initial Meter Volume, ft^3	568.751	462.289	611.434	505.252	655.456	551.315	
Final Meter Volume, ft^3	611.492	504.750	655.269	551.159	699.652	596.537	
Intra-Port Leak Check Volume, ft^3	0.000	0.000	0.000	0.000	0.000	0.000	
Total Sample Volume, cf	**42.741**	**42.461**	**43.835**	**45.907**	**44.196**	**45.222**	**44.060**
DGM Calibration Factor	0.985	0.975	0.985	0.975	0.985	0.975	0.980
Average DGM Temp, F	60.1	65.1	70.0	69.6	71.3	72.8	68.2
Average DGM delta H, "H2O	1.58	1.58	1.67	1.70	1.67	1.66	1.64
Barometric Pressure, "Hg	29.30	29.30	29.30	29.30	29.30	29.30	29.30
Corrected Sample Vol,dscf	**42.003**	**40.911**	**42.283**	**43.868**	**42.527**	**42.950**	**42.424**
Corrected Sample Vol,dscm	**1.189**	**1.158**	**1.197**	**1.242**	**1.204**	**1.216**	**1.201**
Oxygen, %	12.9	12.9	12.9	12.9	12.6	12.6	12.8
Carbon Dioxide, %	14.2	14.2	13.5	13.5	13.7	13.7	13.8
Nitrogen, %	72.9	72.9	73.6	73.6	73.7	73.7	73.4
Stack Gas Excess Air, %	203.3	203.3	197.5	197.5	183.8	183.8	194.9
Total Moisture Catch Weight, grams	79.1	70.2	76.5	79.9	76.4	78.8	78.4
Stack Gas Moisture, %	**8.1**	**7.5**	**7.8**	**7.9**	**7.8**	**7.9**	**7.8**
Stack Gas Dry Molecular Weight, lb/lbmole	30.79	30.79	30.68	30.68	30.70	30.70	30.72
Stack Gas Wet Molecular Weight, lb/lbmole	29.75	29.83	29.69	29.67	29.71	29.69	29.72
Average Stack Temp, F	307.5	307.5	308.3	308.3	307.8	307.8	307.9
Stack Static (Gauge) Pressure, "H2O	-0.70	-0.70	-0.70	-0.70	-0.70	-0.70	-0.70
Stack Gas Actual Pressure, "Hg	29.25	29.25	29.25	29.25	29.25	29.25	29.25
Average Sqrt delta P	0.835	0.835	0.859	0.859	0.857	0.857	0.850
Pitot Tube Coefficient	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Stack Gas Velocity, ft/second	**56.98**	**56.91**	**58.71**	**58.73**	**58.54**	**58.56**	**58.07**
Nozzle Inside Diameter, inches	0.250	0.250	0.250	0.250	0.250	0.250	
Total Sample Time, min	60	60	60	60	60	60	60
Isokinetic Rate, %	**97.2**	**94.2**	**94.8**	**98.4**	**95.6**	**96.6**	**96.1**
Stack Dimensions	102 in. ID	102 in. ID	102 in. ID	102 in. ID	102 in. ID	102 in. ID	
Stack Area, sq ft	56.75	56.75	56.75	56.75	56.75	56.75	56.75
Stack Gas Flow Rate, acfm	**194,000**	**193,800**	**199,900**	**200,000**	**199,300**	**199,400**	**197,733**
Stack Gas Flow Rate, acmm	5,493	5,488	5,661	5,663	5,644	5,646	5,599
Stack Gas Flow Rate, dscfm	**119,900**	**120,600**	**123,800**	**123,700**	**123,600**	**123,500**	**122,517**
Stack Gas Flow Rate, dscmm	3,395	3,415	3,506	3,503	3,500	3,497	3,469
ALT-009 Post Test Calibration	pass	pass	pass	pass	pass	pass	

Company: Holcim Joppa IL
Source: Kiln 1 Main Stack
Job ID: 23-3318
Train Type: M26A

"ND()" denotes values below detection limits
Note: Average EXCLUDES Non-detect runs' results

		1A 12/08/23 1324-1434	1B 12/08/23 1324-1434	2A 12/08/23 1453-1602	2B 12/08/23 1453-1602	3A 12/08/23 1620-1726	3B 12/08/23 1620-1726	Average
Hydrogen Fluoride	Catch Wt, mg	ND(0.23)	ND(0.227)	ND(0.251)	ND(0.26)	ND(0.241)	)(0.248)	ND(0.243)
	Conc., mg/dscm	ND(0.193)	ND(0.196)	ND(0.210)	ND(0.209)	ND(0.200)	)(0.204)	ND(0.202)
	Conc., mg/dscm @7% O2	ND(0.336)	ND(0.341)	ND(0.364)	ND(0.364)	ND(0.335)	)(0.342)	ND(0.347)
	Conc., mg/dscm @12% CO2	ND(0.163)	ND(0.166)	ND(0.186)	ND(0.186)	ND(0.175)	)(0.179)	ND(0.176)
	Conc., ppmvd	ND(0.233)	ND(0.236)	ND(0.252)	ND(0.252)	ND(0.241)	)(0.245)	ND(0.243)
	Conc., ppmvd @7% O2	ND(0.404)	ND(0.410)	ND(0.438)	ND(0.437)	ND(0.403)	)(0.411)	ND(0.417)
	Conc., ppmvd @12% CO2	ND(0.197)	ND(0.199)	ND(0.224)	ND(0.224)	ND(0.211)	)(0.215)	ND(0.212)
	Emission Rate, lb/hr	ND(0.087)	ND(0.089)	ND(0.097)	ND(0.097)	ND(0.093)	)(0.094)	ND(0.093)
	Clinker Rates (tph and lbs/ton)	64.40	ND(0.0014)	64.40	ND(0.0015)	64.40	ND(0.0015)	ND(0.0014)
Chlorine	Catch Wt, mg	ND(0.181)	ND(0.178)	ND(0.202)	ND(0.17)	ND(0.168)	)(0.176)	ND(0.179)
	Conc., mg/dscm	ND(0.152)	ND(0.154)	ND(0.169)	ND(0.137)	ND(0.140)	)(0.145)	ND(0.149)
	Conc., mg/dscm @7% O2	ND(0.264)	ND(0.267)	ND(0.293)	ND(0.238)	ND(0.234)	)(0.242)	ND(0.256)
	Conc., mg/dscm @12% CO2	ND(0.129)	ND(0.130)	ND(0.150)	ND(0.122)	ND(0.122)	)(0.127)	ND(0.130)
	Conc., ppmvd	ND(0.052)	ND(0.052)	ND(0.057)	ND(0.046)	ND(0.047)	)(0.049)	ND(0.051)
	Absolute Difference, ppmvd (<0.2 required)		0.001		0.011		0.002	
	Conc., ppmvd @7% O2	ND(0.090)	ND(0.091)	ND(0.099)	ND(0.081)	ND(0.079)	)(0.082)	ND(0.087)
	Conc., ppmvd @12% CO2	ND(0.044)	ND(0.044)	ND(0.051)	ND(0.041)	ND(0.041)	)(0.043)	ND(0.044)
	Emission Rate, lb/hr	ND(0.068)	ND(0.069)	ND(0.078)	ND(0.063)	ND(0.065)	)(0.067)	ND(0.069)
	Clinker Rates (tph and lbs/ton)	64.40	ND(0.0011)	64.40	ND(0.0011)	64.40	ND(0.0010)	ND(0.0011)

Holcim; Joppa IL
Main Stack
Run 1

Spectrum	Date	Time	HCN PCA 191c R1 191c		HF ppm (10) 191C	SF6 (10) 191C	Ethylene (100,3000) 191C	H2O% (40) 191C	CO2% (40) 191C
SPC__005806.LAB	12/08/23	13:23:42.398	1.050		-0.012	0.003	0.857	4.513	12.501
SPC__005807.LAB	12/08/23	13:24:46.338	1.131		-0.009	0.006	0.764	5.219	12.402
SPC__005808.LAB	12/08/23	13:25:50.227	1.058		-0.029	0.006	0.747	4.066	12.436
SPC__005809.LAB	12/08/23	13:26:54.169	1.064		-0.019	0.004	0.784	3.829	12.468
SPC__005810.LAB	12/08/23	13:27:58.027	1.172		-0.015	0.008	0.729	3.770	12.575
SPC__005811.LAB	12/08/23	13:29:01.945	0.997		-0.008	0.005	0.852	3.751	12.835
SPC__005812.LAB	12/08/23	13:30:05.835	1.273		0.001	0.005	0.889	4.990	12.379
SPC__005813.LAB	12/08/23	13:31:09.774	1.142		-0.001	0.004	0.792	3.870	12.606
SPC__005814.LAB	12/08/23	13:32:13.655	1.012		-0.018	0.004	0.832	3.741	12.659
SPC__005815.LAB	12/08/23	13:33:17.840	1.152		-0.017	0.005	0.810	3.674	12.855
SPC__005816.LAB	12/08/23	13:34:21.850	0.877		-0.030	0.003	0.846	3.659	13.114
SPC__005817.LAB	12/08/23	13:35:25.381	1.271		-0.029	0.004	0.810	4.461	12.677
SPC__005818.LAB	12/08/23	13:36:29.281	1.207		-0.005	0.007	0.870	4.977	12.604
SPC__005819.LAB	12/08/23	13:37:33.224	1.083		-0.020	0.003	0.850	4.222	12.967
SPC__005820.LAB	12/08/23	13:38:37.136	1.101		-0.008	0.005	0.885	5.446	12.805
SPC__005821.LAB	12/08/23	13:39:40.997	1.266		-0.023	0.002	0.838	4.041	12.974
SPC__005822.LAB	12/08/23	13:40:44.945	1.194		-0.014	0.006	0.825	3.714	12.964
SPC__005823.LAB	12/08/23	13:41:48.818	0.922		-0.012	0.004	0.839	3.858	13.000
SPC__005824.LAB	12/08/23	13:42:52.992	1.256		-0.007	0.004	0.795	3.841	13.001
SPC__005825.LAB	12/08/23	13:43:56.677	1.266		-0.013	0.005	0.822	4.578	12.989
SPC__005826.LAB	12/08/23	13:45:00.587	1.301		-0.023	0.001	0.804	3.878	13.045
SPC__005827.LAB	12/08/23	13:46:04.600	0.906		-0.007	0.003	0.815	3.933	13.113
SPC__005828.LAB	12/08/23	13:47:08.369	1.049		-0.012	0.000	0.822	3.872	13.090
SPC__005829.LAB	12/08/23	13:48:12.309	0.910		-0.009	0.003	0.871	3.858	13.213
SPC__005830.LAB	12/08/23	13:49:16.177	1.118		-0.012	0.003	0.844	4.270	13.273
SPC__005831.LAB	12/08/23	13:50:20.081	1.206		-0.018	0.003	0.901	4.108	13.190
SPC__005832.LAB	12/08/23	13:51:24.353	1.187		-0.019	0.003	0.882	4.155	13.051
SPC__005833.LAB	12/08/23	13:52:27.935	1.143		-0.014	0.004	0.887	4.056	13.044
SPC__005834.LAB	12/08/23	13:53:32.145	1.105		-0.009	0.003	0.928	3.937	13.152
SPC__005835.LAB	12/08/23	13:54:35.703	0.991		-0.019	0.004	0.917	3.843	13.335
SPC__005836.LAB	12/08/23	13:55:39.650	1.034		-0.025	0.001	0.855	3.803	13.099
SPC__005837.LAB	12/08/23	13:56:43.514	1.084		-0.020	0.005	0.828	3.712	13.064
SPC__005838.LAB	12/08/23	13:57:47.669	1.100		0.002	0.004	0.875	4.505	13.098
SPC__005839.LAB	12/08/23	13:58:51.327	1.163		-0.017	0.005	0.873	3.791	13.127
SPC__005840.LAB	12/08/23	13:59:55.237	2.818		0.130	0.005	0.819	15.919	10.864
SPC__005841.LAB	12/08/23	14:00:59.194	0.031		0.007	-0.004	0.679	23.777	10.351
SPC__005842.LAB	12/08/23	14:02:03.066	1.333		-0.004	-0.002	0.995	15.870	11.325
SPC__005843.LAB	12/08/23	14:03:07.014	0.758		-0.011	-0.002	1.012	13.629	11.529
SPC__005844.LAB	12/08/23	14:04:10.967	0.767		0.002	0.001	0.963	10.857	12.031
SPC__005845.LAB	12/08/23	14:05:14.914	0.894		-0.042	0.003	0.996	8.900	12.277
SPC__005846.LAB	12/08/23	14:06:18.970	0.719		-0.050	0.003	1.028	7.942	12.573
SPC__005847.LAB	12/08/23	14:07:22.623	0.889		-0.007	0.002	0.954	8.211	12.479
SPC__005848.LAB	12/08/23	14:08:26.483	1.040		-0.010	0.003	1.000	7.654	12.491
SPC__005849.LAB	12/08/23	14:09:30.391	1.110		-0.003	0.004	0.969	7.207	12.578
SPC__005850.LAB	12/08/23	14:10:34.396	0.907		-0.023	0.003	0.939	6.650	12.663
SPC__005851.LAB	12/08/23	14:11:38.206	1.128		-0.013	0.003	0.927	6.629	12.512
SPC__005852.LAB	12/08/23	14:12:42.174	0.910		-0.027	0.004	0.998	6.377	12.532
SPC__005853.LAB	12/08/23	14:13:46.025	0.894		-0.035	0.003	0.995	6.151	12.770
SPC__005854.LAB	12/08/23	14:14:49.914	0.871		-0.014	0.006	0.950	6.237	12.777
SPC__005855.LAB	12/08/23	14:15:53.855	0.873		-0.013	0.003	0.960	6.178	12.866
SPC__005856.LAB	12/08/23	14:16:58.067	1.196		-0.039	0.006	0.811	5.824	12.839
SPC__005857.LAB	12/08/23	14:18:02.040	1.255		-0.046	0.003	0.912	5.666	12.873
SPC__005858.LAB	12/08/23	14:19:05.563	1.197		-0.054	0.004	0.948	5.425	13.141
SPC__005859.LAB	12/08/23	14:20:09.435	1.137		-0.037	0.003	0.940	5.361	13.079
SPC__005860.LAB	12/08/23	14:21:13.340	1.074		-0.027	0.005	0.873	5.377	13.046
SPC__005861.LAB	12/08/23	14:22:17.244	1.095		-0.039	0.003	0.919	5.344	13.196
SPC__005862.LAB	12/08/23	14:23:21.153	1.082		-0.041	0.004	0.970	5.348	13.205
SPC__005863.LAB	12/08/23	14:24:25.098	1.011		-0.037	0.003	0.908	5.475	12.886
Main Out Run 1		**(actual)**	**1.082**	<	**0.032**	**0.004**	**0.879**	**5.896**	**12.717**
Oxygen	**12.9%**	**(ppm,dry @7% O2)**	**2.040**	<	**0.060**	**0.007**	**1.657**		
DSCFM	**120,250**	**(lbs/hr)**	**0.594**	<	**0.013**	**0.010**	**0.501**	**7.8**	**M26A Moisture**
Clinker (tons/hr)	**64.40**	**(lbs/ton clinker)**	**0.009**	<	**0.0002**				

Holcim; Joppa IL
Main Stack
Run 2

Spectrum	Date	Time	HCN PCA 191c R1 191c		HF ppm (10) 191C	SF6 (10) 191C	Ethylene (100,3000) 191C	H2O% (40) 191C	CO2% (40) 191C
SPC__005890.LAB	12/08/23	14:54:00.917	0.866		-0.033	0.004	0.944	5.353	13.022
SPC__005891.LAB	12/08/23	14:55:04.931	1.119		-0.030	0.003	0.955	5.755	12.945
SPC__005892.LAB	12/08/23	14:56:08.731	1.102		-0.011	0.005	0.931	6.879	12.469
SPC__005893.LAB	12/08/23	14:57:12.995	0.804		-0.025	0.003	0.981	7.340	12.426
SPC__005894.LAB	12/08/23	14:58:16.898	1.002		-0.043	0.002	0.955	7.282	12.491
SPC__005895.LAB	12/08/23	14:59:20.532	0.691		-0.055	-0.001	0.948	9.208	12.140
SPC__005896.LAB	12/08/23	15:00:24.719	0.873		-0.065	-0.000	0.977	8.036	12.351
SPC__005897.LAB	12/08/23	15:01:28.258	0.899		-0.027	-0.000	0.985	7.351	12.318
SPC__005898.LAB	12/08/23	15:02:32.161	0.874		-0.036	0.002	0.929	8.302	12.104
SPC__005899.LAB	12/08/23	15:03:36.194	0.947		-0.013	0.003	0.959	7.272	12.416
SPC__005900.LAB	12/08/23	15:04:39.990	0.746		-0.051	-0.002	0.946	9.856	11.919
SPC__005901.LAB	12/08/23	15:05:43.887	0.766		-0.045	0.003	0.936	8.237	12.081
SPC__005902.LAB	12/08/23	15:06:47.789	0.841		-0.031	0.001	0.927	7.490	12.323
SPC__005903.LAB	12/08/23	15:07:51.687	0.739		-0.024	0.005	0.939	7.015	12.263
SPC__005904.LAB	12/08/23	15:08:55.597	0.955		-0.013	0.001	0.886	7.186	12.148
SPC__005905.LAB	12/08/23	15:09:59.585	0.848		-0.032	0.006	0.955	7.210	12.100
SPC__005906.LAB	12/08/23	15:11:03.467	0.894		-0.024	0.004	0.896	6.626	12.061
SPC__005907.LAB	12/08/23	15:12:07.313	1.126		-0.016	0.004	0.955	6.476	12.081
SPC__005908.LAB	12/08/23	15:13:11.221	0.685		-0.031	0.004	0.952	7.119	11.927
SPC__005909.LAB	12/08/23	15:14:15.251	0.820		-0.013	0.004	0.844	7.219	11.941
SPC__005910.LAB	12/08/23	15:15:19.071	0.653		-0.005	0.002	0.855	8.210	11.770
SPC__005911.LAB	12/08/23	15:16:23.027	0.833		-0.017	0.004	0.933	7.512	11.911
SPC__005912.LAB	12/08/23	15:17:26.825	0.934		-0.014	0.003	0.892	7.089	11.801
SPC__005913.LAB	12/08/23	15:18:30.740	0.825		-0.015	0.001	0.946	6.874	11.875
SPC__005914.LAB	12/08/23	15:19:34.651	0.845		-0.009	0.005	0.975	7.087	11.891
SPC__005915.LAB	12/08/23	15:20:38.567	0.951		-0.013	0.001	0.850	7.463	11.699
SPC__005916.LAB	12/08/23	15:21:42.512	0.872		-0.043	-0.002	0.904	9.349	11.391
SPC__005917.LAB	12/08/23	15:22:46.824	0.849		-0.031	0.004	0.910	7.838	11.645
SPC__005918.LAB	12/08/23	15:23:50.267	1.024		-0.021	0.004	0.885	7.304	11.782
SPC__005919.LAB	12/08/23	15:24:54.209	0.888		-0.015	0.007	0.849	6.955	11.680
SPC__005920.LAB	12/08/23	15:25:58.072	0.809		-0.017	0.006	0.869	6.877	11.713
SPC__005921.LAB	12/08/23	15:27:01.966	0.910		-0.018	0.005	0.859	6.868	11.766
SPC__005922.LAB	12/08/23	15:28:06.204	0.949		-0.020	0.005	0.885	7.075	11.831
SPC__005923.LAB	12/08/23	15:29:09.792	0.868		-0.022	0.004	0.913	6.846	11.898
SPC__005924.LAB	12/08/23	15:30:14.065	0.981		-0.018	0.005	0.854	6.730	11.771
SPC__005925.LAB	12/08/23	15:31:17.644	1.070		-0.013	0.004	0.846	6.423	11.936
SPC__005926.LAB	12/08/23	15:32:21.520	0.870		-0.021	0.005	0.778	6.107	11.993
SPC__005927.LAB	12/08/23	15:33:25.564	1.021		-0.028	0.005	0.876	5.987	11.972
SPC__005928.LAB	12/08/23	15:34:29.412	1.272		-0.024	0.005	0.895	5.736	12.121
SPC__005929.LAB	12/08/23	15:35:33.324	1.033		-0.027	0.006	0.860	5.407	12.049
SPC__005930.LAB	12/08/23	15:36:37.127	1.044		-0.018	0.004	0.811	5.074	12.163
SPC__005931.LAB	12/08/23	15:37:41.148	1.164		-0.026	0.004	0.722	4.768	12.072
SPC__005932.LAB	12/08/23	15:38:44.983	1.072		-0.037	0.002	0.807	4.526	12.225
SPC__005933.LAB	12/08/23	15:39:48.841	0.952		-0.032	0.008	0.800	4.252	12.210
SPC__005934.LAB	12/08/23	15:40:53.025	1.157		-0.021	0.004	0.775	4.019	12.125
SPC__005935.LAB	12/08/23	15:41:56.685	0.928		-0.036	0.003	0.759	3.817	12.112
SPC__005936.LAB	12/08/23	15:43:00.542	1.189		-0.019	0.006	0.784	3.619	12.233
SPC__005937.LAB	12/08/23	15:44:04.505	1.224		-0.021	0.005	0.829	3.458	12.333
SPC__005938.LAB	12/08/23	15:45:08.600	1.078		-0.035	0.002	0.772	3.303	12.262
SPC__005939.LAB	12/08/23	15:46:12.260	0.980		-0.029	0.006	0.839	3.180	12.296
SPC__005940.LAB	12/08/23	15:47:16.171	1.007		-0.033	0.005	0.822	3.055	12.380
SPC__005941.LAB	12/08/23	15:48:20.083	1.126		-0.015	0.004	0.845	2.937	12.459
SPC__005942.LAB	12/08/23	15:49:23.983	0.933		-0.034	0.007	0.764	2.836	12.534
SPC__005943.LAB	12/08/23	15:50:27.883	0.891		-0.028	0.007	0.835	2.732	12.398
SPC__005944.LAB	12/08/23	15:51:31.825	1.070		-0.015	0.005	0.859	2.667	12.443
SPC__005945.LAB	12/08/23	15:52:35.701	1.244		-0.036	0.002	0.843	2.588	12.472
Main Out Run 2		**(actual)**	**0.948**	**<**	**0.032**	**0.004**	**0.880**	**6.139**	**12.120**
Oxygen	**12.9%**	**(ppm,dry @7% O2)**	**1.788**	**<**	**0.060**	**0.007**	**1.660**		
DSCFM	**123,750**	**(lbs/hr)**	**0.536**	**<**	**0.013**	**0.011**	**0.516**	**7.9**	**M26A Moisture**
Clinker (tons/hr)	**64.40**	**(lbs/ton clinker)**	**0.008**	**<**	**0.0002**				

Holcim; Joppa IL
Main Stack
Run 3

Spectrum	Date	Time	HCN PCA 191c R1 191c		HF ppm (10) 191C	SF6 (10) 191C	Ethylene (100,3000) 191C	H2O% (40) 191C	CO2% (40) 191C
SPC__005989.LAB	12/08/23	16:40:19.930	1.035		-0.022	0.002	0.978	7.523	12.889
SPC__005990.LAB	12/08/23	16:41:23.865	0.956		-0.018	0.004	0.924	7.070	12.820
SPC__005991.LAB	12/08/23	16:42:28.091	0.919		-0.026	0.003	0.936	7.668	12.636
SPC__005992.LAB	12/08/23	16:43:31.990	1.036		-0.040	0.003	0.956	7.655	12.749
SPC__005993.LAB	12/08/23	16:44:35.572	1.096		-0.028	0.003	1.059	7.278	12.804
SPC__005994.LAB	12/08/23	16:45:39.504	0.873		-0.037	0.004	1.070	7.744	12.741
SPC__005995.LAB	12/08/23	16:46:43.367	0.738		-0.037	0.004	1.058	7.678	12.692
SPC__005996.LAB	12/08/23	16:47:47.609	0.823		-0.058	0.003	1.026	8.586	12.456
SPC__005997.LAB	12/08/23	16:48:51.276	0.903		-0.055	0.002	1.006	7.888	12.826
SPC__005998.LAB	12/08/23	16:49:55.126	1.026		-0.051	0.004	0.976	8.550	12.596
SPC__005999.LAB	12/08/23	16:50:58.989	0.913		-0.058	0.003	1.067	7.887	12.515
SPC__006000.LAB	12/08/23	16:52:02.885	0.804		-0.052	-0.002	1.006	9.476	12.246
SPC__006001.LAB	12/08/23	16:53:06.794	0.942		-0.066	0.000	1.005	8.689	12.388
SPC__006002.LAB	12/08/23	16:54:10.693	0.979		-0.038	0.003	0.954	7.571	12.643
SPC__006003.LAB	12/08/23	16:55:14.948	0.925		-0.039	0.006	0.956	7.086	12.566
SPC__006004.LAB	12/08/23	16:56:18.503	0.961		-0.029	0.001	0.904	6.920	12.620
SPC__006005.LAB	12/08/23	16:57:22.453	0.987		-0.031	0.006	0.935	7.522	12.587
SPC__006006.LAB	12/08/23	16:58:26.657	0.884		-0.019	0.003	0.950	7.420	12.719
SPC__006007.LAB	12/08/23	16:59:30.555	0.874		-0.033	0.001	0.952	8.345	12.455
SPC__006008.LAB	12/08/23	17:00:34.118	0.980		-0.026	0.004	0.973	7.672	12.555
SPC__006009.LAB	12/08/23	17:01:38.038	0.993		-0.031	0.003	0.904	7.261	12.557
SPC__006010.LAB	12/08/23	17:02:41.928	0.762		-0.031	0.003	0.896	7.354	12.399
SPC__006011.LAB	12/08/23	17:03:45.876	0.920		-0.038	0.005	1.017	7.689	12.409
SPC__006012.LAB	12/08/23	17:04:49.771	0.840		-0.031	-0.003	0.864	10.210	12.032
SPC__006013.LAB	12/08/23	17:05:53.693	0.701		-0.020	0.001	0.890	11.323	11.828
SPC__006014.LAB	12/08/23	17:06:57.649	1.016		-0.050	0.001	0.978	8.435	12.295
SPC__006015.LAB	12/08/23	17:08:01.510	1.057		-0.024	0.005	0.980	7.357	12.319
SPC__006016.LAB	12/08/23	17:09:05.339	0.985		-0.020	0.006	0.940	6.822	12.594
SPC__006017.LAB	12/08/23	17:10:09.249	1.112		-0.034	0.003	0.930	6.367	12.669
SPC__006018.LAB	12/08/23	17:11:13.520	0.895		-0.028	0.006	0.999	6.170	12.488
SPC__006019.LAB	12/08/23	17:12:17.061	1.035		-0.014	0.005	0.969	6.148	12.459
SPC__006020.LAB	12/08/23	17:13:20.942	1.027		-0.018	0.003	0.872	6.244	12.634
SPC__006021.LAB	12/08/23	17:14:24.847	0.892		-0.048	0.002	0.885	7.446	12.527
SPC__006022.LAB	12/08/23	17:15:28.852	0.909		-0.026	0.004	1.000	7.607	12.326
SPC__006023.LAB	12/08/23	17:16:32.704	1.172		-0.033	0.006	0.911	7.137	12.331
SPC__006024.LAB	12/08/23	17:17:36.595	0.897		-0.034	0.006	0.954	6.735	12.303
SPC__006025.LAB	12/08/23	17:18:40.796	0.951		-0.017	0.003	0.917	6.977	12.358
SPC__006026.LAB	12/08/23	17:19:44.356	0.873		-0.031	0.001	0.923	7.971	12.111
SPC__006027.LAB	12/08/23	17:20:48.268	0.759		-0.038	0.004	0.901	8.062	12.111
SPC__006028.LAB	12/08/23	17:21:52.279	1.029		-0.037	0.004	0.904	7.471	12.283
SPC__006029.LAB	12/08/23	17:22:56.074	0.963		-0.036	0.006	0.896	7.225	12.341
SPC__006030.LAB	12/08/23	17:23:59.961	0.930		-0.031	0.003	0.896	7.918	12.238
SPC__006031.LAB	12/08/23	17:25:03.909	1.097		-0.046	0.000	0.917	7.770	12.300
SPC__006032.LAB	12/08/23	17:26:07.767	0.992		-0.048	0.001	0.867	7.423	12.207
SPC__006033.LAB	12/08/23	17:27:11.699	0.939		-0.037	0.007	0.951	7.613	12.136
SPC__006034.LAB	12/08/23	17:28:15.569	1.081		-0.038	0.004	0.940	8.250	12.151
SPC__006035.LAB	12/08/23	17:29:19.513	0.962		-0.043	0.001	0.936	8.099	12.315
SPC__006036.LAB	12/08/23	17:30:23.788	1.070		-0.038	0.002	0.866	7.740	12.311
SPC__006037.LAB	12/08/23	17:31:27.281	0.952		-0.034	0.004	0.890	7.699	12.240
SPC__006038.LAB	12/08/23	17:32:31.185	1.053		-0.024	0.002	0.919	7.316	12.238
SPC__006039.LAB	12/08/23	17:33:35.128	0.918		-0.034	0.002	0.900	7.566	12.386
SPC__006040.LAB	12/08/23	17:34:39.032	1.035		-0.024	0.003	0.857	7.494	12.387
SPC__006041.LAB	12/08/23	17:35:43.149	1.056		-0.044	0.004	0.911	7.129	12.346
SPC__006042.LAB	12/08/23	17:36:46.822	0.880		-0.057	0.003	1.007	9.013	12.287
SPC__006043.LAB	12/08/23	17:37:50.809	0.927		-0.077	-0.002	0.934	7.980	12.384
SPC__006044.LAB	12/08/23	17:38:54.593	1.007		-0.040	0.001	0.964	7.168	12.463
Main Out Run 3		**(actual)**	**0.953**	<	**0.032**	**0.003**	**0.946**	**7.686**	**12.433**
Oxygen	**12.6%**	**(ppm,dry @7% O2)**	**1.731**	<	**0.058**	**0.005**	**1.719**		
DSCFM	**123,550**	**(lbs/hr)**	**0.537**	<	**0.013**	**0.009**	**0.554**	**7.9**	**M26A Moisture**
Clinker (tons/hr)	**64.40**	**(lbs/ton clinker)**	**0.008**	<	**0.0002**				

Appendix B

Field Data
and
CEM/FTIR Data

EPA Method 1
Traverse Point Location for Circular Ducts

Plant LaFarge Joppa Plant

City Grand Chain **State** Illinois

Location Kiln 2 Stack

Stack ID (inches) 102

Nipple Length 35

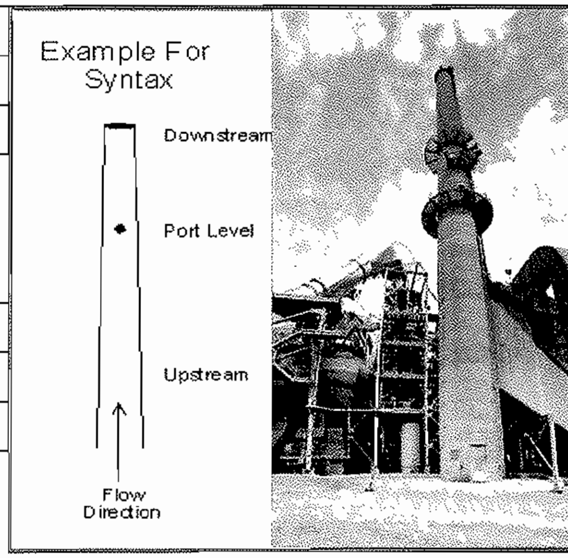
Nearest Upstream Disturbance (Bend, ID FAN, etc)

Distance (inches) 816 Type of Disturbance **Stack Breaching**

Nearest Downstream Disturbance (Bend, or Stack Outlet)

Distance (inches) 1344 Type of Disturbance **Stack Outlet**

Sampler SCS **Date** 12/18/17



Stack Schematic (Draw by hand after printing)

(Mark with an "x")

Particulate Traverse? x **Yes** ☐ **No**

Number of Traverse Points Required 6

Traverse Point Number	Fraction of Stack Internal Diam.	Stack ID (Inches)	Diameter Frac. x Stack ID	Nipple Length (Inches)	Traverse Point Distance from outside Nipple
1	0.044	102	4.49	35	39 1/2 in.
2	0.146	102	14.89	35	49 7/8 in.
3	0.296	102	30.19	35	65 1/4 in.
4	0.704	102	71.81	35	106 3/4 in.
5	0.854	102	87.11	35	122 1/8 in.
6	0.956	102	97.51	35	132 1/2 in.

Cyclonic Flow Check Data Sheet

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Holcim Joppa IL	12/05/23	Main Stack	Cyclonic Flow Check	

OPERATOR	Barometric Pressure (Pb (In. Hg)	STATIC PRESS (in. H2O)	AMBIENT TEMP (deg. F)	STACK ID (In.)	PITOT Cp	DGM BOX No.	DGM delta H@	DGM CAL FACTOR (gamma)		PROBE ID NO
HB/GM	29.30	-0.80	70	102	0.83	MS21	NA	NA		5A

EPA Method 2 Data

Run Time (24 hr)	Traverse Port Point ID	Pitot Delta P READING " H2O	STACK TEMP deg F	Absolute Angle at null (0) Delta P READING " H2O
	A 1	0.80	316	10
	2	0.70	317	5
	3	0.52	315	5
	B 1	0.79	315	15
	2	0.71	316	10
	3	0.55	316	15
	C 1	0.77	315	5
	2	0.59	317	10
	3	0.54	316	5
	D 1	0.84	317	0
	2	0.81	318	10
	3	0.70	316	10
Pitot Leak Check				
Averages				

Average of Absolute Angle Readings must be < 20 degrees

METHOD 26A FIELD DATA SHEET

PLANT AND CITY		DATE	SAMPLING LOCATION			SAMPLE TYPE		RUN NUMBER		
Tulsa Lafarge Holcim		12/ 8 /23	Main Stack			M26A		1 A		

OPERATOR	AMBIENT PRESS (In. Hg)	STATIC PRESSURE (in. Water)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (In.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
Guy Mayer	29.3	~0.9	~73	NA	102	~~0.85~~ 0.84	5 ft eff Glass line	.250 .250 .250	.250

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
11%	MS-21	1.69	0.985	5A	5A	CEM	.001 CU. FT @ 12 "Hg	.001 CU. FT @ 12 "Hg	12%	15%	2.27

PITOT LEAK CHECK ----> [] PASSED [] FAILED

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
A-1	0	13:24	568.751	.80	1.8	257	308	61	256	54	3
2	5		572.42	.70	1.6	252	308	62	260	52	3
3	10		575.69	.52	1.2	251	302	63	255	52	3
	15	13:39	578.828	End of Port							

INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT) INITIAL ____ FINAL ____ LEAK RATE: ____ CU.FT @ ____ INCHES Hg ____ CU.FT @ ____ INCHES Hg

B-1	15	13:43	578.828	.79	1.8	252	307	62	255	50	3
2	20		582.14	.71	1.6	253	311	62	258	52	3
3	25		585.17	.55	1.2	256	306	63	260	54	4
	30	13:58	588.834	End of Port							

INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT) INITIAL ____ FINAL ____ LEAK RATE: ____ CU.FT @ ____ INCHES Hg ____ CU.FT @ ____ INCHES Hg

C-1	30	14:01	588.834	.77	1.7	252	308	65	256	56	4
2	35		592.96	.69	1.6	255	308	66	252	56	4
3	40		596.64	.54	1.2	259	303	68	259	56	4
	45	14:16	599.957	End of Port							

INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT) INITIAL ____ FINAL ____ LEAK RATE: ____ CU.FT @ ____ INCHES Hg ____ CU.FT @ ____ INCHES Hg

D-1	45	14:19	599.957	.84	1.9	253	309	69	259	54	4
2	50		603.77	.81	1.8	256	312	69	256	54	4
3	55		607.62	.70	1.6	259	308	71	259	52	4
	60	14:34	611.492	End of Port							

TOTAL TIME	DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.	AVE. TEMP.
60 Min.	611.492				

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Holcim Joppa IL
Sample Location Main Stack
Run No. JP -M26A- 1A
Filter Number(s) Not Applicable

Sample Date 12/ 8 /23
Recovery Date 12/ 8 /23
Recovered by SCS

MOISTURE

Impingers	1 50 ml 0.1N H_2SO_4 (knockout)	2 100 ml 0.1N H_2SO_4 (tipped)	3 100 ml 0.1N H_2SO_4 (tipped)	4 Optional Knockout (untipped)	5 100 ml 0.1N NaOH (untipped)	6 100 ml 0.1N NaOH (untipped)	Silica gel (untipped)	
Final weight	/	794.4	779.1	620.6	764.8	748.6	1001.5	g
Initial weight	/	755.6	758.4	616.5	761.4	747.0	991.0	g
Net weight	/	38.8	20.7	4.1	3.4	1.6	10.5	g

Description of impinger water clear

60 % spent
B/W Sil gel color
Total moisture = 79.1 grams

RECOVERED SAMPLE

H_2SO_4 Impingers and knockout contents and water rinse
container no. JP -M26A-H2SO4- 1A

Liquid level marked/sealed ✓

NaOH Impingers contents and water rinse
container no. JP -M26A-NaOH 1A

Liquid level marked/sealed ✓

Samples stored and locked
Remarks

METHOD 26A FIELD DATA SHEET

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Lafarge Holcim; Joppa IL	12/8/23		M26A	1B

OPERATOR	AMBIENT PRESS (In. Hg)	STATIC PRESSURE (in. Water)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (In.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
MTP	29.30	-0.7	73	NA	102	~~0.85~~ 0.84	5' effective glass	.249 .250	.250 in

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
11	A515	1.68	.973	S4	S4	CEM	0.00 CU. FT @ 10 "Hg	0.001 CU. FT @ 6 "Hg	12	15	2.25

PITOT LEAK CHECK ----> [X] PASSED [ ] FAILED

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
A-1	0	1324	462.289	.8	1.8	251	308	61	256	58	5
2	5		465.92	.7	1.6	255	308	62	260	56	5
3	10		469.541	.52	1.2	251	302	63	255	52	3
	15	1339	472.541	End of Port							

INTRA-PORT LEAK CHECK?
DGM VOLUME (CU. FT) INITIAL / FINAL / — LEAK RATE: / CU.FT @ / INCHES Hg; CU.FT @ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
B-1	15	1343	472.841	.79	1.8	252	307	60	255	50	5
2	20		476.72	.71	1.6	253	[illegible]	61	258	52	5
3	25		~~469.94~~ 479.94	.55	1.2	256	306	63	260	54	
	30	1358	483.456	End of Port							

INTRA-PORT LEAK CHECK?
DGM VOLUME (CU. FT) INITIAL / FINAL — LEAK RATE: / CU.FT @ / INCHES Hg; CU.FT @ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
C-1	30	1401	483.456	.77	1.7	252	308	65	256	56	5
2	35		486.39	.69	1.5	255	308	66	252	53	5
3	40		490.62	.54	1.2	259	303	68	259	56	5
	45	1416	494.072	End of Port							

INTRA-PORT LEAK CHECK?
DGM VOLUME (CU. FT) INITIAL / FINAL — LEAK RATE: / CU.FT @ / INCHES Hg; CU.FT @ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
D-1	45	1419	494.072	.84	1.9	253	309	69	257	54	5
2	50		497.56	.81	1.8	256	312	69	256	54	5
3	55		501.65	.70	1.6	259	308	71	259	52	5
	60	1434	504.250	End of Port							

TOTAL TIME	DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.	AVE. TEMP.
60 Min.					

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Holcim Joppa IL
Sample Location Main Stack
Run No. JP -M26A- 1B
Filter Number(s) Not Applicable

Sample Date 12/ 8 /23
Recovery Date 12/ 8 /23
Recovered by SCS

MOISTURE

Impingers	1 50 ml 0.1N H_2SO_4 (knockout)	2 100 ml 0.1N H_2SO_4 (tipped)	3 100 ml 0.1N H_2SO_4 (tipped)	4 Optional Knockout (untipped)	5 100 ml 0.1N NaOH (untipped)	6 100 ml 0.1N NaOH (untipped)	Silica gel (untipped)	
Final weight		788.0	784.3	615.3	756.9	749.5	946.5	g
Initial weight		754.9	767.2	612.6	753.2	748.2	934.2	g
Net weight		33.1	17.1	2.7	3.7	1.3	12.3	g

Description of impinger water Clear

20 % spent
Blue Sil gel color
Total moisture = 70.2 grams

RECOVERED SAMPLE

H_2SO_4 Impingers and knockout contents and water rinse
container no. JP -M26A-H2SO4- 1B

Liquid level marked/sealed ✓

NaOH Impingers contents and water rinse
container no. JP -M26A-NaOH 1B

Liquid level marked/sealed ✓

Samples stored and locked
Remarks

METHOD 26A FIELD DATA SHEET

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Toller	12/3/23	Midam Stack	M26A	2 A

OPERATOR	AMBIENT PRESS (In. Hg)	STATIC PRESSURE (in. Water)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (In.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
Tay Watts	29.3	-0.7	~75	n/a	102	~~0.855~~ 0.84	5ft glass	.250 .250 .250	.250

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
11%	MS-21	1.69	.985	5A	5A	CEM	.001 CU. FT @ 12 "Hg	.001 CU. FT @ 12 "Hg	12%	15%	2.29

PITOT LEAK CHECK ----> [] PASSED [] FAILED

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
A-1	0	14:53	611.434	.85	1.9	255	309	67	255	50	5
2	5		615.41	.81	1.8	257	308	67	251	50	4
3	10		618.84	.73	1.7	259	309	68	254	51	4
	15	15:08	622.873	End of Port							

INTRA-PORT LEAK CHECK?
DGM VOLUME (CU. FT) INITIAL ______ FINAL ______ LEAK RATE: ______ CU.FT @ ______ INCHES Hg ______ CU.FT @ ______ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
B-1	15	15:11	622.873	.81	1.8	258	309	69	250	53	4
2	20		626.45	.74	1.7	256	309	70	251	53	4
3	25		630.47	.58	1.3	252	307	71	248	54	4
	30	15:26	633.704	End of Port							

INTRA-PORT LEAK CHECK?
DGM VOLUME (CU. FT) INITIAL ______ FINAL ______ LEAK RATE: ______ CU.FT @ ______ INCHES Hg ______ CU.FT @ ______ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
C-1	30	15:29	633.704	.83	1.8	248	308	70	251	55	5
2	35		637.17	.80	1.8	250	308	71	255	57	5
3	40		640.67	.68	1.5	248	308	71	255	59	5
	45	15:44	644.328	End of Port							

INTRA-PORT LEAK CHECK?
DGM VOLUME (CU. FT) INITIAL ______ FINAL ______ LEAK RATE: ______ CU.FT @ ______ INCHES Hg ______ CU.FT @ ______ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
D-1	45	15:46	644.328	.81	1.8	255	308	71	258	59	
2	50		649.09	.72	1.7	255	309	72	256	58	
3	55		652.49	.53	1.2	256	313	73	253	56	
	60	16:01	655.209	End of Port							

TOTAL TIME	DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.	AVE. TEMP.
60 Min.					

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant ~~Joppa~~ Holcim Joppa IL
Sample Location Main Stack
Run No. JP -M26A- 2A
Filter Number(s) Not Applicable

Sample Date 12/8/23
Recovery Date 12/8/23
Recovered by LGH

MOISTURE

Impingers	1 50 ml 0.1N H_2SO_4 (knockout)	2 100 ml 0.1N H_2SO_4 (tipped)	3 100 ml 0.1N H_2SO_4 (tipped)	4 Optional Knockout (untipped)	5 100 ml 0.1N NaOH (untipped)	6 100 ml 0.1N NaOH (untipped)	Silica gel (untipped)	
Final weight	/	787.2	774.4	650.7	762.8	762.5	974.3	g
Initial weight	/	747.5	756.3	647.4	760.4	761.6	962.2	g
Net weight	/	39.7	18.1	3.3	2.4	0.9	12.1	g

Description of impinger water Clear 55 % spent
B/W Sil gel color
Total moisture = 76.5 grams

RECOVERED SAMPLE

H_2SO_4 Impingers and knockout contents and water rinse
container no. JP -M26A-H2SO4- 2A

Liquid level marked/sealed ✓

NaOH Impingers contents and water rinse
container no. JP -M26A-NaOH 2A

Liquid level marked/sealed ✓

Samples stored and locked

Remarks

METHOD 26A FIELD DATA SHEET

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Lafarge Holcim; Joppa, IL	12/ 8 /23		M26A	2B

OPERATOR	AMBIENT PRESS (In. Hg)	STATIC PRESSURE (in. Water)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (In.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
MTP	29.30	-0.7	75	NA	102	0.84	5' effective / Glass	.249 .250 .251	.250 in

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
11	MS-15	1.68	0.975	SA	SA	CEM	0.001 CU. FT @ 10 "Hg	0.001 CU. FT @ 10 "Hg	12	15	2.23

PITOT LEAK CHECK ----> [X] PASSED [ ] FAILED

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
A-1	0	1453	505.252	.85	1.9	255	309	66	255	50	6
2	5		509.16	.81	1.8	257	302	67	251	50	6
3	10		513.21	.93	2.1	259	304	68	254	51	6
	15	1508	517.189	End of Port							

INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT) INITIAL / FINAL — LEAK RATE: / CU.FT @ / INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
B-1	15	1511	517.189	.81	1.8	256	309	68	250	53	6
2	20		521.23	.74	1.7	256	304	69	251	57	6
3	25		524.68	.58	1.3	252	307	70	248	54	6
	30	1526	528.275	End of Port							

INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT) INITIAL / FINAL — LEAK RATE: / CU.FT @ / INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
C-1	30	1529	528.275	.83	1.9	248	308	71	251	55	6
2	35		532.05	.80	1.8	250	308	71	255	57	6
3	40		536.56	.68	1.5	248	308	72	255	59	6
	45	1544	539.666	End of Port							

INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT) INITIAL / FINAL — LEAK RATE: CU.FT @ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
D-1	45	1546	539.666	.81	1.8	255	308	70	258	54	6
2	50		543.98	.72	1.6	255	309	71	256	58	6
3	55		547.76	.53	1.2	256	313	72	257	56	6
	60	1601	551.169	End of Port							

TOTAL TIME	DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.	AVE. TEMP.
60 Min.					

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Holcim Joppa IL
Sample Location Main Stack
Run No. Joppa JP -M26A- 2B
Filter Number(s) Not Applicable

Sample Date 12/ 8 /23
Recovery Date 12/ 8 /23
Recovered by LGH

MOISTURE

Impingers	1 50 ml 0.1N H_2SO_4 (knockout)	2 100 ml 0.1N H_2SO_4 (tipped)	3 100 ml 0.1N H_2SO_4 (tipped)	4 Optional Knockout (untipped)	5 100 ml 0.1N NaOH (untipped)	6 100 ml 0.1N NaOH (untipped)	Silica gel (untipped)	
Final weight		784.7	786.6	672.9	731.0	751.0	989.0	g
Initial weight		744.5	768.8	668.9	728.5	749.8	974.8	g
Net weight		40.2	17.8	4.0	2.5	1.2	14.2	g

Description of impinger water Clear

10 % spent
B/W Sil gel color
Total moisture = 79.9 grams

RECOVERED SAMPLE

H_2SO_4 Impingers and knockout contents and water rinse
container no. JP -M26A-H2SO4- 2B

Liquid level marked/sealed ✓

NaOH Impingers contents and water rinse
container no. JP -M26A-NaOH 2B

Liquid level marked/sealed ✓

Samples stored and locked

Remarks

METHOD 26A FIELD DATA SHEET

PLANT AND CITY	DATE	SAMPLING/LOCATION	SAMPLE TYPE	RUN NUMBER
Toppa	12/08/23	Main stack	M26A	3 A

OPERATOR	AMBIENT PRESS (In. Hg)	STATIC PRESSURE (in. Water)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (In.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE NUMBER	NOZZLE DIAMETER
[illegible]	29.3	-0.7	75	N/A	102	~~0.55~~ 0.84	5ft eff [illegible]	.250 .250 .250	.250

ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
11	MS-21	1.69	.985	5A	5A	Fail	.001 CU. FT @ 12 "Hg	.001 CU. FT @ 12 "Hg	12%	15%	2.27

PITOT LEAK CHECK ----> [] PASSED [] FAILED

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
A-1	0	16:20	655.456	.84	1.8	256	308	69	255	64	3
2	5		659.26	.71	1.6	255	308	70	253	64	3
3	10		663.43	.52	1.2	255	308	70	256	62	3
	15	16:35	666.775	End of Port							

INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT) INITIAL ______ FINAL ______ LEAK RATE: ______ CU.FT @ ______ INCHES Hg ______ CU.FT @ ______ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
B-1	15	16:37	666.775	.63	1.8	254	309	71	252	63	4
2	20		670.19	.78	1.8	252	308	72	260	62	4
3	25		673.92	.68	1.6	~~259~~ 249	302	72	263	60	4
	30	16:52	677.384	End of Port							

INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT) INITIAL ______ FINAL ______ LEAK RATE: ______ CU.FT @ ______ INCHES Hg ______ CU.FT @ ______ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
C-1	30	16:54	677.384	.80	1.8	258	312	72	255	58	4
2	35		681.34	.75	1.7	260	309	72	255	56	4
3	40		684.29	.59	1.3	262	306	72	256	54	3
	45	17:09	687.681	End of Port							

INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT) INITIAL ______ FINAL ______ LEAK RATE: ______ CU.FT @ ______ INCHES Hg ______ CU.FT @ ______ INCHES Hg

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
D-1	45	17:11	687.681	.85	1.9	263	306	72	258	54	4
2	50		691.45	.78	1.8	258	307	72	259	54	4
3	55		694.96	.72	1.7	250	306	72	262	54	4
	60	17:26	699.658	End of Port							

TOTAL TIME	DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.	AVE. TEMP.
60 Min.	699.652				

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Holcim Joppa IL
Sample Location Main Stack
Run No. Joppa JP-M26A- 3A
Filter Number(s) Not Applicable

Sample Date 1 / 8 /23
Recovery Date 1 / 8 /23
Recovered by SCS

MOISTURE

Impingers	1 50 ml 0.1N H_2SO_4 (knockout)	2 100 ml 0.1N H_2SO_4 (tipped)	3 100 ml 0.1N H_2SO_4 (tipped)	4 Optional Knockout (untipped)	5 100 ml 0.1N NaOH (untipped)	6 100 ml 0.1N NaOH (untipped)	Silica gel (untipped)	
Final weight	/	800.5	776.0	623.7	742.8	736.4	1013.3	g
Initial weight	/	755.6	761.1	619.9	741.0	737.4	1001.3	g
Net weight	/	44.9	14.9	3.8	1.8	-1.0	12.0	g

Description of impinger water Clear

75 % spent
B/W Sil gel color
Total moisture = 76.4 grams

RECOVERED SAMPLE

H_2SO_4 Impingers and knockout contents and water rinse
container no. JP -M26A-H2SO4- 3A

Liquid level marked/sealed ✓

NaOH Impingers contents and water rinse
container no. JP -M26A-NaOH 3A

Liquid level marked/sealed ✓

Samples stored and locked
Remarks

METHOD 26A FIELD DATA SHEET

PLAND AND CITY		DATE	SAMPLING LOCATION			SAMPLE TYPE		RUN NUMBER		
Holcim Lafarge: Joppa, IL		12/ 08 /23				M26A		~~3A~~ 3B		
OPERATOR	AMBIENT PRESS (In. Hg)	STATIC PRESSURE (in. Water)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (In.)	PITOT Cp	PROBE LENGTH AND LINER TYPE		NOZZLE NUMBER	NOZZLE DIAMETER
MTP	29.30	-.07	70	N/A	102	~~0.SG~~ 0.84	5' electric glass		.249 .250 .251	.250 in
ASSUMED MOISTURE (%)	DGM BOX No.	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	O2 CONTENT %	CO2 CONTENT %	K FACTOR
11	MS-15	1.68	.975	SA	SA	CEM	0.001 CU. FT @ 10 "Hg	0.001 CU. FT @ 8 "Hg	12	15	2.25

PITOT LEAK CHECK ----> [x] PASSED [ ] FAILED

TRAVERSE PORT/ /POINT NO.	ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P VELOCITY HEAD (In. H2O)	delta H ORIFICE (In. H2O)	PROBE TEMP (deg. F)	STACK TEMP (deg. F)	DGM IN / OUT TEMP (deg. F)	FILTER OVEN TEMP (deg. F)	Sil Gel EXIT TEMP (deg. F)	SAMPLE TRAIN VAC (in. Hg)
A-1	0	1620	551.315	.84	1.9	256	308	70	255	64	6
2	5		555.47	.71	1.6	255	308	71	253	64	6
3	10		559.26	.51	1.1	255	308	72	256	62	6
	15	1635	562.451	End of Port							

INTRA-PORT LEAK CHECK?
DGM VOLUME (CU. FT) INITIAL / FINAL — LEAK RATE: / CU.FT @ / INCHES Hg; CU.FT @ INCHES Hg

B-1	15	1637	562.451	.83	1.9	254	309	72	252	63	6
2	20		566.31	.78	1.8	252	308	72	260	62	6
3	25		570.26	.68	1.5	249	302	73	263	60	6
	30	1652	573.822	End of Port							

INTRA-PORT LEAK CHECK?
DGM VOLUME (CU. FT) INITIAL / FINAL — LEAK RATE: / CU.FT @ / INCHES Hg; CU.FT @ INCHES Hg

C-1	30	1654	573.822	.80	1.8	258	312	74	255	58	6
2	35		577.26	.75	1.7	260	309	74	255	56	6
3	40		580.59	.59	1.3	262	306	74	256	54	6
	45	1709	583.698	End of Port							

INTRA-PORT LEAK CHECK?
DGM VOLUME (CU. FT) INITIAL / FINAL — LEAK RATE: / CU.FT @ / INCHES Hg; CU.FT @ INCHES Hg

D-1	45	1711	583.698	.85	1.9	263	308	73	258	54	7
2	50		588.224	.78	1.8	258	307	74	259	54	7
3	55		592.14	.72	1.6	250	308	74	262	54	6
	60	1726	596.537	End of Port							

TOTAL TIME	DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.	AVE. TEMP.
60 Min.					

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Holcim Joppa IL
Sample Location Main Stack
Run No. Joppa JP -M26A- 3B
Filter Number(s) Not Applicable

Sample Date 14/08/23
Recovery Date 11/08/23
Recovered by GC

MOISTURE

Impingers	1 50 ml 0.1N H_2SO_4 (knockout)	2 100 ml 0.1N H_2SO_4 (tipped)	3 100 ml 0.1N H_2SO_4 (tipped)	4 Optional Knockout (untipped)	5 100 ml 0.1N NaOH (untipped)	6 100 ml 0.1N NaOH (untipped)	Silica gel (untipped)	
Final weight		808.2	773.6	615.9	762.0	747.1	966.8	g
Initial weight		762.4	759.6	614.6	758.6	747.5	952.1	g
Net weight		45.8	14.0	1.3	3.4	-0.4	14.7	g

Description of impinger water Clear

20 % spent
B/W Sil gel color
Total moisture = 78.8 grams

RECOVERED SAMPLE

H_2SO_4 Impingers and knockout contents and water rinse
container no. JP -M26A-H2SO4- 3B

Liquid level marked/sealed ✓

NaOH Impingers contents and water rinse
container no. JP -M26A-NaOH 3B

Liquid level marked/sealed ✓

Samples stored and locked
Remarks

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Joppa Holcim Joppa IL
Sample Location Main Stack
Run No. Field Blank -M26A-
Filter Number(s) Not Applicable

Sample Date 12/ 8 /23
Recovery Date 12/ 9 /23
Recovered by LGM

MOISTURE

Impingers	1 50 ml 0.1N H_2SO_4 (knockout)	2 100 ml 0.1N H_2SO_4 (tipped)	3 100 ml 0.1N H_2SO_4 (tipped)	4 Optional Knockout (untipped)	5 100 ml 0.1N NaOH (untipped)	6 100 ml 0.1N NaOH (untipped)	Silica gel (untipped)	
Final weight		738.6	739.5	643.6	744.4	745.0	907.2	g
Initial weight		738.6	739.5	643.7	744.5	745.3	907.1	g
Net weight		0.0	0.0	-0.1	-0.1	-0.3	0.1	g

Description of impinger water Clear ______ % spent
______ Sil gel color
Total moisture = ______ grams

RECOVERED SAMPLE

H_2SO_4 Impingers and knockout contents and water rinse
container no. JP -M26A-H2SO4- FB

Liquid level marked/sealed ______

NaOH Impingers contents and water rinse
container no. JP -M26A-NaOH - FB

Liquid level marked/sealed ______

Samples stored and locked ______
Remarks ______

Client: Holcim Joppa IL
Test Location: Main Stack
Date: Dec 08, 2023
Run number 1
One Minute Averages

	Out O2 %,dry	Out CO2 %,dry
1:24:52 PM	13.0	13.5
1:25:52 PM	13.1	13.4
1:26:52 PM	13.2	13.4
1:27:52 PM	13.2	13.4
1:28:52 PM	13.1	13.6
1:29:52 PM	13.1	13.6
1:30:52 PM	13.1	13.4
1:31:52 PM	13.2	13.5
1:32:52 PM	13.1	13.6
1:33:52 PM	13.0	13.8
1:34:52 PM	12.9	14.0
1:35:52 PM	13.1	13.6
1:36:52 PM	13.1	13.7
1:37:52 PM	13.1	13.9
1:38:52 PM	13.0	14.0
1:39:52 PM	13.1	13.9
1:40:52 PM	13.0	13.9
1:41:52 PM	13.1	13.9
1:42:52 PM	13.1	13.9
1:43:52 PM	13.0	14.0
1:44:52 PM	13.0	14.0
1:45:52 PM	13.0	14.0
1:46:52 PM	13.1	14.0
1:47:52 PM	13.1	14.0
1:48:52 PM	13.0	14.2
1:49:52 PM	13.0	14.2
1:50:52 PM	13.0	14.2
1:51:52 PM	13.1	14.0
1:52:52 PM	13.1	14.0
1:53:52 PM	13.0	14.1
1:54:52 PM	12.9	14.3
1:55:52 PM	13.0	14.1
1:56:52 PM	13.1	14.0
1:57:52 PM	13.0	14.1
1:58:52 PM	13.0	14.1
1:59:52 PM	13.1	14.0
2:00:52 PM	13.1	13.9
2:01:52 PM	13.0	14.1
2:02:52 PM	13.1	13.9
2:03:52 PM	13.1	13.9
2:04:52 PM	13.1	13.9
2:05:52 PM	13.1	13.9
2:06:52 PM	13.0	14.1
2:07:52 PM	13.1	14.0
2:08:52 PM	13.1	13.9
2:09:52 PM	13.1	13.9
2:10:52 PM	13.1	14.0
2:11:52 PM	13.1	13.8
2:12:52 PM	13.2	13.8
2:13:52 PM	13.0	14.0
2:14:52 PM	13.1	14.1
2:15:52 PM	13.0	14.1
2:16:52 PM	13.1	14.1
2:17:52 PM	13.1	14.0
2:18:52 PM	13.0	14.2
2:19:52 PM	13.0	14.3
2:20:52 PM	13.1	14.2
2:21:52 PM	13.1	14.2
2:22:52 PM	13.0	14.4
2:23:52 PM	13.0	14.4
Run Avgs	13.1	13.9
Cal Gas	11.8	10.2
Initial Zero	0.1	0.1
Final Zero	0.3	0.2
Initial cal.	11.8	10.1
Final Cal.	12.1	10.0
Corrected Average	12.9	14.2

Client: Holcim Joppa IL
Test Location: Main Stack
Date: Dec 08, 2023
Run number 2
One Minute Averages

	Out O2 %,dry	Out CO2 %,dry
2:54:00 PM	13.0	14.2
2:55:00 PM	13.1	14.1
2:56:00 PM	13.1	14.0
2:57:00 PM	13.2	13.8
2:58:00 PM	13.1	13.8
2:59:00 PM	13.1	13.9
3:00:00 PM	13.1	13.8
3:01:00 PM	13.1	13.8
3:02:00 PM	13.2	13.7
3:03:00 PM	13.2	13.6
3:04:00 PM	13.1	13.8
3:05:00 PM	13.1	13.7
3:06:00 PM	13.2	13.5
3:07:00 PM	13.2	13.7
3:08:00 PM	13.2	13.6
3:09:00 PM	13.2	13.6
3:10:00 PM	13.3	13.4
3:11:00 PM	13.3	13.3
3:12:00 PM	13.3	13.3
3:13:00 PM	13.3	13.3
3:14:00 PM	13.3	13.2
3:15:00 PM	13.3	13.2
3:16:00 PM	13.3	13.2
3:17:00 PM	13.3	13.2
3:18:00 PM	13.4	13.0
3:19:00 PM	13.3	13.1
3:20:00 PM	13.3	13.2
3:21:00 PM	13.4	13.0
3:22:00 PM	13.4	13.0
3:23:00 PM	13.4	13.0
3:24:00 PM	13.3	13.1
3:25:00 PM	13.4	12.9
3:26:00 PM	13.4	12.9
3:27:00 PM	13.4	13.0
3:28:00 PM	13.4	13.0
3:29:00 PM	13.3	13.1
3:30:00 PM	13.4	13.0
3:31:00 PM	13.3	13.0
3:32:00 PM	13.3	13.1
3:33:00 PM	13.3	13.1
3:34:00 PM	13.3	13.1
3:35:00 PM	13.3	13.2
3:36:00 PM	13.3	13.1
3:37:00 PM	13.3	13.2
3:38:00 PM	13.4	13.0
3:39:00 PM	13.3	13.1
3:40:00 PM	13.3	13.1
3:41:00 PM	13.4	13.0
3:42:00 PM	13.4	12.9
3:43:00 PM	13.4	12.9
3:44:00 PM	13.3	13.1
3:45:00 PM	13.3	13.1
3:46:00 PM	13.4	13.0
3:47:00 PM	13.4	13.0
3:48:00 PM	13.3	13.1
3:49:00 PM	13.2	13.2
3:50:00 PM	13.3	13.2
3:51:00 PM	13.3	13.1
3:52:00 PM	13.3	13.1
3:53:00 PM	13.3	13.1
Run Avgs	13.3	13.3
Cal Gas	11.8	10.2
Initial Zero	0.3	0.2
Final Zero	0.4	0.2
Initial cal.	12.1	10.0
Final Cal.	12.3	10.2
Corrected Average	12.9	13.5

Client: Holcim Joppa IL
Test Location: Main Stack
Date: Dec 08, 2023
Run number 3
One Minute Averages

	Out O2 %,dry	Out CO2 %,dry
4:39:56 PM	13.1	14.4
4:40:56 PM	13.1	14.3
4:41:56 PM	13.1	14.2
4:42:56 PM	13.2	14.1
4:43:56 PM	13.1	14.2
4:44:56 PM	13.1	14.2
4:45:56 PM	13.1	14.2
4:46:56 PM	13.1	14.2
4:47:56 PM	13.2	14.0
4:48:56 PM	13.1	14.3
4:49:56 PM	13.0	14.3
4:50:56 PM	13.1	14.1
4:51:56 PM	13.2	14.0
4:52:56 PM	13.2	14.0
4:53:56 PM	13.1	14.1
4:54:56 PM	13.1	14.1
4:55:56 PM	13.2	13.9
4:56:56 PM	13.2	14.0
4:57:56 PM	13.2	14.0
4:58:56 PM	13.1	14.2
4:59:56 PM	13.2	14.1
5:00:56 PM	13.2	14.0
5:01:56 PM	13.2	14.0
5:02:56 PM	13.3	13.8
5:03:56 PM	13.2	13.8
5:04:56 PM	13.2	13.9
5:05:56 PM	13.2	13.9
5:06:56 PM	13.2	13.8
5:07:56 PM	13.3	13.7
5:08:56 PM	13.2	13.8
5:09:56 PM	13.2	13.9
5:10:56 PM	13.2	13.9
5:11:56 PM	13.3	13.7
5:12:56 PM	13.3	13.7
5:13:56 PM	13.2	13.9
5:14:56 PM	13.2	13.9
5:15:56 PM	13.3	13.7
5:16:56 PM	13.3	13.6
5:17:56 PM	13.3	13.5
5:18:56 PM	13.3	13.7
5:19:56 PM	13.3	13.6
5:20:56 PM	13.3	13.5
5:21:56 PM	13.3	13.6
5:22:56 PM	13.2	13.7
5:23:56 PM	13.3	13.7
5:24:56 PM	13.2	13.7
5:25:56 PM	13.2	13.7
5:26:56 PM	13.3	13.6
5:27:56 PM	13.3	13.5
5:28:56 PM	13.2	13.7
5:29:56 PM	13.2	13.8
5:30:56 PM	13.2	13.7
5:31:56 PM	13.3	13.6
5:32:56 PM	13.3	13.6
5:33:56 PM	13.3	13.8
5:34:56 PM	13.3	13.8
5:35:56 PM	13.3	13.7
5:36:56 PM	13.3	13.8
5:37:56 PM	13.3	13.9
5:38:56 PM	13.2	13.9
Run Avgs	13.2	13.9
Cal Gas	11.8	10.2
Initial Zero	0.4	0.2
Final Zero	0.5	0.2
Initial cal.	12.3	10.2
Final Cal.	12.4	10.5
Corrected Average	12.6	13.7

Holcim, Joppa IL　　Main Stack　　December 8, 2023　　Operator ECS

					Run No. 1	13:24-14:24				Run No. 2	14:53-15:53				Run No. 3	16:39-17:39			
Cylinder ID	Gas Type	Value	Internal Response	Cal Error	Pre Run Bias	Percent Bias	Post Run Bias	Percent Bias	Percent Drift	Pre Run Bias	Percent Bias	Post Run Bias	Percent Bias	Percent Drift	Pre Run Bias	Percent Bias	Post Run Bias	Percent Bias	Percent Drift
	O2 Zero	Zero N2	0.0%	0.00%	0.1%	0.46%	0.3%	1.37%	0.91%	0.3%	1.37%	0.4%	1.83%	0.46%	0.4%	1.83%	0.5%	2.28%	0.46%
XC025341	O2 Mid	11.8%	11.7%	-0.41%	11.8%	0.46%	12.1%	1.83%	1.37%	12.1%	1.83%	12.3%	2.74%	0.91%	12.3%	2.74%	12.4%	3.20%	0.46%
ALM056015	O2 Span	21.9%	21.9%	0.00%															
	CO2 Zero	Zero N2	0.0%	0.00%	0.1%	0.55%	0.2%	1.10%	0.55%	0.2%	1.10%	0.2%	1.10%	0.00%	0.2%	1.10%	0.2%	1.10%	0.00%
XC025341	CO2 Mid	10.2%	10.2%	-0.11%	10.1%	-0.55%	10.0%	-1.10%	-0.55%	10.0%	-1.10%	10.2%	0.00%	1.10%	10.2%	0.00%	10.5%	1.65%	1.65%
ALM056015	CO2 Span	18.2%	18.3%	0.72%															

Holcim
Joppa IL
Kiln 1 Main Stack
HCN Analyte Spikes

	Date	**12/08/23**	**12/08/23**	**12/08/23**	**12/08/23**
	Time	**13:05-13:16**	**14:23-14:43**	**15:56-16:12**	**17:38-17:54**
		Pre Run 1	**Post Run 1**	**Post Run 2**	**Post Run 3**
	CC768222	**HCN**	**HCN**	**HCN**	**HCN**
Cs	Spike Direct, ppm	49.23	49.23	49.23	49.23
	SF6 Tracer Direct, ppm	4.85	4.85	4.85	4.85
SF6	Diluted SF6 Tracer, ppm	0.436	0.419	0.363	0.326
	Diluted SF6 Tracer, ppm	0.420	0.359	0.350	0.332
	Average Diluted SF6 Tracer, ppm	0.428	0.389	0.357	0.329
DF	Dilution Ratio	11.33	12.47	13.60	14.74
	Total, ppm	4.817	4.536	4.174	3.960
	Total, ppm	4.681	4.147	4.067	3.463
Ct	Average Total, ppm	4.749	4.342	4.121	3.712
	Pre Spike Native , ppm	1.070	1.082	1.194	0.927
	Pre Spike Native , ppm	1.060	1.011	1.163	1.007
	Post Spike Native , ppm	1.269	1.360	1.350	1.040
	Post Spike Native , ppm	1.224	1.031	1.250	1.017
Cn	Average Native , ppm	1.156	1.121	1.239	0.998
	Spike Recovery	**85.1%**	**83.8%**	**82.1%**	**83.3%**
	CTS Direct (CC426155)				
	Ethylene Expected (ppm)	75.47			75.48
	Ethylene Measured (ppm)	73.98			73.58
	CTS Error	**-2.0%**			**-2.5%**

Holcim; Joppa IL
Main Stack
Pre Run 1 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__005786.LAB	12/08/23	13:02:24.475	1.140	0.005	0.002
SPC__005787.LAB	12/08/23	13:03:28.131	1.051	-0.016	0.002
SPC__005788.LAB	12/08/23	13:04:32.138	1.070	-0.007	0.004
SPC__005789.LAB	12/08/23	13:05:35.986	1.060	-0.016	0.004
SPC__005790.LAB	12/08/23	13:06:40.264	3.358	-0.016	0.298
SPC__005791.LAB	12/08/23	13:07:43.809	4.817	-0.018	0.436
SPC__005792.LAB	12/08/23	13:08:47.774	4.681	-0.028	0.420
SPC__005793.LAB	12/08/23	13:09:51.719	5.322	-0.014	0.510
SPC__005794.LAB	12/08/23	13:10:55.560	0.323	-0.015	-0.000
SPC__005795.LAB	12/08/23	13:11:59.384	0.106	-0.024	0.001
SPC__005796.LAB	12/08/23	13:13:03.301	0.639	-0.007	0.001
SPC__005797.LAB	12/08/23	13:14:07.208	1.334	-0.014	0.003
SPC__005798.LAB	12/08/23	13:15:11.111	1.269	-0.016	0.004
SPC__005799.LAB	12/08/23	13:16:15.021	1.224	-0.017	0.002
SPC__005800.LAB	12/08/23	13:17:18.999	0.856	0.001	0.004
SPC__005801.LAB	12/08/23	13:18:22.846	1.199	-0.001	0.006

Holcim; Joppa IL
Main Stack
Post Run 1 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__005861.LAB	12/08/23	14:22:17.244	1.095	-0.039	0.003
SPC__005862.LAB	12/08/23	14:23:21.153	1.082	-0.041	0.004
SPC__005863.LAB	12/08/23	14:24:25.098	1.011	-0.037	0.003
SPC__005864.LAB	12/08/23	14:25:29.003	3.739	-0.043	0.334
SPC__005865.LAB	12/08/23	14:26:32.872	4.984	-0.029	0.494
SPC__005866.LAB	12/08/23	14:27:36.769	4.893	-0.047	0.462
SPC__005867.LAB	12/08/23	14:28:40.667	4.536	-0.036	0.419
SPC__005868.LAB	12/08/23	14:29:44.577	4.147	-0.046	0.359
SPC__005869.LAB	12/08/23	14:30:48.465	5.530	-0.038	0.519
SPC__005870.LAB	12/08/23	14:31:52.748	0.436	-0.009	0.001
SPC__005871.LAB	12/08/23	14:32:56.319	0.278	-0.032	-0.005
SPC__005872.LAB	12/08/23	14:34:00.191	0.225	-0.036	0.003
SPC__005873.LAB	12/08/23	14:35:04.113	0.851	-0.021	0.006
SPC__005874.LAB	12/08/23	14:36:08.107	0.891	-0.019	0.005
SPC__005875.LAB	12/08/23	14:37:12.363	0.920	-0.033	0.007
SPC__005876.LAB	12/08/23	14:38:15.822	0.880	-0.029	0.005
SPC__005877.LAB	12/08/23	14:39:19.733	0.847	-0.027	0.004
SPC__005878.LAB	12/08/23	14:40:23.634	0.933	-0.035	0.003
SPC__005879.LAB	12/08/23	14:41:27.536	1.360	-0.009	0.002
SPC__005880.LAB	12/08/23	14:42:31.521	1.031	-0.033	0.004

Holcim; Joppa IL
Main Stack
Post Run 2 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__005946.LAB	12/08/23	15:53:39.651	1.289	-0.035	0.002
SPC__005947.LAB	12/08/23	15:54:43.594	1.056	-0.018	0.007
SPC__005948.LAB	12/08/23	15:55:47.830	1.194	-0.021	0.005
SPC__005949.LAB	12/08/23	15:56:51.320	1.163	-0.019	0.005
SPC__005950.LAB	12/08/23	15:57:55.340	1.327	-0.024	0.007
SPC__005951.LAB	12/08/23	15:58:59.126	1.360	-0.009	0.005
SPC__005952.LAB	12/08/23	16:00:03.375	1.142	-0.016	0.042
SPC__005953.LAB	12/08/23	16:01:06.937	3.791	-0.025	0.379
SPC__005954.LAB	12/08/23	16:02:10.926	4.174	-0.036	0.363
SPC__005955.LAB	12/08/23	16:03:14.786	4.067	-0.027	0.350
SPC__005956.LAB	12/08/23	16:04:18.695	3.970	-0.034	0.563
SPC__005957.LAB	12/08/23	16:05:22.691	4.547	-0.014	0.090
SPC__005958.LAB	12/08/23	16:06:26.577	0.190	-0.024	-0.003
SPC__005959.LAB	12/08/23	16:07:30.367	0.173	-0.029	0.007
SPC__005960.LAB	12/08/23	16:08:34.265	0.097	-0.010	0.006
SPC__005961.LAB	12/08/23	16:09:38.171	0.740	-0.030	0.008
SPC__005962.LAB	12/08/23	16:10:42.086	1.350	-0.029	0.006
SPC__005963.LAB	12/08/23	16:11:46.332	1.250	-0.016	0.004

Holcim; Joppa IL
Main Stack
Post Run 3 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__006042.LAB	12/08/23	17:36:46.822	0.880	-0.057	0.003
SPC__006043.LAB	12/08/23	17:37:50.809	0.927	-0.077	-0.002
SPC__006044.LAB	12/08/23	17:38:54.593	1.007	-0.040	0.001
SPC__006045.LAB	12/08/23	17:39:58.496	1.279	-0.033	0.007
SPC__006046.LAB	12/08/23	17:41:02.429	3.683	-0.034	0.385
SPC__006047.LAB	12/08/23	17:42:06.379	5.037	-0.037	0.496
SPC__006048.LAB	12/08/23	17:43:10.266	4.584	-0.015	0.451
SPC__006049.LAB	12/08/23	17:44:14.172	4.263	-0.025	0.372
SPC__006050.LAB	12/08/23	17:45:17.996	3.960	-0.022	0.326
SPC__006051.LAB	12/08/23	17:46:21.884	3.463	-0.016	0.332
SPC__006052.LAB	12/08/23	17:47:25.824	0.267	-0.018	0.001
SPC__006053.LAB	12/08/23	17:48:29.694	0.503	-0.038	0.007
SPC__006054.LAB	12/08/23	17:49:33.582	0.259	-0.020	-0.005
SPC__006055.LAB	12/08/23	17:50:37.524	0.274	-0.028	0.000
SPC__006056.LAB	12/08/23	17:51:41.765	0.430	-0.023	-0.009
SPC__006057.LAB	12/08/23	17:52:45.321	1.040	-0.034	0.006
SPC__006058.LAB	12/08/23	17:53:49.607	1.017	-0.023	0.008
SPC__006059.LAB	12/08/23	17:54:53.091	0.295	-0.035	-0.004

Holcim; Joppa IL
Main Stack
·ı Post Run 3 CTS

Spectrum	Date	Time	Ethylene (100,3000) 191C
SPC__006070.LAB	12/08/23	18:48:00.467	0.054
SPC__006071.LAB	12/08/23	18:49:04.302	17.648
SPC__006072.LAB	12/08/23	18:50:08.433	73.478
SPC__006073.LAB	12/08/23	18:51:12.043	73.589
SPC__006074.LAB	12/08/23	18:52:16.007	73.481
SPC__006075.LAB	12/08/23	18:53:19.861	73.602
SPC__006076.LAB	12/08/23	18:54:23.836	73.579
SPC__006077.LAB	12/08/23	18:55:27.637	73.606
SPC__006078.LAB	12/08/23	18:56:31.537	73.584
SPC__006079.LAB	12/08/23	18:57:35.574	73.331
SPC__006080.LAB	12/08/23	18:58:39.363	73.689
SPC__006081.LAB	12/08/23	18:59:43.260	73.523
SPC__006082.LAB	12/08/23	19:00:47.259	73.586
SPC__006083.LAB	12/08/23	19:01:51.082	73.577
	CTS Average		**73.581**

Holcim; Joppa IL
Main Stack
Main CTS and HCN Direct

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C	Ethylene (100,3000) 191C
SPC__005689.LAB	12/08/23	11:05:58.044	-0.086	0.020	0.001	-0.028
SPC__005690.LAB	12/08/23	11:07:01.911	-0.130	-0.015	-0.000	-0.051
SPC__005691.LAB	12/08/23	11:08:05.826	-0.131	-0.013	0.002	-0.103
SPC__005692.LAB	12/08/23	11:09:09.731	-0.170	0.015	0.002	-0.031
SPC__005693.LAB	12/08/23	11:10:13.643	-0.184	-0.006	0.002	-0.098
SPC__005694.LAB	12/08/23	11:11:17.755	-0.206	-0.010	0.002	-0.030
SPC__005695.LAB	12/08/23	11:12:21.576	-0.037	-0.010	0.000	-0.048
SPC__005696.LAB	12/08/23	11:13:25.458	-0.131	0.023	0.000	-0.090
SPC__005697.LAB	12/08/23	11:14:29.287	-0.132	0.010	-0.000	-0.071
SPC__005698.LAB	12/08/23	11:15:33.185	-0.125	-0.002	0.003	-0.113
SPC__005699.LAB	12/08/23	11:16:37.089	-0.015	-0.013	0.003	-0.034
SPC__005700.LAB	12/08/23	11:17:41.004	-0.090	0.004	0.001	-0.097
SPC__005701.LAB	12/08/23	11:18:45.022	-0.095	-0.021	0.001	-0.065
SPC__005702BKG.LAB	12/08/23	11:21:29.677	0.000	0.000	0.000	0.000
SPC__005703.LAB	12/08/23	11:22:40.225	0.063	0.010	-0.004	0.043
SPC__005704BKG.LAB	12/08/23	11:25:20.358	0.000	0.000	0.000	0.000
SPC__005705.LAB	12/08/23	11:26:30.766	0.004	-0.006	-0.000	0.024
SPC__005706BKG.LAB	12/08/23	11:29:01.678	0.000	0.000	0.000	0.000
SPC__005707.LAB	12/08/23	11:30:12.079	0.012	-0.011	-0.001	-0.070
SPC__005708BKG.LAB	12/08/23	11:32:39.752	0.000	0.000	0.000	0.000
SPC__005709.LAB	12/08/23	11:33:50.177	0.028	0.011	0.000	0.061
SPC__005710.LAB	12/08/23	11:34:54.099	-0.370	-0.014	0.004	0.022
SPC__005711.LAB	12/08/23	11:35:58.040	0.163	0.015	0.001	0.055
SPC__005712.LAB	12/08/23	11:37:01.914	0.033	-0.031	-0.001	0.035
SPC__005713.LAB	12/08/23	11:38:05.964	-0.063	-0.002	-0.001	0.031
SPC__005714.LAB	12/08/23	11:39:09.734	-0.098	-0.010	0.002	0.042
SPC__005715.LAB	12/08/23	11:40:13.646	-0.083	-0.005	0.003	0.065
SPC__005716.LAB	12/08/23	11:41:17.654	0.050	0.001	-0.002	0.077
SPC__005717.LAB	12/08/23	11:42:21.505	-0.227	0.001	-0.015	46.568
SPC__005718.LAB	12/08/23	11:43:25.406	-0.369	-0.014	-0.007	73.941
SPC__005719.LAB	12/08/23	11:44:29.327	-0.317	0.014	-0.011	74.021
	CTS Average					**73.981**
SPC__005720.LAB	12/08/23	11:45:33.193	6.116	0.006	0.639	61.081
SPC__005721.LAB	12/08/23	11:46:37.101	41.476	0.012	4.224	8.189
SPC__005722.LAB	12/08/23	11:47:41.000	42.551	-0.007	4.236	8.559
SPC__005723.LAB	12/08/23	11:48:45.289	42.785	0.004	4.235	8.563
SPC__005724.LAB	12/08/23	11:49:48.860	42.688	-0.022	4.230	8.525
SPC__005725.LAB	12/08/23	11:50:52.732	48.037	-0.001	4.804	0.098
SPC__005726.LAB	12/08/23	11:51:56.642	48.701	-0.010	4.847	-0.637
SPC__005727.LAB	12/08/23	11:53:00.562	49.238	-0.007	4.855	-0.518
SPC__005728.LAB	12/08/23	11:54:04.533	49.308	-0.004	4.848	-0.596
SPC__005729.LAB	12/08/23	11:55:08.431	49.133	-0.007	4.852	-0.616
	HCN/SF6 Spike Average:		**49.226**		**4.850**	

Appendix C

Ion Chromatography Analytical Report Data

Deeco, Inc.

3404 Lake Woodard Drive
Raleigh, NC 27604

Project No: 23-3318
Holcim Joppa

Hydrogen Fluoride & Chlorine

EPA Method 26A Analysis

Analytical Report
41759

el1

Element One, Inc.
6319-D Carolina Beach Rd., Wilmington, NC 28412
910-793-0128 FAX: 910-792-6853 e1lab@e1lab.com

The following data for Analytical Report 41759
has been reviewed for completeness, accuracy,
adherence to method protocol,
and compliance with quality assurance guidelines.

Review by:

Katie Gattis, Quality Assurance Officer
January 8, 2024

Report Reviewed and Finalized by:

Ken Smith, Laboratory Director
January 8, 2024

SUMMARY OF RESULTS

Summary of Analysis

Summary of Method 26A Analysis

Element	Joppa-M26A-R1A e41759-1 Total mg	Joppa-M26A-R2A e41759-2 Total mg	Joppa-M26A-R3A e41759-3 Total mg
HF	< 0.23	< 0.251	< 0.241
Cl_2	< 0.181	< 0.202	< 0.168

Element	Joppa-M26A-R1B e41759-4 Total mg	Joppa-M26A-R2B e41759-5 Total mg	Joppa-M26A-R3B e41759-6 Total mg
HF	< 0.227	< 0.26	< 0.248
Cl_2	< 0.178	< 0.17	< 0.176

Element	Joppa-M26A-FBOFF e41759-7 Total mg
HF	< 0.189
Cl_2	< 0.152

ANALYTICAL NARRATIVE

Element One Analytical Narrative

Client:	Deeco, Inc.	Element One #:	41759
Client ID:	23-3318 Holcim Joppa	Analyst:	LAW
Method:	M26A	Dates Received:	12.18.23
Analytes:	HF, Cl_2	Dates Analyzed:	12.28.23-01.04.24

Summary of Analysis

The samples were prepared and analyzed according to Method 26A protocol. The samples were analyzed for fluoride and chloride on Metrohm 861/788 and 881/858 ion chromatograph systems.

Detection Limits

The Metrohm reporting limit was 0.1 µg/mL for fluoride and chloride.

Analysis QA/QC

Duplicate analyses relative percent difference (RPD), spike recovery and second source verification data are summarized in the Quality Control section. All QA/QC data was within the criteria of the method.

Additional Comments

The reported results have not been corrected for any blank values or spike recovery values. Due to the sample matrix, it was necessary to analyze all samples at a minimum five-fold dilution to reduce interferences and to preserve the anion column. The reported results relate only to the items tested or calibrated.

QUALITY CONTROL SUMMARY

Summary of Quality Control Data

Summary of Method 26A Duplicate Analysis RPD

(Method 26A QC limits: <5% for RPD)

Element	Joppa-M26A-R1A RPD	Joppa-M26A-R2A RPD	Joppa-M26A-R3A RPD
HF	NA	NA	NA
Cl_2	NA	NA	NA

Element	Joppa-M26A-R1B RPD	Joppa-M26A-R2B RPD	Joppa-M26A-R3B RPD
HF	NA	NA	NA
Cl_2	NA	NA	NA

Element	Joppa-M26A-FBOFF RPD
HF	NA
Cl_2	NA

Summary of Method 26A Spike Recoveries

(Method 26A QC limits: 90-110% for Spike Recoveries)

Element	Joppa-M26A-R3A Recovery	Joppa-M26A-R3B Recovery
HF	104%	107%
Cl_2	100%	102%

Second Source Calibration Verification

*(*Laboratory QC limits: 90-110%)*

Element	DL 0.1mg/L Recovery	*QC 5.0mg/L Recovery
HF	110%	101%
Cl_2	92%	98%

SAMPLE CUSTODY

41759

Date:	12/15/23
Lab:	Element One
Train:	EPA Method 26A

DEECO, Inc
3404 Lake Woodard Dr.
Raleigh, NC 27604
919-250-0285

Plant Name: Holcim

Plant Location: Joppa IL

Project Name: 23-3318

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Comments
[signature]	12/18/23	[signature]	12.18.23	

Field Sample No.	Date	Composite or Grab	Analysis Required	Sampling Train	Sample Description	Special Notes	Lab
Joppa-1A-H_2SO_4	12/08/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H_2SO_4 and DI Rinses	Final Volume 437.6 mL	Element One
Joppa-1A-NaOH	12/08/23	Comp.	Chloride ion as Chlorine (Cl_2)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 361.7 mL **Sodium thiosulfate NOT ADDED!**	Element One
Joppa-1B-H_2SO_4	12/08/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H_2SO_4 and DI Rinses	Final Volume 430.6 mL	Element One
Joppa-1B-NaOH	12/08/23	Comp.	Chloride ion as Chlorine (Cl_2)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 355.4 mL **Sodium thiosulfate NOT ADDED!**	Element One
Joppa-2A-H_2SO_4	12/08/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H_2SO_4 and DI Rinses	Final Volume 477.3 mL	Element One
Joppa-2A-NaOH	12/08/23	Comp.	Chloride ion as Chlorine (Cl_2)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 404.1 mL **Sodium thiosulfate NOT ADDED!**	Element One
Joppa-2B-H_2SO_4	12/08/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H_2SO_4 and DI Rinses	Final Volume 493.1 mL	Element One
Joppa-2B-NaOH	12/08/23	Comp.	Chloride ion as Chlorine (Cl_2)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 340.8 mL **Sodium thiosulfate NOT ADDED!**	Element One

Samples received in good condition in Env. Express containers. No empty container.

41759

DEECO, Inc

3404 Lake Woodard Dr.
Raleigh, NC 27604
919-250-0285

Date:	12/15/23
Lab:	Element One
Train:	EPA Method 26A

Plant Name: Holcim

Plant Location: Joppa IL

Project Name: 23-3318

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Comments
	12/18/23		12.18.23	
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Comments
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Comments

Field Sample No.	Date	Composite or Grab	Analysis Required	Sampling Train	Sample Description	Special Notes	Lab
Joppa-3A-H_2SO_4	12/08/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H_2SO_4 and DI Rinses	Final Volume 458.7 mL	Element One
Joppa-3A-NaOH	12/08/23	Comp.	Chloride ion as Chlorine (Cl_2)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 335.7 mL **Sodium thiosulfate NOT ADDED!**	Element One
Joppa-3B-H_2SO_4	12/08/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H_2SO_4 and DI Rinses	Final Volume 471.3 mL	Element One
Joppa-3B-NaOH	12/08/23	Comp.	Chloride ion as Chlorine (Cl_2)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 352.9 mL **Sodium thiosulfate NOT ADDED!**	Element One
Joppa-FBOFF-H_2SO_4	12/08/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H_2SO_4 and DI Rinses	Final Volume 359.5 mL	Element One
Joppa-FBOFF-NaOH	12/08/23	Comp.	Chloride ion as Chlorine (Cl_2)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 304.2 mL **Sodium thiosulfate NOT ADDED!**	Element One

ANALYTICAL DATA

Analytical Calculations

HF -

$$\text{Total HX (mg)} = \frac{[\text{X Results } (\mu g/mL) * \text{Dilution} * \text{Beginning Vol (mL)}]}{1000} * \text{Correction Factor}$$

Where-

X Results= Raw sample concentration (ppm) — *IC Data Sheet*

$$\text{Dilution} = \frac{\text{Diluted Volume}}{\text{Aliquot}}$$ —*IC Run Sheet*

Beginning Volume--*Sample Submission*

1.053= Correction factor for hydrogen fluoride

Cl_2 -

$$\text{Total } X_2 \text{ (mg)} = \frac{\text{X Results } (\mu g/mL) * \text{Dilution} * \text{Beginning Volume (mL)}}{1000}$$

Where-

X Results= Raw sample concentration (ppm)—*Cl_2 IC Data Sheet*

$$\text{Dilution} = \frac{\text{Diluted Volume}}{\text{Aliquot}}$$ —*IC Run Sheet*

Beginning Volume--*Sample Submission*

Analytical Calculations

Spike Recovery-

$$\textbf{Spike (\%)} = \frac{\textbf{(Spiked Result (µg/mL) – Sample Result (µg/mL))}}{\textbf{Spike Amount (µg/mL)}} \quad \textbf{X100}$$

Where-

Spike Result = Raw sample concentration (ppm)--*IC-Data Sheet*

Sample Result = Raw sample concentration (ppm)--*IC-Data Sheet*

Spike Amount—*IC-Data Sheet*

Duplicate Analysis RPD-

$$\textbf{RPD (\%)} = \frac{\textbf{(Duplicate Result (µg/mL) - Sample Result (µg/mL))}}{\textbf{Average (µg/mL)}} \quad \textbf{X100}$$

Where-

Sample Result and Duplicate Results=Raw sample concentration (ppm)--*IC-Data Sheet*

Average= $\frac{\textit{(Duplicate + Sample Results)}}{2}$

elementOne **AIR TESTING SAMPLE SUBMISSION FORM** **Lab ID 41759**

Out of Hold 01.05.24

Analysis Due Date 12.29.23
QA/QC/Report Due Date 01.03.24

Date Rec	12.18.23
Time Rec	1100

Client:	Deeco, Inc.
Project No	23-3318

Volume Marked		Volume Loss			FH pH < 2		BH pH > 8		Ref. Method:
Y	N	Y	N	?	Y	N	Y	N	26A

Volumes on COC LLW 01.04.24

Sample Identification

1	Joppa-M26A-R1A	4	Joppa-M26A-R1B	7	Joppa-M26A-FBOFF
2	Joppa-M26A-R2A	5	Joppa-M26A-R2B		
3	Joppa-M26A-R3A	6	Joppa-M26A-R3B		
	Joppa-M26A-R3A Spike		Joppa-M26A-R3B Spike		

Analyses Requested	Samples 1-7	HF
	Samples 1-7	Cl_2

Runs/FB

	FH Impinger 1 (or Combined Imp)		FH Impinger 2		FH Impinger 3		BH Impinger 4 (or Combined Imp)		BH Impinger 5	
Lab ID	BV, ml	FV, ml	BV, ml	FV, ml	BV, ml	FV, ml	BV, ml	FV, ml	BV, ml	FV, ml
1		439.6						361.7		
2		477.3						404.1		
3.S		458.7						335.7		
4		430.6						355.4		
5		493.1						340.8		
6.S		471.3						352.9		
7		359.5						304.2		

Lab Communications

Rec Runs/FB: H2SO4; NaOH; No RB received---12.18.23 LLB

SS Page 1 of 1
SS by ___
12/19/2023 10:18:04 AM

Imp 1, 2, &3 Prep By / Date 01.03.24 LLW
Imp 4 & 5 Prep By / Date 12.28.23 LLW
Labeled By/Date PDR 12.19.23
ID Verification By/Date mmo 12.19.23

elementOne **M26A-HF IC Data Sheet** **Lab ID #: 41759**

Client: Deeco
Date: 01.08.24
Analyst: LAW
Detection Limit, (µg/ml): 0.10

Column: IonPac AS14A
Eluent: 8.0 mM Na_2CO_3/ 1.0 mM $NaHCO_3$
Flow Rate: 1.0 mL/min.
F^- to HF factor: 1.053

Sample ID	F^- µg/ml	Dilution	Final Vol, ml	HF, Total mg	Spike, µg/ml	% Recovery/ RPD	File Name	Date Time
LRB	0.000	1	10	< 0.001			_2024-01-03_	1/3/2024 18:12
LRB	0.000	1	10	< 0.001		NA	_2024-01-03_	1/3/2024 18:31
LRB SPK	5.076	1	10	0.053	5.00	102%	_2024-01-03_	1/3/2024 18:50
LRB SPK	5.069	1	10	0.053	5.00	101%	_2024-01-03_	1/3/2024 19:09
41759-1	0.000	5	437.6	< 0.23			_2024-01-04_	1/4/2024 7:19
41759-1 DUP	0.000	5	437.6	< 0.23		NA	_2024-01-04_	1/4/2024 7:38
41759-2	0.000	5	477.3	< 0.251			_2024-01-04_	1/4/2024 7:57
41759-2 DUP	0.000	5	477.3	< 0.251		NA	_2024-01-04_	1/4/2024 8:16
41759-3	0.000	5	458.7	< 0.241			_2024-01-04_	1/4/2024 8:34
41759-3 DUP	0.000	5	458.7	< 0.241		NA	_2024-01-04_	1/4/2024 8:53
41759-3 SPK	5.350	5	458.7	12.9	5.00	107%	_2024-01-04_	1/4/2024 9:12
41759-3 SPK DUP	5.045	5	458.7	12.2	5.00	101%	_2024-01-04_	1/4/2024 9:31
41759-4	0.000	5	430.6	< 0.227			_2024-01-04_	1/4/2024 9:49
41759-4 DUP	0.000	5	430.6	< 0.227		NA	_2024-01-04_	1/4/2024 10:08
41759-5	0.000	5	493.1	< 0.26			_2024-01-04_	1/4/2024 11:42
41759-5 DUP	0.000	5	493.1	< 0.26		NA	_2024-01-04_	1/4/2024 12:00
41759-6	0.000	5	471.3	< 0.248			_2024-01-04_	1/4/2024 12:19
41759-6 DUP	0.000	5	471.3	< 0.248		NA	_2024-01-04_	1/4/2024 12:38
41759-6 SPK	5.394	5	471.3	13.4	5.00	108%	_2024-01-04_	1/4/2024 12:57
41759-6 SPK DUP	5.289	5	471.3	13.1	5.00	106%	_2024-01-04_	1/4/2024 13:15
41759-7 FB	0.000	5	359.5	< 0.189			_2024-01-04_	1/4/2024 13:34
41759-7 FB DUP	0.000	5	359.5	< 0.189		NA	_2024-01-04_	1/4/2024 13:53

Linda Ann Webb

elementOne **M26A-HF IC Data Sheet** **Lab ID #: 41759**

Client: Deeco
Date: 01.08.24
Analyst: LAW
Detection Limit, (µg/ml): 0.10

Column: IonPac AS14A
Eluent: 8.0 mM Na_2CO_3/ 1.0 mM $NaHCO_3$
Flow Rate: 1.0 mL/min.
F^- to HF factor: 1.053

Standards	F^- µg/ml	Dilution	QC, µg/ml	% Relative Error	% Recovery	File Name	Date Time
0	0.000					_2024-01-03_	1/3/2024 14:28
0.1	0.099			-1.0%	99%	_2024-01-03_	1/3/2024 14:46
1	1.000			0.0%	100%	_2024-01-03_	1/3/2024 15:05
3	3.104			3.5%	103%	_2024-01-03_	1/3/2024 15:24
5	4.970			-0.6%	99%	_2024-01-03_	1/3/2024 15:43
10	9.927			-0.7%	99%	_2024-01-03_	1/3/2024 16:01
0.1	0.109			9.0%	109%	_2024-01-04_	1/4/2024 15:45
1	0.985			-1.5%	99%	_2024-01-04_	1/4/2024 16:04
3	3.077			2.6%	103%	_2024-01-04_	1/4/2024 16:23
5	5.076			1.5%	102%	_2024-01-04_	1/4/2024 16:41
10	10.331			3.3%	103%	_2024-01-04_	1/4/2024 17:00
Correlation-	0.9997						
QC	5.052		5.00		101%	_2024-01-03_	1/3/2024 16:20
QC	5.001		5.00		100%	_2024-01-03_	1/3/2024 16:39
QC	5.204		5.00		104%	_2024-01-03_	1/3/2024 21:20
QC	5.120		5.00		102%	_2024-01-03_	1/3/2024 21:39
QC	5.486		5.00		110%	_2024-01-04_	1/4/2024 1:42
QC	5.080		5.00		102%	_2024-01-04_	1/4/2024 2:01
QC	5.403		5.00		108%	_2024-01-04_	1/4/2024 6:05
QC	4.540		5.00		91%	_2024-01-04_	1/4/2024 6:23
QC	5.209		5.00		104%	_2024-01-04_	1/4/2024 10:27
QC	5.174		5.00		103%	_2024-01-04_	1/4/2024 10:46
QC	5.152		5.00		103%	_2024-01-04_	1/4/2024 14:49
QC	5.257		5.00		105%	_2024-01-04_	1/4/2024 17:19
DL	0.110		0.10		110%	_2024-01-03_	1/3/2024 17:35
DL	0.110		0.10		110%	_2024-01-03_	1/3/2024 17:54
DL	0.109		0.10		109%	_2024-01-04_	1/4/2024 15:08
DL	0.110		0.10		110%	_2024-01-04_	1/4/2024 17:38
36738-5 QC	6.746	1	6.96		102%	_2024-01-04_	1/4/2024 14:12
36738-5 QC DUP	6.817	1	6.96		103%	_2024-01-04_	1/4/2024 14:30
BLK	0.000					_2024-01-03_	1/3/2024 16:58
BLK	0.000					_2024-01-03_	1/3/2024 17:16
BLK	0.000					_2024-01-03_	1/3/2024 21:57
BLK	0.000					_2024-01-03_	1/3/2024 22:16
BLK	0.086					_2024-01-04_	1/4/2024 2:20
BLK	0.000					_2024-01-04_	1/4/2024 2:38
BLK	0.114					_2024-01-04_	1/4/2024 6:42
BLK	0.000					_2024-01-04_	1/4/2024 7:01
BLK	0.000					_2024-01-04_	1/4/2024 11:04
BLK	0.000					_2024-01-04_	1/4/2024 11:23
BLK	0.000					_2024-01-04_	1/4/2024 15:27
BLK	0.000					_2024-01-04_	1/4/2024 17:56

elementOne

IC Sample Sheet/Digestion Worksheet

Lab ID #: 41751 41753 41759

Date: 1.3.24
Analyst: LNW
Batch name: 010324-41751

Column: IonPac AS14A
Conc. Eluent: 8.0 mM Na_2CO_3/ 1.0mM $NaHCO_3$
10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
Regenerant: 100 mM H_3PO_4
Flow Rate: 1.0 mL/min.

Instrument: 8011786
Lot# IC11-99-3
Lot # IC11-108-3
Method: 300/26A

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
1	0.0			QC	MANF	R^2	
2	0.1		F-	RBC010594	Samarkkich	0.9997	
3	1.0		Cl-	4308559	RICCA	0.9990	
4	3.0						
5	5.0						
6	10.0						
7	QC						
8	QC						
9	BLK						
10	BLK						
11	DL						
12	DL						
13	LRB						
14	LRB						
15	LRB+						
16	LRB+						
17	41751-1		HCl		—	5X	
18	-1d				—		
19	-3				—		
20	-3d				—		
21	-3+				5.049		
22	-3+d				5.085		
23	QC						
24	QC						
25	BLK						

Manual integrations noted by M
Curve IC Lot # IC11-109-2 Comments: pg 1 of 4
Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: **IC ME Solution** 2308029-250 HPS **IC NO2 Solution** 2308942-250 HPS
QC: Spike 50 uL from 1000 ug/mL F, Cl, Br, and SO_4 Std. to 10mL sample; lot #'s listied above.
QC: Spike 20 uL from 1000 ug/mL NO_2, NO_3, and PO_4 Std. to 10mL sample; lot #'s listed above.
Submitted for QC- Date:_____ Time:_____ By:_____ QC Review- Date:_____ Time:_____ By:_____

elementOne

IC Sample Sheet/Digestion Worksheet

Lab ID #: 41751 41753 41759

Date: 01.03.24
Analyst: ws
Batch name: 010324-41751

Column: IonPac AS14A
Conc. Eluent: 8.0 mM Na_2CO_3/ 1.0mM $NaHCO_3$
10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
Regenerant: 100 mM H_3PO_4
Flow Rate: 1.0 mL/min.

Instrument: 861/788
Lot# ICII-99-3
Lot # ICII-108-3
Method: 300/26A

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
26	BLK						
27	41751-2		HCl		—	5x	
28	-2d		↓		—	↓	
29	-4				—		
30	-4d				—		
31	-5				—		
32	-5d				—		
33	-6				—		
34	-6d				—		
35	-6t				5.022		
36	-6td		↓		4.784	↓	
37	QC						
38	QC						
39	BLK						
40	BLK						
41	41751-7 H_2SO_4		HCl		—	5x	
42	-7d H_2SO_4		↓		—	↓	
43	41753-1		HCl		3.489	20x	
44	-1d		↓		3.488	↓	
45	-2				3.458		
46	-2d				3.463		
47	-2t				8.491		
48	-2td				8.143	↓	
49	-3 Blk				—	5x	
50	-3d Blk		↓		—	↓	

Manual Integrations noted by M
Curve IC Lot #______ Comments: pg 2 of 4
Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: **IC ME Solution** ______ **IC NO2 Solution** ______
QC: Spike 50 uL from 1000 ug/mL F, Cl, Br, and SO_4 Std. to 10mL sample; lot #'s listied above.
QC: Spike 20 uL from 1000 ug/mL NO_2, NO_3, and PO_4 Std. to 10mL sample; lot #'s listed above.
Submitted for QC- Date:____ Time:____ By:____ QC Review- Date:____ Time:____ By:____

elementOne

IC Sample Sheet/Digestion Worksheet

Lab ID #: 41751 41753 41759

Date: 01.03.24
Analyst: LW
Batch name: 010324-41751

Column: IonPac AS14A
Conc. Eluent: 8.0 mM Na_2CO_3/ 1.0mM $NaHCO_3$
10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
Regenerant: 100 mM H_3PO_4
Flow Rate: 1.0 mL/min.

Instrument: 8017788
Lot# K11-99-3
Lot # 1C11-108-3
Method: 300/26A

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
51	QC						
52	QC						
53	BLK						
54	BLK						
55	41759-1		~~HCl~~ HF		—	5x	
56	-1d				—		
57	-2				—		
58	-2d				—		
59	-3				—		
60	-3d				—		
61	-3+				5.350		
62	-3+d				5.045		
63	-4				—		
64	-4d				—		
65	QC						
66	QC						
67	BLK						
68	BLK						
69	41759-5		HF		—	5x	
70	-5d				—		
71	-6				—		
72	-6d				—		
73	-6+				5.394		
74	-6+d				5.289		
75	-7 FB				—		

Manual integrations noted by M
Curve IC Lot #________ Comments: pg 3 of 4
Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: **IC ME Solution** ________ **IC NO2 Solution** ________
QC: Spike 50 uL from 1000 ug/mL F, Cl, Br, and SO_4 Std. to 10mL sample; lot #'s listied above.
QC: Spike 20 uL from 1000 ug/mL NO_2/ NO_3/ and PO_4 Std. to 10mL sample; lot #'s listed above.
Submitted for QC- Date:______ Time:______ By:______ QC Review- Date:______ Time:______ By:______

elementOne **IC Sample Sheet/Digestion Worksheet** **Lab ID #:** 41751 41753 41759

Date: 01.03.24
Analyst: LWJ
Batch name: 010324-41751

Column: IonPac AS14A
Conc. Eluent: 8.0 mM Na_2CO_3/ 1.0mM $NaHCO_3$
10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
Regenerant: 100 mM H_3PO_4
Flow Rate: 1.0 mL/min.

Instrument: 801/788
Lot# IC111-99-3
Lot # IC11-108-3
Method: 300/26A

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
76	41759-7d FB		HF			5x	
77	367378-5 QC		HF HCl	F 6.246	Cl 5.635	↓	
78	-5 QC		↓	6.817	5.663	1x	TV HCl = 5.52
79	QC					↓	TV HF = 6.96
80	DL						
81	BLK						
82	0.1						
83	1.0						
84	3.0						
85	5.0						
86	10.0						
87	QC						
88	DL						
89	BLK						

Manual integrations noted by M
Curve IC Lot #__________ Comments: pg 1 of 4
Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: **IC ME Solution** __________ **IC NO2 Solution** __________
QC: Spike 50 uL from 1000 ug/mL F, Cl, Br, and SO_4 Std. to 10mL sample; lot #'s listied above.
QC: Spike 20 uL from 1000 ug/mL NO_2, NO_3, and PO_4 Std. to 10mL sample; lot #'s listed above.
Submitted for QC- Date:______ Time:______ By:______ QC Review- Date:______ Time:______ By:______

Metrohm 881/858 Ion Chromatograph System

elementOne **M26A-Cl_2 IC Data Sheet** **Lab ID #: 41759**

Client: Deeco
Date: 01.03.24
Analyst: LAW
Detection Limit, (µg/ml): 0.10

Column: IonPac AS14A
Eluent: 8.0 mM Na_2CO_3/ 1.0 mM $NaHCO_3$
Flow Rate: 1.0 mL/min.
1.000

Sample ID	Cl^- µg/ml	Dilution	Final Vol, ml	Cl_2, Total mg	Spike, µg/ml	% RPD/ Recovery	File Name	Date Time
LRB	0.019	1	10	< 0.001			4c485cef:18cab84278c:-74a8	12/28/2023 17:14
LRB	0.018	1	10	< 0.001		NA	4c485cef:18cab84278c:-74a6	12/28/2023 17:38
LRB SPK	5.243	1	10	0.052	5.00	104%	4c485cef:18cab84278c:-74a4	12/28/2023 18:01
LRB SPK	5.244	1	10	0.052	5.00	105%	4c485cef:18cab84278c:-74a2	12/28/2023 18:25
41759-1	0.058	5	361.7	< 0.181			4c485cef:18cab84278c:-7470	12/29/2023 4:12
41759-1 DUP	0.044	5	361.7	< 0.181		NA	4c485cef:18cab84278c:-746e	12/29/2023 4:36
41759-2	0.000	5	404.1	< 0.202			4c485cef:18cab84278c:-746c	12/29/2023 4:59
41759-2 DUP	0.046	5	404.1	< 0.202		NA	4c485cef:18cab84278c:-746a	12/29/2023 5:23
41759-3	0.000	5	335.7	< 0.168			4c485cef:18cab84278c:-7468	12/29/2023 5:46
41759-3 DUP	0.050	5	335.7	< 0.168		NA	4c485cef:18cab84278c:-7466	12/29/2023 6:10
41759-3 SPK	5.073	5	335.7	8.52	5.00	100%	4c485cef:18cab84278c:-7464	12/29/2023 6:33
41759-3 SPK DUP	5.039	5	335.7	8.46	5.00	100%	4c485cef:18cab84278c:-7462	12/29/2023 6:57
41759-4	0.063	5	355.4	< 0.178			4c485cef:18cab84278c:-7460	12/29/2023 7:20
41759-4 DUP	0.061	5	355.4	< 0.178		NA	4c485cef:18cab84278c:-7421	12/29/2023 7:44
41759-5	0.016	5	340.8	< 0.17			4c485cef:18cab84278c:-729a	12/29/2023 9:41
41759-5 DUP	0.045	5	340.8	< 0.17		NA	4c485cef:18cab84278c:-7298	12/29/2023 10:05
41759-6	0.013	5	352.9	< 0.176			4c485cef:18cab84278c:-7296	12/29/2023 10:28
41759-6 DUP	0.034	5	352.9	< 0.176		NA	4c485cef:18cab84278c:-7294	12/29/2023 10:52
41759-6 SPK	5.087	5	352.9	8.98	5.00	102%	4c485cef:18cab84278c:-7292	12/29/2023 11:15
41759-6 SPK DUP	5.111	5	352.9	9.02	5.00	102%	4c485cef:18cab84278c:-7290	12/29/2023 11:39
41759-7	0.015	5	304.2	< 0.152			4c485cef:18cab84278c:-728e	12/29/2023 12:02
41759-7 DUP	0.010	5	304.2	< 0.152		NA	4c485cef:18cab84278c:-728c	12/29/2023 12:26

LindaAnW

elementOne **M26A-Cl_2 IC Data Sheet** **Lab ID #: 41759**

Client: Deeco
Date: 01.03.24
Analyst: LAW
Detection Limit, (µg/ml): 0.10

Column: IonPac AS14A
Eluent: 8.0 mM Na_2CO_3/ 1.0 mM $NaHCO_3$
Flow Rate: 1.0 mL/min.
1.000

Standards	Cl^- µg/ml	Dilution	QC µg/ml	%Relative Error	% Recovery	File Name	Date Time
0	0.000					4c485cef:18cab84278c:-7116	12/28/2023 12:32
0.1	0.093			-7.0%	93%	4c485cef:18cab84278c:-7114	12/28/2023 12:56
1	0.912			-8.8%	91%	4c485cef:18cab84278c:-7112	12/28/2023 13:19
3	3.028			0.9%	101%	4c485cef:18cab84278c:-7110	12/28/2023 13:43
5	5.133			2.7%	103%	4c485cef:18cab84278c:-710e	12/28/2023 14:07
10	9.933			-0.7%	99%	4c485cef:18cab84278c:-710c	12/28/2023 14:30
0.1	0.110			10.0%	110%	4c485cef:18cab84278c:-71f1	12/29/2023 14:47
1	0.940			-6.0%	94%	4c485cef:18cab84278c:-71ef	12/29/2023 15:10
3	3.023			0.8%	101%	4c485cef:18cab84278c:-710a	12/29/2023 15:34
5	5.150			3.0%	103%	4c485cef:18cab84278c:-7108	12/29/2023 15:57
10	10.854			8.5%	109%	4c485cef:18cab84278c:-7106	12/29/2023 16:21

Correlation- 0.999792

QC	4.903		5.00		98%	4c485cef:18cab84278c:-74b4	12/28/2023 14:54
QC	5.160		5.00		103%	4c485cef:18cab84278c:-74b2	12/28/2023 15:17
QC	5.179		5.00		104%	4c485cef:18cab84278c:-7494	12/28/2023 21:09
QC	4.836		5.00		97%	4c485cef:18cab84278c:-7492	12/28/2023 21:33
QC	5.183		5.00		104%	4c485cef:18cab84278c:-7478	12/29/2023 2:38
QC	5.184		5.00		104%	4c485cef:18cab84278c:-7476	12/29/2023 3:02
QC	5.047		5.00		101%	4c485cef:18cab84278c:-72a2	12/29/2023 8:07
QC	5.121		5.00		102%	4c485cef:18cab84278c:-72a0	12/29/2023 8:31
QC	5.274		5.00		105%	4c485cef:18cab84278c:-71f7	12/29/2023 13:36
QC	5.371		5.00		107%	4c485cef:18cab84278c:-7104	12/29/2023 16:44
QC	5.299		5.00		106%	4c485cef:18cab84278c:-70f6	12/29/2023 19:29
DL	0.092		0.10		92%	4c485cef:18cab84278c:-74ac	12/28/23 16:28
DL	0.090		0.10		90%	4c485cef:18cab84278c:-74aa	12/28/2023 16:51
DL	0.092		0.10		92%	4c485cef:18cab84278c:-71f5	12/29/2023 14:00
DL	0.092		0.10		92%	4c485cef:18cab84278c:-7102	12/29/2023 17:08
40034-7QC	4.161	20	78.00		107%	4c485cef:18cab84278c:-728a	12/29/2023 12:49
40034-7QC DUP	4.148	20	78.00		106%	4c485cef:18cab84278c:-7288	12/29/2023 13:13
BLK	0.005					4c485cef:18cab84278c:-74b0	12/28/2023 15:41
BLK	0.002					4c485cef:18cab84278c:-74ae	12/28/2023 16:04
BLK	0.004					4c485cef:18cab84278c:-7490	12/28/2023 21:56
BLK	0.003					4c485cef:18cab84278c:-748e	12/28/2023 22:20
BLK	0.002					4c485cef:18cab84278c:-7474	12/29/2023 3:25
BLK	0.004					4c485cef:18cab84278c:-7472	12/29/2023 3:49
BLK	0.001					4c485cef:18cab84278c:-729e	12/29/2023 8:54
BLK	0.001					4c485cef:18cab84278c:-729c	12/29/2023 9:18
BLK	0.003					4c485cef:18cab84278c:-71f3	12/29/2023 14:23
BLK	0.002					4c485cef:18cab84278c:-7100	12/29/2023 17:31
BLK	0.021					4c485cef:18cab84278c:-70f4	12/29/2023 19:52

elementOne **IC Sample Sheet/Digestion Worksheet** **Lab ID #:** 41722 | 41759

Date: 12.28.23
Analyst: KN

Column: IonPac AS14A
Conc. Eluent: 8.0 mM Na_2CO_3/ 1.0mM $NaHCO_3$
10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
Regenerant: 100mM H_3PO_4
Flow Rate: 1.0 mL/min.

Instrument: 881 | 858
Lot# 1C11-99-3
Lot # 1C11-106-2
Method: 26A NaOH

Batch name: 122823-41722 Cl2

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
1	0.0		R^2	QC lot #			
2	0.1	Cl	.999792	Ricca 4	308J59		
3	1.0						
4	3.0						
5	5.0						
6	10.0						
7	QC						
8	QC						
9	BLK						
10	BLK						
11	DL						
12	DL						
13	LRB						
14	LRB						
15	LRB+						
~~16~~	LRB+						
17	41722-7		Cl2	10x	2.739	10x	
18	-7d		↓	↓	2.743	↓	
19	-8				2.957		
20	-8d				2.924		
21	-10			5x	0.144	5x	
22	-10d			↓	0.146	↓	
23	QC						
24	QC						
25	BLK						

Manual integrations noted by M
Curve IC Lot # 1C11-107-4 Sodium Thiosulfate Lot # 1C11-73-4 Comments: p. 1 of 4
Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: **IC ME Solution** HPS 2308D29-250
QC: Spike 50 uL from 1000 ug/mL Br Std. to 10mL sample; lot #'s listied above.
Submitted for QC- Date: 123023 Time: 10:26 By: KN QC Review- Date: ____ Time: ____ By: ____

elementOne **IC Sample Sheet/Digestion Worksheet** **Lab ID #:** 41722 | 41759

Date: 12.28.23
Analyst: KLT

Column: IonPac AS14A
Conc. Eluent: 8.0 mM Na_2CO_3/ 1.0mM $NaHCO_3$
10mL Conc. Eluent Diluted to FV=1L with filtered UPDI

Instrument: 881|858
Lot# IC11-99-3

Batch name: 122823-41722 Cl2
Regenerant: 100mM H_3PO_4
Lot # IC11-106-2
Flow Rate: 1.0 mL/min.
Method: 26A NaOH

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
26	BLK						
27	41722-9		Cl2		1.970	10x	
28	-9d				2.036		
29	-9+				7.293		
30	-9+d				7.298		
31	-11				0.163	5x	
32	-11d				0.157		
33	-12				0.257		Bad RPD
34	-12d				0.144		56% recheck
35	-12+				5.352		
36	-12+d				5.361		
37	QC						
38	QC						
39	BLK						
40	BLK						
41	41759-1		Cl2		—	5x	
42	-1d				—		
43	-2				—		
44	-2d				—		
45	-3				—		
46	-3d				—		
47	-3+				5.073		
48	-3+d				5.039		
49	-4d KLT 12-28-23				—		
50	-4d				—		

Manual integr
Curve IC Lot #________ Sodium Thiosulfate Lot #________ Comments: p. 2 of 4
Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: **IC ME Solution** ________
QC: Spike 50 uL from 1000 ug/mL Br Std. to 10mL sample; lot #'s listed above.
Submitted for QC- Date:_____ Time:_____ By:_____ QC Review- Date:_____ Time:_____ By:_____

elementOne **IC Sample Sheet/Digestion Worksheet** **Lab ID #:** 41722|41759

Date: 12-28-23
Analyst: vch
Batch name: 122823-41722 Cl2

Column: IonPac AS14A
Conc. Eluent: 8.0 mM Na_2CO_3/ 1.0mM $NaHCO_3$
10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
Regenerant: 100mM H_3PO_4
Flow Rate: 1.0 mL/min.

Instrument: 881|858
Lot# IC11-99-3
Lot # IC11-106-2
Method: 26A NaOH

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
S1	QC						
S2	QC						
S3	BLK						
S4	BLK						
S5	41759-5		Cl_2		—	5X	
S6	-5d				—		
S7	-6				—		
S8	-6d				—		
S9	-6t				5.087		
60	-6td				5.111		
61	-7				—		
62	-7d				—		
63	40034-7 QC				4.161	20X	TV=78
64	-7 QCd				4.148		
65	QC						
66	DL						
67	BLK						
68	0.1						
69	1.0						
70	3.0						
71	5.0						
72	10.0						
73	QC						
74	DL						
75	BLK						

Manual integra
Curve IC Lot #______ Sodium Thiosulfate Lot #______ Comments: p. 3 of 4
Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: **IC ME Solution** ______
QC: Spike 50 uL from 1000 ug/mL Br Std. to 10mL sample; lot #'s listed above.
Submitted for QC- Date:______ Time:______ By:______ QC Review- Date:______ Time:______ By:______

41722

elementOne **IC Sample Sheet/Digestion Worksheet** **Lab ID #:** 41759

Date: 12-28-23
Analyst: LW

Column: IonPac AS14A
Conc. Eluent: 8.0 mM Na_2CO_3/ 1.0mM $NaHCO_3$

Instrument: 8811858
Lot# ICll-99-3

Batch name: 122823-41722

10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
Regenerant: 100mM H_3PO_4
Flow Rate: 1.0 mL/min.

Lot # ICll-106-2
Method: 26A NaOH

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
76	41722-12		Cl_2		0.343	5X	
77	-12D		↓		0.346	↓	
78	-12L				5.565		
79	-12LD		↓		5.443	↓	
80	QC						
81	Blk						

Manual integra
Curve IC Lot #__________ Sodium Thiosulfate Lot #__________ Comments: pg 4 of 4
Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: **IC ME Solution**________
QC: Spike 50 uL from 1000 ug/mL Br Std. to 10mL sample; lot #'s listied above.
Submitted for QC- Date:______ Time:______ By:______ QC Review- Date:______ Time:______ By:______

Appendix D

Plant Process Data

Date/Time	K1: CLINKER_PROD (TNHR) Raw Value
Run 1	
12/08/2023 13:24	64.4
12/08/2023 13:25	64.4
12/08/2023 13:26	64.4
12/08/2023 13:27	64.4
12/08/2023 13:28	64.4
12/08/2023 13:29	64.4
12/08/2023 13:30	64.4
12/08/2023 13:31	64.4
12/08/2023 13:32	64.4
12/08/2023 13:33	64.4
12/08/2023 13:34	64.4
12/08/2023 13:35	64.4
12/08/2023 13:36	64.4
12/08/2023 13:37	64.4
12/08/2023 13:38	64.4
12/08/2023 13:39	64.4
12/08/2023 13:40	64.4
12/08/2023 13:41	64.4
12/08/2023 13:42	64.4
12/08/2023 13:43	64.4
12/08/2023 13:44	64.4
12/08/2023 13:45	64.4
12/08/2023 13:46	64.4
12/08/2023 13:47	64.4
12/08/2023 13:48	64.4
12/08/2023 13:49	64.4
12/08/2023 13:50	64.4
12/08/2023 13:51	64.4
12/08/2023 13:52	64.4
12/08/2023 13:53	64.4
12/08/2023 13:54	64.4
12/08/2023 13:55	64.4
12/08/2023 13:56	64.4
12/08/2023 13:57	64.4
12/08/2023 13:58	64.4
12/08/2023 13:59	64.4
12/08/2023 14:00	64.4
12/08/2023 14:01	64.4
12/08/2023 14:02	64.4
12/08/2023 14:03	64.4

Date/Time	K1: CLINKER_PROD (TNHR) Raw Value
12/08/2023 14:04	64.4
12/08/2023 14:05	64.4
12/08/2023 14:06	64.4
12/08/2023 14:07	64.4
12/08/2023 14:08	64.4
12/08/2023 14:09	64.4
12/08/2023 14:10	64.4
12/08/2023 14:11	64.4
12/08/2023 14:12	64.4
12/08/2023 14:13	64.4
12/08/2023 14:14	64.4
12/08/2023 14:15	64.4
12/08/2023 14:16	64.4
12/08/2023 14:17	64.4
12/08/2023 14:18	64.4
12/08/2023 14:19	64.4
12/08/2023 14:20	64.4
12/08/2023 14:21	64.4
12/08/2023 14:22	64.4
12/08/2023 14:23	64.4
12/08/2023 14:24	64.4
12/08/2023 14:25	64.4
Run 1 Average	**64.4**

Date/Time	K1: CLINKER_PROD (TNHR) Raw Value
Run 2	
12/08/2023 14:53	64.4
12/08/2023 14:54	64.4
12/08/2023 14:55	64.4
12/08/2023 14:56	64.4
12/08/2023 14:57	64.4
12/08/2023 14:58	64.4
12/08/2023 14:59	64.4
12/08/2023 15:00	64.4
12/08/2023 15:01	64.4
12/08/2023 15:02	64.4
12/08/2023 15:03	64.4
12/08/2023 15:04	64.4
12/08/2023 15:05	64.4
12/08/2023 15:06	64.4
12/08/2023 15:07	64.4
12/08/2023 15:08	64.4
12/08/2023 15:09	64.4
12/08/2023 15:10	64.4
12/08/2023 15:11	64.4
12/08/2023 15:12	64.4
12/08/2023 15:13	64.4
12/08/2023 15:14	64.4
12/08/2023 15:15	64.4
12/08/2023 15:16	64.4
12/08/2023 15:17	64.4
12/08/2023 15:18	64.4
12/08/2023 15:19	64.4
12/08/2023 15:20	64.4
12/08/2023 15:21	64.4
12/08/2023 15:22	64.4
12/08/2023 15:23	64.4
12/08/2023 15:24	64.4
12/08/2023 15:25	64.4
12/08/2023 15:26	64.4
12/08/2023 15:27	64.4
12/08/2023 15:28	64.4
12/08/2023 15:29	64.4
12/08/2023 15:30	64.4
12/08/2023 15:31	64.4
12/08/2023 15:32	64.4

Date/Time	K1: CLINKER_PROD (TNHR) Raw Value
12/08/2023 15:33	64.4
12/08/2023 15:34	64.4
12/08/2023 15:35	64.4
12/08/2023 15:36	64.4
12/08/2023 15:37	64.4
12/08/2023 15:38	64.4
12/08/2023 15:39	64.4
12/08/2023 15:40	64.4
12/08/2023 15:41	64.4
12/08/2023 15:42	64.4
12/08/2023 15:43	64.4
12/08/2023 15:44	64.4
12/08/2023 15:45	64.4
12/08/2023 15:46	64.4
12/08/2023 15:47	64.4
12/08/2023 15:48	64.4
12/08/2023 15:49	64.4
12/08/2023 15:50	64.4
12/08/2023 15:51	64.4
12/08/2023 15:52	64.4
Run 2 Average	**64.4**

Date/Time	K1: CLINKER_PROD_CD (TNHR) Raw Value
12/08/2023 16:20	64.4
12/08/2023 16:21	64.4
12/08/2023 16:22	64.4
12/08/2023 16:23	64.4
12/08/2023 16:24	64.4
12/08/2023 16:25	64.4
12/08/2023 16:26	64.4
12/08/2023 16:27	64.4
12/08/2023 16:28	64.4
12/08/2023 16:29	64.4
12/08/2023 16:30	64.4
12/08/2023 16:31	64.4
12/08/2023 16:32	64.4
12/08/2023 16:33	64.4
12/08/2023 16:34	64.4
12/08/2023 16:35	64.4
12/08/2023 16:36	64.4
12/08/2023 16:37	64.4
12/08/2023 16:38	64.4
12/08/2023 16:39	64.4
12/08/2023 16:40	64.4
12/08/2023 16:41	64.4
12/08/2023 16:42	64.4
12/08/2023 16:43	64.4
12/08/2023 16:44	64.4
12/08/2023 16:45	64.4
12/08/2023 16:46	64.4
12/08/2023 16:47	64.4
12/08/2023 16:48	64.4
12/08/2023 16:49	64.4
12/08/2023 16:50	64.4
12/08/2023 16:51	64.4
12/08/2023 16:52	64.4
12/08/2023 16:53	64.4
12/08/2023 16:54	64.4
12/08/2023 16:55	64.4
12/08/2023 16:56	64.4
12/08/2023 16:57	64.4
12/08/2023 16:58	64.4
12/08/2023 16:59	64.4
12/08/2023 17:00	64.4

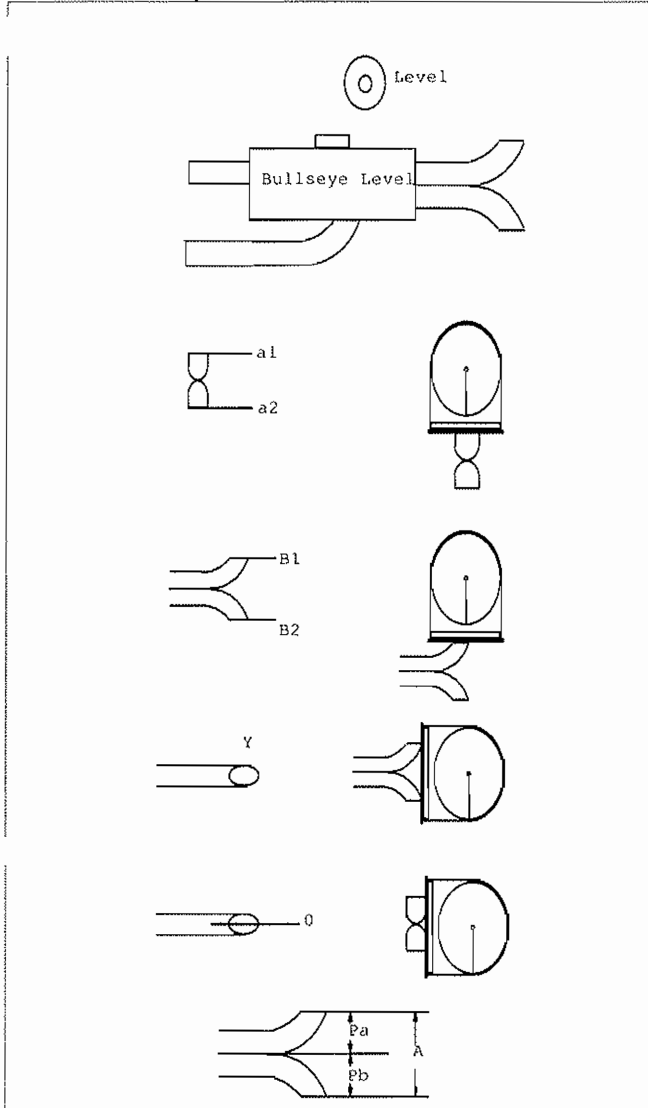
Date/Time	K1: CLINKER_PROD_CD (TNHR) Raw Value
12/08/2023 17:01	64.4
12/08/2023 17:02	64.4
12/08/2023 17:03	64.4
12/08/2023 17:04	64.4
12/08/2023 17:05	64.4
12/08/2023 17:06	64.4
12/08/2023 17:07	64.4
12/08/2023 17:08	64.4
12/08/2023 17:09	64.4
12/08/2023 17:10	64.4
12/08/2023 17:11	64.4
12/08/2023 17:12	64.4
12/08/2023 17:13	64.4
12/08/2023 17:14	64.4
12/08/2023 17:15	64.4
12/08/2023 17:16	64.4
12/08/2023 17:17	64.4
Run 3 Average	**64.4**

Appendix E

Calibration Documents

	Probe or Pitot No:	5A

Pitot Tube Inspection Sheet



Date	01/03/23
Tube Assembly Level?	Yes
Ports Damaged?	No
-10 deg < a1 < +10 deg	2
-10 deg < a2 < +10 deg	1
-5 deg < B1 < +5 deg	1
-5 deg < B2 < +5 deg	1
Y (gamma)	1
0 (theta)	1
A (alpha)	0.951
Z = A (sin y) < 0.125"?	yes
W = A (sin 0) < 0.031"?	yes
Pa =	0.475
Pb =	0.476
Tube Diameter (Dt) =	0.376
Pa = Pb +- 0.063"?	yes
(1.05 x Dt)?	0.3948
(1.50 x Dt)?	0.564
(1.05 x Dt)< P < (1.50 x Dt)?	yes
Eligible for Default Pitot Calibration Factor (Cp = 0.84)?	**Yes**

Thermocouple Calibration

Type of Reference Thermometer?	Mercury	Date	01/03/23
Barometeric Pressure?	29.52	Ambient Temperature?	68

Source	Reference Temp, F	Thermocouple Temp, F	Absolute Temp Difference
cold air	37	38	-0.20%
medium air	215	215	0.00%
hot air	325	325	0.00%

Windtunnel Calibration

Pitot Reading	Reference (0.99)	5A S-Type Pitot	Cp
ΔP_1	0.31	0.44	0.84
ΔP_2	0.31	0.43	0.85
ΔP_3	0.31	0.43	0.85
		Average Pitot Tube Calibration Factor--->	**0.85**

Thermocouple Calibration Check (EPA ALT-011 Procedure), performed on 1/3/23

Source	Ref. Temp. F	Thermocouple Temp. F	± 2 deg F?
Ambient	68	66.9	Yes

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

Quality - Service - Reliability

ENVIRONMENTAL SUPPLY COMPANY

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record data and information in the GREEN cells, YELLOW cells are calculated.

DATE: 12/28/21   METER SERIAL #: M5-15
METER PART #: M5-15   CRITICAL ORIFICE SET SERIAL #: 14315

BAROMETRIC PRESSURE (in Hg): INITIAL 30.03   FINAL 30.03   AVG (P_{bar}) 30.03

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT³) INITIAL	DGM READINGS FINAL	NET (V_m)	AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	ΔH@
12	1	0.3283				0.000						0							
	2					0.000						0							
	3					0.000						0							
																AVG =			
15	1	0.4094	18	353.924	359.213	5.289	75	62	65	62	62	62.75	10.00	0.8	5.3733	5.3168	0.989		1.62
	2	0.4094	18	359.213	364.553	5.340	76	65	66	62	63	64	10.00	0.8	5.4122	5.3119	0.981		1.62
	3					0.000						0							
																AVG =	0.985	1.09	
19	1	0.5047	18	364.553	371.213	6.660	76	66	70	63	65	66	10.00	1.3	6.7325	6.5483	0.973		1.72
	2	0.5047	18	371.213	377.910	6.697	76	70	72	65	66	68.25	10.00	1.3	6.7411	6.5483	0.971		1.72
	3					0.000						0							
																AVG =	0.972	-0.29	
23	1	0.6426	18	377.910	386.465	8.555	77	70	74	66	68	69.5	10.00	2.1	8.6078	8.3298	0.968		1.71
	2	0.6426	18	386.465	395.066	8.601	77	74	75	68	69	71.5	10.00	2.1	8.6215	8.3298	0.966		1.71
	3					0.000						0							
																AVG =	0.967	-0.81	
32	1	0.8587				0.000						0							
	2					0.000						0							
	3					0.000						0							
																AVG =			

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = **0.975**

AVERAGE ΔH@ = **1.68**

Potentiometer Check, °F (per manufacturer procedure)		
	0	@ 0 F
	496	@ 500 F
	1000	@ 1000 F

Avg Absolute Difference = **0.1%**

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, Vm (std), and the critical orifice, Vcr (std), and the DGM calibration factor, Y. These equations are automatically calculated in the

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$ = Net volume of gas sample passed through DGM, corrected to standard conditions

K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$ = DGM calibration factor

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

ENVIRONMENTAL SUPPLY COMPANY

Quality - Service - Reliability

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record data and information in the GREEN cells, YELLOW cells are calculated.

DATE: 12_8_22

METER PART #: M5-21

METER SERIAL #: M5-21

CRITICAL ORIFICE SET SERIAL #: 14315

BAROMETRIC PRESSURE (in Hg): INITIAL 29.99 FINAL 29.99 AVG (P_{bar}) 29.99

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT³) INITIAL	DGM READINGS (FT³) FINAL	DGM READINGS (FT³) NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	ΔH@
12	1	0.3283				0.000						0							
	2					0.000						0							
	3					0.000						0							
																AVG =			
15	1	0.4094	18	58.501	63.745	5.244	67	69	69	69	69	69	10.00	0.86	5.2584	5.3499	1.017		1.69
	2	0.4094	18	63.811	69.109	5.298	67	69	70	69	69	69.25	10.00	0.86	5.3100	5.3499	1.008		1.69
	3					0.000						0							
																AVG =	1.012	2.83	
19	1	0.5047	18	69.109	75.825	6.716	68	70	71	69	70	70	10.00	1.3	6.7289	6.5890	0.979		1.69
	2	0.5047	18	75.825	82.595	6.770	67	70	72	69	70	70.25	10.00	1.3	6.7798	6.5953	0.973		1.68
	3					0.000						0							
																AVG =	0.976	-0.87	
23	1	0.6426	18	82.595	91.263	8.668	67	70	74	69	70	70.75	10.00	2.1	8.6894	8.3973	0.966		1.68
	2	0.6426	18	91.263	99.971	8.708	67	72	76	70	70	72	10.00	2.1	8.7089	8.3973	0.964		1.68
	3					0.000						0							
																AVG =	0.965	-1.96	
32	1	0.8587				0.000						0							
	2					0.000						0							
	3					0.000						0							
																AVG =			

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, Vm (std), and the critical orifice, Vcr (std), and the DGM calibration factor, Y. These equations are automatically calculated in the

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = **0.985**

AVERAGE ΔH@ = **1.69**

Potentiometer Check, °F (per manufacturer procedure)		
	0	@ 0 F
	496	@ 500 F
	1000	@ 1000 F

Avg Absolute Difference = **0.1%**

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$ = Net volume of gas sample passed through DGM, corrected to standard conditions

K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$ = DGM calibration factor

Company: Holcim Joppa IL
Source: Kiln 1 Main Stack
Job ID: 23-3318
Train Type: M26A

Alt-009 Alternate Post Test Calibration Data	M5-21 1A 12/08/23 1324-1434	M5-15 1B 12/08/23 1324-1434	2A 12/08/23 1453-1602	2B 12/08/23 1453-1602	3A 12/08/23 1620-1726	3B 12/08/23 1620-1726	M5-21 Average	M5-15 Average
Vm	42.741	42.461	43.835	45.907	44.196	45.222		
Tm	520.1	525.1	530	529.6	531.3	532.8		
Pb	29.3	29.3	29.3	29.3	29.3	29.3		
Havg	1.58	1.58	1.67	1.7	1.67	1.66		
H@	1.69	1.68	1.69	1.68	1.69	1.68		
Md	30.788	30.788	30.676	30.676	30.696	30.696		
(Havg)^0.5	1.25442894	1.25108176	1.28820797	1.30013563	1.28831104	1.28396073		
Run Time, Min	60	60	60	60	60	60		
Meter Gamma	0.985	0.975	0.985	0.975	0.985	0.975		
Calculated Gamma (Yqa)	0.987	0.999	1.000	0.966	0.992	0.971	0.993	0.979
% difference from Actual Y	0.24%	2.45%	1.49%	0.94%	0.76%	0.42%	0.8%	1.3%

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
630 United Drive
Durham, NC 27713
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E04NI77E15A3796	Reference Number:	122-402248430-1
Cylinder Number:	XC025341B	Cylinder Volume:	151.1 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	2015 PSIG
PGVP Number:	B22021	Valve Outlet:	590
Gas Code:	CO,CO2,O2,BALN	Certification Date:	Oct 13, 2021

Expiration Date: Oct 13, 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.

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 MONOXIDE	65.00 PPM	64.10 PPM	G1	+/- 0.8% NIST Traceable	10/13/2021
CARBON DIOXIDE	10.00 %	10.22 %	G1	+/- 0.6% NIST Traceable	10/12/2021
OXYGEN	12.00 %	11.79 %	G1	+/- 0.4% NIST Traceable	10/12/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09010213	KAL004779	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 16, 2024
NTRM	19060402	6162642Y	11.105 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Dec 04, 2025
NTRM	10010616	K014963	9.967 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VA-5001 CO2 BF89GV17	Nondispersive Infrared (NDIR)	Sep 15, 2021
Horiba VIA510 CO 1G46EA07	Nondispersive Infrared (NDIR)	Sep 22, 2021
Siemens Oxymat 61 M3299 O2	Paramagnetic	Sep 14, 2021

Triad Data Available Upon Request

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
630 United Drive
Durham, NC 27713
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E04NI59E15A38X3	Reference Number:	122-402389885-1A
Cylinder Number:	ALM-056015	Cylinder Volume:	143.7 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	2016 PSIG
PGVP Number:	B22022	Valve Outlet:	590
Gas Code:	CO,CO2,O2,BALN	Certification Date:	Mar 28, 2022

Expiration Date: Mar 28, 2030

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
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 MONOXIDE	120.0 PPM	116.5 PPM	G1	+/- 0.3% NIST Traceable	03/28/2022
CARBON DIOXIDE	18.00 %	18.17 %	G1	+/- 0.7% NIST Traceable	03/28/2022
OXYGEN	22.00 %	21.90 %	G1	+/- 0.5% NIST Traceable	03/28/2022
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13010207	KAL003102	246.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.2%	Oct 16, 2024
NTRM	12061508	CC354696	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024
NTRM	08010220	K013155	23.20 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VA-5001 CO2 BF89GV17	Nondispersive Infrared (NDIR)	Mar 01, 2022
Horiba VIA510 CO RS2EGL6K	Nondispersive Infrared (NDIR)	Mar 01, 2022
Siemens Oxymat 61 M3299 O2	Paramagnetic	Mar 01, 2022

Triad Data Available Upon Request

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
630 United Drive
Durham, NC 27713
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Part Number:	X02NI99C15A54F5	Reference Number:	122-402705571-1
Cylinder Number:	CC426155	Cylinder Volume:	144.0 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	2015 PSIG
Analysis Date:	Mar 28, 2023	Valve Outlet:	350
Lot Number:	122-402705571-1		

Expiration Date: Mar 28, 2031

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

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	75.00 PPM	75.47 PPM	+/- 2%
NITROGEN	Balance		

Approved for Release

Airgas
an Air Liquide company

CERTIFICATE OF ACCURACY: *GMACS-c Calibration Standard*

SAY LABORATORY | CUSTOMER INFORMATION

IRGAS SPECIALTY GASES
Exploratory Products Group
6141 Easton Road
Plumsteadville, PA 18949

Work Order #: 160-402845897-1
Sales Order #: 1123601913
PO #: 7100179560

Customer: DEECO Inc.
Address 1: 3404 Lake Woodard Road
Address 2:
City / State / Zip: Raleigh, NC 27604

PRODUCT INFORMATION

COMPOSITION	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
Hydrogen Cyanide	49.9 PPM	2.3 PPM	4.6 %
Sulfur Hexafluoride	5.0 PPM	0.07 PPM	1.3 %
Nitrogen	Balance		

CYLINDER #: CC768222
CYLINDER TYPE: 150A Aluminum
CGA: 350 SS
CYLINDER PRESSURE: 2000 psig

AIRGAS PART #: X03NI99C15AC0W8
CERTIFICATION DATE: 7-Sep-2023
EXPIRATION DATE: 7-Mar-2024
MIXTURE DEW POINT: N/A

CERTIFICATION DATA

BLENDING PROCESS: GravStat™ Gravimetry

COMPONENT	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
Hydrogen Cyanide	50.02 PPM	0.9 PPM	1.8 %
lfur Hexafluoride	5.02 PPM	0.07 PPM	1.3 %

CONFIRMING ANALYSIS: FTIR Spectroscopy
INSTRUMENT / MODEL: CAI Model 700 FTIR

COMPONENT	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
Hydrogen Cyanide	49.8 PPM	2.1 PPM	4.2 %

REFERENCE STANDARD: GMPS-c 50 PPM Hydrogen Cyanide
CYLINDER NUMBER: CC768196
EXPIRATION DATE: 2/29/2024

COMPONENT	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
Hydrogen Cyanide	48.9 PPM	1.7 PPM	3.4 %

CALIBRATION CURVE DATA	Curve Order	Correlation	Slope (X2)	Slope (X)	Intercept
Point-to-Point Matching Std	Linear / Direct Ratio	N/A	N/A	N/A	N/A

INTERLOCK STATISTICS

	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
BLEND RESULT:	50.02 PPM	0.9 PPM	1.8 %
ANALYSIS RESULT:	49.8 PPM	2.1 PPM	4.2 %
INTERLOCK RESULT:	49.9 PPM	2.3 PPM	4.6 %

COMMENTS / SPECIAL INSTRUCTIONS

A GMACS-c ("Candidate GMACS") is made and certified according to the EPA GMACS Procedure (Alt-114) found at: https://cfpub.epa.gov
2. Do not use this standard if pressure is less than 200 psig.
3. Do not use or store this product at or below the stated dew point.

APPROVED BY: ______________________ BOB GRASMEDER

Client: Holcim Joppa IL
Test Location: Main Stack Stratification Check
Date: Dec 08, 2023
Run number 1
One Minute Averages

	Reference Out O2 %,dry	Plant Out O2 %,dry
Point !		
1:24:52 PM	13.0	12.3
1:25:52 PM	13.1	12.3
1:26:52 PM	13.2	12.4
1:27:52 PM	13.2	12.4
1:28:52 PM	13.1	12.3
1:29:52 PM	13.1	12.4
Point 2	13.1	12.4
1:30:52 PM	13.1	12.4
1:31:52 PM	13.2	12.4
1:32:52 PM	13.1	12.4
1:33:52 PM	13.0	12.3
1:34:52 PM	12.9	12.3
1:35:52 PM	13.1	12.3
Point 3	13.1	12.3
1:36:52 PM	13.1	12.4
1:37:52 PM	13.1	12.4
1:38:52 PM	13.0	12.3
1:39:52 PM	13.1	12.2
1:40:52 PM	13.0	12.3
1:41:52 PM	13.1	12.3
Averages	13.1	12.3

Date/Time	K1: O2_DRY (PCT) Expression Value
12/08/2023 13:24	12.34
12/08/2023 13:25	12.34
12/08/2023 13:26	12.42
12/08/2023 13:27	12.41
12/08/2023 13:28	12.34
12/08/2023 13:29	12.35
12/08/2023 13:30	12.35
12/08/2023 13:31	12.35
12/08/2023 13:32	12.37
12/08/2023 13:33	12.34
12/08/2023 13:34	12.31
12/08/2023 13:35	12.32
12/08/2023 13:36	12.35
12/08/2023 13:37	12.35
12/08/2023 13:38	12.34
12/08/2023 13:39	12.24
12/08/2023 13:40	12.25
12/08/2023 13:41	12.30

Analysis Valid[illegible] Report

Sample Filename: F:\Joppa\December 8\SPC__005798.LAB

Filename for noise: F:\Midlothian on Rental\November 14\SPC__000837.LAB
Interferences Filenames: C:\Midlothian on Rental\November 15\SPC__001463.LAB
C:\Midlothian on Rental\November 15\SPC__001464.LAB
C:\Midlothian on Rental\November 15\SPC__001465.LAB
C:\Midlothian on Rental\November 15\SPC__001466.LAB
C:\Midlothian on Rental\November 15\SPC__001467.LAB
C:\Midlothian on Rental\November 15\SPC__001468.LAB
C:\Midlothian on Rental\November 15\SPC__001469.LAB
C:\Midlothian on Rental\November 15\SPC__001470.LAB

Recipe path: C:\OLT\recipes\Cement Testing R3.MGRCP

Gas calibration Name	Conc	MDC3	MDC2	MDC1	MAU	FMU*R	OCU	~ DL	~ CL	~ Bias	Sigma	Range	Span	Comment
JP HCN (200) PCA 191C 191C	1.27	0.22	-	0.31	0.38	0.26	0.38	-	0.03	-	-	0-200	-	Good
HF PPM (10) 191C	-0.02	0.14	0.05	0.04	0.07	0.25	0.25	0.07	0.11	0.02	0.02	0-10	-	Close to DL
SF6 (10) 191C	0	0.01	-	0	0	0.02	0.02	-	0.01	-	-	0-10	-	Close to DL
ETHYLENE (100,3000) 191C	0.72	1.1	0.33	0.17	0.29	1.92	1.92	1.08	1.08	0.75	0.11	0-3000	-	Close to DL
H2O% (40) 191C	3.54	0.04	-	0.01	0.02	0.09	0.09	-	0.07	-	-	0-40	-	Good
CO2% (40) 191C	12.55	0.24	-	0.01	0.02	0.34	0.34	-	0.25	-	-	0-40	-	Good
HCL PPM (100) 191C	0	0.55	0.05	0.15	0.28	1	1	0.06	0.42	0.01	0.02	0-100	-	Close to DL
SO2 (1000) 191C	1.27	0.59	0.37	0.14	0.27	1.14	1.14	0.79	0.79	0.42	0.12	0-1000	-	Close to DL
NO (350,3000) 191C	193.54	4.69	0.22	0.26	0.35	6.42	6.42	0.45	3.9	0.23	0.07	0-3000	-	Good
NH3 (300) 191C (1OF2)	1.39	0.76	0.03	0.12	0.2	1.29	1.29	0.15	0.61	0.11	0.01	0-300	-	Check it!
CO (500) 191C (1OF2)	81.19	1.93	-	0.2	0.43	4	4	-	1.62	-	-	0-500	-	Good
CO% (1) 191C (2OF2)	0.01	0	0	0	0	0	0	0	0	0	0	0-1	-	Good
FORMALDEHYDE (70) 191C	0.72	1.12	0.28	0.2	0.24	1.35	1.35	0.33	0.91	0.04	0.09	0-70	-	Close to DL
ACETALDEHYDE (1000) 191C	-0.59	2.25	0.23	0.35	0.38	2.45	2.45	0.59	1.89	0.35	0.08	0-1000	-	Close to DL
CH4 (250) 191C (1OF2)	3.42	0.9	0.05	0.26	0.7	2.37	2.37	0.06	0.55	0.01	0.02	0-250	-	Good
PROPANE (100) 191C	-0.45	0.6	0.42	0.12	0.14	0.72	0.72	0.72	0.72	0.3	0.14	0-100	-	Close to DL
HBR (100) 180C	-0.52	3.82	0.17	0.68	1.39	7.76	7.76	0.19	3.15	0.02	0.06	0-100	-	Close to DL
NO2 (150) 191C (1OF2)	-0.07	0.22	0.04	0.02	0.03	0.23	0.23	0.05	0.19	0.01	0.01	0-150	-	Close to DL
NO2 (2000) 191C (2OF2)	-1.41	4.7	2.03	0.88	1.12	5.99	5.99	3.81	3.82	1.78	0.68	0-2000	-	Close to DL
N2O (100,200,300) 191C	0.77	0.18	0.05	0.04	0.05	0.2	0.2	0.07	0.12	0.02	0.02	0-300	-	Good
NH3 (3000) 191C (2OF2)	1.93	4.41	0.35	1.19	2.25	8.32	8.32	0.44	3.39	0.09	0.12	0-3000	-	Close to DL
CH4 (3000) 191C (2OF2)	3.36	4.23	0.34	1.1	1.81	6.96	6.96	0.61	3.07	0.27	0.11	0-3000	-	Close to DL
ACETYLENE (1000) 191C	0.33	1.55	0.15	0.31	0.37	1.88	1.88	0.21	1.25	0.06	0.05	0-1000	-	Close to DL
PROPYLENE (200,1000) 191C	-0.48	2.77	0.19	0.43	0.5	3.25	3.25	0.49	2.34	0.3	0.06	0-1000	-	Close to DL
COS (100) 150C	0.14	0.17	0.02	0.02	0.02	0.23	0.23	0.02	0.15	0	0.01	0-100	-	Close to DL
ETHANE (500) 191C	0.42	0.91	0.32	0.2	0.22	1.02	1.02	0.54	0.71	0.22	0.11	0-500	-	Close to DL
H2SO4 (50) 150C	0.01	0.1	0.04	0.05	0.05	0.1	0.1	0.29	0.29	0.25	0.01	0-50	-	Close to DL
MEOH (10) 191C	0.41	0.37	0.14	0.14	0.16	0.43	0.43	0.17	0.24	0.03	0.05	0-10	-	Close to DL
SO3 (150) 191C	2.2	0.24	0.7	0.03	0.04	0.26	0.26	1.14	1.14	0.44	0.23	0-150	-	Close to DL

Analysis Valid Report

Sample Filename: F:\Joppa\December 8\SPC__005799.LAB

Filename for noise: F:\Midlothian on Rental\November 14\SPC__000837.LAB
Interferences Filenames: C:\Midlothian on Rental\November 15\SPC__001463.LAB
C:\Midlothian on Rental\November 15\SPC__001464.LAB
C:\Midlothian on Rental\November 15\SPC__001465.LAB
C:\Midlothian on Rental\November 15\SPC__001466.LAB
C:\Midlothian on Rental\November 15\SPC__001467.LAB
C:\Midlothian on Rental\November 15\SPC__001468.LAB
C:\Midlothian on Rental\November 15\SPC__001469.LAB
C:\Midlothian on Rental\November 15\SPC__001470.LAB

Recipe path: C:\OLT\recipes\Cement Testing R3.MGRCP

Gas calibration Name	Conc	MDC3	MDC2	MDC1	MAU	FMU*R	OCU	~ DL	~ CL	~ Bias	Sigma	Range	Span	Comment
JP HCN (200) PCA 191C 191C	1.22	0.18	-	0.31	0.38	0.22	0.38	-	0.02	-	-	0-200	-	Good
HF PPM (10) 191C	-0.02	0.15	0.05	0.04	0.07	0.26	0.26	0.07	0.11	0.02	0.02	0-10	-	Close to DL
SF6 (10) 191C	0	0.01	-	0	0	0.02	0.02	-	0.01	-	-	0-10	-	Close to DL
ETHYLENE (100,3000) 191C	0.8	1.11	0.33	0.17	0.29	1.93	1.93	1.08	1.08	0.75	0.11	0-3000	-	Close to DL
H2O% (40) 191C	3.41	0.04	-	0.01	0.02	0.09	0.09	-	0.07	-	-	0-40	-	Good
CO2% (40) 191C	12.79	0.24	-	0.01	0.02	0.33	0.33	-	0.26	-	-	0-40	-	Good
HCL PPM (100) 191C	0.01	0.54	0.05	0.15	0.28	0.99	0.99	0.06	0.42	0.01	0.02	0-100	-	Close to DL
SO2 (1000) 191C	1.17	0.62	0.37	0.14	0.27	1.19	1.19	0.79	0.79	0.42	0.12	0-1000	-	Close to DL
NO (350,3000) 191C	188.64	4.63	0.22	0.26	0.35	6.34	6.34	0.45	3.8	0.23	0.07	0-3000	-	Good
NH3 (300) 191C (1OF2)	1.36	0.77	0.03	0.12	0.2	1.3	1.3	0.15	0.61	0.11	0.01	0-300	-	Check it!
CO (500) 191C (1OF2)	83.23	1.96	-	0.2	0.43	4.06	4.06	-	1.66	-	-	0-500	-	Good
CO% (1) 191C (2OF2)	0.01	0	0	0	0	0	0	0	0	0	0	0-1	-	Good
FORMALDEHYDE (70) 191C	0.74	1.13	0.28	0.2	0.24	1.36	1.36	0.33	0.92	0.04	0.09	0-70	-	Close to DL
ACETALDEHYDE (1000) 191C	-0.6	2.3	0.23	0.35	0.38	2.51	2.51	0.59	1.94	0.35	0.08	0-1000	-	Close to DL
CH4 (250) 191C (1OF2)	3.45	0.94	0.05	0.26	0.7	2.48	2.48	0.06	0.59	0.01	0.02	0-250	-	Good
PROPANE (100) 191C	-0.45	0.6	0.42	0.12	0.14	0.72	0.72	0.72	0.72	0.3	0.14	0-100	-	Close to DL
HBR (100) 180C	-0.59	3.87	0.17	0.68	1.39	7.87	7.87	0.19	3.2	0.02	0.06	0-100	-	Close to DL
NO2 (150) 191C (1OF2)	-0.11	0.21	0.04	0.02	0.03	0.22	0.22	0.05	0.19	0.01	0.01	0-150	-	Close to DL
NO2 (2000) 191C (2OF2)	-1.01	4.69	2.03	0.88	1.12	5.97	5.97	3.81	3.82	1.78	0.68	0-2000	-	Close to DL
N2O (100,200,300) 191C	0.78	0.17	0.05	0.04	0.05	0.2	0.2	0.07	0.11	0.02	0.02	0-300	-	Good
NH3 (3000) 191C (2OF2)	1.79	4.28	0.35	1.19	2.25	8.08	8.08	0.44	3.26	0.09	0.12	0-3000	-	Close to DL
CH4 (3000) 191C (2OF2)	3.38	3.94	0.34	1.1	1.81	6.49	6.49	0.61	2.78	0.27	0.11	0-3000	-	Check it!
ACETYLENE (1000) 191C	0.27	1.62	0.15	0.31	0.37	1.96	1.96	0.21	1.32	0.06	0.05	0-1000	-	Close to DL
PROPYLENE (200,1000) 191C	-0.47	2.84	0.19	0.43	0.5	3.32	3.32	0.49	2.41	0.3	0.06	0-1000	-	Close to DL
COS (100) 150C	0.14	0.17	0.02	0.02	0.02	0.23	0.23	0.02	0.15	0	0.01	0-100	-	Close to DL
ETHANE (500) 191C	0.46	0.91	0.32	0.2	0.22	1.01	1.01	0.54	0.7	0.22	0.11	0-500	-	Close to DL
H2SO4 (50) 150C	0.02	0.1	0.04	0.05	0.05	0.11	0.11	0.29	0.29	0.25	0.01	0-50	-	Close to DL
MEOH (10) 191C	0.42	0.37	0.14	0.14	0.16	0.43	0.43	0.17	0.24	0.03	0.05	0-10	-	Close to DL
SO3 (150) 191C	2.12	0.24	0.7	0.03	0.04	0.26	0.26	1.14	1.14	0.44	0.23	0-150	-	Close to DL

Buzzi Unicem, Maryneal TX
Main Stack
Pretest

Spectrum	Date	Time	HCN PCA 191c R1 191c	SF6 (10) 191C	Ethylene (100,3000) 191C	HF ppm (10) 191C	SNR 2500	sBeam @ 2500
SPC__000830BKG.LAB	11/14/23	06:57:22.688	0.000	0.000	0.000	0.000	NaN	1.41
SPC__000831.LAB	11/14/23	06:58:33.020	-0.004	-0.001	-0.037	0.011	6779.16	1.42
SPC__000832BKG.LAB	11/14/23	07:01:13.650	0.000	0.000	0.000	0.000	5353.34	1.42
SPC__000833.LAB	11/14/23	07:02:24.028	-0.064	0.003	-0.062	0.018	5553.53	1.42
SPC__000834.LAB	11/14/23	07:03:28.036	-0.154	-0.000	0.013	0.007	4837.84	1.42
SPC__000835.LAB	11/14/23	07:04:32.104	0.035	0.001	-0.014	0.003	5479.59	1.42
SPC__000836BKG.LAB	11/14/23	07:07:39.052	0.000	0.000	0.000	0.000	5734.58	1.42
SPC__000837.LAB	11/14/23	07:08:49.639	-0.051	-0.001	-0.019	-0.002	6223.51	1.42
SPC__000838.LAB	11/14/23	07:09:53.338	-0.032	-0.003	0.027	-0.000	5809.30	1.42
SPC__000839.LAB	11/14/23	07:10:57.234	0.046	-0.000	-0.014	-0.017	3759.60	1.42
SPC__000840.LAB	11/14/23	07:12:01.138	-0.011	-0.001	-0.102	0.016	4373.66	1.42
SPC__000841.LAB	11/14/23	07:13:05.164	0.080	-0.001	-0.068	0.002	5347.95	1.42
SPC__000842.LAB	11/14/23	07:14:08.941	0.059	-0.001	-0.051	-0.012	5012.46	1.42
SPC__000843.LAB	11/14/23	07:15:12.843	-0.029	-0.002	-0.084	-0.006	4706.13	1.42
	Standard Deviation x 3		**0.156**	**0.002**		**0.032**		
		Averages					**5033.23**	**1.42**
SPC__003144.LAB	11/29/23	10:07:23.437	-0.070	-0.009	73.818	0.009	3771.37	1.25
SPC__003145.LAB	11/29/23	10:08:27.783	-0.180	-0.008	74.579	0.010	4602.22	1.25
SPC__003146.LAB	11/29/23	10:09:31.168	-0.255	-0.011	74.391	0.004	3362.83	1.25
SPC__003147.LAB	11/29/23	10:10:35.067	-0.286	-0.016	74.456	-0.005	3721.81	1.25
Ethylene Calibration Transfer Standard (CC426155; 75.47 ppm)					**74.475**			
SPC__003163.LAB	11/29/23	10:32:14.551	195.980	9.583	-0.647	-0.007	NaN	1.25
SPC__003164.LAB	11/29/23	10:33:18.264	196.278	9.585	-0.465	-0.017	4782.81	1.25
SPC__003165.LAB	11/29/23	10:34:22.223	196.975	9.583	-0.523	-0.015	5254.76	1.25
SPC__003166.LAB	11/29/23	10:35:26.094	197.038	9.580	-0.445	-0.014	5634.48	1.25
SPC__003167.LAB	11/29/23	10:36:30.150	197.342	9.580	-0.500	-0.009	5809.63	1.25
HCN Standard (CC768233; 199.1 ppm HCN/10.0 ppm SF6)			**196.908**	**9.582**				
SPC__003172.LAB	11/29/23	10:41:49.573	49.888	4.852	-0.442	-0.014	4728.10	1.25
SPC__003173.LAB	11/29/23	10:42:53.522	49.909	4.847	-0.380	-0.005	4092.51	1.25
SPC__003174.LAB	11/29/23	10:43:57.490	49.927	4.851	-0.391	-0.016	3563.85	1.25
SPC__003175.LAB	11/29/23	10:45:01.307	49.815	4.849	-0.423	-0.020	4533.18	1.25
SPC__003176.LAB	11/29/23	10:46:05.212	49.899	4.848	-0.380	-0.004	3854.17	1.25
HCN Standard (CC768222; 49.9 ppm HCN/5.0 ppm SF6)			**49.887**	**4.849**				

Calibration Generated	0... 30 PM 01/23/2024	Gas ID	JP HCN (200) PCA 191C 191c	Lo Alarm	NaN	Span	Offset. .0000
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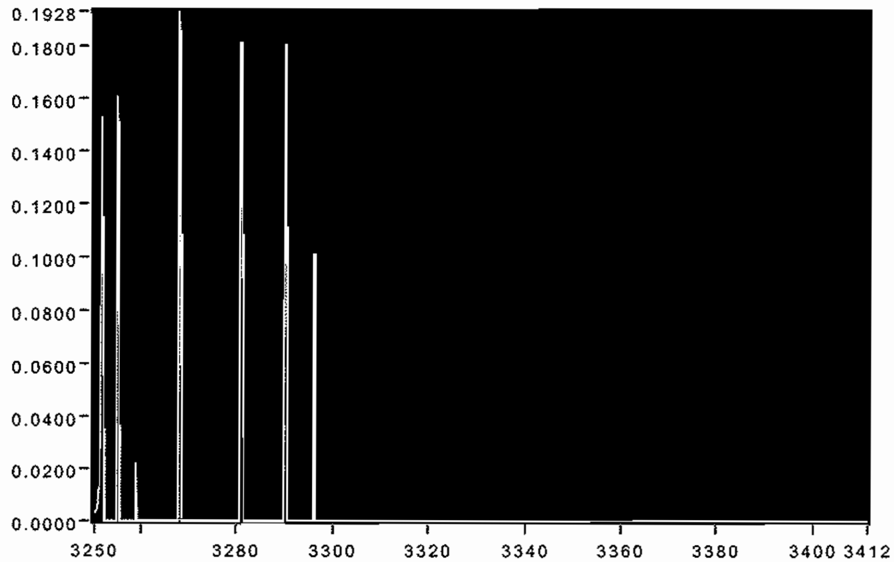

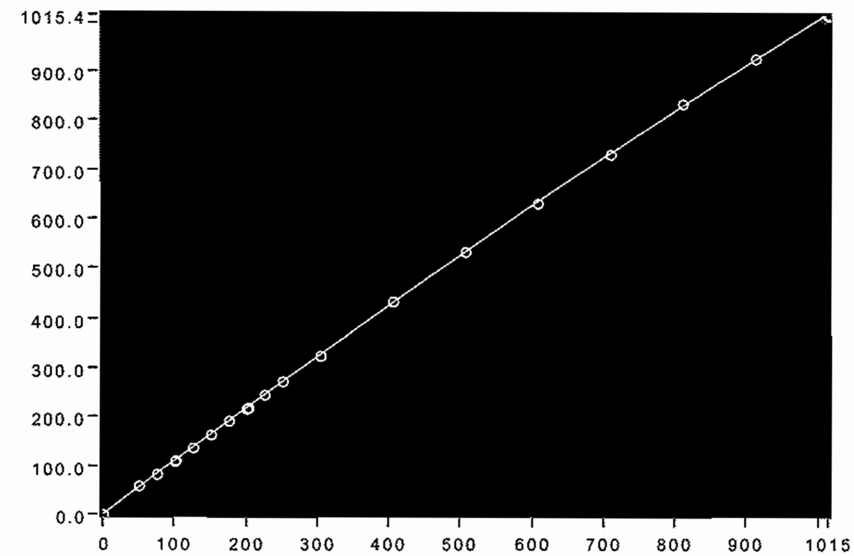

Cal Spectra	Temp (C)	Pres (atm)	Conc (ppm-m)	Actual	Calc'd
HCN (200) PCA 191C (9.86ppm, 5.11r	191.209	0.977	50.385	50.338	58.237
HCN (200) PCA 191C (14.79ppm, 5.11	191.194	0.977	75.577	75.505	81.720
HCN (200) PCA 191C (19.72ppm, 5.11	191.202	0.977	100.769	100.670	108.747
HCN (200) PCA 191C (19.87ppm, 5.11	191.196	0.978	101.536	101.566	110.280
HCN (200) PCA 191C (24.65ppm, 5.11	191.204	0.977	125.962	125.832	137.313
HCN (200) PCA 191C (29.58ppm, 5.11	191.209	0.977	151.154	150.999	163.724
HCN (200) PCA 191C (34.51ppm, 5.11	191.225	0.977	176.346	176.168	191.822
HCN (200) PCA 191C (39.44ppm, 5.11	191.217	0.977	201.538	201.349	216.408
HCN (200) PCA 191C (39.74ppm, 5.11	191.194	0.978	203.071	203.055	218.455
HCN (200) PCA 191C (44.37ppm, 5.11	191.203	0.977	226.731	226.500	244.631
HCN (200) PCA 191C (49.30ppm, 5.11	191.199	0.977	251.923	251.691	271.923
HCN (200) PCA 191C (59.61ppm, 5.11	191.221	0.978	304.607	304.577	324.687
HCN (200) PCA 191C (79.48ppm, 5.11	191.195	0.977	406.143	405.954	433.793
HCN (200) PCA 191C (99.35ppm, 5.11	191.258	0.977	507.679	507.181	534.025
HCN (200) PCA 191C (119.22ppm, 5.11	191.209	0.977	609.214	608.643	630.430
HCN (200) PCA 191C (139.09ppm, 5.11	191.246	0.977	710.750	709.953	730.206
HCN (200) PCA 191C (158.96ppm, 5.11	191.263	0.977	812.286	811.364	834.115
HCN (200) PCA 191C (178.83ppm, 5.11	191.221	0.977	913.821	913.339	926.649
HCN (200) PCA 191C (198.70ppm, 5.11	191.202	0.978	1015.357	1015.357	1015.357

Interpolation: Quadratic — Force Through Zero ☒

Min % Residuals ☐ Excl. Zero ☐ Quant w/ Highest ☐

Spectral Regions
Region 00 - 3250.25 to 3411.52 cm-1
Region 01 - 593.01 to 840.34 cm-1
Region 02 - 1295.95 to 1518.21 cm-1
Region 03 - 2496.93 to 2901.43 cm-1
Region 04 - 3172.38 to 3250.01 cm-1
Region 05 - 3881.35 to 4113.97 cm-1

Calibration Generated: .22 AM 06/26/2012

Gas ID: HF ppm (10) 191C

LRF Path: C:\OLT\Methods R3\Cement-coal-EGU method 191C\HF ppm (10) 191C_12.lrf

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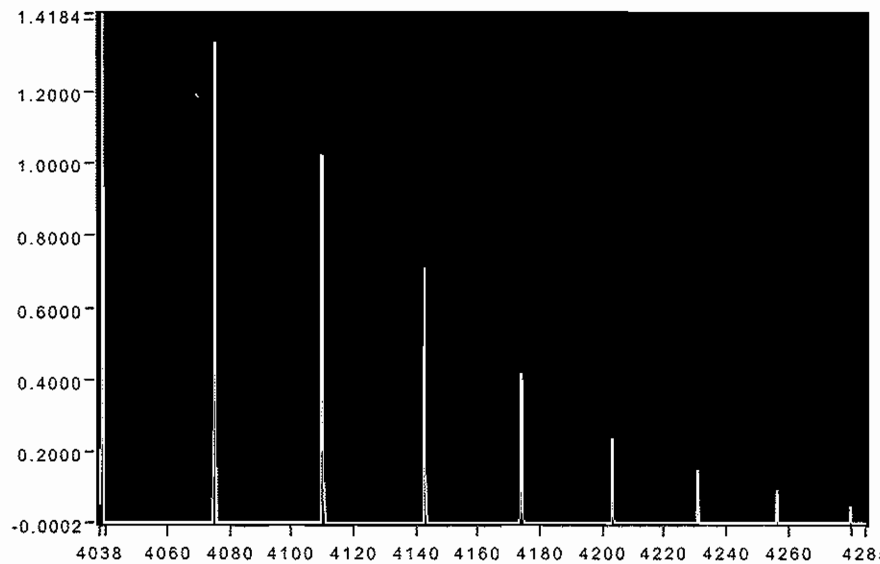
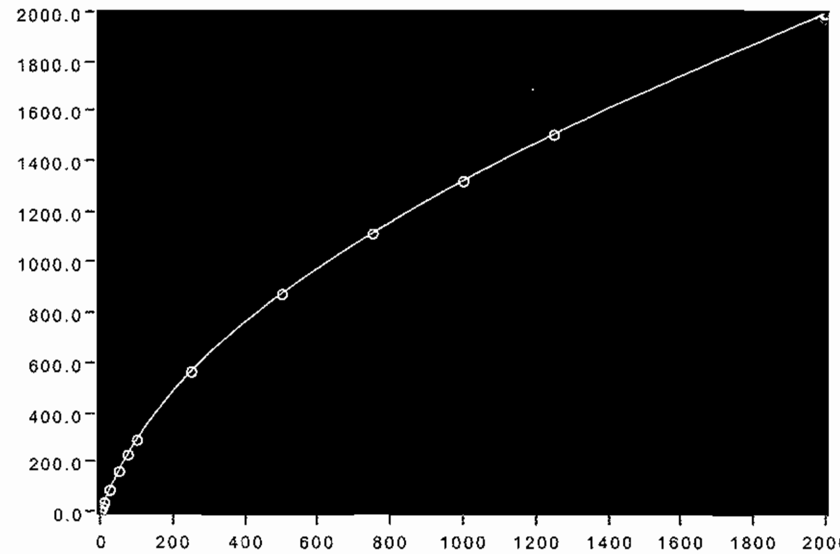
Hi Alarm: NaN

Span: Offse. J0000

Mutations: FALSE





Cal Spectra	Temp (C)	Pres (atm)	Conc (ppm-m)	Actual	Calc'd
HF 96 MNB-fz 1ppm-m (1ppm, 1.000m,	191.000	1.000	1.000	1.000	3.620
HF 96 MNB-fz 5ppm-m (5ppm, 1.000m,	191.000	1.000	5.000	5.000	17.914
HF 96 MNB-fz 10ppm-m (10ppm, 1.000m	191.000	1.000	10.000	10.000	35.375
HF 96 MNB-fz 25ppm-m (25ppm, 1.000	191.000	1.000	25.000	25.000	85.208
HF 96 MNB-fz 50ppm-m (50ppm, 1.000	191.000	1.000	50.000	50.000	160.659
HF 96 MNB-fz 75ppm-m (75ppm, 1.000	191.000	1.000	75.000	75.000	228.048
HF 96 MNB-fz 100ppm-m (100ppm, 1.00	191.000	1.000	100.000	100.000	288.789
HF 96 MNB-fz 250ppm-m (250ppm, 1.0	191.000	1.000	250.000	250.000	565.147
HF 96 MNB-fz 500ppm-m (500ppm, 1.0	191.000	1.000	500.000	500.000	875.753
HF 96 MNB-fz 750ppm-m (750ppm, 1.0	191.000	1.000	750.000	750.000	1115.993
HF 96 MNB-fz 1000ppm-m (1000ppm, 1.	191.000	1.000	1000.000	1000.000	1322.828
HF 96 MNB-fz 1250ppm-m (1250ppm, 1	191.000	1.000	1250.000	1250.000	1509.378
HF 96 MNB-fz 2000ppm-m (2000ppm, 1	191.000	1.000	2000.000	2000.000	2000.000

Interpolation: Spline

Force Through Zero ☒

Min % Residuals ☐ Excl. Zero ☐ Quant w/ Highest ☐

Spectral Regions
Region 00 - 4037.90 to 4284.87 cm-1
Region 01 - 3405.41 to 4037.84 cm-1
Region 02 - 4284.93 to 4363.63 cm-1

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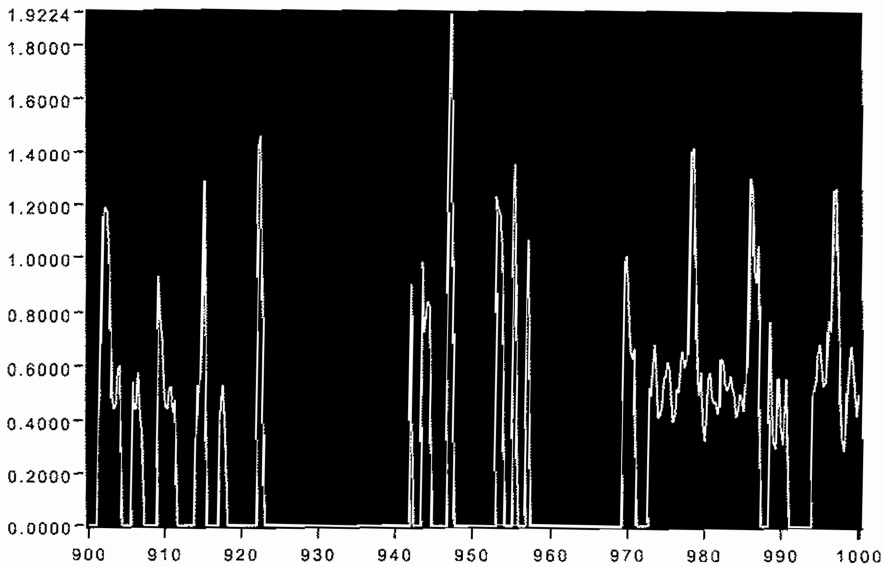

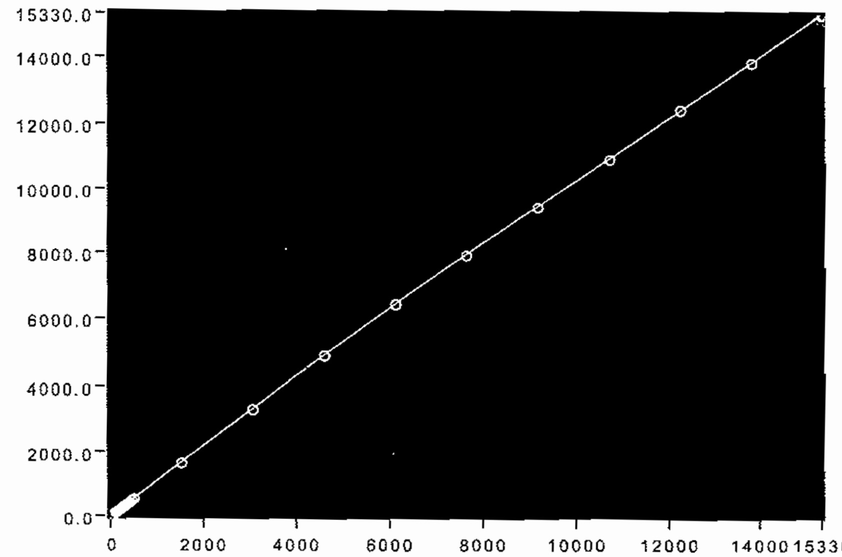

Cal Spectra	Temp (C)	Pres (atm)	Conc (ppm-m)	Actual	Calc'd
Ethylene (9.74ppm, 5.11m, 190C).lab	190.014	0.994	49.792	49.542	54.522
Ethylene (19.49ppm, 5.11m, 190C).lab	189.989	0.994	99.594	99.135	107.070
Ethylene (29.23ppm, 5.11m, 190C).lab	189.985	0.994	149.365	148.729	162.298
Ethylene (38.98ppm, 5.11m, 190C).lab	189.998	0.995	199.188	198.392	217.388
Ethylene (48.72ppm, 5.11m, 190C).lab	189.971	0.995	248.959	247.990	272.190
Ethylene (58.46ppm, 5.11m, 190C).lab	189.964	0.995	298.731	297.587	327.537
Ethylene (68.21ppm, 5.11m, 190C).lab	189.977	0.995	348.553	347.251	383.508
Ethylene (77.95ppm, 5.11m, 190C).lab	189.933	0.995	398.325	396.868	439.409
Ethylene (87.70ppm, 5.11m, 190C).lab	189.964	0.995	448.127	446.506	495.696
Ethylene (97.44ppm, 5.11m, 190C).lab	189.934	0.995	497.918	496.089	551.021
Ethylene (300.00ppm, 5.11m, 190C).la	189.942	0.997	1533.000	1531.357	1654.977
Ethylene (600.00ppm, 5.11m, 190C).la	189.991	0.998	3066.000	3063.066	3290.420
Ethylene (900.00ppm, 5.11m, 190C).la	189.934	0.998	4599.000	4597.015	4885.213
Ethylene (1200.00ppm, 5.11m, 190C).la	189.933	0.998	6132.000	6130.754	6446.341
Ethylene (1500.00ppm, 5.11m, 190C).la	189.960	0.998	7664.999	7658.046	7940.995
Ethylene (1800.00ppm, 5.11m, 190C).la	189.922	0.998	9197.999	9195.039	9445.204
Ethylene (2100.00ppm, 5.11m, 190C).la	189.971	0.998	10730.999	10728.462	10942.161
Ethylene (2400.00ppm, 5.11m, 190C).la	189.936	0.998	12263.999	12262.913	12444.229
Ethylene (2700.00ppm, 5.11m, 190C).la	189.914	0.998	13796.999	13797.629	13888.468

Interpolation Quartic

Force Through Zero ☒

Min % Residuals ☒ Excl. Zero ☐ Quant w/ Highest ☐

Spectral Regions
Region 00 - 900.12 to 1000.16 cm-1
Region 01 - 615.91 to 899.88 cm-1
Region 02 - 1000.40 to 1211.33 cm-1
Region 03 - 1341.75 to 2117.96 cm-1
Region 04 - 2901.41 to 3286.87 cm-1

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Gas ID SF6 (10) 191C

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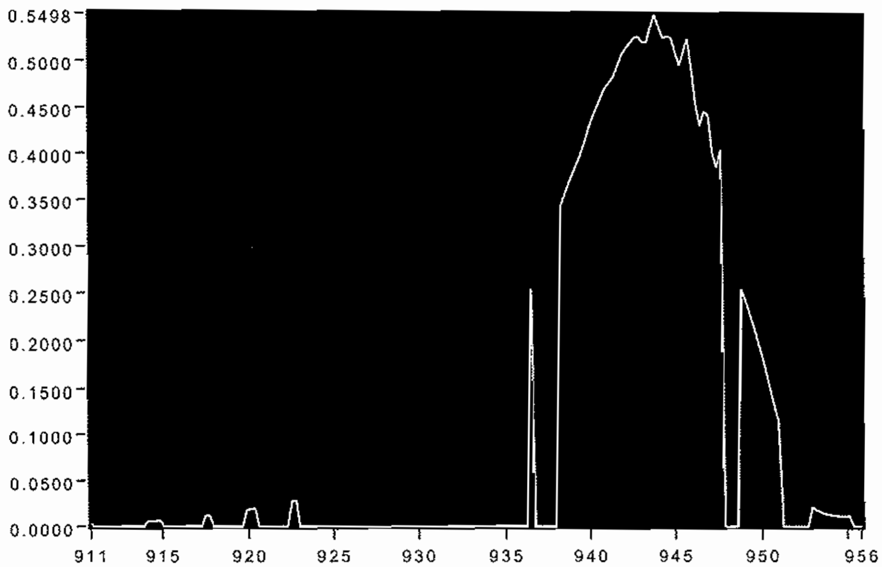
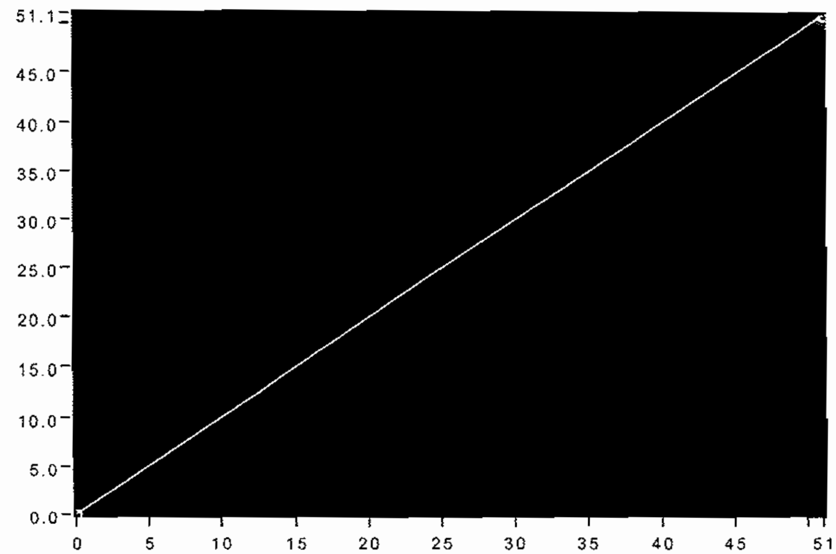
Hi Alarm NaN

Span Offset [illegible]00000

Mutations FALSE





Cal Spectra	Temp (C)	Pres (atm)	Conc (ppm-m)	Actual	Calc'd
SF6 (10ppm, 5.11m, 191C) #1.LAB	191.504	1.008	51.100	51.100	51.100

Interpolation Linear

Force Through Zero ☒

Min % Residuals ☒ Excl. Zero ☐ Quant w/ Highest ☐

Spectral Regions
Region 00 - 910.73 to 955.81 cm-1
Region 01 - 902.05 to 910.49 cm-1
Region 02 - 956.05 to 1004.99 cm-1

Appendix F

Test Participants

Scott Steinsberger	Project Manager and FTIR Operator
Lee Harris	Sample Recovery Technician
Gage Mayer	Sampling Technician
Michael Powell	Sampling Technician
Richard Painter	Holcim Plant Contact

Appendix G

RTR Sampling and Analytical Protocol

PROTOCOL TO PERFORM A SAMPLING AND ANALYTICAL TESTING PROGRAM AS PART OF THE US EPA RISK AND TECHNOLOGY REVIEW

at

Holcim Inc.
Joppa Facility
2500 Portland Road
Grand Chain, IL 62941

Submitted By:
DEECO, INC.
3404 Lake Woodard Road
Raleigh, NC 27604

September 29, 2023

Copy # 1

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

The United States Environmental Protection Agency (US EPA) has directed the portland cement industry (SIC 3241) to conduct emissions testing as part of the US EPA Risk and Technology Review (RTR). This document provides the overall test program approach and specifies minimum sample collection procedures, data quality objectives, and quality assurance/quality control measures to be used by the source testing firms selected by the cement companies performing tests. The test program is designed to be a comprehensive and robust test of each facility. The quality assurance and quality control (QA/QC) measures are designed to produce standardized data having known precision and accuracy. Collection of accurate, representative, and standardized data for facilities with low emissions is necessary especially in view of MACT standard setting procedures.

Cement kiln pyro-processing systems located throughout the US will be included in this request. Individual facilities have a wide range of kiln system configurations and air pollution control (APC) trains. Site-specific considerations will be required to capture emissions profiles for the target analytes that represent the extent of control or possible emissions increases from these controls.

1.2 PLANT NAME, ADDRESS, AND CONTACT

Holcim (US) Inc. - Joppa Facilty
2500 Portland Road
Grand Chain, Illinois 62941

Mr. Richard Painter
TEL (618) 614-0189
FAX (618) 543-7413
E-Mail richard.painter@holcim.com

1.3 PROCESS OF INTEREST

The process to be tested at the Joppa facility is a "long dry" cement kiln. It produces portland cement without an external preheater/precalciner. There is no inline raw mill. There are two kilns located on-site, however one is used. As of this writing, Kiln System #2 is idled, with gases from Kiln System #1 exhausted through the Kiln #2 stack. Kiln System #2 has been idle all of 2023 and there are no plans to bring the kiln up therefore it will not be tested.

1.4 AIR POLLUTION CONTROL EQUIPMENT

The Holcim Joppa facility operates a number of air pollution control devices which help control and lower stack emissions. Those air pollution control devices include an Electrostatic Precipitator (ESP), Low-NO_x Burners, Selective Catalytic Reduction (SCR), Dry Absorbent Addition (DAA) System and the Kiln #2 Baghouse.

1.5 EMISSION POINTS AND SAMPLING LOCATIONS

The emissions from the Kiln #1 are exhausted from the Kiln #2 stack.

1.6 POLLUTANTS TO BE MEASURED

Emission testing will be conducted for hydrogen cyanide (HCN), hydrogen fluoride (HF), and diatomic chlorine (Cl_2). Concurrent measurements to determine volumetric flow rate will be made. The sampling and analytical procedures to be followed are discussed in detail in Section 4.

1.7 EXPECTED TEST DATES

Test dates are to be determined.

1.8 TEST PROGRAM ORGANIZATION

The test program organizational chart is presented in Figure 1.1.

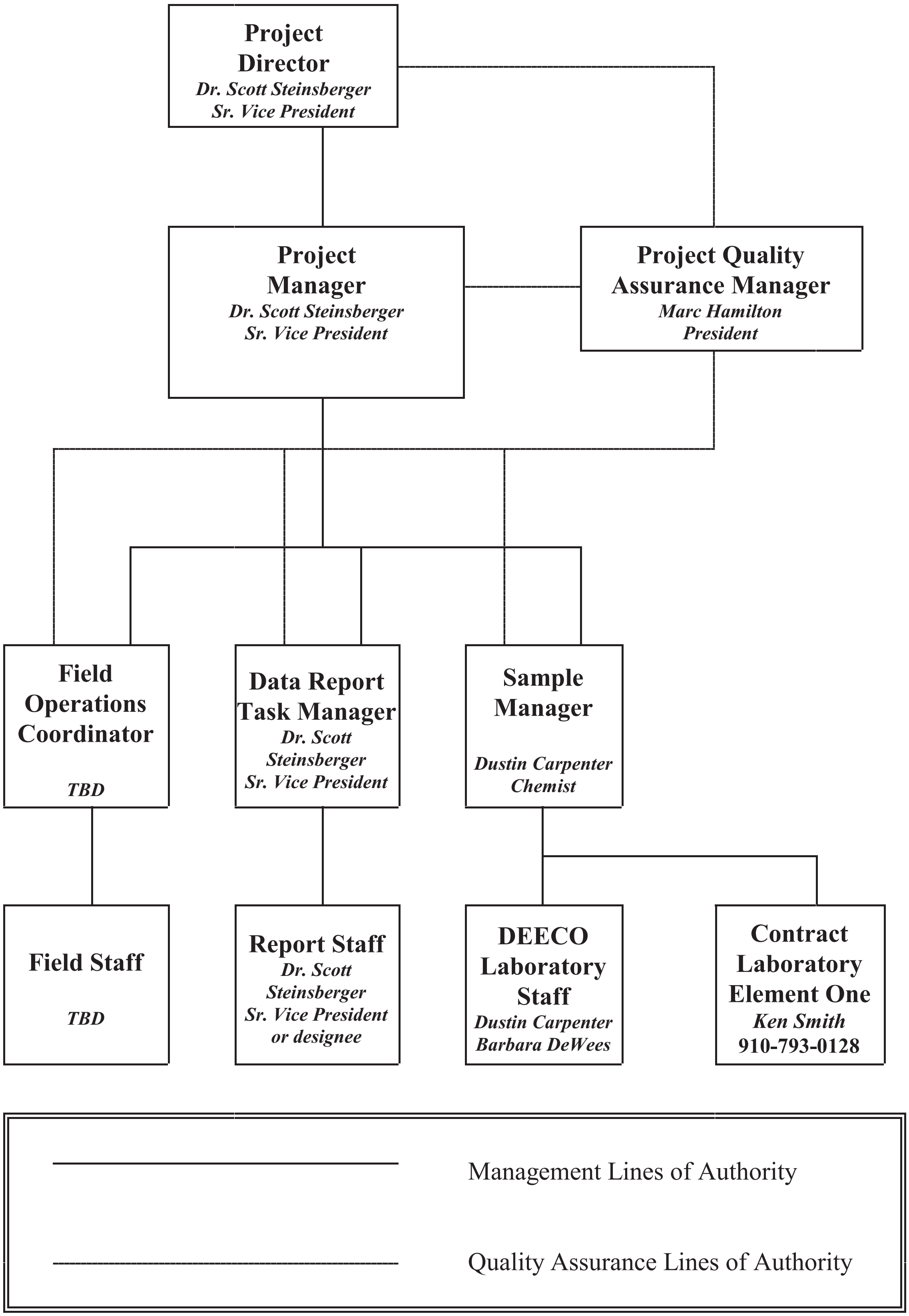


Figure 1.1 Organizational Chart

2.0 SOURCE DESCRIPTION

2.1 PROCESS DESCRIPTION

Holcim's Joppa facility manufactures Portland cements and cement-based products using the "long dry" cement kiln process. There are two kilns located on-site and two raw mills. The facility is capable of producing approximately one million tons of cement products when operating as originally designed. As of this writing, Kiln System #2 is idled, with gases from Kiln System #1 exhausted through the Kiln #2 stack. Kiln System #2 has been idle all of 2023 and there are no plans to restart it.

Raw materials include sources of calcium, iron, silica, and alumina. The raw materials are ground into a fine mix and are introduced into a rotary kiln and exposed to temperatures near 3000°F. In the kiln, the four primary ingredients melt together and undergo chemical and mineralogical changes to produce an interim product called clinker. This clinker is a hard, black, glassy compound which does not resemble the raw materials. Clinker, gypsum and other materials are added to the finish mills and the materials are ground to a fine powder which is the final product - Portland Cement.

Depending on the proportions of the original raw materials, the duration and intensity of the kiln processing, and the parameters set during grinding, different cements are produced with distinctly different capabilities and uses. The manufacturing process consists of the following activities: Raw material receiving; Raw material storage; Raw material reclaim; Raw material grinding; Raw material storage and kiln feed; Pyroprocessing (kilns); Clinker storage; Clinker reclaim; Clinker grinding; Cement storage and Cement loadout.

The Holcim Joppa facility operates a number of air pollution control devices which help control and lower stack emissions. Those air pollution control devices include an Electrostatic Precipitator (ESP), Low-NO_x Burners, Selective Catalytic Reduction (SCR), Dry Absorbent Addition (DAA) System and the Kiln 2 Baghouse.

2.2 CONTROL EQUIPMENT DESCRIPTION

The Holcim Joppa facility operates a number of air pollution control devices which help control and lower stack emissions. Those air pollution control devices include an Electrostatic Precipitator (ESP), Low-NO_x Burners, Selective Catalytic Reduction (SCR) with ammonia injection, Dry Absorbent Addition (DAA) System and the Kiln 2 Baghouse.

A schematic of the Joppa process, including control equipment is shown below in Figure 2.1.

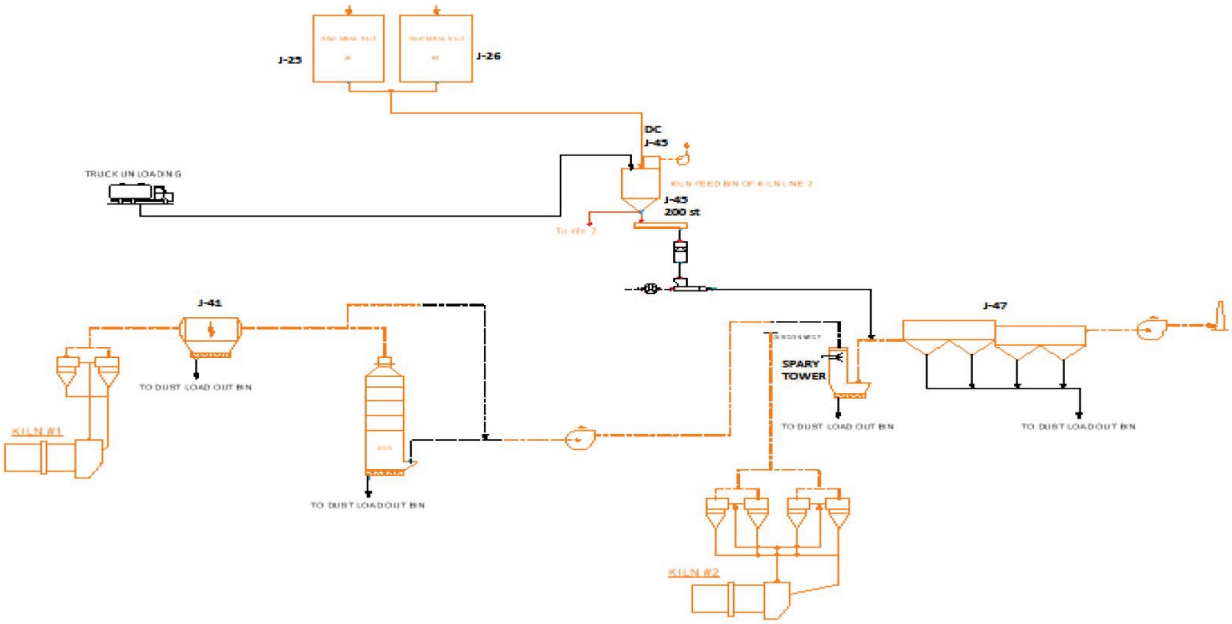


Figure 2.1 Joppa Detailed Process Schematic

3.0 TEST PROGRAM

3.1 OBJECTIVES

An air emissions sampling and analytical program will be conducted on the Common stack at the Joppa cement facility located in Joppa, Illinois. All testing will be performed following accepted EPA methodology. The test program is to provide a standardized data set to the EPA and the cement industry so that reliable facility inter-comparisons of emissions can be made.

All testing will be performed in strict accordance with "DRAFT GENERAL TEST PLAN Testing To Determine HCN, HF, and Cl_2 Emissions From Cement Kilns" dated March 2, 2023" and the specifications stipulated in 40 CFR 60, Appendix A for flow rate following EPA Method 1, 2, 3A, and 4) and hydrogen fluoride (HF) and diatomic chlorine (Cl_2) following EPA Method 26A and in 40 CFR 63, Appendix A for hydrogen cyanide (HCN) and (HF) following EPA Method 320. All sampling runs will be one hour long.

The source emission test will be performed on a date to be determined. Testing will be conducted under representative process and control system operating conditions. For facilities with inline raw mills, testing will be performed while operating in the "Mill On" and "Mill Off" conditions. Joppa has no inline raw mill, therefore only a single operating condition will be tested.

3.2 TEST MATRIX

Table 3-1 presents the sampling and analytical matrix and proposed test schedule.

TABLE 3-1 PROGRAM OUTLINE AND TENTATIVE TEST SCHEDULE

Sampling Location	No. of runs	Sample/Type Pollutant	Sampling Method	Sample Run Times (min)	Analytical Method	Analytical Laboratory
Day 1						
Stack	Arrive on-site and set up test equipment on the Kiln 1 exhaust (from Kiln 2 stack)					
Day 2						
Kiln 1 from Kiln 2 Stack	3	O_2/CO_2	EPA Method 3A	60	Paramagnetic (O_2) NDIR (CO_2)	DEECO
	3	HF and Cl_2	EPA Method 26A[1]	60	Ion Chromatograph	Element One
	3	HCN and HF	EPA Method 320	60	FTIR (Method 320)	DEECO

[1] Stack gas flow rate and moisture measurement may be taken from concurrent Method 26A sampling trains.

3.3 TEST COORDINATION

Mr. Richard Painter, the Joppa facility contact, will serve as the test coordinator and will be responsible for:

1. Scheduling the start of all testing
2. Principal contact with the agency officials concerning the tests
3. Principal contact with DEECO concerning the tests
4. Recording the process data during the testing
5. Providing copies of any field test data to the agency

If there is a temporary equipment malfunction in the middle of a test, radio contact will be made with the test crew in order to delay the test. When problems have been corrected, the test will continue from the point where it was delayed. If the malfunction or upset condition results in an extended test delay, then the affected test run(s) may be aborted and a new run(s) conducted when the malfunction has been corrected or process upset cleared. Any samples or field data from aborted runs may be discarded.

4.0 SAMPLING LOCATION DESCRIPTIONS

4.1 SAMPLING LOCATION DESCRIPTION

The Kiln 1 Stack 2 (which is the same stack formerly used for Kiln #2) is vertically-oriented and circular with an inside diameter of 102". The stack gas sampling ports are located more than 7.5 diameters above the ID fan breaching and more than 0.5 diameters below the stack outlet. The location meets the minimum specifications for a measurement site under EPA Method 1. Cyclonic flow checks, as described in EPA Method 1 Section 2.4, using the Type-S pitot null procedure and angle measurements will be conducted at the Common stack test location.

A twelve (12) point sampling traverse will be made using six (6) point traverses in each of two perpendicular directions (or 3 points in each of 4 sampling ports) at the Common stack. Each traverse will be made at each sampling location using a type-S pitot tube in accordance with EPA Methods 2 procedures. Gas temperatures are to be measured using calibrated Type K thermocouples and digital readout devices. All measurements are to be performed in accordance with the procedures in EPA Methods 2, and 26A.

A schematic of the common stack is provided in Figure 4.1.

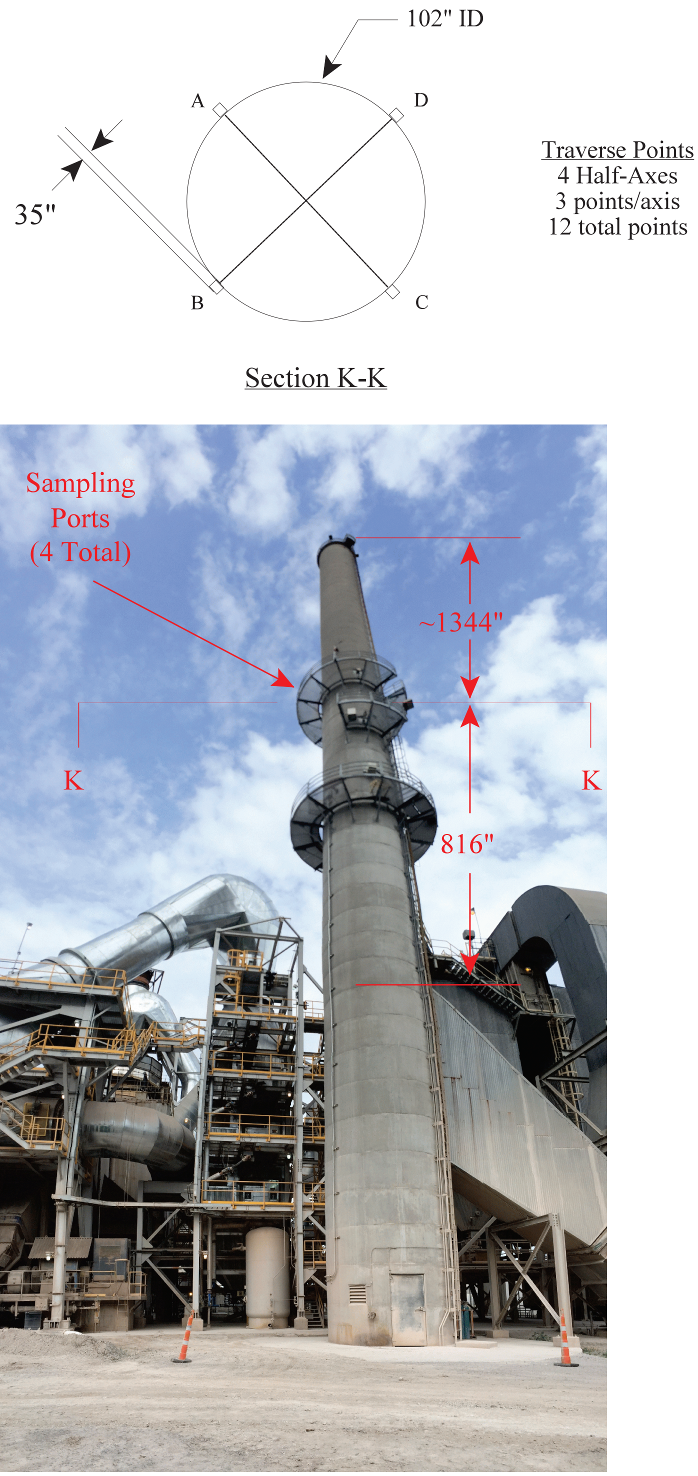


Figure 4.1 Schematic of Stack Sampling Location

5.0 SAMPLING AND ANALYTICAL PROCEDURES

This section contains a brief description of the sampling and analytical procedures for each method that will be employed during the test program. All equipment, procedures, and quality assurance measures necessary for completion of the test program will meet or exceed the specifications of the appropriate methods Any deviations from the methods to ensure quality representativeness of the results are also discussed.

5.1 TEST METHODS

The methods for the test program are described below, and apply to all process operating conditions (e.g. where there is an inline raw mill, testing will be performed while operating in the “Mill On" and “Mill Off” conditions). Table 3-1 outlines expected operating conditions for this test.

5.1.1 SAMPLING POINT DETERMINATION - EPA METHOD 1

The number and location of the sampling or traverse points will be determined according to the procedures outlined in EPA Method 1. The sample location will be inspected to insure EPA Method 1 criteria is met. All points will be at least 1.0 inches from the stack wall, per Method 1.

5.1.2 FLUE GAS VELOCITY AND VOLUMETRIC FLOW RATE - EPA METHOD 2

The flue gas velocity and volumetric flow rate will be determined according to the procedures outlined in EPA Method 2. Velocity measurements will be made using type S pitot tubes conforming to the calibration specifications outlined in EPA Method 2, Section 10.1. Each Type-S pitot tube, calibrated according to these standards, will have an assigned coefficient. Differential pressures will be measured with Magnehelic gauges of appropriate range or with fluid manometers. Effluent gas temperatures will be measured with chromel-alumel thermocouples equipped with digital readouts.

5.1.3 OUTLET FLUE GAS COMPOSITION - EPA METHOD 3A

Outlet flue gas analysis for oxygen (O_2) and carbon dioxide (CO_2) concentrations, and the calculation of percent excess air and flue gas dry molecular weight will be performed in accordance with EPA Method 3A.

To evaluate the sampling location and points for FTIR and O_2 sampling, a three-point O_2 concentration stratification test on a line passing through the centroidal area at 16.7, 50.0 and 83.3 percent of the measurement line (or for stacks is greater than 2.4 meters (7.8 ft) at 0.4, 1.2 and 2.0 meters from the stack or duct wall). The procedures in Section 8.1.2 of Method 7E will be followed, but oxygen will be used as parameter as allowed by fourth sentence in Section 8.1.2. The plant O_2 CEMS as a control. A criteria of <5% variation from combined mean for each point will be used as indication of non-stratification and allowing single point sampling at the point closest to the mean. Otherwise, sampling for equal periods at the three test points during test run will be conducted.

Per EPA Method 3A for determining molecular weight, integrated sampling will be obtain using the Method 320 sampling system described in Section 5.1.6.

A portion of the hot , wet gas sample will be sent through a condensing system to remove the stack moisture, A portion of the moisture-free gas sample will be snt to a CAI Model 200 O_2 (or equivalent) analyzer measures using the paramagnetic technique. An oxygen molecule, because of its sp3 electron orbital distribution, has an unpaired electron and hence displays a magnetic orientation. Since other elements that display this magnetic phenomenon are not common gasses at normal temperatures, the paramagnetic measurement technique is virtually specific for oxygen. The sample gas flows through a detection cell located in a very strong magnetic field. The concentration of O_2 gas present induces a pressure differential in the detector cell. The amount of differential pressure is proportional to the concentration of O_2 gas present.

Calibration procedures will be performed in accordance with EPA methodology. Analyzers will be calibrated before and after each test and a calibration check between each test run.

The pretest calibrations will consist of the following steps:

- Internal (direct) calibration of each analyzer to adjust calibration and check linearity.
- External (through the entire sampling system) calibration to check the system bias on zero and span gases.

The post test calibration will consist of an external system bias calibration check.

The analyzer will be as calibrated using a certified zero and span (mid or high range) gas. Zero and span gases were directed to each analyzer through the appropriate plumbing, the calibration gas flow rates will be adjusted to the correct flow rate and the analyzer will be adjusted with the appropriate span pot.

After the analyzer is properly adjusted the linearity will be checked using a low and high range calibration gas. The maximum allowable limit for linearity is 2% of the analyzer range. All analyzers will be shown to be linear within these limits before proceding..

The external calibration bias check will be performed by placing the CEM system in sampling mode and injecting a zero and span gas into the sample line at the probe exit. This check shows if there is any sampling system related bias, and also checks the integrity of the sample line.

5.1.3.1 Calibration Gases-DEECO will use EPA Protocol and/or ±2% NIST Traceable gases for calibration as required by the various reference methods employed in this test program. Calibration gases will be selected from previous experience with similar sources and/or from information obtained from the facility engineer prior to sampling. In some cases if the gases that are selected are out of the optimum range of operation then no significant impact of data quality is expected due to the linear nature of the analyzers that were used.

Audit gases, if available from a federal or a state agency, will be analyzed.

5.1.3.2 Sampling Procedures-At the completion of the pretest calibration routine, the CEM system will be ready for operation. No further adjustments of sample flow rates, analyzer zero or span adjustments, or other critical CEM operating parameters will be made until testing and post test calibration were complete.

Each sampling run will be one hour. At the completion for each test run, calibration gases will be used to check between test runs. A zero and the upscale calibration gas closest to the actual emission concentrations will be used for the pretest and post test calibrations.

5.1.4 FLUE GAS MOISTURE CONTENT - EPA METHOD 4

The flue gas moisture content will be determined in conjunction with the EPA Method 26A trains according to the sampling and analytical procedures outlined in EPA Method 4. (**NOTE:** In order to maintain isokinetic sampling, the sampling rate used may be required to temporarily exceed the EPA Method 4-specified maximum sampling rate of 0.75 CFM, based on observed stack gas pitot readings.) The impingers will be connected in series and will contain reagents as described below. The impingers will be contained in an ice bath in order to assure condensation of the moisture in the flue gas stream. Any moisture that is not condensed in the impingers is captured in the silica gel, therefore all moisture can be weighed and entered into moisture content calculations.

5.1.5 HYDROGEN FLUORIDE AND DIATOMIC CHLORINE - EPA METHOD 26A

Sampling and analytical procedures will be similar to those outlined in EPA Method 26A to determine primarily diatomic chlorine (Cl_2) emissions and hydrogen fluoride (HF) emissions at main stack outlet sampling locations. Duplicate simultaneous trains (a.k.a "paired trains") for each test run will be used to determine precision.

Sample is collected through a heated glass probe, followed by a heated quartz fiber filter, where stack gas HF and Cl_2 are collected in a series of chilled impingers. The sampling train impingers will contain 50 ml of 0.1N sulfuric acid in the first impinger (optional should high moisture warrant a modified short stem), 100 ml of 0.1N sulfuric acid in the second and third, an empty fourth impinger, 100 ml of 0.1N NaOH in the fifth and sixth and 200 grams of silica gel in the last impinger. (**NOTE**: For plants with scrubbers, the optional cyclone may be used since the gas stream may be saturated with moisture.)

Sampling will be conducted isokinetically (±10%) with readings of flue gas parameters recorded at traverse points selected according to EPA Method 1. Leak-checks on the Method 26A sampling train will be are performed before and after each sampling run and optionally for any port change. In the event that any portion of the train needed to be disassembled and reassembled (i.e., due to filter or resin changes), leak-checks are performed. The sampling train leak-checks and leakage rate (where applicable) are documented on the field test data sheet for each respective run. All leak checks will be acceptable.

The glass button hook nozzle and probe liner will be constructed of borosilicate glass or quartz. The filter holder will be constructed of borosilicate glass with a Teflon frit filter support and a sealing gasket. A heated quartz fiber filter, for sources above 210°C, or PTFE-bonded glass fiber filter will be used. The probe and filter housing will heated to above 248°F and not exceed an upper boundary of 273°F. Probe liners and filter holders will be cleaned thoroughly prior to testing.

The Method 26A trains will be operated isokinetically for a minimum of 60 minutes and collect a minimum of 1 dry, standard cubic meter (DSCM). Pretest preparations, preliminary determinations, and leak check procedures will be those outlined in EPA Method 5.

After completion of sampling the train will be leak checked and transferred to the sample recovery trailer. All leak checks will be acceptable. The impingers will be weighed to determine moisture gain in accordance with EPA Method 4.

Sample recovery will involve quantitative recovery of the sulfuric acid impinger contents and the NaOH impinger contents into separate tare-weighed, precleaned polyethylene sample containers.

The nozzle, probe, filter and filter housing will not be recovered.

The contents of sulfuric acid impingers, including the contents if any of the empty (2^{nd} knockout or fourth) impinger will be quantitatively transferred to the tare-weighed, precleaned polyethylene sample container, followed by three rinses with deionized (DI) water of the impingers and all connecting glassware (including the connecting glassware to the first impinger) placed in the same H_2SO_4 container. The container will be labeled and weighed to determine the final sample volume. The liquid level will be marked on the sample container.

The contents NaOH impingers will be quantitatively transferred to a second tare-weighed, precleaned polyethylene sample container, followed by three rinses with DI water of the impingers and all connecting glassware placed in the same NaOH container. The container will be labeled and weighed to determine the final sample volume. The liquid level will be marked on the sample container

Sample recovery from each train will include:

1. Container No. 1 - Contents 1^{st} knockout, H_2SO_4 impingers, and 2^{nd} knockout and, and DI rinse of impingers and connecting glassware; and
2. Container No. 2 - Contents NaOH impingers, and DI rinse of impingers and connecting glassware.

Additional quality control consists of collecting and analyzing a field blank train for every three test runs. The blank train is to be assembled from a used train, leak checked and sit for a period equal to the sampling time (i.e, 1-hr). The blank train data will be used to determine the method detection limit for the test program target analytes (ie. The lowest number that could be detected), and compared to stack emissions.

Reagent blanks of 0.1 N H_2SO_4, 0.1N NaOH, and DI water will be collected and archived for later analysis should there be any issues with the field blank train samples

The H_2SO_4 impinger solutions will be analyzed using ion chromatography techniques for fluoride ions (F^-) (EPA SW-9057). Duplicate analyses will be performed on the samples and a reagent blank. Precision will be demonstrated by duplicate injection of each sample, the results of each individual analysis must be within 5% of their mean to be acceptable. If the precision criteria is not met, analysis of the sample is repeated until consecutive injections meet the criteria.

The NaOH impinger solutions will be treated with sodium thiosulfate to ensure complete conversion of hypochlorous acid (HClO) to chloride ions (Cl^-). The resulting solution will be analyzed using ion chromatography techniques for chloride ions (EPA SW-9057). Duplicate analyses will be performed on the samples and a reagent blank. Precision will be demonstrated by duplicate injection of each sample, the results of each individual analysis must be within 5% of their mean to be acceptable. If the precision criteria is not met, analysis of the sample is repeated until consecutive injections meet the criteria.

All EPA Method 26A HF/Cl_2 samples will be analyzed by Element One of Wilmington NC. Refer to Section 1, Figure 1.1 for contact information.

The relative deviation (RD)will be calculated as described in EPA Method 30B between the Cl_2 concentrations measured with the paired trains.

5.1.6 HYDROGEN CYANIDE AND HYDROGEN FLUORIDE - EPA METHOD 320

EPA Method 320 will be performed to determine emissions of concentrations of HCN and HF. Three, 1-hour sampling runs will be conducted under representative process and control system operating conditions.

The gas sample will be extracted from the stack through a glass-lined probe and filter heated to 375° F. For external calibration checks and analyte spikes, the gases will be introduced in front of the heated filter. Any excess calibration gas will be diverted through the sample probes into the source. Outflow of gas from the heated filter enclosure was transported through a Teflon sample line heated to 375° F. For this source approximately 100’ of sample line will be required. The heated sample line will be connected directly to the FTIR sample cell. Using heat-traced Teflon tubing the exit of the FTIR cell will be connected to a sample pump with a heated stainless steel pump head. The pump discharge will be directed to a proprietary chiller-type gas conditioner to remove moisture prior to delivery sample gas to the O_2/CO_2 monitors.

The distribution of the gas sample to the monitors will be accomplished using a panel equipped with valves and rotometers. The gas sample was then divided and directed to the analyzers.

FTIR sample cell will be maintained at 191°C and connected to a MKS Instruments Multigas 2030 Fourier Transform Infrared Spectrometer and Detector.

The FTIR spectrometer will measure vapor phase organic or inorganic compounds which absorb energy in the mid-infrared spectral region, about 400 to 4000 cm^{-1} (25 to 2.5 μm). Continuous measurement will be made by matching sample absorbance bands with bands in reference spectra, and comparing sample band intensities with reference band intensities.

The principle limitation to FTIR spectroscopy are the presence of interfering compounds that also absorb energy in the mid-infrared spectral region. In a cement kiln stack gas matrix, water vapor (H_2O) and carbon dioxide (CO_2) are the primary interferents that must be incorporated into the identification and quantitation method.

The FTIR software performs the computation for a single compound by subtracting all the other compounds (interferants and target) from the absorbance spectra and quantifies the single compound based on the remain absorbance. The FTIR software provides a Standard Error Calculation (SEC) value that is an indication of how well the identification and quantitation has been performed. A high SEC indicates that other interferants have not been accounted for in the analysis method, and a low SEC is indicative of greater confidence measurement.

The instrument is operated with a resolution of 0.5 cm^{-1} with 4x zero filling. Beer-Norton Medium apodization is used with amplitude phase correction.

For this RTR test program, following specific QA/QC activities for EPA Method 320 will be performed and criterium met.

<u>5.1.6.1 Laboratory QA/QC Activities Before Field Test Program</u>- Before field testing occurs, the following QA/QC activities will be conducted;

1) Seven consecutive samples of dry nitrogen <u>through the sampling system</u> will be acquired and used to calculate the standard deviation for each of the test program target analytes multiplied

by a factor of 3. These data will be considered representative of detection limits for this test program and are to be compared to the 0.5 ppm required DL;

2) From these seven dry nitrogen samples, the results for the Signal-to-Noise Ratio (SNR) @ 2500 cm^{-1} should be >2500, at 64 scans and the results for single beam intensity @ 2500 cm^{-1} should be >0.9; and

3 Upon receipt of HCN calibration gases a direct analysis will be performed to verify FTIR response agrees with tag value within 5%. Analysis results will be reported to PCA to assess need for modified reference spectra and/or change to direct analysis criterion:

5.1.6.2 QA/QCActivities During Field Test Program- During the field test program, following QA/QC activities will be performed and criterium met;

1) On each test day prior to any testing , an instrument background will be collected using dry nitrogen directed to the gas cell. The background will be collected with at least 128 scans;
2) The probe, filter, sample line and all sample system components in contact with effluent will be maintained at or above 375ºF or 191ºC (consistent with FTIR calibration temperature) to avoid any possible "cold spots;"
3) Heated sample lines will be ≤100 feet wherever possible, and not longer than 200 feet, without prior approval for unusual test circumstances;
4) A system zero with all sampling system components at operating temperature will be performed by injecting nitrogen at the sample probe and through sample filter and entire measurement system. After zero equilibration has been achieved, all measurement components will be quantified for at least 128 scans;
5) Ambient air will be sampled until equilibration of the measurement system has been achieved and all measurement components will be quantify for at least 128 scans;
6) The sample probe will be position at effluent measurement point and sampling will continue until equilibration of the measurement system has been achieved. At this point, the effluent concentrations will be quantified with two consecutive 64-scan samples as the initial native concentration for the dynamic spike;
7) Analyte spiking will be conducted for HCN before the first test run, and after each successive test run for a minimum of 4 spikes per test condition. (Additional spikes would be required before and after corrective action for the sampling or analysis system and/or before and after removing the sampling system from the stack.) These results will determine accuracy;
8) The spike gas injections will be maintained at 10% or less of total sample volume. The spike gas concentration and flow rate will be selected to approximately double the native effluent concentration, or the spike will be conducted to add 3-4 ppm to native concentration, whichever results in greater spiked concentration. Spike recovery results will be within ±20% of the expected value or ±0.5 ppm, whichever is least restrictive. (Specific HCN gases will be manufactured for this test program in the range of 50-100 ppm to provide spikes in the 5-10 ppm range, or lower. An SF_6 or appropriate tracer will be used to calculate the exact spike gas dilution ratio of 10% or less;)
9) After the dynamic spike, nitrogen will be sent through the sampling system until all traces of spike gas are removed and lines are proven below DL for target analytes;
10) The nitrogen purge will be discontinued and the sampling system will be allowed to equilibrate with stack gas before starting a test run. The first two consecutive 64-scan samples of a sample run will be used for the final native concentration. Residual results for HCN and HF will be verified to be less than 0.2-0.3 ppm for data acceptance, or less than 5% of the measured value, whichever is least restrictive. Calculate the standard deviation for

each of the test program target analytes for seven consecutive sample spectra from Run 1, multiplied by a factor of 3. These data will be compared to the pre-test system nitrogen standard deviation results and also included in the facility test report;

11) The SNR @ 2500 cm^{-1}, at 64 scans, and the results for single beam intensity @ 2500 cm^{-1} will be verified to met the >2500 and >0.9 criterium; respectively. The analyte spiking for HCN and subsequent system nitrogen injection will be conducted after each test run. Continue sequence until at least three valid runs per test condition are completed.

6.0 QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES

6.1 QA/QC PROCEDURES

The QA/QC procedures for this RTR test program are summarized in Table 6-1.

TABLE 6-1 QA/QC PROCEDURES AND REQUIREMENTS

Target Analyte	Test Method	Detection Limit	QA/QC
HCN	EPA Method 320	0.5 ppm	Increase scans if needed to achieve detection limits. Increasing to 400 from relative 64 (gives a 2.5 S/N advantage). HCN spiking before and after each run by adding 10% or less spike to approximately double the native effluent concentration, or conduct spike to add 3-4 ppm to native concentration, whichever results in greater spiked concentration. Spike recovery results shall be within ±20% of the expected value or ±0.5 ppm, whichever is least restrictive 5% pre-to-post run calibration transfer standard (CTS) requirement
HF		0.2-0.3 ppm	Rely on CTS (5%), HCN and tracer gas responses to validate HF FTIR data
Cl_2	EPA Method 26A	~ 0.07 mg/m^3 (~0.2 ppm)	Duplicate Simultaneous Trains; Collect minimum of 1 dscm for each sample train. Acceptance criteria for paired samples: 10% Relative Deviation or 0.2 ppm absolute difference, whichever is least restrictive. Insert dry impinger between acid and base impingers
Effluent Flow Rate	EPA Methods 1-4	Not Applicable	As per M26A isokinetic testing or separately by Methods 1-3. FTIR measurements for H_2O. **Wind Tunnel calibrated pitot tube having a Cp of 0.84 or less is required for all flow measurements**. Compare preliminary velocity traverse measurements and sample run flow rate measurements to installed certified flow rate monitor. Investigate and resolve differences greater than 10% of average flow rate.
O_2	EPA Method 3A	Not Applicable	Analyte concentrations corrected @ 7% O_2 Span is 10%, 15%, or 20% (for co-mingled stacks only) Acceptance criteria are 0.2% O_2 difference for analyzer calibration error, and 0.3% O_2 for system bias checks, and zero and upscale drift checks.

6.2 SAMPLE IDENTIFICATION AND CUSTODY

Sample custody procedures for this program are based on EPA recommended procedures. Since samples will be analyzed by one or more laboratories as well as in the field, the custody procedures emphasize careful documentation of sample collection and field analytical data and the use of chain of custody records for samples being transported. The procedures which will be used are discussed below.

The project manager will be responsible for ensuring that proper custody and documentation procedures are followed for the field sampling and field analytical efforts. He will be assisted in this effort by key sampling personnel involved in sampling recovery.

Samples will be collected, transported, and stored in clean containers which are constructed of materials inert to the analytical matrix such as glass jars. Only containers which allow air tight seals will be used. Amber glass jars will be employed when containers are needed to inhibit photochemical reactions.

All sampling data, including information regarding sampling times, locations, and any specific considerations associated with sample acquisition will be recorded on preformatted data sheets. All samples will be given unique, identifying alphanumeric sample codes which will serve to track samples from the field to the laboratory.

Samples will be stored for transport from the lab to the field to the lab in storage boxes constructed in a fashion which minimizes movement and thus prevents breakage of containers. For example, boxes used for transporting glass containers will have foam inserts with form-fitting cutouts. Sample transport boxes will be locked except when in use. Vans containing equipment and samples will be locked whenever they are left unattended.

A daily activity log will be maintained by the project supervisor. This will be an informal log used to record various types of information, such as minor problems which arise, sketches of sampling locations, names and phone numbers of plant contacts. daily activity summaries, etc.

This section provides information regarding the organization of the sampling and analytical program. The following details the key positions and their responsibilities. Once personnel have been assigned to these positions, their qualifications will be provided as an addendum.

The organization of the project team, including QA functions, is shown in the project organization chart (see Figure 1.1).

7.0 SAMPLE CUSTODY

Sample custody procedures for this program are based on EPA recommended procedures. Since samples will be analyzed by one or more laboratories as well as in the field, the custody procedures emphasize careful documentation of sample collection and field analytical data and the use of chain of custody records for samples being transported. The procedures which will be used are discussed below.

7.1 FIELD SAMPLING OPERATIONS

The project manager will be responsible for ensuring that proper custody and documentation procedures are followed for the field sampling and field analytical efforts. He will be assisted in this effort by key sampling personnel involved in sampling recovery.

Samples will be collected, transported, and stored in clean containers which are constructed of materials inert to the analytical matrix such as glass jars. Only containers which allow air tight seals will be used. Amber glass jars will be employed when containers are needed to inhibit photochemical reactions.

All sampling data, including information regarding sampling times, locations, and any specific considerations associated with sample acquisition will be recorded on preformatted data sheets. All samples will be given unique, identifying alphanumeric sample codes which will serve to track samples from the field to the laboratory.

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A daily activity log will be maintained by the project supervisor. This will be an informal log used to record various types of information, such as minor problems which arise, sketches of sampling locations, names and phone numbers of plant contacts. daily activity summaries, etc.

7.2 ANALYTICAL OPERATIONS

Analytical operations will be performed on-site in the laboratory as well as in the remote laboratories. Samples analyzed by outside laboratories are transported with a Change of Custody form. This form will list sample identifications, analytical parameters, sample matrices, anticipated date of results, and other relevant information necessary to ensure the appropriate analyses are performed and to document the progress of the samples.

8.0 INTERNAL QUALITY CONTROL CHECKS

Specific quality control (QC) procedures will be followed to ensure the continuous production of useful and valid data throughout the course of this test program. The QC checks and procedures described in this section represent an integral part of the overall sampling and analytical scheme. Strict adherence to prescribed procedures is quite often the most applicable QC check. A discussion of both the sampling and analytical QC checks that will be utilized during this program is presented below.

8.1 EQUIPMENT INSPECTION AND MAINTENANCE

Each item of field test equipment will be assigned a unique, permanent identification number. An effective preventative maintenance program is necessary to ensure data quality. Each item of equipment returning from the field will be inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated where necessary.

Each item of equipment transported to the field for this test program will be inspected again before being packed to detect equipment problems which may originate during periods of storage. This minimizes lost time on the job site due to equipment failure.

Occasional equipment failure in the field is unavoidable despite the most rigorous inspection and maintenance procedures. For this reason, replacement equipment for all critical sampling train components will be transported to the job site.

8.2 EQUIPMENT CALIBRATION

New items for which calibration is required will be calibrated before initial field use. Equipment whose calibration status may change with use or time will be inspected in the field before testing begins and again upon return form each field use. When an item of equipment is found to be out of calibration, it will be repaired and recalibrated or retired from service. All equipment will be periodically recalibrated in full, regardless of the outcome of these regular inspections.

Calibrations will be conducted in a manner, and at a frequency, which meets or exceeds U.S. EPA specifications. The calibration procedures outlined in the EPA Methods will be followed. When these methods are inapplicable, methods such as those prescribed by the American Society for Testing Materials (ASTM) will be used.

Data obtained during calibrations will be recorded on standardized forms, which will be checked for completeness and accuracy by the quality assurance manager. Data reduction and subsequent calculations will be performed using computer facilities. Calculations will be checked at least twice for accuracy. Copies of calibration forms will be included in the test or projects reports.

Emissions sampling equipment requiring calibration includes pitot tubes, pressure gauges, thermometers, dry gas meters and barometers. The following sections elaborate on the calibration procedures to be followed for these items of equipment.

A: **Pitot Tubes.** All Type S pitot tubes used, whether separate or attached to a sampling probe, will be constructed in-house or by a third-party vendor. Each new pitot will be calibrated in accordance with Section 10.1 of EPA Method 2. Each Type-S pitot tube, calibrated according to these standards, will have an assigned coefficient. This coefficient should not change as long as the pitot tube is not damaged.

Each pitot tube will be inspected visually upon return from the field. If a cursory inspection indicates damage or raises doubt that the pitot remains in accordance with the EPA geometry standards, the pitot tube will be refurbished as needed and recalibrated.

B: **Differential Pressure Gauge.** All meter consoles used are equipped with 10-inch water column (W.C.) inclined-vertical manometers. Fluid manometers do not require calibration other than leak checks. Manometers will be leak checked in the field prior to each test series, and again upon return from the field.

C: **Impinger Thermometer.** Prior to the start of testing, the thermometer used to monitor the temperature of the gas leaving the last impinger will be compared with a mercury-in-glass thermometer which meets ASTM E-1 No. 63F specifications. The impinger thermometer is adjusted if necessary until is agrees within 2ºF of the reference thermometer. If the thermometer is not adjustable, it is labeled with a correction factor.

D: **Dry Gas Meter Thermometer.** The thermometer used to measure the temperature of the metered gas sample will be checked prior to each field trip against an ASTM mercury-in-glass thermometer. The dry gas meter thermometer is acceptable if the values agree within ± 5.4ºF. Thermometers not meeting this requirements will be adjusted or labeled with a correction factor.

E: **Flue Gas Temperature Sensor.** All thermocouples employed for the measurement of flue gas temperature are calibrated upon receipt. Initial calibrations will be performed at three points (ice bath, boiling water, and hot oil). An ASTM mercury-in-glass thermometer will be used as a reference. The thermocouple is acceptable if the agreement is within 1.5 percent (absolute) at each of the three calibration points.

Before and after each field use, the reading from the flue gas thermocouple-potentiometer combination will be compared with an ASTM mercury-in-glass reference thermometer at ambient conditions. If the two agree within ± 1.5 percent (absolute), the thermocouple and potentiometer are considered to be in proper working order.

F: **Dry Gas Meter and Orifice.** Two procedures will be used to calibrate the dry gas meter and orifice simultaneously. The full calibration will be a complete laboratory procedure used to obtain the calibration factor of the dry gas meter. Full calibrations will be performed over a wide range of orifice settings. A simpler procedure, the post-test calibration, will be designed to check whether the calibration factor has changed.

A dry gas meter that is calibrated annually against a spirometer or a set of calibrated critical orifices will be used as a transfer standard. During the annual calibration, triplicate calibration runs will be performed at seven flow rates ranging from 0.25 to 1.40 cfm.

G: **Dry Gas Meter.** Each metering system receives a full calibration at the time of purchase and a post-test calibration after each field use. If the calibration factor, γ, deviates by less than five percent from the initial value, the test data are acceptable. If γ deviates by more than 5 percent, the meter is recalibrated and the meter coefficient (initial or recalibrated) that yields the lowest sample volume for the test runs is used.

EPA Method 5 requires another full calibration anytime the post-test calibration check indicates that γ changed by more than 5 percent. Standard practice is to adjust and recalibrate the dry gas meter anytime γ is found to be outside the range of 0.96 to 1.04. Post-test calibrations will be performed after each field test series per EPA Method 5, section 16.3 procedures.

H: **Orifice.** An orifice calibration factor will be calculated for each flow setting during a full calibration. If the range of values does not vary by more than 0.20 in H_2O over a range of 0.4 to 4.0 in H_2O, the arithmetic average of the values obtained during the calibration is used.

I: **Barometer.** Each field barometer will be adjusted before each test series to agree within ± 0.1 inches of a reference aneroid barometer. The reference barometer will be checked against the station pressure value (corrected for elevation difference) reported by the National Weather Service.

8.3 SAMPLING QUALITY CONTROL PROCEDURES

The following pretest QC checks will be conducted:

- All sampling equipment will be thoroughly checked to ensure clean and operable components.
- Equipment will be inspected for possible damage from shipment.
- The oil manometer or Magnehelic gauge used to measure pressure across the Type S pitot tube will be leveled and zeroed.
- The number and location of the sampling traverse points will be checked before taking measurements.
- The temperature measurement system will be visually checked for damage and operability by measuring the ambient temperature prior to each traverse.

In addition to the general QC procedures listed above, QC procedures specific to each sampling method will also be incorporated into the sampling scheme. These methods and specific procedures are discussed below.

A: Sampling Train QC checks. The following QC procedures will be emphasized:

Prior to Start of Tests

- Keep all cleaned glassware and sample train components sealed until train assembly.
- Assemble the sampling trains in an environment free from uncontrolled dust.
- Visually inspect each sampling train for proper assembly.
- Perform pretest calculations to determine the proper sampling nozzle size.

Prior to Each Test Run

- Visually inspect the sampling nozzle.
- Visually inspect the Type S pitot tube.
- Leak check each leg of the Type S pitot tube.
- Leak check the entire sampling train.

During Each Test Run

- Readings of temperature and differential pressure will be taken at each transverse point.
- All sampling data and calculations will be recorded on preformatted data sheets.
- All calibration data forms will be reviewed for completeness and accuracy.
- Any unusual occurrences will be noted during each run on the appropriate data form.
- The project supervisor will review sampling data sheets daily during testing.
- Properly maintain the roll and pitch axis of the Type S pitot tube and the sampling nozzle.
- Leak check the train before and after any move from one sampling port to another during a run (at DEECO's option) or if a filter change takes place.
- Conduct additional leak checks if the sampling time exceeds 4 hours.
- Maintain the probe, filter, and impingers at the proper temperatures.
- Maintain ice in the ice bath at all times.
- Make proper readings of the dry gas meter, delta P and delta H, temperature, and pump vacuum during sampling at each traverse point.
- Maintain isokinetic sampling within ± 10% of 100%.

After Each Test Run

- Visually inspect the sampling nozzle.
- Visually inspect the Type S pitot tube.
- Leak check each leg of the Type S pitot tube.
- Leak check the entire sampling train.

B: QC for Volumetric air flow rate determinations

Flue Gas Velocity. Data required to determine the flue gas velocity will be collected using the methodology specified in EPA Method 2. Quality control procedures are as follows.

- Visually inspect the Type S pitot tube before and after sampling.
- Leak check both legs of the pitot tube before and after sampling.
- Check the number and location of the sampling traverse points before taking measurements.

Flue Gas Molecular Weight. In the event that that integrated bag samples are to be used for determination of flue gas molecular weight, EPA Method 3 will be the sampling technique specified. Quality control will focus on the following procedures:

- The sampling train will be leak checked before and after each run.
- A constant sampling rate will be used in withdrawing a sample.
- The sampling train will be purged prior to sample collection.
- The sampling port will be properly sealed to prevent air in-leakage.

Moisture Content. The moisture content of the gas stream will be determined using the technique specified in EPA Method 4. The following QC checks will be performed:

- The sampling train will be leak checked before and after each run.
- Ice will be maintained in the ice bath throughout each run to insure an exit temperature (after the silica gel impinger) of $\leq 67°F$.

8.4 ANALYTICAL QUALITY CONTROL PROCEDURES

All analyses for this program will be performed using accepted laboratory procedures in accordance with the specified analytical protocols. Adherence to prescribed QC procedures will ensure data of consistent and measurable quality. Analytical QC will focus upon the use of control standards to provide a measure of analytical precision and accuracy. Also, specific acceptance criteria are defined for various analytical operations including calibrations, control standard analyses, drift checks, blanks, etc. The following general QC procedures will be incorporated into the analytical effort:

- The on-site project manager will review all analytical data and QC data on a daily basis for completeness and acceptability.
- Analytical QC data will be tabulated using the appropriate charts and forms on a daily basis
- Copies of the QC data tabulation will be submitted to the quality assurance manager following the completion of the test program.
- All hard copy raw data (i.e., chromatograms, computer printouts, etc.) will be maintained in organized files.

Specific analytical QC procedures for the Orsat analyzer (if used) are listed below.

- The analyzer will be leveled and the fluid levels zeroed prior to use.
- The analyzer will be leak checked prior to use.
- The analyzer will be thoroughly purged with sample prior to use.
- The analyzer will be checked by analyzing an ambient air sample.

EPA Method 26A Sample Analysis QC Checks are listed below.

- Calibration curve consisting of 4 calibration levels that bracket the expected sample range. Dilute samples as necessary to reach the calibration range;
- Duplicate analysis of calibration standards, before and after sample analysis, with duplicate injections being within 5% of their mean;
- Duplicate analysis of reagent blanks, quality control samples and field samples with duplicate injections being within 5% of their mean;
- Matrix spike samples may be prepared and analyzed. Matrix spike recoveries should be 90-110%
- A field blank will be carried through the procedure and analyzed with the field samples.
- An audit sample will be analyzed for if available from two or more independent, Approved Audit Sample Providers no less than 60 days prior to the test effort.

9.0 REPORTING AND DATA REDUCTION REQUIREMENTS

9.1 DATA REPORTING

The reporting units for HCN, HF, and Cl_2 will be in parts-per-million by volume, wet basis ($ppm_{v,d}$), parts-per-million by volume, dry corrected to 7% oxygen ($ppm_{v,d}$@7%O_2), pounds-per-hour (lbs/hr), and pounds-per-ton of clinker (lbs/ton). Additional supporting data for CO_2, O_2, and H_2O concentrations and volumetric flow rates (actual cubic feet-per-minute, wet,standard cubic feet-per-minute, and dry,standard cubic feet-per-minute) will be reported. The clinker production, in short tons-per-hour (TPH) will be reported.

Any data that is not acceptable because of technical difficulties will be indicated, and an explanation of the technical problem will be given. All related QC and calibration data will be in the final report.

9.2 REPORT CONTENTS

Copies of the test report will be submitted after the test series has been completed. Results reported will include, but not be limited to emission rates and concentrations of gaseous pollutants, and process sample determinations, any liquid stream constituents determinations, and any other type of data requested. This report will also include a list of all personnel present during testing, summary results, descriptions of test procedures used, a description of the source and its operation during testing, test locations drawings, example calculations, raw field data, and equipment calibrations.

9.3 DATA REDUCTION

Care will be exercised to ensure hand recorded data is written accurately and legibly. Additionally, the use of prepared data recording forms, conveniently formatted, is an important aid to verify that all necessary data items are recorded. The collected field and laboratory data will be reviewed by the analyst and the Project Manager.

The Project Manager will reduce and validate all of the sampling and analytical data that is collected. The sampling data will include flow measurements, calibrations, etc. Each laboratory will reduce all analytical results prior to their submission to the Project Manager. The analytical data will be used to determine concentrations and emission rates of the compounds of interest.

Data reduction follows guidelines published in EPA Reference Methods, where applicable, and by guideline documents where EPA Reference Methods are not available. Validated computer programs will be used to calculate all reported values.

9.4 DATA VALIDATION

A second technical review of the data will be performed and documented by a qualified scientist other than the one who performed the actual analyses. The second reviewer will include evidence (e.g., check marks, recalculations, etc.) that show which data points were checked. Finally, the second reviewer will sign and date the cover page of the data packet or the record that was reviewed.

In-situ measurements will be validated by demonstrated acceptable post-test leak checks and calibration verifications according to the referenced method used.

Analysis data may be validated according to defined criteria by a secondary reviewer or by the analyst. At a minimum and if applicable, analysis data will be validated according to the following criteria (additional method-specific criteria or project requirements may apply):

- Sampling records complete and traceable

- All appropriate QC samples included with the analytical batch and reported with the sample results

- Routine tuning, calibration and inspection of analytical instrumentation documented and performed prior to analyses

- Initial and continuing calibration criteria met

- Method/reagent blanks confirm no background contamination

- Surrogate recoveries within criteria

- Qualitative sample results (e.g., retention times, mass spectra, isotopic ratios) consistent with standard data

- Sample data within the calibrated range of the instrument

- Chromatograms or other raw data consistent with computer-generated quantitation reports

- Accuracy of intermediate data manipulations, transcribed numbers and/or final reported results verified

- Reference standards, instrumentation, sample identification, analysts, methodology, and sequence of processing clearly identified and traceable in the project records

- Lost data or corrective actions documented (e.g., loss of sample, reanalysis, redilutions, additional cleanup steps, alternative calculations etc.)

- Data that does not meet the validation requirements flagged accordingly

- Data reported in the correct units (e.g., "ppm" should not be used without specifying volume or mass units; "ug/g" are preferred units for data reporting)

10.0 PLANT ENTRY AND SAFETY

10.1 SAFETY RESPONSIBILITIES

The Project Manager is responsible for ensuring compliance with plant entry, health, and safety requirements. The Facility Contact (refer to Section 1.2) as the authority to impose or waive facility restrictions. The Project Manager has the authority to negotiate with facility person any deviations from the facility restrictions.

10.2 SAFETY PROGRAM

DEECO has a comprehensive health and safety program that satisfies Federal OSHA and MSHA requirements. The basic elements include: (1) written policies and procedures, (2) routine training of employees and supervisors, (3) medical monitoring, (4) use of personal protection equipment, (5) hazard communication, (6) pre-mobilization meetings with Holcim personnel and DEECO test team personnel, and (7) routine surveillance of the on-going test work.

10.3 SAFETY REQUIREMENTS

All test personnel will adhere to the following standard safety and precautionary measures as follows:

1) Confine activities to test area only;
2) Wear hard hats at all times on-site, except inside sample recovery trailers and mobile CEM laboratory;
3) Wear protective shoes or boots in test area:
4) Wear protective glasses or goggles at the outlet test sites, and other areas as designated;
5) Have readily available first aid equipment and fire extinguishers.

Before or on the first day on-site, the Project Manager will fill out the Emergency Response Procedure form and provide copies to be posted at each test site.

Appendix A

Sampling and Analytical Methods

The sampling and analytical methods for this sampling effort can be found at the following website:

Promulgated EPA test methods, 40 CFR 60 (Methods 1-4, 26A, and 320)

https://www.epa.gov/emc/emc-promulgated-test-methods