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

**Buzzi Unicem USA, Inc.
Signal Mountain Cement Company
Chattanooga, Tennessee**

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TEST DATES: December 13, 2023

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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.

Signal Mountain is a 900,000 ton per year rated cement pyro-processing system. The plant operates one dry-process rotary kiln that has a preheater/precalciner (PH/PC). It has an FLS in-line calciner with one additional tertiary air duct. An in-line raw mill provides kiln feed to the system. The gases from the kiln process exhaust out of a main Kiln Stack.

The Signal Mountain facility kiln has a baghouse to control particulate matter (PM).

A more detailed description of the processes is provided in Section 2 of the RTR Sampling and Analytical Protocol reproduced in Appendix

The Buzzi retained DEECO Inc. (DEECO) to conduct emission tests for for hydrogen cyanide (HCN), hydrogen fluoride (HF), and diatomic chlorine (Cl₂). 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; BUZZI UNICEM USA, INC., SIGNAL MOUNTAIN FACILITY, CHATTANOOGA TN; DECEMBER 13, 2023

Test Parameters	Main Stack Raw Mill On	Main Stack Raw Mill Off
Hydrogen Cyanide (FTIR) parts-per-million, dry basis corrected to 7% O ₂ pounds-per-hour pounds-per-ton of clinker	3.3 1.8 0.015	3.4 1.9 0.016
Hydrogen Fluoride (FTIR) parts-per-million, dry basis corrected to 7% O ₂ pounds-per-hour pounds-per-ton of clinker	<0.056 <0.023 <0.0002	<0.045 <0.018 <0.0002
Hydrogen Fluoride (Method 26A) parts-per-million, dry basis corrected to 7% O ₂ pounds-per-hour pounds-per-ton of clinker	<0.316 <0.128 <0.0011	<0.260 <0.106 <0.0009
Diatomic Chlorine (Method 26A) parts-per-million, dry basis corrected to 7% O ₂ pounds-per-hour pounds-per-ton of clinker	<0.076 <0.109 <0.0009	<0.065 <0.093 <0.0008

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

Testing was performed on the main stack under two conditions, Raw Mill On and Raw Mill Off. Three Raw Mill On runs and three Raw Mill Off runs were conducted on December 13, 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, 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 BUZZI UNICEM USA, INC., SIGNAL MOUNTAIN FACILITY, CHATTANOOGA TN

Location and Frequency	Test Parameter	Sampling Method	Sampling Procedure	Analysis Method	Analysis Procedure
Kiln 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 Buzzi's Signal Mountain facility located in Chattanooga, TN 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 main stack under two conditions; Raw Mill On and Raw Mill Off and the results are summarized in Tables 2.1 and 2.2, respectively.

TABLE 2.1 BUZZI UNICEM USA, INC., SIGNAL MOUNTAIN FACILITY, CHATTANOOGA TN; KILN MAIN STACK HYDROGEN CYANIDE, HYDROGEN FLUORIDE, AND DIATOMIC CHLORINE EMISSIONS; RAW MILL ON; DECEMBER 13, 2023

Test Parameter	Main Stack Raw Mill On Run 1	Main Stack Raw Mill On Run 2	Main Stack Raw Mill On Run 3	Main Stack Raw Mill On Average
Time	08:15-09:33	09:48-11:03	11:16-12:29	December 13, 2023
Flow Rate (dscfm)	217,500	213,400	213,300	214,733
Oxygen	12.5%	12.5%	12.4%	12.5%
Carbon Dioxide	15.4%	15.6%	15.7%	15.6%
Moisture	4.8%	5.6%	4.9%	5.1%
Hydrogen Cyanide (FTIR)				
ppm _{dry} at 7% O ₂	3.4	3.3	3.2	3.3
pounds-per-hour	1.9	1.8	1.8	1.8
pounds-per-ton of clinker	0.016	0.015	0.015	0.015
Hydrogen Fluoride (FTIR)				
ppm _{dry} at 7% O ₂	<0.056	<0.056	<0.055	<0.056
pounds-per-hour	<0.023	<0.023	<0.022	<0.023
pounds-per-ton of clinker	<0.0002	<0.0002	<0.0002	<0.0002
Hydrogen Fluoride (Method 26A)				
ppm _{dry} at 7% O ₂	<0.313	<0.312	<0.325	<0.316
pounds-per-hour	<0.128	<0.125	<0.132	<0.128
pounds-per-ton of clinker	<0.0011	<0.0011	<0.0011	<0.0011
Diatomic Chlorine (Method 26A)				
ppm _{dry} at 7% O ₂	<0.076	<0.083	<0.069	<0.076
pounds-per-hour	<0.110	<0.118	<0.099	<0.109
pounds-per-ton of clinker	<0.0009	<0.0010	<0.0008	<0.0009

TABLE 2.2 BUZZI UNICEM USA, INC., SIGNAL MOUNTAIN FACILITY, CHATTANOOGA TN; KILN MAIN STACK HYDROGEN CYANIDE, HYDROGEN FLUORIDE, AND DIATOMIC CHLORINE EMISSIONS; RAW MILL OFF; DECEMBER 13, 2023

Test Parameter	Main Stack Raw Mill Off Run 1	Main Stack Raw Mill Off Run 2	Main Stack Raw Mill Off Run 3	Main Stack Raw Mill Off Average
Time	13:15-14:29	14:45-16:00	16:13-17:30	December 13, 2023
Flow Rate (dscfm)	177,400	174,400	171,200	174,333
Oxygen	10.9%	10.8%	9.7%	10.5%
Carbon Dioxide	18.8%	18.7%	19.0%	18.8%
Moisture	6.1%	5.9%	6.3%	6.1%
Hydrogen Cyanide (FTIR)				
ppm _{dry} at 7% O ₂	3.4	3.5	3.3	3.4
pounds-per-hour	1.8	1.9	1.9	1.9
pounds-per-ton of clinker	0.015	0.016	0.016	0.016
Hydrogen Fluoride (FTIR)				
ppm _{dry} at 7% O ₂	<0.047	<0.047	<0.042	<0.045
pounds-per-hour	<0.019	<0.018	<0.018	<0.018
pounds-per-ton of clinker	<0.0002	<0.0002	<0.0002	<0.0002
Hydrogen Fluoride (Method 26A)				
ppm _{dry} at 7% O ₂	<0.262	<0.268	<0.252	<0.260
pounds-per-hour	<0.104	<0.106	<0.108	<0.106
pounds-per-ton of clinker	<0.0009	<0.0009	<0.0009	<0.0009
Diatomic Chlorine (Method 26A)				
ppm _{dry} at 7% O ₂	<0.069	<0.062	<0.064	<0.065
pounds-per-hour	<0.097	<0.086	<0.097	<0.093
pounds-per-ton of clinker	<0.0008	<0.0007	<0.0008	<0.0008

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 main stack at Buzzi's Signal Mountain facility in Chattanooga TN. 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 measurement site for the Kiln Stack was located in a vertically-oriented rectangular duct. The duct had an inside dimension of 84" deep by 180" wide, with an equivalent diameter of 114.5". The nearest upstream disturbance was located 756" (~6.6 diameters) from the sampling ports. The nearest downstream disturbance was located 1,587" (~13.9 diameters) from the sampling ports. Four (4) test ports are located at equidistant across the width of the duct. The number and location of the sampling or traverse points were determined according to the procedures outlined in EPA Method 1. The traverse point locations are provided in Appendix B. All points were at least 1.0 inches from the stack wall, per Method 1.

The sampling location met the minimum specifications for selection of a measurement site as outlined in 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 at the stack test location were conducted.

A twelve (12) point sampling traverse were made using 3 points in each of 4 sampling ports at the main stack. Each traverse was made at each sampling location using a type-S pitot tube in accordance with EPA Methods 2 procedures. The traverse point locations are provided in Appendix B. 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 main stack is provided in Figure 3-1.

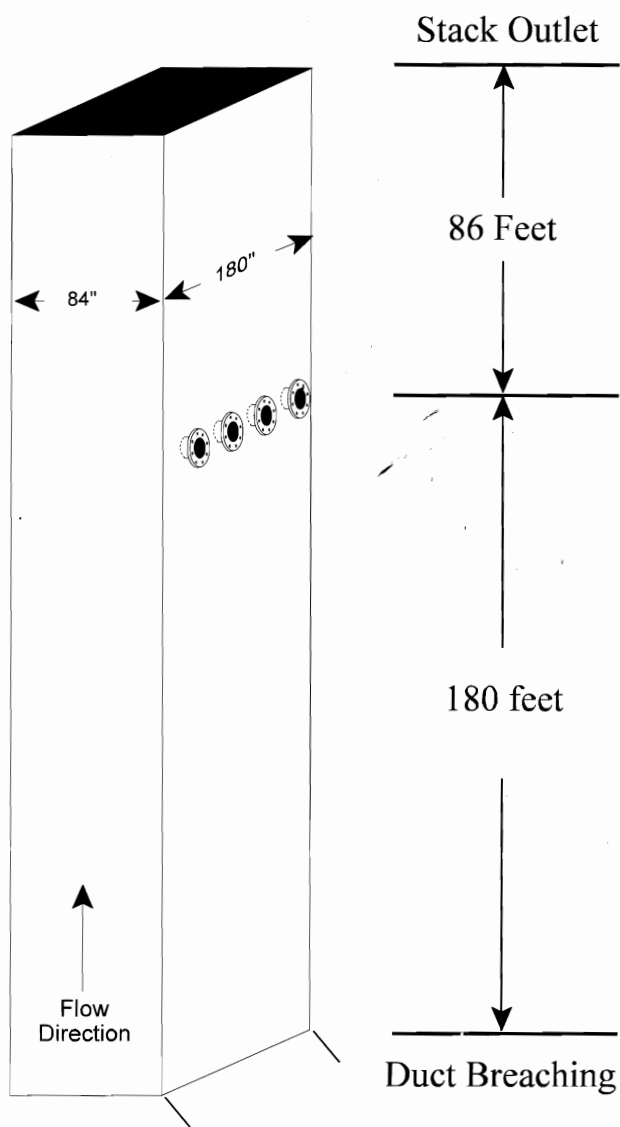
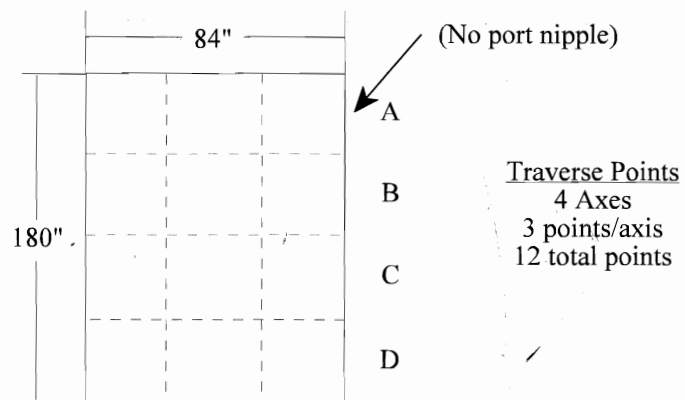


Figure 3.1 Schematic of the Main Stack Sampling Location

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 (O₂) and carbon dioxide (CO₂) 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 O₂ sampling, a three-point O₂ 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, but oxygen will be used as parameter as allowed by fourth sentence in Section 8.1.2. The plant O₂ 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 will be obtain using the 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 O₂/CO₂ 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 used EPA Protocol and/or $\pm 2\%$ 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.

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 ($\pm 10\%$) 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 will be 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-weighted, 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-weighted, 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 MAIN STACK; DECEMBER 13, 2023

Run	Time	Train A Diatomic Chlorine Concentration (ppm,dry)	Train B Diatomic Chlorine Concentration (ppm,dry)	Absolute Difference (ppm,dry)
December 13, 2023; Main Stack; Raw Mill On				
Run 1	08:15-09:33	<0.051	<0.041	0.010
Run 2	09:48-11:03	<0.042	<0.058	0.016
Run 3	11:16-12:29	<0.041	<0.043	0.002
December 13, 2023; Main Stack; Raw Mill Off				
Run 1	13:15-14:29	0.059	<0.040	0.019
Run 2	14:45-16:00	0.051	<0.038	0.013
Run 3	16:13-17:30	0.062	<0.041	0.020

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 O₂/CO₂ 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 O₂/CO₂ 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 (H₂O) and carbon dioxide (CO₂) 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/QC Activities 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 375°F or 191°C (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 been achieved, all measurement components will be 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 will be 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 $\pm 20\%$ of the expected value. An SF_6 tracer was used to calculate the exact spike gas dilution ratio of 10% or less;
- 7) After the dynamic spike, nitrogen was sent through the sampling system until all traces of spike gas are removed and lines are proven below DL for target analytes;

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__006419.LAB	49.09	4.82			
SPC__006420.LAB	49.17	4.82			
SPC__006421.LAB	49.27	4.82			
Averages	49.17	4.82			
Residuals for Post HCN analyte spike native scans					
SPC_006450.LAB					
Concentration	1.94		-0.03		
MDC3	1.62		0.18		
MDC3%	NA		NA		
SPC_006457LAB					
Concentration	2.69		-0.03		
MDC3	1.54		0.20		
MDC3%	NA		NA		
Final SNR @ 2500 cm⁻¹ and single beam intensity @ 2500 cm⁻¹					
SPC_006954.LAB				3720.3	0.87

- 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 were higher than expected and the signal throughput was slightly low, but the analyte spikes were within 10% and are the ultimate QA of the method.
- 9) The final SNR @ 2500 cm^{-1} , at 64 scans, and the results for single beam intensity @ 2500 cm^{-1} were verified to meet 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 MAIN STACK; DECEMBER 13, 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
December 13, 2023; Main Stack Raw Mill On					
Pre Run 1	07:58-08:08	2.11	4.21	90.2%	-2.2%
Post Run 1	09:14-09:33	1.94	4.22	95.7%	
Post Run 2	10:48-11:01	1.89	4.24	93.9%	
Post Run 3	12:17-12:33	1.91	3.87	90.1%	
December 13, 2023; Main Stack Raw Mill Off					
Pre Run 1	13:09-13:20	2.23	4.71	95.6%	
Post Run 1	14:19-14:31	2.38	4.50	92.5%	
Post Run 2	15:55-16:06	2.54	4.86	91.9%	
Post Run 3	17:14-17:36	2.54	4.92	97.1%	-3.1%

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 will be Buzzi Unicem. 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 ft³/rev capacity and ± 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 system's pump is operated for 5 minutes at an orifice manometer setting of 0.5 inches H₂O to heat up the pump and system to stabilize the meter inlet and outlet temperatures. Values for the orifice setting (ΔH), 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 (γ) 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 was performed following EPA Method 5, Section 16.3 or a 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: Buzzi Unicem; Chattanooga TN
Source: Kiln Main Stack; Mill On
Job ID: 23-3317
Train Type: M26A

	1A	1B	2A	2B	3A	3B	Average
	12/13/23	12/13/23	12/13/23	12/13/23	12/13/23	12/13/23	
	815-933	815-933	948-1103	948-1103	1116-1229	1116-1229	
Initial Meter Volume, ft ³	700.206	596.658	749.835	646.404	798.871	696.168	
Final Meter Volume, ft ³	749.631	646.002	798.742	695.787	847.831	746.699	
Intra-Port Leak Check Volume, ft ³	0.000	0.000	0.000	0.000	0.000	0.000	
Total Sample Volume, cf	49.425	49.344	48.907	49.383	48.960	50.531	49.425
DGM Calibration Factor	0.985	0.975	0.985	0.975	0.985	0.975	0.980
Average DGM Temp, F	57.3	53.8	61.7	57.7	64.0	64.1	59.8
Average DGM delta H, "H2O	2.20	2.20	2.17	2.17	2.12	2.18	2.17
Barometric Pressure, "Hg	29.70	29.70	29.70	29.70	29.67	29.67	29.69
Corrected Sample Vol,dscf	49.574	49.324	48.637	48.988	48.421	49.466	49.068
Corrected Sample Vol,dscm	1.404	1.397	1.377	1.387	1.371	1.401	1.390
Oxygen, %	12.5	12.5	12.5	12.5	12.4	12.4	12.5
Carbon Dioxide, %	15.4	15.4	15.6	15.6	15.7	15.7	15.6
Nitrogen, %	72.1	72.1	71.9	71.9	71.9	71.9	72.0
Stack Gas Excess Air, %	191.3	191.3	192.9	192.9	188.4	188.4	190.9
Total Moisture Catch Weight, grams	52.1	53.8	58.4	65.5	55.7	50.3	57.2
Stack Gas Moisture, %	4.7	4.9	5.3	5.9	5.1	4.6	5.1
Stack Gas Dry Molecular Weight, lb/lbmole	30.96	30.96	31.00	31.00	31.01	31.01	30.99
Stack Gas Wet Molecular Weight, lb/lbmole	30.35	30.33	30.31	30.23	30.34	30.41	30.33
Average Stack Temp, F	317.4	319.2	322.8	323.6	324.3	325.8	322.2
Stack Static (Gauge) Pressure, "H2O	-1.50	-1.50	-1.50	-1.50	-1.50	-1.50	-1.50
Stack Gas Actual Pressure, "Hg	29.59	29.59	29.59	29.59	29.56	29.56	29.58
Average Sqrt delta P	0.800	0.798	0.791	0.793	0.784	0.792	0.793
Pitot Tube Coefficient	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Stack Gas Velocity, ft/second	54.09	54.03	53.70	53.93	53.28	53.81	53.81
Nozzle Inside Diameter, inches	0.270	0.270	0.270	0.270	0.270	0.270	
Total Sample Time, min	60	60	60	60	60	60	60
Isokinetic Rate, %	100.1	100.1	100.2	101.3	100.6	101.5	100.6
Stack Dimensions	84 x 180 in.	84 x 180 in.	84 x 180 in.	84 x 180 in.	84 x 180 in.	84 x 180 in.	
Stack Area, sq ft	105.00	105.00	105.00	105.00	105.00	105.00	105.00
Stack Gas Flow Rate, acfm	340,800	340,400	338,300	339,800	335,700	339,000	339,000
Stack Gas Flow Rate, acmm	9,650	9,639	9,580	9,622	9,506	9,599	9,599
Stack Gas Flow Rate, dscfm	218,100	216,900	213,700	213,100	211,900	214,700	214,733
Stack Gas Flow Rate, dscmm	6,176	6,142	6,051	6,034	6,000	6,080	6,081
13774736.84	13698947.37	13496842.11	13458947				
pass	pass	pass	pass	pass	pass	pass	
ALT-009 Post Test Calibration							

Company: Buzzi Unicem; Chattanooga TN
Source: Kiln Main Stack; Mill On
Job ID: 23-3317
Train Type: M26A

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

	1A 12/13/23 815-933	1B 12/13/23 815-933	2A 12/13/23 948-1103	2B 12/13/23 948-1103	3A 12/13/23 1116-1229	3B 12/13/23 1116-1229	Average
Hydrogen Fluoride	Catch Wt, mg	ND()	ND()	ND()	ND()	ND()	ND()
	Conc., mg/dscm	0.229	0.215	0.218	0.238	0.22	0.222
	Conc., mg/dscm @7% O2	0.163	0.156	0.157	0.174	0.157	0.160
	Conc., mg/dscm @12% CO2	0.270	0.258	0.260	0.284	0.257	0.263
	Conc., ppmvd	0.127	0.120	0.121	0.133	0.120	0.123
	Conc., ppmvd @7% O2	0.196	0.188	0.189	0.209	0.189	0.192
	Conc., ppmvd @12% CO2	0.325	0.311	0.313	0.341	0.309	0.316
	Emission Rate, lb/hr	0.153	0.144	0.145	0.160	0.144	0.148
	Clinker Rates (tph and lbs/ton)	0.133	0.125	0.125	0.138	0.126	0.128
		117.90	118.40	0.0011	119.70	0.0011	0.0011
Chlorine	Catch Wt, mg	0.21	0.17	0.238	0.166	0.178	0.189
	Conc., mg/dscm	ND()	ND()	0.172	0.121	0.127	0.136
	Conc., mg/dscm @7% O2	0.150	0.123	0.172	0.121	0.127	0.136
	Conc., mg/dscm @12% CO2	0.248	0.204	0.284	0.198	0.208	0.224
	Conc., ppmvd	0.117	0.095	0.132	0.093	0.097	0.105
	Absolute Difference, ppmvd (<0.2 required)	0.051	0.042	0.058	0.041	0.043	0.046
	Conc., ppmvd @7% O2	0.084	0.069	0.016	0.067	0.070	0.076
	Conc., ppmvd @12% CO2	0.040	0.032	0.045	0.031	0.033	0.036
	Emission Rate, lb/hr	0.122	0.099	0.137	0.096	0.102	0.109
	Clinker Rates (tph and lbs/ton)	117.90	118.40	0.0010	119.70	0.0008	0.0009

Buzzi Unicem: Chattanooga TN
Main Stack; Mill On

Run 1		Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C	Ethylene (100,3000) 191C	H2O% (40) 191C	CO2% (40) 191C
Spectrum	12/13/23	08:15:31.625	1.954	-0.030	-0.009	0.910	4.592	14.263	
SPC_006457.LAB	12/13/23	08:16:35.833	2.012	-0.035	-0.000	0.983	4.821	14.304	
SPC_006458.LAB	12/13/23	08:17:39.405	1.942	-0.035	-0.002	0.943	4.842	14.203	
SPC_006459.LAB	12/13/23	08:18:43.347	1.929	-0.024	-0.004	0.898	4.863	14.195	
SPC_006460.LAB	12/13/23	08:19:47.490	1.896	-0.069	-0.006	0.907	4.887	14.402	
SPC_006461.LAB	12/13/23	08:20:51.207	1.971	-0.016	-0.003	0.935	4.916	14.211	
SPC_006462.LAB	12/13/23	08:21:55.134	1.922	-0.035	-0.005	0.915	4.851	14.169	
SPC_006463.LAB	12/13/23	08:22:58.921	1.949	-0.051	-0.007	0.915	4.939	14.257	
SPC_006464.LAB	12/13/23	08:24:02.824	1.984	-0.061	-0.005	0.965	4.926	14.207	
SPC_006465.LAB	12/13/23	08:25:06.720	1.991	-0.048	-0.004	0.856	5.028	14.126	
SPC_006466.LAB	12/13/23	08:26:10.674	1.986	-0.060	-0.001	0.983	5.166	14.254	
SPC_006467.LAB	12/13/23	08:27:14.544	1.924	-0.052	-0.003	0.930	5.163	14.129	
SPC_006468.LAB	12/13/23	08:28:18.440	1.921	-0.073	-0.001	1.022	5.127	13.957	
SPC_006469.LAB	12/13/23	08:29:22.346	2.023	-0.071	-0.002	0.963	5.028	14.287	
SPC_006470.LAB	12/13/23	08:30:26.530	1.953	-0.059	-0.003	1.009	5.028	14.320	
SPC_006471.LAB	12/13/23	08:31:30.169	1.912	-0.045	-0.006	0.871	4.920	14.179	
SPC_006472.LAB	12/13/23	08:32:34.398	1.976	-0.034	-0.004	0.880	4.868	14.251	
SPC_006473.LAB	12/13/23	08:33:37.977	1.887	-0.033	-0.005	0.933	4.860	14.217	
SPC_006474.LAB	12/13/23	08:34:41.877	1.952	-0.065	-0.004	0.889	4.893	14.338	
SPC_006475.LAB	12/13/23	08:35:45.909	1.870	-0.054	-0.004	0.817	4.898	14.252	
SPC_006476.LAB	12/13/23	08:36:49.707	1.832	-0.041	-0.004	0.693	4.981	14.117	
SPC_006477.LAB	12/13/23	08:37:53.588	1.892	-0.039	-0.004	0.876	5.034	14.312	
SPC_006478.LAB	12/13/23	08:38:57.510	1.805	0.008	-0.003	0.806	5.141	14.307	
SPC_006479.LAB	12/13/23	08:40:01.401	2.024	-0.069	-0.003	0.908	5.189	14.078	
SPC_006480.LAB	12/13/23	08:41:05.304	1.934	-0.049	-0.003	0.940	5.248	14.271	
SPC_006481.LAB	12/13/23	08:42:09.210	1.932	-0.072	-0.002	0.872	5.368	14.255	
SPC_006482.LAB	12/13/23	08:43:13.117	2.000	-0.039	-0.003	0.936	5.368	14.209	
SPC_006483.LAB	12/13/23	08:44:17.030	2.028	-0.057	-0.005	0.932	5.289	14.313	
SPC_006484.LAB	12/13/23	08:45:20.924	1.583	-0.064	0.006	0.785	5.166	14.027	
SPC_006485.LAB	12/13/23	08:46:24.870	1.929	-0.044	-0.003	0.875	5.115	14.033	
SPC_006486.LAB	12/13/23	08:47:28.788	1.832	-0.021	-0.004	0.821	5.068	14.146	
SPC_006487.LAB	12/13/23	08:48:32.727	1.889	-0.045	-0.002	0.830	5.022	14.208	
SPC_006488.LAB	12/13/23	08:49:36.594	1.916	-0.022	-0.002	0.917	4.963	14.246	
SPC_006489.LAB	12/13/23	08:50:40.496	1.919	-0.067	-0.003	0.913	4.962	14.331	
SPC_006490.LAB	12/13/23	08:51:44.592	2.097	-0.042	0.000	0.856	4.968	14.267	
SPC_006491.LAB	12/13/23	08:52:48.300	2.004	-0.071	-0.007	0.876	4.968	14.222	
SPC_006492.LAB	12/13/23	08:53:52.178	1.997	-0.039	-0.002	0.785	4.936	14.302	
SPC_006493.LAB	12/13/23	08:54:56.332	1.878	-0.058	-0.008	0.909	4.915	14.280	
SPC_006494.LAB	12/13/23	08:56:00.306	1.991	-0.073	-0.006	0.830	4.947	14.257	
SPC_006495.LAB	12/13/23	08:57:03.918	2.044	-0.044	-0.003	0.953	4.973	14.162	
SPC_006496.LAB	12/13/23	08:58:07.865	2.068	-0.130	-0.010	0.859	5.006	14.150	
SPC_006497.LAB	12/13/23	08:59:11.892	2.102	-0.013	0.000	0.651	5.046	14.384	
SPC_006498.LAB	12/13/23	09:00:15.997	1.873	-0.058	-0.002	0.741	5.063	14.300	
SPC_006499.LAB	12/13/23	09:01:19.542	1.924	-0.054	-0.001	0.865	5.091	14.175	
SPC_006500.LAB	12/13/23	09:02:23.468	1.950	-0.071	-0.002	0.905	5.085	14.245	
SPC_006501.LAB	12/13/23	09:03:27.333	1.889	-0.042	-0.006	0.910	5.074	14.388	
SPC_006502.LAB	12/13/23	09:04:31.295	1.918	-0.055	-0.002	0.843	5.111	14.158	
SPC_006503.LAB	12/13/23	09:05:35.449	1.928	-0.045	-0.005	0.891	5.093	14.293	
SPC_006504.LAB	12/13/23	09:06:39.012	1.997	-0.067	-0.005	0.954	5.137	14.145	
SPC_006505.LAB	12/13/23	09:07:43.008	2.023	-0.053	-0.001	0.939	5.134	14.274	
SPC_006506.LAB	12/13/23	09:08:47.068	1.909	-0.071	-0.004	0.822	5.148	14.215	
SPC_006507.LAB	12/13/23	09:09:50.726	2.013	-0.070	-0.003	0.913	5.224	14.258	
SPC_006508.LAB	12/13/23	09:10:54.873	1.999	-0.067	-0.002	0.812	5.209	14.245	
SPC_006509.LAB	12/13/23	09:11:58.625	1.963	-0.069	-0.006	0.922	5.163	14.137	
SPC_006510.LAB	12/13/23	09:13:02.451	1.950	-0.068	-0.001	0.773	5.139	14.210	
SPC_006511.LAB	12/13/23	09:14:06.359	1.923	-0.067	-0.008	0.815	5.083	14.354	
SPC_006512.LAB	12/13/23	09:15:10.306	1.957	-0.058	-0.005	0.794	5.091	14.287	
SPC_006513.LAB	12/13/23	09:15:10.306	1.945	0.032	-0.004	0.881	5.037	14.229	
Mill On Run 1	12.5%	(actual)	1.945	<					M26A Moisture
Oxygen	217.500	(ppm.dry @7% O2)	3.381	<					4.8
DSCFM	117.90	(lbs/hr)	1.870	<					
Clinker (tons/hr)			0.016	<					

Buzzi Unicem; Chattanooga TN
Main Stack; Mill On

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_006543.LAB	12/13/23	09:49:24.218	1.858	-0.080	-0.004	0.799	5.136	14.295
SPC_006544.LAB	12/13/23	09:50:28.216	1.900	-0.087	-0.005	0.838	5.151	14.369
SPC_006545.LAB	12/13/23	09:51:32.032	1.989	-0.070	-0.003	0.895	5.100	14.297
SPC_006546.LAB	12/13/23	09:52:36.313	1.913	-0.066	-0.003	0.915	5.068	14.232
SPC_006547.LAB	12/13/23	09:53:39.834	1.867	-0.041	-0.001	0.695	5.079	14.529
SPC_006548.LAB	12/13/23	09:54:44.132	1.935	-0.047	-0.005	0.804	5.108	14.288
SPC_006549.LAB	12/13/23	09:55:48.022	1.907	-0.065	-0.002	0.804	5.120	14.569
SPC_006550.LAB	12/13/23	09:56:51.600	1.848	-0.045	0.001	0.802	5.085	14.458
SPC_006551.LAB	12/13/23	09:57:55.707	1.945	-0.079	-0.002	0.897	5.046	14.184
SPC_006552.LAB	12/13/23	09:58:59.703	1.884	-0.058	-0.002	0.675	5.074	14.524
SPC_006553.LAB	12/13/23	10:00:03.269	1.834	-0.051	-0.003	0.755	5.110	14.519
SPC_006554.LAB	12/13/23	10:01:07.222	1.904	-0.066	-0.002	0.841	5.120	14.425
SPC_006555.LAB	12/13/23	10:02:11.227	1.868	-0.043	-0.002	0.712	5.099	14.595
SPC_006556.LAB	12/13/23	10:03:14.984	1.864	-0.056	-0.002	0.747	5.106	14.529
SPC_006557.LAB	12/13/23	10:04:18.926	1.902	-0.070	0.001	0.699	5.161	14.405
SPC_006558.LAB	12/13/23	10:05:22.831	1.798	-0.073	0.001	0.701	5.242	14.407
SPC_006559.LAB	12/13/23	10:06:26.740	1.893	-0.091	-0.003	0.806	5.313	14.217
SPC_006560.LAB	12/13/23	10:07:30.608	1.837	-0.059	-0.001	0.815	5.285	14.279
SPC_006561.LAB	12/13/23	10:08:34.512	1.763	-0.052	-0.001	0.805	5.222	14.537
SPC_006562.LAB	12/13/23	10:09:38.457	1.826	-0.059	-0.005	0.880	5.215	14.310
SPC_006563.LAB	12/13/23	10:10:42.692	1.817	-0.051	0.000	0.742	5.088	14.482
SPC_006564.LAB	12/13/23	10:11:46.229	1.826	-0.059	-0.005	0.841	4.977	14.299
SPC_006565.LAB	12/13/23	10:12:50.147	1.944	-0.067	-0.003	0.822	4.951	14.200
SPC_006566.LAB	12/13/23	10:13:54.043	1.812	-0.039	-0.000	0.724	4.919	14.540
SPC_006567.LAB	12/13/23	10:14:57.989	1.878	-0.039	0.000	0.788	4.945	14.455
SPC_006568.LAB	12/13/23	10:16:01.880	1.932	-0.059	-0.005	0.855	4.998	14.245
SPC_006569.LAB	12/13/23	10:17:05.904	1.831	-0.062	-0.001	0.645	5.017	14.572
SPC_006570.LAB	12/13/23	10:18:09.929	1.937	-0.097	-0.002	0.814	5.071	14.294
SPC_006571.LAB	12/13/23	10:19:13.678	1.906	-0.082	-0.002	0.788	5.148	14.107
SPC_006572.LAB	12/13/23	10:20:17.779	1.834	-0.048	0.001	0.837	5.212	14.555
SPC_006573.LAB	12/13/23	10:21:21.422	1.934	-0.048	-0.001	0.702	5.352	14.526
SPC_006574.LAB	12/13/23	10:22:25.279	1.953	-0.077	-0.000	0.707	5.397	14.431
SPC_006575.LAB	12/13/23	10:23:29.190	1.932	-0.065	-0.002	0.752	5.393	14.553
SPC_006576.LAB	12/13/23	10:24:33.185	1.992	-0.086	-0.002	0.744	5.270	14.191
SPC_006577.LAB	12/13/23	10:25:36.996	1.839	-0.035	-0.000	0.783	5.200	14.460
SPC_006578.LAB	12/13/23	10:26:41.244	1.856	-0.072	0.000	0.705	5.120	14.527
SPC_006579.LAB	12/13/23	10:27:45.147	1.796	-0.074	-0.004	0.698	5.173	14.172
SPC_006580.LAB	12/13/23	10:28:48.711	1.842	-0.060	-0.006	0.753	5.135	14.376
SPC_006581.LAB	12/13/23	10:29:52.745	1.859	-0.050	-0.006	0.805	5.129	14.375
SPC_006582.LAB	12/13/23	10:30:56.866	1.850	-0.087	-0.002	0.797	5.059	14.317
SPC_006583.LAB	12/13/23	10:32:00.429	1.818	-0.050	-0.000	0.761	5.028	14.595
SPC_006584.LAB	12/13/23	10:33:04.339	1.912	-0.052	-0.002	0.813	5.020	14.305
SPC_006585.LAB	12/13/23	10:34:08.273	1.838	-0.091	-0.005	0.793	5.056	14.228
SPC_006586.LAB	12/13/23	10:35:12.176	1.756	-0.057	-0.003	0.865	5.064	14.363
SPC_006587.LAB	12/13/23	10:36:16.118	1.869	-0.056	-0.005	0.814	5.026	14.290
SPC_006588.LAB	12/13/23	10:37:19.952	1.833	-0.080	-0.003	0.761	4.977	14.231
SPC_006589.LAB	12/13/23	10:38:23.905	1.827	-0.047	-0.003	0.782	4.933	14.362
SPC_006590.LAB	12/13/23	10:39:27.803	1.887	-0.098	-0.004	0.728	4.954	14.253
SPC_006591.LAB	12/13/23	10:40:31.722	1.812	-0.060	-0.006	0.762	5.042	14.310
SPC_006592.LAB	12/13/23	10:41:35.614	1.795	-0.060	0.001	0.719	4.987	14.289
SPC_006593.LAB	12/13/23	10:42:39.479	1.927	-0.066	-0.003	0.841	4.974	14.264
SPC_006594.LAB	12/13/23	10:43:43.379	1.863	-0.066	-0.005	0.860	4.992	14.252
SPC_006595.LAB	12/13/23	10:44:47.626	1.873	-0.084	-0.003	0.810	5.063	14.211
SPC_006596.LAB	12/13/23	10:45:51.556	1.875	-0.067	-0.003	0.870	5.106	14.353
SPC_006597.LAB	12/13/23	10:46:55.437	1.865	-0.079	-0.002	0.741	5.046	14.329
SPC_006598.LAB	12/13/23	10:47:59.000	1.913	-0.073	-0.001	0.841	5.034	14.293
Mill On Run 2		(actual)	1.871	< 0.032	-0.002	0.785	5.102	14.367
Oxygen	12.5%	(ppm,dry @7% O2)	3.280	< 0.056		1.376	5.6	M26A Moisture
DSCFM	213,400	(lbs/hr)	1.780	< 0.023		0.775		
Clinker (tons/hr)	118,40	(lbs/ton clinker)	0.015	< 0.0002		0.007		

Buzzi Unicem; Chattanooga TN
Main Stack; Mill On

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_006624.LAB	12/13/23	11:17:00.406	2.098	-0.056	-0.010	0.596	4.929	14.254
SPC_006625.LAB	12/13/23	11:18:04.399	1.948	-0.059	-0.002	0.804	4.940	14.240
SPC_006626.LAB	12/13/23	11:19:08.219	1.809	-0.084	0.000	0.809	4.988	14.553
SPC_006627.LAB	12/13/23	11:20:12.491	1.833	-0.086	-0.002	0.771	4.964	14.481
SPC_006628.LAB	12/13/23	11:21:16.031	1.968	-0.066	-0.002	0.906	4.995	14.268
SPC_006629.LAB	12/13/23	11:22:19.931	1.960	-0.066	-0.002	0.774	4.965	14.349
SPC_006630.LAB	12/13/23	11:23:24.219	1.871	-0.056	0.003	0.708	4.992	14.604
SPC_006631.LAB	12/13/23	11:24:28.107	1.887	-0.059	-0.001	0.683	5.034	14.460
SPC_006632.LAB	12/13/23	11:25:31.646	1.878	-0.072	-0.003	0.757	5.079	14.437
SPC_006633.LAB	12/13/23	11:26:35.592	1.895	-0.082	-0.003	0.719	5.049	14.515
SPC_006634.LAB	12/13/23	11:27:39.464	1.915	-0.075	-0.001	0.805	5.047	14.441
SPC_006635.LAB	12/13/23	11:28:43.366	1.731	-0.067	0.004	0.537	5.068	14.612
SPC_006636.LAB	12/13/23	11:29:47.270	1.791	-0.091	-0.001	0.648	5.062	14.518
SPC_006637.LAB	12/13/23	11:30:51.218	1.944	-0.078	-0.005	0.806	5.049	14.303
SPC_006638.LAB	12/13/23	11:31:55.138	1.833	-0.066	-0.001	0.685	5.054	14.574
SPC_006639.LAB	12/13/23	11:32:58.987	1.889	-0.072	-0.007	0.798	5.049	14.277
SPC_006640.LAB	12/13/23	11:34:02.896	1.816	-0.044	-0.002	0.747	5.085	14.534
SPC_006641.LAB	12/13/23	11:35:06.798	1.796	-0.067	-0.003	0.620	5.087	14.580
SPC_006642.LAB	12/13/23	11:36:10.740	1.916	-0.049	0.002	0.821	5.051	14.423
SPC_006643.LAB	12/13/23	11:37:14.622	1.858	-0.077	-0.000	0.850	5.014	14.607
SPC_006644.LAB	12/13/23	11:38:18.548	1.955	-0.055	0.005	0.839	5.085	14.585
SPC_006645.LAB	12/13/23	11:39:22.421	1.842	-0.034	-0.002	0.659	5.125	14.442
SPC_006646.LAB	12/13/23	11:40:26.395	1.825	-0.076	-0.004	0.671	5.122	14.483
SPC_006647.LAB	12/13/23	11:41:30.230	1.922	-0.040	-0.003	0.797	5.134	14.731
SPC_006648.LAB	12/13/23	11:42:34.133	1.898	-0.046	-0.001	0.779	5.179	14.511
SPC_006649.LAB	12/13/23	11:43:38.162	1.934	-0.063	-0.002	0.722	5.132	14.491
SPC_006650.LAB	12/13/23	11:44:42.326	1.797	-0.051	-0.000	0.705	5.254	14.503
SPC_006651.LAB	12/13/23	11:45:45.846	1.826	-0.090	-0.003	0.706	5.308	14.328
SPC_006652.LAB	12/13/23	11:46:49.757	1.846	-0.034	-0.001	0.739	5.279	14.676
SPC_006653.LAB	12/13/23	11:47:53.930	1.983	-0.043	0.000	0.780	5.195	14.598
SPC_006654.LAB	12/13/23	11:50:01.469	1.991	-0.059	0.001	0.808	5.134	14.503
SPC_006655.LAB	12/13/23	11:50:51.568	1.869	-0.082	0.000	0.795	5.066	14.630
SPC_006656.LAB	12/13/23	11:51:05.368	1.856	-0.061	0.004	0.847	4.963	14.605
SPC_006657.LAB	12/13/23	11:52:09.272	1.901	-0.079	-0.002	0.710	4.893	14.499
SPC_006658.LAB	12/13/23	11:53:13.518	1.934	-0.057	0.002	0.678	4.801	14.498
SPC_006659.LAB	12/13/23	11:54:17.084	1.915	-0.068	-0.004	0.849	4.792	14.338
SPC_006660.LAB	12/13/23	11:55:21.034	1.941	-0.067	0.000	0.798	4.830	14.648
SPC_006661.LAB	12/13/23	11:56:24.934	1.843	-0.067	-0.001	0.685	4.839	14.628
SPC_006662.LAB	12/13/23	11:57:28.905	1.943	-0.061	-0.002	0.706	4.946	14.567
SPC_006663.LAB	12/13/23	11:58:32.703	1.923	-0.079	-0.004	0.810	4.991	14.345
SPC_006664.LAB	12/13/23	11:59:36.897	1.905	-0.074	0.000	0.722	5.070	14.571
SPC_006665.LAB	12/13/23	12:00:40.514	1.922	-0.041	0.003	0.772	5.190	14.658
SPC_006666.LAB	12/13/23	12:01:44.419	1.886	-0.063	-0.003	0.765	5.311	14.332
SPC_006667.LAB	12/13/23	12:02:48.374	2.031	-0.063	-0.003	0.836	5.234	14.534
SPC_006668.LAB	12/13/23	12:03:52.227	1.812	-0.046	-0.000	0.752	5.304	14.803
SPC_006669.LAB	12/13/23	12:04:56.133	1.925	-0.057	-0.006	0.620	5.300	14.686
SPC_006670.LAB	12/13/23	12:06:00.047	1.837	-0.041	0.000	0.688	5.229	14.772
SPC_006671.LAB	12/13/23	12:07:04.074	1.918	-0.064	-0.004	0.767	5.147	14.216
SPC_006672.LAB	12/13/23	12:08:07.887	1.872	-0.037	0.002	0.662	5.147	14.823
SPC_006673.LAB	12/13/23	12:09:11.759	1.929	-0.065	-0.002	0.840	5.154	14.866
SPC_006674.LAB	12/13/23	12:10:15.703	1.918	-0.050	-0.000	0.745	5.157	14.559
SPC_006675.LAB	12/13/23	12:11:19.677	1.885	-0.073	-0.002	0.771	5.100	14.559
SPC_006676.LAB	12/13/23	12:12:23.862	1.876	-0.042	0.002	0.777	5.098	14.742
SPC_006677.LAB	12/13/23	12:13:27.376	1.848	-0.054	0.001	0.730	5.095	14.598
SPC_006678.LAB	12/13/23	12:14:31.283	1.758	-0.040	-0.002	0.616	5.121	14.678
SPC_006679.LAB	12/13/23	12:15:35.202	1.901	-0.082	-0.004	0.741	5.092	14.448
SPC_006680.LAB	12/13/23	12:16:39.092	1.912	-0.066	-0.002	0.755	4.987	14.534
Mill On Run 3		(actual)	1.889	<	-0.001	0.745	5.075	14.527
Oxygen	12.4%	(ppm,dry @7% O2)	3.247	<	0.055	1.280	4.9	M26A Moisture
DSCFM	213,300	(lbs/hr)	1.782	<	0.022	0.006		
Clinker (tons/hr)	119.70	(lbs/ton clinker)	0.015	<	0.002			

Company: Buzzi Unicem; Chattanooga TN
Source: Main Stack; Mill Off
Job ID: 23-3317
Train Type: M26A

	4A	4B	5A	5B	6A	6B	
	12/13/23	12/13/23	12/13/23	12/13/23	12/06/23	12/06/23	
	1315-1429	1315-1429	1445-1600	1445-1600	1613-1730	1613-1730	Average
Initial Meter Volume, ft ³	848.104	748.608	902.812	805.555	955.761	862.169	
Final Meter Volume, ft ³	902.336	805.139	955.581	861.915	1008.534	916.129	
Intra-Port Leak Check Volume, ft ³	0.000	0.000	0.000	0.000	0.000	0.000	
Total Sample Volume, cf	54.232	56.531	52.769	56.360	52.773	53.960	54.438
DGM Calibration Factor	0.985	0.975	0.985	0.975	0.985	0.975	0.980
Average DGM Temp, F	75.3	75.1	80.7	83.7	80.3	78.8	79.0
Average DGM delta H, "H2O	2.48	2.67	2.35	2.64	2.32	2.45	2.49
Barometric Pressure, "Hg	29.70	29.70	29.70	29.70	29.70	29.70	29.70
Corrected Sample Vol,dscf	52.603	54.322	50.656	53.297	50.694	51.467	52.173
Corrected Sample Vol,dscm	1.490	1.538	1.434	1.509	1.436	1.457	1.477
Oxygen, %	10.9	10.9	10.8	10.8	9.7	9.7	10.5
Carbon Dioxide, %	18.8	18.8	18.7	18.7	19.0	19.0	18.8
Nitrogen, %	70.3	70.3	70.5	70.5	71.3	71.3	70.7
Stack Gas Excess Air, %	142.3	142.3	138.2	138.2	106.3	106.3	128.9
Total Moisture Catch Weight, grams	74.9	72.1	68.3	68.2	74.8	69.8	70.9
Stack Gas Moisture, %	6.3	5.9	6.0	5.7	6.5	6.0	6.1
Stack Gas Dry Molecular Weight, lb/lbmole	31.44	31.44	31.42	31.42	31.43	31.43	31.43
Stack Gas Wet Molecular Weight, lb/lbmole	30.60	30.65	30.62	30.66	30.56	30.62	30.62
Average Stack Temp, F	370.4	372.6	370.2	371.4	371.8	372.5	371.5
Stack Static (Gauge) Pressure, "H2O	-1.50	-1.50	-1.50	-1.50	-1.50	-1.50	-1.50
Stack Gas Actual Pressure, "Hg	29.59	29.59	29.59	29.59	29.59	29.59	29.59
Average Sqrt delta P	0.672	0.700	0.654	0.691	0.650	0.676	0.674
Pitot Tube Coefficient	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Stack Gas Velocity, ft/second	46.76	48.74	45.49	48.07	45.30	47.09	46.91
Nozzle Inside Diameter, inches	0.310	0.310	0.310	0.310	0.310	0.310	
Total Sample Time, min	60	60	60	60	60	60	60
Isokinetic Rate, %	101.2	100.1	99.9	99.3	101.1	98.3	100.0
Stack Dimensions	84 x 180 in.	84 x 180 in.	84 x 180 in.	84 x 180 in.	84 x 180 in.	84 x 180 in.	
Stack Area, sq ft	105.00	105.00	105.00	105.00	105.00	105.00	105.00
Stack Gas Flow Rate, acfm	294.600	307.100	286.600	302.800	285.400	296.700	295.533
Stack Gas Flow Rate, acmm	8,342	8,696	8,116	8,574	8,082	8,402	8,369
Stack Gas Flow Rate, dscfm	173.600	181.200	169.400	179.400	167.500	174.900	174.333
Stack Gas Flow Rate, dscmm	4,916	5,131	4,797	5,080	4,743	4,953	4,937
ALT-009 Post Test Calibration	pass	pass	pass	pass	pass	pass	

Company: Buzzi Unicem; Chattanooga TN
Source: Main Stack; Mill Off
Job ID: 23-3317
Train Type: M26A

"NDIY" denotes values below detection limits
NOTE: Average INCLUDES Non-detect runs' results

	4A 12/13/23 1315-1429	4B 12/13/23 1315-1429	5A 12/13/23 1445-1600	5B 12/13/23 1445-1600	6A 12/06/23 1613-1730	6B 12/06/23 1613-1730	Average
Hydrogen Fluoride	Catch Wt, mg	ND()	ND()	ND()	ND()	ND()	ND()
	Conc., mg/dscm	0.238	0.236	0.233	0.243	0.237	0.240
	Conc., mg/dscm @7% O2	0.160	0.153	0.162	0.161	0.163	0.162
	Conc., mg/dscm @12% CO2	0.222	0.213	0.224	0.222	0.202	0.216
	Conc., ppmvd	0.102	0.098	0.104	0.103	0.103	0.103
	Conc., ppmvd @7% O2	0.192	0.184	0.195	0.194	0.196	0.195
	Conc., ppmvd @12% CO2	0.267	0.256	0.269	0.266	0.243	0.260
	Emission Rate, lb/hr	0.123	0.118	0.125	0.124	0.124	0.124
	Clinker Rates (tph and lbs/ton)	0.104	0.104	0.103	0.108	0.107	0.106
		117.80	0.0009	117.10	0.0009	0.0009	0.0009
Chlorine	Catch Wt, mg	0.258	0.183	0.217	0.171	0.177	0.211
	Conc., mg/dscm	0.173	0.119	0.151	0.113	0.121	0.143
	Conc., mg/dscm @7% O2	0.241	0.165	0.208	0.156	0.151	0.191
	Conc., mg/dscm @12% CO2	0.111	0.076	0.097	0.073	0.077	0.091
	Conc., ppmvd	0.059	0.040	0.051	0.038	0.041	0.049
	Absolute Difference, ppmvd (<0.2 required)		0.018		0.013	0.020	
	Conc., ppmvd @7% O2	0.082	0.056	0.071	0.053	0.051	0.065
	Conc., ppmvd @12% CO2	0.037	0.026	0.033	0.025	0.026	0.031
	Emission Rate, lb/hr	0.113	0.081	0.096	0.076	0.080	0.093
	Clinker Rates (tph and lbs/ton)	117.90	0.0008	117.10	0.0007	0.0008	0.0008

Buzzi Unicem, Chattanooga TN
Main Stack; Mill Off

Run 1		Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C	Ethylene (100,3000) 191C	H2O% (40) 191C	CO2% (40) 191C
Spectrum		12/13/23	13:18:32.050	2.288	-0.043	-0.004	0.885	6.199	17.008
SPC_006737.LAB		12/13/23	13:19:35.990	2.303	-0.065	-0.006	0.897	6.197	17.025
SPC_006738.LAB		12/13/23	13:20:39.896	2.194	-0.053	-0.003	0.844	6.177	17.044
SPC_006740.LAB		12/13/23	13:21:43.797	2.253	-0.022	-0.003	0.910	6.206	16.820
SPC_006741.LAB		12/13/23	13:22:47.775	2.209	-0.063	-0.007	0.808	6.188	17.104
SPC_006742.LAB		12/13/23	13:23:51.564	2.341	-0.047	-0.003	0.860	6.221	17.049
SPC_006743.LAB		12/13/23	13:24:55.864	2.245	-0.040	-0.004	0.792	6.217	16.819
SPC_006744.LAB		12/13/23	13:25:59.729	2.195	-0.030	-0.001	0.808	6.223	16.815
SPC_006745.LAB		12/13/23	13:27:03.328	2.125	-0.028	-0.005	0.791	6.233	16.992
SPC_006746.LAB		12/13/23	13:28:07.191	2.232	-0.064	-0.002	0.870	6.267	17.090
SPC_006747.LAB		12/13/23	13:29:11.445	2.210	-0.019	-0.007	0.883	6.275	17.037
SPC_006748.LAB		12/13/23	13:30:14.998	2.257	-0.035	-0.005	0.836	6.241	16.864
SPC_006749.LAB		12/13/23	13:31:18.986	2.255	-0.060	-0.004	0.824	6.301	16.807
SPC_006750.LAB		12/13/23	13:32:22.914	2.210	-0.034	-0.002	0.838	6.264	16.969
SPC_006751.LAB		12/13/23	13:33:26.802	2.278	-0.045	-0.004	0.879	6.245	17.022
SPC_006752.LAB		12/13/23	13:34:30.665	2.272	-0.067	-0.002	0.866	6.245	16.798
SPC_006753.LAB		12/13/23	13:35:34.521	2.244	-0.058	-0.001	0.944	6.235	16.877
SPC_006754.LAB		12/13/23	13:36:38.451	2.184	-0.024	-0.003	0.872	6.265	17.017
SPC_006755.LAB		12/13/23	13:37:42.575	2.104	-0.027	-0.006	0.840	6.272	16.941
SPC_006756.LAB		12/13/23	13:38:46.232	2.286	-0.014	-0.003	0.868	6.267	17.024
SPC_006757.LAB		12/13/23	13:39:50.221	2.261	-0.071	-0.004	0.912	6.296	16.896
SPC_006758.LAB		12/13/23	13:40:54.057	2.261	-0.026	-0.003	0.901	6.245	17.008
SPC_006759.LAB		12/13/23	13:41:57.989	2.245	-0.034	-0.005	0.862	6.244	16.975
SPC_006760.LAB		12/13/23	13:43:02.266	2.304	-0.034	-0.005	1.086	6.258	16.863
SPC_006761.LAB		12/13/23	13:44:05.792	2.271	-0.086	-0.004	0.846	6.246	17.006
SPC_006762.LAB		12/13/23	13:45:09.701	2.352	-0.016	-0.006	0.851	6.263	16.956
SPC_006763.LAB		12/13/23	13:46:13.681	2.347	-0.047	-0.004	0.904	6.247	16.732
SPC_006764.LAB		12/13/23	13:47:17.475	2.183	-0.031	-0.004	0.883	6.259	16.959
SPC_006765.LAB		12/13/23	13:48:21.494	2.335	-0.033	-0.002	0.929	6.250	16.853
SPC_006766.LAB		12/13/23	13:49:25.277	2.266	-0.055	-0.002	0.921	6.027	16.874
SPC_006767.LAB		12/13/23	13:50:29.221	2.280	-0.069	0.000	0.929	5.797	17.071
SPC_006768.LAB		12/13/23	13:51:33.086	2.284	-0.024	-0.001	0.929	6.164	17.081
SPC_006769.LAB		12/13/23	13:52:37.085	2.233	-0.095	-0.004	0.926	6.273	17.004
SPC_006770.LAB		12/13/23	13:53:40.969	2.294	-0.076	-0.008	0.879	6.279	17.173
SPC_006771.LAB		12/13/23	13:54:44.800	2.278	-0.019	-0.006	0.945	6.260	17.111
SPC_006772.LAB		12/13/23	13:55:48.701	2.293	-0.020	-0.008	0.828	6.273	16.941
SPC_006773.LAB		12/13/23	13:56:52.611	2.363	-0.054	-0.005	0.964	6.255	16.868
SPC_006774.LAB		12/13/23	13:57:56.641	2.330	-0.037	-0.009	1.022	6.245	16.731
SPC_006775.LAB		12/13/23	13:59:00.528	2.404	-0.051	-0.006	1.052	6.264	16.710
SPC_006776.LAB		12/13/23	14:00:04.331	2.319	-0.033	-0.006	0.884	6.240	17.001
SPC_006777.LAB		12/13/23	14:01:08.219	2.343	-0.019	-0.007	0.936	6.232	16.826
SPC_006778.LAB		12/13/23	14:02:12.423	2.323	-0.047	-0.006	0.845	6.216	16.702
SPC_006779.LAB		12/13/23	14:03:16.069	2.364	-0.055	-0.005	0.804	6.218	16.752
SPC_006780.LAB		12/13/23	14:04:19.972	2.327	-0.031	-0.006	0.921	6.207	16.670
SPC_006781.LAB		12/13/23	14:05:23.833	2.331	-0.029	-0.005	0.849	6.248	16.889
SPC_006782.LAB		12/13/23	14:06:27.893	2.326	-0.033	-0.008	0.821	6.223	16.721
SPC_006783.LAB		12/13/23	14:07:31.637	2.394	-0.017	-0.005	0.971	6.221	16.690
SPC_006784.LAB		12/13/23	14:08:35.539	2.335	-0.034	-0.004	0.845	6.225	16.623
SPC_006785.LAB		12/13/23	14:09:39.460	2.387	-0.058	-0.002	0.958	6.234	16.751
SPC_006786.LAB		12/13/23	14:10:43.396	2.377	-0.070	-0.005	1.018	6.232	16.848
SPC_006787.LAB		12/13/23	14:11:47.401	2.326	-0.064	-0.004	0.876	6.226	16.940
SPC_006788.LAB		12/13/23	14:12:51.200	2.306	-0.072	-0.006	0.883	6.248	16.811
SPC_006789.LAB		12/13/23	14:13:55.063	2.358	-0.068	-0.004	0.959	6.247	16.885
SPC_006790.LAB		12/13/23	14:14:58.976	2.391	-0.063	-0.005	1.003	6.244	16.925
SPC_006791.LAB		12/13/23	14:16:02.878	2.335	-0.059	-0.005	0.864	6.250	16.722
SPC_006792.LAB		12/13/23	14:17:06.891	2.324	-0.076	-0.003	0.940	6.272	16.866
SPC_006793.LAB		12/13/23	14:18:10.678	2.376	-0.063	-0.004	1.047	6.278	17.297
Mill Off Run 1		(actual)		2.290	0.032	-0.004	0.899	6.231	16.910
Oxygen		10.9%	ppm,dry @7% O2	3.390	<		1.331	6.1	M26A Moisture
DSCFM		177.400	(lbs/hr)	1.821	<		0.742		
Clinker (tons/hr)		117.80	(lbs/ton clinker)	0.015	<		0.006		

Buzzi Unicem; Chattanooga TN
Main Stack; Mill Off

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	Ethylene (100,3000) 191C	H2O% (40) 191C	CO2% (40) 191C
SPC_006818 LAB	12/13/23	14:46:30.190	2.380	-0.067	0.001	6.267	16.812
SPC_006819 LAB	12/13/23	14:47:34.074	2.410	-0.061	0.001	6.289	16.946
SPC_006820 LAB	12/13/23	14:48:38.034	2.391	-0.069	-0.007	6.268	16.984
SPC_006821 LAB	12/13/23	14:49:41.843	2.454	-0.059	-0.004	6.260	16.828
SPC_006822 LAB	12/13/23	14:50:46.098	2.306	-0.069	-0.002	6.224	16.815
SPC_006823 LAB	12/13/23	14:51:49.998	2.504	-0.048	-0.003	6.250	16.728
SPC_006824 LAB	12/13/23	14:52:53.552	2.420	-0.073	-0.001	6.223	16.866
SPC_006825 LAB	12/13/23	14:53:57.450	2.368	-0.079	-0.001	6.229	16.817
SPC_006826 LAB	12/13/23	14:55:01.371	2.395	-0.094	-0.001	6.238	16.744
SPC_006827 LAB	12/13/23	14:56:05.278	2.362	-0.074	-0.002	6.243	16.756
SPC_006828 LAB	12/13/23	14:57:09.273	2.379	-0.094	-0.005	6.275	16.785
SPC_006829 LAB	12/13/23	14:58:13.112	2.447	-0.063	-0.004	6.271	16.714
SPC_006830 LAB	12/13/23	14:59:16.970	2.379	-0.077	-0.008	6.267	16.981
SPC_006831 LAB	12/13/23	15:00:20.927	2.400	-0.078	-0.003	6.263	16.822
SPC_006832 LAB	12/13/23	15:01:24.904	2.348	-0.060	-0.003	6.293	16.845
SPC_006833 LAB	12/13/23	15:02:28.682	2.429	-0.078	-0.006	6.280	16.909
SPC_006834 LAB	12/13/23	15:03:32.856	2.537	-0.072	0.001	6.296	16.859
SPC_006835 LAB	12/13/23	15:04:36.866	2.386	-0.067	-0.004	6.276	16.859
SPC_006836 LAB	12/13/23	15:05:40.398	2.368	-0.073	-0.006	6.267	16.964
SPC_006837 LAB	12/13/23	15:06:44.296	2.442	-0.060	-0.004	6.259	16.758
SPC_006838 LAB	12/13/23	15:07:48.201	2.522	-0.036	-0.005	6.261	16.667
SPC_006839 LAB	12/13/23	15:08:52.233	2.452	-0.075	-0.003	6.247	16.833
SPC_006840 LAB	12/13/23	15:09:56.007	2.539	-0.057	-0.003	6.287	16.848
SPC_006841 LAB	12/13/23	15:10:59.910	2.509	-0.085	-0.001	6.261	16.952
SPC_006842 LAB	12/13/23	15:12:03.856	2.468	-0.065	-0.004	6.251	16.783
SPC_006843 LAB	12/13/23	15:13:07.764	2.465	-0.057	-0.006	6.236	16.702
SPC_006844 LAB	12/13/23	15:14:11.623	2.431	-0.057	-0.005	6.235	16.711
SPC_006845 LAB	12/13/23	15:15:15.533	2.429	-0.031	-0.004	6.220	16.519
SPC_006846 LAB	12/13/23	15:16:19.758	2.476	-0.476	-0.003	6.243	16.678
SPC_006847 LAB	12/13/23	15:17:23.335	2.418	-0.033	-0.006	6.249	16.676
SPC_006848 LAB	12/13/23	15:18:27.245	2.410	-0.074	-0.009	6.245	16.815
SPC_006849 LAB	12/13/23	15:19:31.141	2.405	-0.036	-0.003	6.246	16.663
SPC_006850 LAB	12/13/23	15:20:35.461	2.409	-0.062	-0.005	6.239	16.708
SPC_006851 LAB	12/13/23	15:21:39.007	2.378	-0.070	-0.004	6.250	16.746
SPC_006852 LAB	12/13/23	15:22:42.858	2.553	-0.077	-0.006	6.250	16.749
SPC_006853 LAB	12/13/23	15:23:46.753	2.405	-0.080	0.002	6.266	16.816
SPC_006854 LAB	12/13/23	15:24:50.703	2.452	-0.094	-0.002	6.247	16.668
SPC_006855 LAB	12/13/23	15:25:54.909	2.496	-0.063	-0.007	6.270	16.737
SPC_006856 LAB	12/13/23	15:26:58.458	2.496	-0.067	-0.005	6.215	16.770
SPC_006857 LAB	12/13/23	15:28:02.387	2.519	-0.081	-0.006	5.939	16.869
SPC_006858 LAB	12/13/23	15:29:06.392	2.508	-0.064	-0.006	6.030	17.101
SPC_006859 LAB	12/13/23	15:30:10.172	2.483	-0.069	-0.007	6.305	17.094
SPC_006860 LAB	12/13/23	15:31:14.199	2.458	-0.081	-0.002	6.332	16.862
SPC_006861 LAB	12/13/23	15:32:17.978	2.436	-0.068	-0.006	6.328	16.996
SPC_006862 LAB	12/13/23	15:33:21.880	2.590	-0.065	-0.004	6.261	16.851
SPC_006863 LAB	12/13/23	15:34:26.178	2.486	-0.057	-0.001	6.103	16.068
SPC_006864 LAB	12/13/23	15:35:29.694	2.296	-0.078	0.001	5.960	15.890
SPC_006865 LAB	12/13/23	15:36:33.596	2.249	-0.067	-0.004	5.973	16.087
SPC_006866 LAB	12/13/23	15:37:37.930	2.305	-0.079	-0.007	5.999	16.311
SPC_006867 LAB	12/13/23	15:38:41.498	2.154	-0.056	-0.002	5.961	16.271
SPC_006868 LAB	12/13/23	15:39:45.310	2.293	-0.090	0.013	5.963	16.129
SPC_006869 LAB	12/13/23	15:40:49.241	2.400	-0.057	-0.008	5.989	16.380
SPC_006870 LAB	12/13/23	15:41:53.116	2.382	-0.059	-0.008	6.004	16.664
SPC_006871 LAB	12/13/23	15:42:57.023	2.502	-0.111	-0.004	6.275	17.822
SPC_006872 LAB	12/13/23	15:44:00.930	2.603	-0.091	-0.004	6.507	17.898
SPC_006873 LAB	12/13/23	15:45:04.838	2.603	-0.076	-0.007	6.585	17.697
Mill Off Run 2		(actual)	2.427	0.032	-0.004	6.223	16.783
Oxygen	10.8%	(ppm, dry @7% O2)	3.548	<	-0.005	5.9	M26A Moisture
DSCFM	174,400	(lbs/hr)	1.892	<	-0.003		
Clinker (tons/hr)	117.80	(lbs/ton clinker)	0.016	<	-0.000		

Run 3

Spectr

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__006899.LAB	12/13/23	16:13:53.736	2.512					-0.080	-0.005						1.103	6.386				6.386		17.153
SPC__006900.LAB	12/13/23	16:14:57.669	2.524					-0.063	-0.005						1.294	6.359				6.359		17.071
SPC__006901.LAB	12/13/23	16:16:01.539	2.693					-0.055	-0.005						1.183	6.349				6.349		17.163
SPC__006902.LAB	12/13/23	16:17:05.447	2.561					-0.071	-0.003						1.097	6.348				6.348		17.084
SPC__006903.LAB	12/13/23	16:18:09.712	2.433					-0.085	-0.002						1.157	6.335				6.335		16.984
SPC__006904.LAB	12/13/23	16:19:13.251	2.444					-0.081	-0.005						1.080	6.324				6.324		16.997
SPC__006905.LAB	12/13/23	16:20:17.509	2.489					-0.084	-0.006						1.075	6.343				6.343		16.963
SPC__006906.LAB	12/13/23	16:21:21.166	2.452					-0.083	-0.002						1.123	6.312				6.312		17.111
SPC__006907.LAB	12/13/23	16:22:25.309	2.463					-0.076	-0.006						1.078	6.331				6.331		17.018
SPC__006908.LAB	12/13/23	16:23:28.871	2.463					-0.074	-0.002						1.076	6.338				6.338		16.966
SPC__006909.LAB	12/13/23	16:24:32.772	2.454					-0.085	-0.006						1.038	6.323				6.323		17.101
SPC__006910.LAB	12/13/23	16:25:36.673	2.433					-0.059	-0.005						1.111	6.349				6.349		16.970
SPC__006911.LAB	12/13/23	16:26:40.581	2.570					-0.072	-0.008						1.092	6.384				6.384		16.925
SPC__006912.LAB	12/13/23	16:27:44.882	2.500					-0.077	-0.005						1.046	6.351				6.351		17.028
SPC__006913.LAB	12/13/23	16:28:48.510	2.373					-0.094	-0.006						1.126	6.348				6.348		16.971
SPC__006914.LAB	12/13/23	16:29:52.398	2.433					-0.070	-0.002						1.009	6.338				6.338		16.866
SPC__006915.LAB	12/13/23	16:30:56.235	2.446					-0.085	-0.000						1.125	6.350				6.350		16.901
SPC__006916.LAB	12/13/23	16:32:00.171	2.468					-0.054	-0.005						1.005	6.354				6.354		17.207
SPC__006917.LAB	12/13/23	16:33:04.004	2.365					-0.057	-0.004						1.005	6.343				6.343		17.194
SPC__006918.LAB	12/13/23	16:34:07.947	2.463					-0.071	-0.007						0.980	6.350				6.350		17.031
SPC__006919.LAB	12/13/23	16:35:12.145	2.453					-0.064	-0.006						1.110	6.342				6.342		17.062
SPC__006920.LAB	12/13/23	16:36:15.776	2.479					-0.061	-0.004						1.045	6.320				6.320		17.034
SPC__006921.LAB	12/13/23	16:37:19.611	2.457					-0.089	-0.004						1.175	6.325				6.325		16.907
SPC__006922.LAB	12/13/23	16:38:23.617	2.546					-0.059	-0.003						1.021	6.330				6.330		17.095
SPC__006923.LAB	12/13/23	16:39:27.422	2.448					-0.067	-0.004						1.028	6.335				6.335		17.014
SPC__006924.LAB	12/13/23	16:40:31.354	2.461					-0.083	-0.005						1.087	6.314				6.314		16.957
SPC__006925.LAB	12/13/23	16:41:35.225	2.470					-0.088	-0.006						1.222	6.326				6.326		17.003
SPC__006926.LAB	12/13/23	16:42:39.132	2.475					-0.078	-0.006						1.149	6.338				6.338		17.135
SPC__006927.LAB	12/13/23	16:43:43.139	2.500					-0.070	-0.004						1.053	6.369				6.369		16.957
SPC__006928.LAB	12/13/23	16:44:47.279	2.525					-0.085	-0.002						1.130	6.361				6.361		16.964
SPC__006929.LAB	12/13/23	16:45:50.896	2.552					-0.055	-0.008						1.133	6.347				6.347		17.081
SPC__006930.LAB	12/13/23	16:46:54.784	2.520					-0.064	-0.003						1.141	6.354				6.354		17.054
SPC__006931.LAB	12/13/23	16:47:58.664	2.536					-0.075	-0.002						1.051	6.351				6.351		17.004
SPC__006932.LAB	12/13/23	16:49:02.560	2.587					-0.094	-0.003						1.069	6.361				6.361		17.093
SPC__006933.LAB	12/13/23	16:50:06.505	2.465					-0.071	-0.004						1.076	6.354				6.354		16.988
SPC__006934.LAB	12/13/23	16:51:10.644	2.504					-0.094	-0.004						1.145	6.377				6.377		17.032
SPC__006935.LAB	12/13/23	16:52:14.603	2.485					-0.064	-0.005						1.251	6.363				6.363		16.963
SPC__006936.LAB	12/13/23	16:53:18.565	2.497					-0.090	-0.007						1.138	6.366				6.366		17.239
SPC__006937.LAB	12/13/23	16:54:22.069	2.540					-0.072	-0.005						1.141	6.379				6.379		17.037
SPC__006938.LAB	12/13/23	16:55:26.000	2.513					-0.077	-0.007						1.104	6.383				6.383		17.028
SPC__006939.LAB	12/13/23	16:56:29.876	2.619					-0.073	-0.002						1.178	6.383				6.383		17.206
SPC__006940.LAB	12/13/23	16:57:33.777	2.564					-0.077	-0.004						1.168	6.392				6.392		17.087
SPC__006941.LAB	12/13/23	16:58:36.044	2.560					-0.092	-0.006						1.190	6.409				6.409		16.941
SPC__006942.LAB	12/13/23	16:59:41.628	2.586					-0.056	-0.003						1.094	6.381				6.381		17.301
SPC__006943.LAB	12/13/23	17:00:45.486	2.513					-0.094	-0.003						1.096	6.381				6.381		17.156
SPC__006944.LAB	12/13/23	17:01:49.396	2.552					-0.084	-0.005						1.218	6.380				6.380		17.063
SPC__006945.LAB	12/13/23	17:02:53.294	2.478					-0.078	-0.006						1.252	6.350				6.350		17.003
SPC__006946.LAB	12/13/23	17:03:57.583	2.510					-0.076	-0.007						1.157	6.353				6.353		17.034
SPC__006947.LAB	12/13/23	17:05:01.107	2.525					-0.085	-0.011						1.084	6.230				6.230		16.916
SPC__006948.LAB	12/13/23	17:06:05.005	2.631					-0.090	-0.007						1.221	6.359				6.359		17.034
SPC__006949.LAB	12/13/23	17:07:08.907	2.502					-0.060	-0.004						1.109	6.095				6.095		17.133
SPC__006950.LAB	12/13/23	17:08:12.848	2.472					-0.092	-0.003						1.174	6.308				6.308		16.940
SPC__006951.LAB	12/13/23	17:09:17.057	2.521					-0.078	-0.005						1.046	6.297				6.297		16.907
SPC__006952.LAB	12/13/23	17:10:20.708	2.565					-0.084	-0.004						1.152	6.309				6.309		17.001
SPC__006953.LAB	12/13/23	17:11:24.523	2.510					-0.076	-0.002						1.241	6.333				6.333		16.994
SPC__006954.LAB	12/13/23	17:12:28.436	2.542					-0.082	-0.002						1.150	6.333				6.333		16.920
Mill Off Run 3		(actual)	2.504					< 0.032	-0.005						1.118	6.335				6.335		17.032
Oxygen	9.7%	(ppm.dry @7% O2)	3.314					< 0.042							1.480	6.3						M26A Moisture
DSCFM	171.100	(lbs/hr)	1.923					< 0.018							0.891							
Clinker (tons/hr)	117.80	(lbs/ton clinker)	0.016					< 0.0002							0.008							

Appendix B

**Field Data
and
CEM/FTIR Data**

Cyclonic Flow Check Data Sheet

PLANT AND CITY			DATE	SAMPLING LOCATION		SAMPLE TYPE		RUN NUMBER	
Bengal Chhatanogai			12/12/23	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
HH/GM	29.5	-1.5	40	544 180	0.85	M521	NA	NA	GM1

EPA Method 2 Data

[illegible]

Average of Absolute Angle Readings must be < 20 degrees

PAGE 1 of 1

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Signal MT TN
 Sample Location Main Stack
 Run No. SM ON -M26A-1A
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SC

772.5 **MOISTURE**

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	~~605.7~~	741.5	757.8	613.2	746.5	738.2	980.1	g
Initial weight		747.5	745.8	612.3	746.5	737.5	966.4	g
Net weight		25.0	12.0	0.7	0.0	0.7	13.7	g

Description of impinger water clear 33 % spent
BW Sil gel color
 Total moisture = 52.1 grams

RECOVERED SAMPLE

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

Liquid level
 marked/sealed ☒

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

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

PLANT AND CITY		DATE	SAMPLING LOCATION		SAMPLE TYPE		RUN NUMBER			
B-211 Uranium Charleston 44		12/13/13	M26A		13					
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	DIAMETER	
3.5	1.68	1.5	75	NA	84x180	0.84	84x180	1.43	2.70	
ASSUMED DGM MOISTURE 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 %	
3.5	1.68	1.975	1.5	1.5	1.5	0.84	0.84	11.4	11.4	
PITOT LEAK CHECK										
TRAVERSE ELAPSED TEST TIME (MIN)	CLOCK TIME (24-HR)	DGM READING Vm (cu. ft.)	delta P	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)	
A-1 0	8:15	596.658	1.5	2.2	248	320	50	254	60	
2 5		611.95	1.5	2.2	253	322	51	258	60	
3 10		605.21	1.8	1.8	251	318	51	258	58	
15	8:30	608.644	End of Port							
INTRA-PORT LEAK CHECK?										
DGM VOLUME (CU. FT)	INITIAL	FINAL	LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg					
B-1 15	8:36	608.644	1.70	2.4	250	318	51	259	58	
2 20		612.22	1.70	2.4	250	318	51	258	58	
3 25		616.26	1.65	2.2	252	318	52	262	58	
30	8:51	620.34	End of Port							
INTRA-PORT LEAK CHECK?										
DGM VOLUME (CU. FT)	INITIAL	FINAL	LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg					
C-1 30	8:57	610.34	1.67	2.3	249	318	53	260	59	
2 35		625.11	1.61	2.4	248	318	54	259	58	
3 40		629.08	1.63	2.2	251	320	55	259	58	
45	9:12	633.33	End of Port							
INTRA-PORT LEAK CHECK?										
DGM VOLUME (CU. FT)	INITIAL	FINAL	LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg					
D-1 45	9:18	633.33	1.66	2.3	246	310	58	248	51	
2 50		637.46	1.63	2.2	250	320	59	261	50	
3 55		641.41	1.51	1.8	252	320	60	248	50	
60	9:33	646.002	End of Port							
TOTAL TIME										
60 Min.										
DGM VOLUME					AVE SQRT delta P		AVE. TEMP.		AVE. TEMP.	
646.002					1.5		50		50	

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Seghal Mt TN
 Sample Location Main Stack
 Run No. SM ON -M26A-1B
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 2/13/23
 Recovered by SLG

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	~~X~~	766.9	765.2	650.4	754.8	745.3	921.4	g
Initial weight	~~X~~	751.0	748.4	646.2	752.6	744.4	907.6	g
Net weight	~~X~~	15.9	16.8	4.2	2.2	0.9	13.8	g

Description of impinger water Clear 10 % spent
B/A Sil gel color
 Total moisture = 53.8 grams

RECOVERED SAMPLE

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

Liquid level
 marked/sealed ☒

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

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

PLANT AND CITY		DATE		SAMPLING LOCATION			SAMPLE TYPE		RUN NUMBER	
Suez Canal		12/13/23		Main Stack			M26A		2A	
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	DIAMETER	
Lee Harris	29.70	-1.5	40	NA	321x180	0.350-843	9 ft glass line PVC	269	270	
ASSUMED DGM MOISTURE BOX No. (%)	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	LEAK CHECK (FINAL)	CO2 CONTENT %	K FACTOR	
6.8	1.69	0.985	8M	8M	6500	0.001	0.001	11.4	3.214	
PITOT LEAK CHECK ----> PASSED										
TRAVERSE ELAPSED PORT/POINT NO.	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 0948	749.835	0.69	2.4	255	323	63	255	57	3
2	5	754.34	0.67	2.3	254	323	62	255	58	3
3	10	758.64	0.59	2.0	255	323	63	256	59	2
15	1003	762.489	End of Port							
INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT)										
		INITIAL	LEAK RATE:		CU.FT @ CU.FT @		INCHES Hg INCHES Hg			
B-1	15 1007	762.489	0.72	2.5	254	323	61	255	56	4
2	20	766.90	0.68	2.3	256	323	62	254	58	4
3	25	771.22	0.57	2.0	254	323	62	257	57	3
30	1022	775.11	End of Port							
INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT)										
		INITIAL	LEAK RATE:		CU.FT @ CU.FT @		INCHES Hg INCHES Hg			
C-1	30 1028	775.11	0.66	2.3	254	324	60	256	53	4
2	35	779.25	0.61	2.1	256	322	60	254	52	4
3	40	783.18	0.49	1.7	255	321	62	257	51	2
45	1043	786.739	End of Port							
INTRA-PORT LEAK CHECK? DGM VOLUME (CU. FT)										
		INITIAL	LEAK RATE:		CU.FT @ CU.FT @		INCHES Hg INCHES Hg			
D-1	45 1048	786.739	0.65	2.2	256	322	60	256	52	4
2	50	790.86	0.66	2.3	255	323	62	256	51	4
3	55	795.29	0.54	1.9	256	323	63	255	51	3
60	1103	798.742	End of Port							
TOTAL TIME 60 Min.										
		DGM VOLUME	AVE SQRT delta P	AVE delta H	AVE. TEMP.	AVE. TEMP.				

**EPA METHOD 26A RECOVERY
AND INTEGRITY DATA SHEET**

Plant Buzzie Signal Mt TN
 Sample Location Maui Stach
 Run No. 5M 011 -M26A-2A
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SCS

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	/	770.7	762.2	621.1	743.8	744.5	960.3	g
Initial weight	/	743.8	749.1	618.3	742.1	743.6	947.3	g
Net weight	/	26.9	13.1	2.8	1.7	0.9	13.0	g

Description of impinger water clear 10 % spent
132 Sil gel color
 Total moisture = 58.4 grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. 5M -M26A-H2SO4- 2A

Liquid level
 marked/sealed ☒

NaOH Impingers contents and water rinse
 container no. 5M -M26A-NaOH 2A

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

METHOD 26A FIELD DATA SHEET

PAGE 1 of 1

PLANT AND CITY		DATE	SAMPLING LOCATION		SAMPLE TYPE		RUN NUMBER	
Operator: <i>Chakraborty</i>		12/13/12	<i>Midland Falls Mill on</i>		M26A			<i>L 13</i>
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 DIAMETER
	99.17	-1.5	75	11A	84x180	0.8884	<i>5 ft off</i>	261, 270, 271
ASSUMED DGM MOISTURE BOX No. (%)	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	PROBE CHECK (INITIAL)	PROBE CHECK (FINAL)	O2 CONTENT %	K FACTOR
53	1.68	44	6N	CEM 2	0.01	0.01	14.3	3.45
PITOT LEAK CHECK: <i>44</i> PASSED <i>6N</i> FAILED <i>CEM 2</i>								
TRAVERSE 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)	SAMPLE TRAIN VAC (in. Hg)
A-1 0	9:48	646.404	0.67	7.3	249	320	52	50
2 5		650.92	0.61	2.1	150	323	52	50
3 10		654.32	0.53	1.8	249	324	58	50
15	10:03	658.196	End of Port					
INTRA-PORT LEAK CHECK? INITIAL: <i>10:07</i> FINAL: <i>10:12</i> LEAK RATE: <i>65</i> CU.FT @ <i>2.2</i> INCHES Hg								
B-1 15		658.196	0.65	2.2	249	325	56	54
2 20		662.21	0.64	2.2	250	324	58	54
3 25		666.43	0.51	1.8	250	325	60	52
30	10:22	670.373	End of Port					
INTRA-PORT LEAK CHECK? INITIAL: <i>10:18</i> FINAL: <i>10:23</i> LEAK RATE: <i>67</i> CU.FT @ <i>1.3</i> INCHES Hg								
C-1 30		670.373	0.67	1.3	250	324	60	52
2 35		674.36	0.65	1.2	251	324	60	51
3 40		678.62	0.63	1.3	251	323	60	51
45	10:33	682.578	End of Port					
INTRA-PORT LEAK CHECK? INITIAL: <i>10:48</i> FINAL: <i>10:53</i> LEAK RATE: <i>71</i> CU.FT @ <i>1.3</i> INCHES Hg								
D-1 45		682.578	0.71	1.3	249	322	58	51
2 50		686.95	0.68	1.3	250	324	59	51
3 55		691.86	0.62	1.1	249	325	59	51
60		691.86	End of Port					
TOTAL TIME 60 Min.								
DGM VOLUME					AVE SQRT delta P		AVE. TEMP.	
695.787								

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzell Signal Mt TN
 Sample Location Main 3 track
 Run No. SM ON -M26A- 2B
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SCS

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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		762.8	763.8	674.0	739.6	758.4	999.4	g
Initial weight		739.6	750.1	670.7	738.6	757.4	988.7	g
Net weight		23.2	13.0	3.3	1.0	10.7	14.3	g

Description of impinger water clear 45 % spent
13/42 Sil gel color
 Total moisture = 65.5 grams

RECOVERED SAMPLE

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

Liquid level
 marked/sealed ☒

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

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

METHOD 26A FIELD DATA SHEET

PAGE 1 of 1

PLANT AND CITY		DATE		SAMPLING LOCATION			SAMPLE TYPE		RUN NUMBER		
Buzzi Unicem - Chattanooga, TN		11/13/13		Main Stack			M26A		3A		
OPERATOR		AMBIENT PRESS (In. Hg)		STATIC PRESSURE (In. Water)		AMBIENT TEMP (deg. F)		PITOT Cp		PROBE LENGTH AND LINER TYPE	
J. Harris		29.70		-1.5		5.0		0.84		8 ft gages	
ASSUMED DGM MOISTURE BOX No. (%)		DGM H@		DGM CAL FACTOR (Y)		STACK THERM NO.		LEAK CHECK (INITIAL)		O ₂ CONTENT %	
5.5		1.69		0.985		8/4		0.031		14.3	
PITOT LEAK CHECK ----> PASSED											
TRAVERSE 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)	
A-1		0 1116		798.871		0.63		2.7		256	
2		5		803.09		0.65		2.2		258	
3		10		807.24		0.59		2.0		252	
15		1131		811.134		End of Port					
INTRA-PORT LEAK CHECK?											
DGM VOLUME (CU. FT)		INITIAL FINAL		LEAK RATE: CU. FT @ CU. FT @		INCHES Hg INCHES Hg					
B-1		15 1135		811.134		0.61		2.1		254	
2		20		815.73		0.60		2.3		256	
3		25		819.49		0.70		2.4		252	
30		1150		823.952		End of Port					
INTRA-PORT LEAK CHECK?											
DGM VOLUME (CU. FT)		INITIAL FINAL		LEAK RATE: CU. FT @ CU. FT @		INCHES Hg INCHES Hg					
C-1		30 1157		823.952		0.57		2.0		257	
2		35		827.97		0.59		2.0		254	
3		40		831.88		0.49		1.7		250	
45		1212		835.406		End of Port					
INTRA-PORT LEAK CHECK?											
DGM VOLUME (CU. FT)		INITIAL FINAL		LEAK RATE: CU. FT @ CU. FT @		INCHES Hg INCHES Hg					
D-1		45 1214		835.406		0.59		2.0		251	
2		50		839.34		0.64		2.2		255	
3		55		843.51		0.68		2.3		256	
60		1229		847.831		End of Port					
TOTAL TIME				DGM VOLUME		AVE SQRT delta P		AVE. TEMP.		AVE. TEMP.	
60 Min.											

✓

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Signal Mt TN
 Sample Location Main Stack
 Run No. 5M ON -M26A- 3A
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SCS

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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		<u>799.0</u>	<u>769.5</u>	<u>612.8</u>	<u>745.8</u>	<u>754.1</u>	<u>990.4</u>	g
Initial weight		<u>767.7</u>	<u>758.4</u>	<u>612.4</u>	<u>743.7</u>	<u>753.5</u>	<u>980.2</u>	g
Net weight		<u>31.3</u>	<u>11.1</u>	<u>0.4</u>	<u>2.1</u>	<u>0.6</u>	<u>10.2</u>	g

Description of impinger water clear 60 % spent
Bu Sil gel color
 Total moisture = 55.7 grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. 5M -M26A-H2SO4- 3A

Liquid level
 marked/sealed ☒

NaOH Impingers contents and water rinse
 container no. 5M -M26A-NaOH 3A

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

METHOD 26A FIELD DATA SHEET

PAGE 1 of 1

PLANT AND CITY		DATE	SAMPLING LOCATION		SAMPLE TYPE	RUN NUMBER	
Burlington, Vermont		12/13/13	Main Street Mill Pond		M26A	3	
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
11/11/13	7.17	-1.5	~15	NA	84x180	0.84	NOZZLE DIAMETER
ASSUMED DGM MOISTURE BOX No. (%)	DGM H@	DGM CAL FACTOR (Y)	STACK THERM NO.	STACK PITOT NO.	ORSAT NO.	LEAK CHECK (INITIAL)	CO2 CONTENT %
5.5	1.68	9.75	45	47	3	0.84	11.4
PITOT LEAK CHECK: ☒ PASSED ☐ FAILED							
TRAVERSE PORT/POINT NO.	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)
A-1	0 11:16	696.168	0.7	2.4	245	322	60
2	5	701.01	.70	2.4	150	326	62
3	10	705.43	1.02	2.1	150	326	62
End of Port							
INTRA-PORT LEAK CHECK?							
DGM VOLUME (CU. FT)	INITIAL FINAL	LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg			
B-1	15 11:35	709.296	.66	7.3	248	329	63
2	20	713.51	.68	7.3	249	327	63
3	25	717.72	.52	1.8	252	325	65
End of Port							
INTRA-PORT LEAK CHECK?							
DGM VOLUME (CU. FT)	INITIAL FINAL	LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg			
C-1	30 11:57	721.692	.66	7.3	249	326	66
2	35	726.12	.64	7.3	250	328	66
3	40	730.75	.55	1.9	250	324	66
End of Port							
INTRA-PORT LEAK CHECK?							
DGM VOLUME (CU. FT)	INITIAL FINAL	LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg			
D-1	45 12:14	734.239	.65	7.3	249	326	65
2	50	738.22	.65	7.3	249	328	65
3	55	741.13	.55	1.8	252	323	66
End of Port							
INTRA-PORT LEAK CHECK?							
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D-1	45 12:14	734.239	.65	7.3	249	326	65
2	50	738.22	.65	7.3	24		

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Aguascaltepec MT TN
 Sample Location Main Stack
 Run No. 5M DN -M26A- 313
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SCS

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	/	757.2	764.5	651.9	756.7	759.3	931.8	g
Initial weight	/	737.9	748.5	648.4	756.0	758.7	921.6	g
Net weight	/	19.3	16.0	3.5	0.7	0.6	10.2	g

Description of impinger water clear 30 % spent
BW Sil gel color
 Total moisture = 50.3 grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. 5M -M26A-H2SO4- 313

Liquid level
 marked/sealed _____

NaOH Impingers contents and water rinse
 container no. 5M -M26A-NaOH 313

Liquid level
 marked/sealed _____

Samples stored and locked _____
 Remarks _____

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Signal Mt. TN
 Sample Location Main Stack
 Run No. SM -M26A-ONFB
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SCS

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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		764.9	767.7	697.4	745.0	738.3	9.44.5	g
Initial weight		765.0	767.8	647.3	745.0	738.4	944.3	g
Net weight								g

Description of impinger water clean 30 % spent
BTW Sil gel color
 Total moisture = _____ grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. SM-M26A-H2SO4-ONFB

Liquid level
 marked/sealed ☒

NaOH Impingers contents and water rinse
 container no. SM-M26A-NaOH-ONFB

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

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[illegible]

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Signal MT TN
 Sample Location Moore
 Run No. SM DTT -M26A-4A
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SCS

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	X	807.4	778.9	620.3	748.0	768.9	970.5	g
Initial weight	X	760.7	765.3	617.5	747.3	768.2	960.1	g
Net weight	X	46.7	13.6	2.8	0.7	0.7	10.4	g

Description of impinger water clear 35 % spent
13/W Sil gel color
 Total moisture = 74.9 grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. SM -M26A-H2SO4- 4A

Liquid level
 marked/sealed ☒

NaOH Impingers contents and water rinse
 container no. SM -M26A-NaOH - 4A

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

PAGE 1 of 1



**EPA METHOD 26A RECOVERY
AND INTEGRITY DATA SHEET**

Plant Burzi Gual MT TN
 Sample Location Main Stack
 Run No. SM -M26A-4B
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by gch

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	X	777.3	784.2	678.6	766.6	749.1	1010.5	g
Initial weight	X	747.1	763.4	672.3	764.1	748.2	999.1	g
Net weight	✓	30.2	20.8	6.3	2.5	0.9	11.4	g

Description of impinger water Clear 40 % spent
13.1 Sil gel color
 Total moisture = 72.1 grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. SM -M26A-H2SO4- 4B

Liquid level
 marked/sealed ✓

NaOH Impingers contents and water rinse
 container no. SM -M26A-NaOH 413

Liquid level
 marked/sealed ✓

Samples stored and locked _____
 Remarks _____

METHOD 26A FIELD DATA SHEET

PAGE 1 of 1

PLANT AND CITY		DATE		SAMPLING LOCATION			SAMPLE TYPE		RUN NUMBER		
Brazos Valley, TX		12/13/23		Main Stack			M26A		5A		
OPERATOR		AMBIENT PRESS (in. Hg)		STATIC PRESSURE (in. Water)		AMBIENT TEMP (deg. F)		PITOT Cp		PROBE LENGTH AND LINER TYPE	
1000		28.70		~1.5		60		0.85		8.4 glass effective	
ASSUMED MOISTURE BOX No. (%)		DGM H@		DGM CAL FACTOR (Y)		THERM NO.		LEAK CHECK (INITIAL)		O2 CONTENT %	
6		1.69		0.985		8.2		0.01		10.8	
TRAVEL ELAPSED TEST TIME (MIN)		CLOCK TIME (24-HR)		DGM READING Vm (cu. ft.)		VELOCITY HEAD (in. H2O)		delta H ORIFICE (in. H2O)		PROBE TEMP (deg. F)	
A-1		0 1445		902.812		0.49		2.7		155	
2		5		907.44		0.47		2.6		158	
3		10		911.81		0.45		2.5		151	
15		1500		916.361		End of Port					
INTRA-PORT LEAK CHECK?		INITIAL		FINAL		LEAK RATE:		CU.FT @ CU.FT @		INCHES Hg INCHES Hg	
DGM VOLUME (CU. FT)		15		1500		0.52		2.8		154	
B-1		20		921.06		0.48		2.6		158	
2		25		926.03		0.47		2.6		152	
30		1521		930.679		End of Port					
INTRA-PORT LEAK CHECK?		INITIAL		FINAL		LEAK RATE:		CU.FT @ CU.FT @		INCHES Hg INCHES Hg	
DGM VOLUME (CU. FT)		30		1526		0.44		2.4		153	
C-1		35		935.21		0.42		2.3		155	
2		40		939.59		0.33		1.8		150	
3		45		943.565		End of Port					
INTRA-PORT LEAK CHECK?		INITIAL		FINAL		LEAK RATE:		CU.FT @ CU.FT @		INCHES Hg INCHES Hg	
DGM VOLUME (CU. FT)		45		1541		0.41		2.2		152	
D-1		50		947.93		0.36		2.0		152	
2		55		951.85		0.32		1.7		152	
3		60		955.561		End of Port					
INTRA-PORT LEAK CHECK?		INITIAL		FINAL		LEAK RATE:		CU.FT @ CU.FT @		INCHES Hg INCHES Hg	
DGM VOLUME (CU. FT)		60		1600		0.41		2.2		152	
D-1		55		955.561		0.32		1.7		152	
2		60		955.561		0.32		1.7		152	
3		60		955.561		0.32		1.7		152	
TOTAL TIME		60 Min.		DGM VOLUME		AVE SQRT delta P		AVE. TEMP.		AVE. TEMP.	
60 Min.											

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Segnal MT TN
 Sample Location Main Street
 Run No. SM -M26A-5A
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SC

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	X	793.7	758.4	614.7	759.7	741.9	298.8	g
Initial weight	X	750.2	745.6	613.7	757.2	741.7	290.5	g
Net weight	X	43.5	12.8	1.0	2.5	0.2	8.3	g

Description of impinger water Clear 50 % spent
B/W Sil gel color
 Total moisture = 68.3 grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. SM -M26A-H2SO4- 5A

Liquid level
 marked/sealed ☒

NaOH Impingers contents and water rinse
 container no. SM -M26A-NaOH 5A

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

METHOD 26A FIELD DATA SHEET

PAGE 1 of 1

PLANT AND CITY		DATE		SAMPLING LOCATION			SAMPLE TYPE		RUN NUMBER		
Chaffinville		12/13/23		William Street			M26A		53		
OPERATOR	JAMBERT PRESS (In. Hg)	STATIC PRESSURE (in. Water)	AMBIENT TEMP (deg. F)	FILTER NUMBERS	STACK ID (In.)	PITOT Cp	PROBE LENGTH AND LINER TYPE	NOZZLE	DIAMETER		
	19.7	-1.5	~75	11K	84180	0.99084	8" High Pressure	309	310.311		
ASSUMED DGM MOISTURE 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	
15.15	168	975	NO	470	12M	0.14	0.01	10.8	18.6	5.45	
PITOT LEAK CHECK ---> PASSED											
TRaverse 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	14:45	805.555	.51	2.8	246	373	83	248	58	7	
2 5		810.43	.57	3.1	250	373	83	250	58	8	
3 10		815.83	.46	2.5	250	374	84	251	60	7	
15	15:00	820.569	End of Port								
INTRA-PORT LEAK CHECK?											
DGM VOLUME (CU. FT)	INITIAL	FINAL	LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg						
B-1 15	15:06	820.569	.56	3.1	248	372	83	254	61	8	
2 20		815.86	.55	3.1	252	372	84	264	60	8	
3 25		831.06	.47	2.6	249	372	84	260	56	6	
30	15:11	835.826	End of Port								
INTRA-PORT LEAK CHECK?											
DGM VOLUME (CU. FT)	INITIAL	FINAL	LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg						
C-1 30	15:20	835.826	.47	2.6	252	365	83	253	61	9	
2 35		840.68	.49	2.7	249	377	84	257	60	7	
3 40		845.43	.40	2.2	252	375	84	262	58	6	
45	15:41	849.333	End of Port								
INTRA-PORT LEAK CHECK?											
DGM VOLUME (CU. FT)	INITIAL	FINAL	LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg						
D-1 45	15:45	849.333	.45	2.5	249	367	83	249	58	7	
2 50		853.57	.42	2.3	251	368	84	254	56	6	
3 55		857.66	.40	2.2	253	369	85	255	56	6	
60	16:00	861.915	End of Port								
TOTAL TIME											
60 Min.	DGM VOLUME		AVE SQRT delta P		AVE. TEMP.		AVE. TEMP.				
	861.915										

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Signal Mt TN
 Sample Location Main Stack
 Run No. SM -M26A- 5B
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by GLS

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	X	779.1	772.6	654.6	758.3	753.9	944.1	g
Initial weight	X	750.0	753.2	649.0	756.9	753.5	931.8	g
Net weight	X	29.1	19.4	5.6	1.4	0.4	12.3	g

Description of impinger water Clear 75 % spent
B/W Sil gel color
 Total moisture = 68.2 grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. SM -M26A-H2SO4- 5B

Liquid level
 marked/sealed ☒

NaOH Impingers contents and water rinse
 container no. SM -M26A-NaOH 5B

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

PAGE 1 of 1

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Signal Mt TN
 Sample Location Main Stack
 Run No. SM -M26A- 6A
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by hcs

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	X	791.1	748.5	622.3	748.6	764.3	982.2	g
Initial weight	X	745.4	735.9	619.1	748.0	763.5	970.3	g
Net weight	✓	45.7	12.6	3.2	0.6	0.8	11.9	g

Description of impinger water clean 45 % spent
B/W Sil gel color
 Total moisture = 74.8 grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. SM -M26A-H2SO4- 6A

Liquid level
 marked/sealed ✓

NaOH Impingers contents and water rinse
 container no. SM -M26A-NaOH 6A

Liquid level
 marked/sealed ✓

Samples stored and locked _____
 Remarks _____

✓

PAGE 1 of 1

PLANT AND CITY		DATE		SAMPLING LOCATION		SAMPLE TYPE		RUN NUMBER	
OPERATOR		AMBIENT PRESS (In. Hg)		STATIC PRESSURE (in. Water)		AMBIENT TEMP (deg. F)		PROBE LENGTH AND LINER TYPE	
ASSUMED DGM MOISTURE BOX No. (%)		DGM H@		DGM CAL FACTOR (Y)		STACK TEMP NO.		PITOT ORSAT NO.	
TRAVEL ELAPSED TEST TIME (MIN)		CLOCK TIME (24-HR)		DGM READING Vm (cu. ft.)		VELOCITY HEAD (In. H2O)		delta H ORIFICE (In. H2O)	
PORT/POINT NO.		DGM		DGM		DGM		DGM	
A-1		0	16:15	862.169	862.169	1.50	2.6	152	370
2		5		866.6	866.6	.48	2.5	253	370
3		10		890.22	890.22	.38	2.1	258	373
15		15	16:18	874.660	874.660	End of Port			
INTRA-PORT LEAK CHECK?		DGM VOLUME (CU. FT)		INITIAL FINAL		LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg	
B-1		15	16:31	874.660	874.660	.46	1.4	247	371
2		20		879.83	879.83	.46	1.4	253	370
3		25		884.15	884.15	.39	2.1	251	369
30		30	16:46	889.052	889.052	End of Port			
INTRA-PORT LEAK CHECK?		DGM VOLUME (CU. FT)		INITIAL FINAL		LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg	
C-1		30	16:55	889.052	889.052	.57	2.8	249	373
2		35		893.84	893.84	.51	2.5	253	374
3		40		897.68	897.68	.49	1.6	252	376
45		45	17:10	902.238	902.238	End of Port			
INTRA-PORT LEAK CHECK?		DGM VOLUME (CU. FT)		INITIAL FINAL		LEAK RATE: CU.FT @ CU.FT @		INCHES Hg INCHES Hg	
D-1		45	17:16	902.238	902.238	.49	2.6	248	374
2		50		906.83	906.83	.46	2.4	254	393
3		55		911.42	911.42	.38	2.1	256	396
60		60	17:30	916.179	916.179	End of Port			
TOTAL TIME		60 Min.		DGM VOLUME		AVE Sqrt delta P		AVE. TEMP.	
				916.179				AVE. TEMP.	

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Buzzi Signal Mt TN
 Sample Location Mt Signal
 Run No. SM -M26A- 6B
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SG

MOISTURE

757.8

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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	~~X~~	<u>790.8</u>	<u>765.6</u>	<u>677.3</u>	<u>753.0</u>	<u>757.8</u>	<u>1021.2</u>	g
Initial weight	~~X~~	<u>761.0</u>	<u>743.9</u>	<u>671.7</u>	<u>751.6</u>	<u>756.3</u>	<u>1010.6</u>	g
Net weight	~~X~~	<u>29.0</u>	<u>21.7</u>	<u>5.6</u>	<u>1.4</u>	<u>1.5</u>	<u>10.6</u>	g

Description of impinger water clear 75 % spent
B/W Sil gel color
 Total moisture = 69.8 grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. SM -M26A-H2SO4- 6B

Liquid level marked/sealed ✓

NaOH Impingers contents and water rinse
 container no. SM -M26A-NaOH 6B

Liquid level marked/sealed ✓

Samples stored and locked _____
 Remarks _____

EPA METHOD 26A RECOVERY AND INTEGRITY DATA SHEET

Plant Bugji Signal Mt TN
 Sample Location Main Stack
 Run No. SM Off -M26A- FB
 Filter Number(s) Not Applicable

Sample Date 12/13/23
 Recovery Date 12/13/23
 Recovered by SLJ

MOISTURE

Impingers	1 50 ml 0.1N H ₂ SO ₄ (knockout)	2 100 ml 0.1N H ₂ SO ₄ (tipped)	3 100 ml 0.1N H ₂ SO 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		749.3	780.9	612.1	735.0	739.0	987.0	g
Initial weight		749.4	780.9	612.3	734.8	739.3	986.9	g
Net weight								g

Description of impinger water Clear 30 % spent
BLW Sil gel color
 Total moisture = _____ grams

RECOVERED SAMPLE

H₂SO₄ Impingers and knockout contents and water rinse
 container no. SM -M26A-H2SO4- Off FB

Liquid level
 marked/sealed ☒

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

Liquid level
 marked/sealed ☒

Samples stored and locked _____
 Remarks _____

Client: Buzzi Signal MT
 Test Location: Main Stack Mill On
 Date: Dec 13 23 Start Time: 08:15:35
 Run number 1
 One Minute Averages

	O2 %,dry	CO2 %,dry
08:16:33	12.4	15.2
08:17:33	12.4	15.2
08:18:33	12.5	15.1
08:19:33	12.5	15.3
08:20:33	12.5	15.4
08:21:33	12.5	15.1
08:22:33	12.5	15.1
08:23:33	12.5	15.3
08:24:33	12.5	15.2
08:25:33	12.5	15.2
08:26:33	12.5	15.3
08:27:33	12.5	15.2
08:28:33	12.5	15.0
08:29:33	12.5	15.3
08:30:33	12.4	15.4
08:31:33	12.5	15.2
08:32:33	12.5	15.2
08:33:33	12.5	15.3
08:34:33	12.5	15.2
08:35:33	12.5	15.3
08:36:33	12.5	15.2
08:37:33	12.5	15.1
08:38:33	12.4	15.4
08:39:33	12.4	15.3
08:40:33	12.5	15.2
08:41:33	12.4	15.3
08:42:33	12.4	15.4
08:43:33	12.4	15.3
08:44:33	12.4	15.4
08:45:33	12.4	15.2
08:46:33	12.5	15.0
08:47:33	12.5	15.2
08:48:33	12.5	15.2
08:49:33	12.5	15.2
08:50:33	12.5	15.3
08:51:33	12.4	15.4
08:52:33	12.4	15.2
08:53:33	12.5	15.3
08:54:33	12.5	15.3
08:55:33	12.5	15.3
08:56:33	12.5	15.2
08:57:33	12.5	15.2
08:58:33	12.5	15.2
08:59:33	12.5	15.4
09:00:33	12.5	15.4
09:01:33	12.4	15.3
09:02:33	12.5	15.3
09:03:33	12.5	15.4
09:04:33	12.5	15.3
09:05:33	12.5	15.3
09:06:33	12.4	15.3
09:07:33	12.4	15.3
09:08:33	12.5	15.3
09:09:33	12.4	15.4
09:10:33	12.5	15.3
09:11:33	12.5	15.3
09:12:33	12.5	15.2
09:13:33	12.5	15.3
09:14:33	12.4	15.4
09:15:33	12.5	15.4
Run Avgs	12.5	15.3
Cal Gas	12.1	18.2
Initial Zero	0.1	0.2
Final Zero	0.1	0.3
Initial cal.	12.1	18.0
Final Cal.	12.0	17.9
Corrected Average	12.5	15.4

Client: Buzzi Signal MT
 Test Location: Main Stack Mill On
 Date: Dec 13 23 Start Time: 09:48:19
 Run number 2
 One Minute Averages

	O2 %,dry	CO2 %,dry
09:49:17	12.4	15.4
09:50:17	12.5	15.5
09:51:17	12.4	15.4
09:52:17	12.4	15.3
09:53:17	12.4	15.3
09:54:17	12.4	15.6
09:55:17	12.4	15.4
09:56:17	12.4	15.6
09:57:17	12.4	15.4
09:58:17	12.4	15.3
09:59:17	12.4	15.5
10:00:17	12.4	15.6
10:01:17	12.4	15.4
10:02:17	12.4	15.6
10:03:17	12.4	15.6
10:04:17	12.4	15.4
10:05:17	12.4	15.5
10:06:17	12.5	15.4
10:07:17	12.4	15.4
10:08:17	12.4	15.5
10:09:17	12.4	15.6
10:10:17	12.4	15.4
10:11:17	12.5	15.5
10:12:17	12.5	15.4
10:13:17	12.5	15.3
10:14:17	12.4	15.6
10:15:17	12.4	15.5
10:16:17	12.4	15.3
10:17:17	12.4	15.6
10:18:17	12.4	15.5
10:19:17	12.4	15.2
10:20:17	12.4	15.5
10:21:17	12.4	15.7
10:22:17	12.4	15.4
10:23:17	12.4	15.7
10:24:17	12.4	15.5
10:25:17	12.5	15.3
10:26:17	12.4	15.6
10:27:17	12.4	15.5
10:28:17	12.4	15.3
10:29:17	12.4	15.6
10:30:17	12.4	15.5
10:31:17	12.4	15.4
10:32:17	12.3	15.6
10:33:17	12.4	15.5
10:34:17	12.4	15.3
10:35:17	12.4	15.5
10:36:17	12.4	15.5
10:37:17	12.5	15.3
10:38:17	12.4	15.5
10:39:17	12.4	15.4
10:40:17	12.5	15.4
10:41:17	12.4	15.4
10:42:17	12.4	15.5
10:43:17	12.4	15.4
10:44:17	12.4	15.4
10:45:17	12.5	15.4
10:46:17	12.4	15.5
10:47:17	12.4	15.5
10:48:17	12.4	15.4
Run Avgs	12.4	15.5
Cal Gas	12.1	18.2
Initial Zero	0.1	0.3
Final Zero	0.1	0.4
Initial cal.	12.0	17.9
Final Cal.	12.0	18.0
Corrected Average	12.5	15.6

Client: Buzzi Signal MT
 Test Location: Main Stack Mill On
 Date: Dec 13 23 Start Time: 11:16:11
 Run number 3
 One Minute Averages

	O2 %,dry	CO2 %,dry
11:17:09	12.4	15.3
11:18:09	12.4	15.3
11:19:09	12.4	15.5
11:20:09	12.4	15.5
11:21:09	12.4	15.4
11:22:09	12.4	15.2
11:23:09	12.3	15.6
11:24:09	12.3	15.4
11:25:09	12.4	15.4
11:26:09	12.4	15.5
11:27:09	12.4	15.5
11:28:09	12.4	15.4
11:29:09	12.3	15.6
11:30:09	12.3	15.5
11:31:09	12.4	15.3
11:32:09	12.3	15.6
11:33:09	12.4	15.4
11:34:09	12.3	15.4
11:35:09	12.3	15.6
11:36:09	12.3	15.4
11:37:09	12.3	15.5
11:38:09	12.3	15.7
11:39:09	12.3	15.5
11:40:09	12.3	15.4
11:41:09	12.3	15.7
11:42:09	12.2	15.7
11:43:09	12.3	15.5
11:44:09	12.3	15.5
11:45:09	12.3	15.6
11:46:09	12.3	15.4
11:47:09	12.2	15.7
11:48:09	12.2	15.7
11:49:09	12.2	15.5
11:50:09	12.3	15.6
11:51:09	12.3	15.6
11:52:09	12.2	15.5
11:53:09	12.3	15.5
11:54:09	12.3	15.4
11:55:09	12.3	15.5
11:56:09	12.3	15.7
11:57:09	12.3	15.6
11:58:09	12.3	15.5
11:59:09	12.3	15.4
12:00:09	12.3	15.6
12:01:09	12.2	15.7
12:02:09	12.2	15.4
12:03:09	12.3	15.6
12:04:09	12.2	15.9
12:05:09	12.2	15.7
12:06:09	12.2	15.8
12:07:09	12.3	15.4
12:08:09	12.2	15.7
12:09:09	12.2	16.0
12:10:09	12.1	15.7
12:11:09	12.2	15.5
12:12:09	12.2	15.7
12:13:09	12.2	15.7
12:14:09	12.2	15.7
12:15:09	12.2	15.7
12:16:09	12.2	15.5
Run Avgs	12.3	15.6
Cal Gas	12.1	18.2
Initial Zero	0.1	0.4
Final Zero	0.2	0.4
Initial cal.	12.0	18.0
Final Cal.	12.0	17.9
Corrected Average	12.4	15.7

Client: Buzzzi Signal MT
 Test Location: Main Stack Mill On
 Date: Dec 13 23 Start Time: 13:20:31
 Run number 4
 One Minute Averages

	O2 %,dry	CO2 %,dry
13:21:29	10.9	18.4
13:22:29	11.0	18.3
13:23:29	10.8	18.7
13:24:29	10.9	18.4
13:25:29	11.0	18.2
13:26:29	11.0	18.2
13:27:29	10.9	18.5
13:28:29	10.9	18.6
13:29:29	10.8	18.6
13:30:29	11.0	18.3
13:31:29	10.9	18.3
13:32:29	11.0	18.4
13:33:29	10.9	18.5
13:34:29	11.0	18.3
13:35:29	11.0	18.3
13:36:29	11.0	18.4
13:37:29	10.9	18.5
13:38:29	10.9	18.4
13:39:29	10.9	18.5
13:40:29	10.9	18.3
13:41:29	10.9	18.5
13:42:29	10.9	18.4
13:43:29	10.9	18.3
13:44:29	10.9	18.5
13:45:29	10.8	18.5
13:46:29	10.9	18.2
13:47:29	10.9	18.4
13:48:29	10.9	18.3
13:49:29	10.8	18.4
13:50:29	10.9	18.4
13:51:29	10.7	18.6
13:52:29	10.8	18.4
13:53:29	10.7	18.6
13:54:29	10.8	18.7
13:55:29	10.8	18.5
13:56:29	10.8	18.4
13:57:29	10.9	18.3
13:58:29	10.9	18.2
13:59:29	10.9	18.2
14:00:29	10.9	18.5
14:01:29	10.9	18.3
14:02:29	11.0	18.1
14:03:29	11.0	18.2
14:04:29	11.0	18.1
14:05:29	10.9	18.3
14:06:29	11.0	18.2
14:07:29	11.0	18.2
14:08:29	11.1	18.0
14:09:29	11.0	18.1
14:10:29	11.0	18.3
14:11:29	11.0	18.4
14:12:29	11.0	18.4
14:13:29	11.0	18.3
14:14:29	10.9	18.4
14:15:29	10.9	18.4
14:16:29	11.0	18.2
14:17:29	11.0	18.4
14:18:29	11.0	18.7
14:19:29	10.8	19.4
14:20:29	10.9	18.5
Run Avgs	10.9	18.4
Cal Gas	12.1	18.2
Initial Zero	0.2	0.4
Final Zero	0.2	0.3
Initial cal.	12.0	17.9
Final Cal.	12.2	17.8
Corrected Average	10.9	18.8

Client: Buzzi Signal MT
 Test Location: Main Stack Mill On
 Date: Dec 13 23 Start Time: 14:45:05
 Run number 5
 One Minute Averages

	O2 %,dry	CO2 %,dry
14:46:03	11.0	18.2
14:47:03	11.0	18.2
14:48:03	10.8	18.4
14:49:03	10.9	18.4
14:50:03	10.9	18.3
14:58:55	11.0	18.2
14:59:55	10.9	18.4
15:00:55	10.9	18.2
15:01:55	10.9	18.3
15:02:55	10.9	18.3
15:03:55	10.8	18.3
15:04:55	10.9	18.3
15:05:55	10.9	18.4
15:06:55	10.9	18.3
15:07:55	10.9	18.0
15:08:55	10.9	18.1
15:09:55	10.8	18.3
15:10:55	10.9	18.3
15:11:55	10.9	18.3
15:12:55	11.0	18.1
15:13:55	11.0	18.1
15:14:55	11.0	18.0
15:15:55	11.0	17.9
15:16:55	11.0	18.1
15:17:55	11.0	18.1
15:18:55	10.9	18.2
15:19:55	11.0	18.0
15:20:55	11.0	18.1
15:21:55	11.0	18.1
15:22:55	11.0	18.1
15:23:55	10.9	18.2
15:24:55	10.9	18.1
15:25:55	11.0	18.1
15:26:55	10.9	18.2
15:27:55	10.9	18.2
15:28:55	10.9	18.3
15:29:55	10.8	18.6
15:30:55	10.8	18.5
15:31:55	10.8	18.3
15:32:55	10.8	18.4
15:33:55	11.0	18.2
15:34:55	11.5	17.3
15:35:55	11.9	17.0
15:36:55	11.8	17.3
15:37:55	11.6	17.6
15:38:55	11.7	17.5
15:39:55	11.7	17.4
15:40:55	11.7	17.6
15:41:55	11.7	17.8
15:42:55	11.2	18.8
15:43:55	10.5	19.7
15:44:55	10.3	19.4
15:45:55	10.2	19.3
15:46:55	10.2	19.4
15:47:55	10.2	19.6
15:48:55	10.3	19.5
15:49:55	10.5	19.0
15:50:55	10.4	19.4
15:51:55	10.3	19.4
15:52:55	10.3	19.4
Run Avgs	10.9	18.3
Cal Gas	12.1	18.2
Initial Zero	0.2	0.3
Final Zero	0.3	0.2
Initial cal.	12.2	17.8
Final Cal.	12.3	17.8
Corrected Average	10.8	18.7

Client: Buzzi Signal MT
 Test Location: Main Stack Mill On
 Date: Dec 13 23 Start Time: 16:13:07
 Run number 6
 One Minute Averages

	O2 %,dry	CO2 %,dry
16:14:05	10.9	18.6
16:15:05	10.9	18.6
16:16:05	10.9	18.6
16:17:05	11.0	18.7
16:18:05	11.0	18.5
16:19:05	11.0	18.5
16:20:05	11.0	18.4
16:21:05	11.0	18.4
16:22:05	11.0	18.7
16:23:05	11.0	18.4
16:24:05	11.0	18.5
16:25:05	11.0	18.6
16:26:05	11.0	18.4
16:27:05	11.0	18.4
16:28:05	10.9	18.5
16:29:05	10.9	18.5
16:30:05	11.0	18.3
16:31:05	11.0	18.3
16:32:05	10.9	18.6
16:33:05	10.9	18.8
16:34:05	10.9	18.5
16:35:05	10.9	18.6
16:36:05	10.9	18.5
16:37:05	10.9	18.4
16:38:05	11.0	18.4
16:39:05	10.9	18.6
16:40:05	11.0	18.5
16:41:05	11.0	18.4
16:42:05	11.0	18.5
16:43:05	10.9	18.7
16:44:05	10.9	18.4
16:45:05	10.9	18.4
16:46:05	10.9	18.6
16:47:05	10.9	18.5
16:48:05	10.9	18.5
16:49:05	10.9	18.6
16:50:05	10.9	18.5
16:51:05	10.9	18.5
16:52:05	10.9	18.5
16:53:05	10.9	18.6
16:54:05	10.8	18.7
16:55:05	10.8	18.5
16:56:05	10.9	18.6
16:57:05	10.8	18.8
16:58:05	10.8	18.6
16:59:05	10.9	18.5
17:00:05	10.8	18.9
17:01:05	10.8	18.7
17:02:05	10.8	18.6
17:03:05	10.9	18.5
17:04:05	10.8	18.6
17:05:05	10.9	18.4
17:06:05	10.9	18.3
17:07:05	10.8	18.5
17:08:05	10.8	18.5
17:09:05	10.8	18.4
17:10:05	10.8	18.5
17:11:05	10.8	18.5
17:12:05	10.8	18.5
17:13:05	10.8	18.4
Run Avgs	10.9	18.5
Cal Gas	12.1	18.2
Initial Zero	0.3	0.2
Final Zero	12.3	0.1
Initial cal.	12.1	17.8
Final Cal.	12.0	17.7
Corrected Average	9.7	19.0

Buzzi Unicem; Chattanooga TN

Main Stack: Raw Mill Off

December 13, 2023

Operator

575

[illegible]

Buzzi Unicem Chattanooga TN
Signal Mountain Plant
Main Stack; Raw Mill ON and Raw Mill Off
HCN Analyte Spikes

	Date Time	Raw Mill On 12/13/23 07:58-08:08 Main Pre 1 HCN	Raw Mill On 12/13/23 09:15-09:28 Main Post 1 HCN	Raw Mill On 12/13/23 10:48-11:01 Main Post 2 HCN	Raw Mill On 12/13/23 12:17-12:33 Main Post 3 HCN	Raw Mill Off 12/13/23 13:09-13:20 Main Pre 4 HCN	Raw Mill Off 12/13/23 14:19-14:31 Main Post 4 HCN	Raw Mill Off 12/13/23 15:55-16:06 Main Post 5 HCN	Raw Mill Off 12/13/23 17:14-17:36 Main Post 6 HCN
Cs	CC768222 Spike Direct, ppm SF6 Tracer Direct, ppm	49.17 4.82	49.17 4.82	49.17 4.82	49.17 4.82	49.17 4.82	49.17 4.82	49.17 4.82	49.17 4.82
SF6	Diluted SF6 Tracer, ppm Diluted SF6 Tracer, ppm Average Diluted SF6 Tracer, ppm	0.247 0.231 0.239	0.242 0.245 0.244	0.268 0.243 0.256	0.221 0.225 0.223	0.277 0.257 0.267	0.247 0.226 0.237	0.266 0.259 0.263	0.268 0.240 0.254
DF	Dilution Ratio	20.16	19.79	18.86	21.61	18.05	20.38	18.36	18.97
Ct	Total, ppm Total, ppm Average Total, ppm	4.164 4.251 4.208	4.211 4.234 4.223	4.310 4.174 4.242	3.926 3.806 3.866	4.797 4.627 4.712	4.556 4.439 4.498	4.867 4.861 4.864	4.968 4.878 4.923
Cn	Pre Spike Native , ppm Pre Spike Native , ppm Post Spike Native , ppm Post Spike Native , ppm Average Native , ppm	1.925 1.881 1.942 2.702 2.113	1.957 1.980 1.924 1.912 1.943	1.913 1.880 1.865 1.917 1.894	1.912 1.938 1.839 1.929 1.905	2.193 2.144 2.288 2.303 2.232	2.413 2.448 2.281 2.385 2.382	2.546 2.524 2.546 2.546 2.541	2.598 2.432 2.562 2.570 2.541
	Spike Recovery	90.2%	95.7%	93.9%	90.1%	95.6%	92.5%	91.9%	97.1%
	CTS Direct (CC426155)								
	Ethylene Expected (ppm)	75.47							75.47
	Ethylene Measured (ppm)	73.81							73.15
	CTS Error	-2.2%							-3.1%

Buzzi Unicem; Chattanooga TN

Main Stack; Mill On

Pre Run 1 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__006441.LAB	12/13/23	07:57:10.227	1.186	0.084	-0.013
SPC__006442.LAB	12/13/23	07:58:14.138	1.925	0.022	-0.007
SPC__006443.LAB	12/13/23	07:59:18.040	1.881	-0.011	-0.000
SPC__006444.LAB	12/13/23	08:00:22.033	1.808	-0.019	-0.004
SPC__006445.LAB	12/13/23	08:01:26.320	1.818	-0.009	-0.006
SPC__006446.LAB	12/13/23	08:02:29.799	4.164	-0.037	0.247
SPC__006447.LAB	12/13/23	08:03:33.757	4.251	-0.037	0.261
SPC__006448.LAB	12/13/23	08:04:37.567	3.336	0.009	0.151
SPC__006449.LAB	12/13/23	08:05:41.466	2.000	-0.019	-0.006
SPC__006450.LAB	12/13/23	08:06:45.412	1.942	-0.030	-0.002
SPC__006451.LAB	12/13/23	08:07:49.280	2.702	-0.052	0.097
SPC__006452.LAB	12/13/23	08:08:53.515	0.106	-0.020	-0.000

Buzzi Unicem; Chattanooga TN
Main Stack; Mill On
Post Run 1 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__006512.LAB	12/13/23	09:14:06.359	1.923	-0.067	-0.008
SPC__006513.LAB	12/13/23	09:15:10.306	1.957	-0.058	-0.005
SPC__006514.LAB	12/13/23	09:16:14.215	1.980	-0.048	-0.003
SPC__006515.LAB	12/13/23	09:17:18.162	2.005	-0.076	-0.003
SPC__006516.LAB	12/13/23	09:18:22.025	4.211	-0.077	0.242
SPC__006517.LAB	12/13/23	09:19:26.250	4.234	-0.064	0.245
SPC__006518.LAB	12/13/23	09:20:29.771	2.010	-0.038	0.136
SPC__006519.LAB	12/13/23	09:21:34.022	0.049	-0.015	-0.001
SPC__006520.LAB	12/13/23	09:22:37.586	0.187	-0.007	-0.004
SPC__006521.LAB	12/13/23	09:23:41.493	0.147	-0.016	-0.005
SPC__006522.LAB	12/13/23	09:24:45.416	1.392	-0.001	-0.012
SPC__006523.LAB	12/13/23	09:25:49.349	1.924	-0.081	-0.006
SPC__006524.LAB	12/13/23	09:26:53.267	1.912	-0.047	-0.004
SPC__006525.LAB	12/13/23	09:27:57.170	1.893	-0.052	-0.004
SPC__006526.LAB	12/13/23	09:31:17.824	2.692	-0.062	-0.002

Buzzi Unicem; Chattanooga TN
Main Stack; Mill On
Post Run 2 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__006597.LAB	12/13/23	10:46:55.437	1.865	-0.079	-0.002
SPC__006598.LAB	12/13/23	10:47:59.000	1.913	-0.073	-0.001
SPC__006599.LAB	12/13/23	10:49:03.294	1.880	-0.066	-0.003
SPC__006600.LAB	12/13/23	10:50:06.818	2.859	-0.063	0.115
SPC__006601.LAB	12/13/23	10:51:10.724	4.310	-0.060	0.268
SPC__006602.LAB	12/13/23	10:52:14.702	4.174	-0.069	0.243
SPC__006603.LAB	12/13/23	10:53:18.521	1.869	-0.022	0.129
SPC__006604.LAB	12/13/23	10:54:22.479	0.106	-0.002	-0.003
SPC__006605.LAB	12/13/23	10:55:26.335	0.071	-0.026	-0.000
SPC__006606.LAB	12/13/23	10:56:30.233	0.056	-0.011	-0.002
SPC__006607.LAB	12/13/23	10:57:34.182	0.423	0.000	-0.003
SPC__006608.LAB	12/13/23	10:58:38.054	1.835	-0.060	-0.004
SPC__006609.LAB	12/13/23	10:59:41.957	1.865	-0.043	-0.000
SPC__006610.LAB	12/13/23	11:00:45.860	1.917	-0.059	-0.001
SPC__006611.LAB	12/13/23	11:01:49.896	1.871	-0.045	0.003

Buzzi Unicem; Chattanooga TN

Main Stack; Mill On

Post Run 3 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__006679.LAB	12/13/23	12:15:35.202	1.901	-0.082	-0.004
SPC__006680.LAB	12/13/23	12:16:39.092	1.912	-0.066	-0.002
SPC__006681.LAB	12/13/23	12:17:43.388	1.938	-0.073	-0.005
SPC__006682.LAB	12/13/23	12:18:47.177	3.433	-0.054	0.165
SPC__006683.LAB	12/13/23	12:19:50.815	4.113	-0.073	0.244
SPC__006684.LAB	12/13/23	12:20:54.722	3.926	-0.081	0.221
SPC__006685.LAB	12/13/23	12:21:58.617	3.806	-0.028	0.225
SPC__006686.LAB	12/13/23	12:23:02.625	0.225	-0.018	0.002
SPC__006687.LAB	12/13/23	12:24:06.455	0.131	-0.001	-0.000
SPC__006688.LAB	12/13/23	12:25:10.329	0.080	-0.020	0.001
SPC__006689.LAB	12/13/23	12:26:14.606	0.046	-0.008	0.002
SPC__006690.LAB	12/13/23	12:27:18.135	0.049	-0.023	-0.000
SPC__006691.LAB	12/13/23	12:28:22.049	0.089	-0.013	-0.007
SPC__006692.LAB	12/13/23	12:29:26.100	0.701	-0.013	-0.009
SPC__006693.LAB	12/13/23	12:30:29.860	1.793	-0.025	-0.006
SPC__006694.LAB	12/13/23	12:31:33.771	1.839	-0.029	-0.005
SPC__006695.LAB	12/13/23	12:32:37.947	1.929	-0.062	-0.006
SPC__006696.LAB	12/13/23	12:33:41.616	1.925	-0.023	-0.004

Buzzi Unicem; Chattanooga TN

Main Stack; Mill Off

Pre Run 4 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__006725.LAB	12/13/23	13:04:34.953	2.144	-0.055	-0.006
SPC__006726.LAB	12/13/23	13:05:38.709	2.142	-0.065	-0.003
SPC__006727.LAB	12/13/23	13:06:42.619	2.244	-0.072	-0.004
SPC__006728.LAB	12/13/23	13:07:46.801	2.142	-0.027	-0.007
SPC__006729.LAB	12/13/23	13:08:50.466	2.193	-0.053	-0.002
SPC__006730.LAB	12/13/23	13:11:05.072	2.144	-0.062	-0.002
SPC__006731.LAB	12/13/23	13:12:08.655	3.127	-0.064	0.096
SPC__006732.LAB	12/13/23	13:13:12.563	4.797	-0.056	0.277
SPC__006733.LAB	12/13/23	13:14:16.781	4.627	-0.016	0.257
SPC__006734.LAB	12/13/23	13:15:20.360	1.809	-0.039	0.111
SPC__006735.LAB	12/13/23	13:16:24.226	0.086	-0.003	0.003
SPC__006736.LAB	12/13/23	13:17:28.168	1.464	-0.005	-0.013
SPC__006737.LAB	12/13/23	13:18:32.050	2.288	-0.043	-0.004
SPC__006738.LAB	12/13/23	13:19:35.990	2.303	-0.065	-0.006
SPC__006739.LAB	12/13/23	13:20:39.896	2.194	-0.053	-0.003

Buzzi Unicem; Chattanooga TN

Main Stack; Mill Off

Post Run 4 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__006793.LAB	12/13/23	14:18:10.678	2.376	-0.063	-0.007
SPC__006794.LAB	12/13/23	14:19:14.617	2.413	-0.061	-0.005
SPC__006795.LAB	12/13/23	14:20:18.551	2.448	-0.078	-0.006
SPC__006796.LAB	12/13/23	14:21:22.740	3.028	-0.061	0.052
SPC__006797.LAB	12/13/23	14:22:26.379	4.556	-0.080	0.247
SPC__006798.LAB	12/13/23	14:23:30.198	4.439	-0.069	0.226
SPC__006799.LAB	12/13/23	14:24:34.128	1.998	-0.002	0.131
SPC__006800.LAB	12/13/23	14:25:38.105	0.124	0.001	-0.006
SPC__006801.LAB	12/13/23	14:26:41.904	0.120	-0.006	-0.009
SPC__006802.LAB	12/13/23	14:27:45.818	1.705	-0.014	-0.013
SPC__006803.LAB	12/13/23	14:28:49.730	2.279	-0.077	-0.004
SPC__006804.LAB	12/13/23	14:29:53.673	2.281	-0.049	-0.004
SPC__006805.LAB	12/13/23	14:30:57.531	2.385	-0.080	-0.001
SPC__006806.LAB	12/13/23	14:32:01.484	2.694	-0.285	0.116

Buzzi Unicem; Chattanooga TN

Main Stack; Mill Off

Post Run 5 HCN Analyte Spike

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C
SPC__006881.LAB	12/13/23	15:53:36.066	2.553	-0.076	-0.004
SPC__006882.LAB	12/13/23	15:54:39.962	2.546	-0.064	-0.004
SPC__006883.LAB	12/13/23	15:55:43.910	2.524	-0.033	-0.005
SPC__006884.LAB	12/13/23	15:56:47.776	4.079	-0.036	0.194
SPC__006885.LAB	12/13/23	15:57:51.676	4.867	-0.063	0.266
SPC__006886.LAB	12/13/23	15:58:55.581	4.861	-0.054	0.259
SPC__006887.LAB	12/13/23	15:59:59.734	2.533	-0.054	0.152
SPC__006888.LAB	12/13/23	16:01:03.426	0.222	-0.002	-0.004
SPC__006889.LAB	12/13/23	16:02:07.329	0.055	-0.006	-0.000
SPC__006890.LAB	12/13/23	16:03:11.275	0.108	0.025	0.001
SPC__006891.LAB	12/13/23	16:04:15.136	2.288	-0.055	-0.007
SPC__006892.LAB	12/13/23	16:05:19.004	2.546	-0.066	-0.007
SPC__006893.LAB	12/13/23	16:06:22.954	2.546	-0.072	-0.002
SPC__006894.LAB	12/13/23	16:07:26.854	2.597	-0.043	-0.004

Buzzi Unicem; Chattanooga TN
Main Stack; Mill Off
Post Run 6 HCN Analyte Spike and CTS

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C	Ethylene (100,3000) 191C
SPC__006954.LAB	12/13/23	17:12:28.436	2.542	-0.082	-0.002	1.150
SPC__006955.LAB	12/13/23	17:13:32.324	2.598	-0.093	-0.003	1.091
SPC__006956.LAB	12/13/23	17:14:36.315	2.432	-0.067	-0.004	1.092
SPC__006957.LAB	12/13/23	17:15:40.242	3.779	-0.083	0.141	1.099
SPC__006958.LAB	12/13/23	17:16:44.419	4.958	-0.078	0.268	1.131
SPC__006959.LAB	12/13/23	17:17:48.315	4.878	-0.078	0.240	1.133
SPC__006960.LAB	12/13/23	17:18:51.833	2.788	-0.026	0.157	0.208
SPC__006961.LAB	12/13/23	17:19:55.780	0.105	-0.001	-0.008	-0.196
SPC__006962.LAB	12/13/23	17:20:59.684	0.136	-0.009	-0.009	-0.154
SPC__006963.LAB	12/13/23	17:22:03.551	1.016	-0.032	-0.010	0.267
SPC__006964.LAB	12/13/23	17:23:07.800	2.651	-0.072	-0.003	1.259
SPC__006965.LAB	12/13/23	17:24:11.766	2.562	-0.083	-0.005	1.239
SPC__006966.LAB	12/13/23	17:25:15.267	2.570	-0.089	-0.005	1.296
SPC__006967.LAB	12/13/23	17:26:19.200	1.142	-0.020	-0.014	0.402
SPC__006968.LAB	12/13/23	17:27:23.078	0.053	0.008	0.003	-0.142
SPC__006969.LAB	12/13/23	17:28:26.977	0.052	-0.001	0.001	-0.148
SPC__006970.LAB	12/13/23	17:29:30.881	0.031	-0.000	-0.019	25.342
SPC__006971.LAB	12/13/23	17:30:35.176	0.063	0.001	-0.011	90.024
SPC__006972.LAB	12/13/23	17:31:38.725	0.062	-0.010	-0.005	79.902
SPC__006973.LAB	12/13/23	17:32:42.700	0.085	-0.015	-0.005	72.303
SPC__006974.LAB	12/13/23	17:33:46.884	0.058	0.004	-0.006	72.665
SPC__006975.LAB	12/13/23	17:34:50.442	0.150	-0.003	-0.013	73.273
SPC__006976.LAB	12/13/23	17:35:54.357	0.097	-0.018	-0.008	73.030
SPC__006977.LAB	12/13/23	17:36:58.223	-0.026	0.003	-0.012	72.709

Buzzi Unicem; Chattanooga TN
Main Stack; Mill On
CTS and HCN Analyte Spike Direct

Spectrum	Date	Time	HCN PCA 191c R1 191c	HF ppm (10) 191C	SF6 (10) 191C	Ethylene (100,3000) 191C
SPC__006403BKG.LAB	12/13/23	06:09:03.258	0.000	0.000	0.000	0.000
SPC__006404.LAB	12/13/23	06:10:13.666	-0.293	0.017	0.001	-0.088
SPC__006405.LAB	12/13/23	06:11:17.572	0.051	-0.009	0.002	-0.063
SPC__006406.LAB	12/13/23	06:12:21.532	0.384	-0.009	-0.014	51.324
SPC__006407.LAB	12/13/23	06:13:25.374	-0.364	0.014	-0.006	73.656
SPC__006408.LAB	12/13/23	06:14:29.284	-0.359	0.008	-0.000	73.744
SPC__006409.LAB	12/13/23	06:15:33.207	-0.551	0.003	-0.003	73.877
CTS Average						73.811
SPC__006410.LAB	12/13/23	06:16:37.428	14.750	-0.002	1.537	42.945
SPC__006411.LAB	12/13/23	06:17:41.079	46.881	0.001	4.816	-0.166
SPC__006412.LAB	12/13/23	06:18:44.943	47.920	0.011	4.830	-0.249
SPC__006413.LAB	12/13/23	06:19:48.810	47.958	0.006	4.818	-0.249
SPC__006414.LAB	12/13/23	06:20:52.755	48.089	0.010	4.817	-0.233
SPC__006415.LAB	12/13/23	06:21:56.991	48.452	-0.004	4.811	-0.297
SPC__006416.LAB	12/13/23	06:23:00.857	48.291	-0.014	4.813	-0.324
SPC__006417.LAB	12/13/23	06:24:04.427	48.480	-0.012	4.818	-0.213
SPC__006418.LAB	12/13/23	06:25:08.327	48.507	0.009	4.817	-0.349
SPC__006419.LAB	12/13/23	06:26:12.230	49.088	-0.008	4.818	-0.351
SPC__006420.LAB	12/13/23	06:27:16.142	49.166	-0.024	4.821	-0.321
SPC__006421.LAB	12/13/23	06:28:20.039	49.267	0.006	4.818	-0.286
HCN Analyte Spike Averages			49.174		4.819	

Appendix C

Ion Chromatography Analytical Report Data

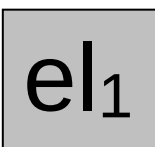
Deeco, Inc.
3404 Lake Woodard Drive
Raleigh, NC 27604

Project No: 23-3317
Buzzi Unicem

Hydrogen Fluoride & Chlorine

EPA Method 26A Analysis

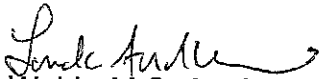
Analytical Report
41760



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 41760
has been reviewed for completeness, accuracy,
adherence to method protocol,
and compliance with quality assurance guidelines.

Review by:


Linda Ann Webb, M.S. Analytical Chemist
January 09, 2024

Report Reviewed and Finalized by:


Ken Smith, Laboratory Director
January 09, 2024

SUMMARY OF RESULTS

Summary of Analysis

Summary of Method 26A Analysis

Element	SM- M26A-R1A e41760-1 Total mg	SM- M26A-R2A e41760-2 Total mg	SM- M26A-R3A e41760-3 Total mg
HF	< 0.229	< 0.215	< 0.238
Cl ₂	< 0.210	< 0.170	< 0.166

Element	SM- M26A-R4A e41760-4 Total mg	SM- M26A-R5A e41760-5 Total mg	SM- M26A-R6A e41760-6 Total mg
HF	< 0.238	< 0.233	< 0.250
Cl ₂	0.258	0.217	0.261

Element	SM- M26A-R1B e41760-7 Total mg	SM- M26A-R2B e41760-8 Total mg	SM- M26A-R3B e41760-9 Total mg
HF	< 0.211	< 0.218	< 0.220
Cl ₂	< 0.169	0.238	< 0.178

Element	SM- M26A-R4B e41760-10 Total mg	SM- M26A-R5B e41760-11 Total mg	SM- M26A-R6B e41760-12 Total mg
HF	< 0.236	< 0.243	< 0.237
Cl ₂	< 0.183	< 0.171	< 0.177

Element	SM- M26A-FBON e41760-13 Total mg	SM- M26A-FBOFF e41760-14 Total mg
HF	< 0.216	< 0.229
Cl ₂	< 0.173	< 0.167

elementOne

ANALYTICAL NARRATIVE

Element One Analytical Narrative

Client:	Deeco, Inc.	Element One #:	41760
Client ID:	23-3317 Buzzi Unicem	Analyst:	LAW
Method:	M26A	Dates Received:	12.18.23
Analytes:	HF, Cl ₂	Dates Analyzed:	01.04-06.23

Summary of Analysis

The samples were prepared and analyzed according to Method 26A protocol. The samples were analyzed for fluoride and chloride on a Metrohm 861/788 chromatograph system.

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	SM- M26A-R1A RPD	SM- M26A-R2A RPD	SM- M26A-R3A RPD
HF	NA	NA	NA
Cl ₂	NA	NA	NA

Element	SM- M26A-R4A RPD	SM- M26A-R5A RPD	SM- M26A-R6A RPD
HF	NA	NA	NA
Cl ₂	0.0%	1.6%	2.4%

Element	SM- M26A-R1B RPD	SM- M26A-R2B RPD	SM- M26A-R3B RPD
HF	NA	NA	NA
Cl ₂	NA	1.4%	NA

Element	SM- M26A-R4B RPD	SM- M26A-R5B RPD	SM- M26A-R6B RPD
HF	NA	NA	NA
Cl ₂	NA	NA	NA

Element	SM- M26A-FBON RPD	SM- M26A-FBOFF RPD
HF	NA	NA
Cl ₂	NA	NA

Summary of Quality Control Data

Summary of Method 26A Spike Recoveries

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

Element	SM- M26A-R3A Recovery	SM- M26A-R3B Recovery
HF	109%	108%
Cl ₂	102%	104%

Second Source Calibration Verification

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

Element	DL 0.1mg/L Recovery	*QC 5.0mg/L Recovery
HF	90%	102%
Cl ₂	101%	101%

SAMPLE CUSTODY

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

41760
 Date: 12/10/23
 Lab: Element One
 Train: EPA Method 26

Plant Name: Buzzi Unicem
 Plant Location: Festus MO
 Project Name: 23-3317

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Comments			
<i>OK</i>	<i>12/18/23</i>	<i>Don K. No</i>	<i>12-18-23</i>				
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
SM-1A-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 435.8 mL	Element One
SM-1A-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 419.0 mL Sodium thiosulfate NOT ADDED!	Element One
SM-1B-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 401.8 mL	Element One
SM-1B-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 338.2 mL Sodium thiosulfate NOT ADDED!	Element One
SM-2A-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 407.8 mL	Element One
SM-2A-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 339.8 mL Sodium thiosulfate NOT ADDED!	Element One
SM-2B-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26A	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 414.6 mL	Element One
SM-2B-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26A	0.1N NaOH and DI Rinses	Final Volume 326.0 mL Sodium thiosulfate NOT ADDED!	Element One

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

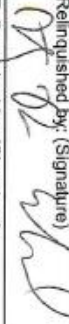
DEECO, Inc
 3404 Lake Woodard Dr.
 Raleigh, NC 27604
 919-250-0285

Plant Name: Buzzi Unicem

Plant Location: Festus MO

Project Name: 23-3317

41760
 Date: 12/10/23
 Lab: Element One
 Train: EPA Method 26

Relinquished by: (Signature)		Date/Time	12/18/23	Received by: (Signature)		Date/Time	12.18.23	Comments	
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		
SM-3A-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26a	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 452.1 mL	Element One		
SM-3A-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26a	0.1N NaOH and DI Rinses	Final Volume 332.9 mL Sodium thiosulfate NOT ADDED!	Element One		
SM-3B-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26a	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 417.8 mL	Element One		
SM-3B-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26a	0.1N NaOH and DI Rinses	Final Volume 356.0mL Sodium thiosulfate NOT ADDED!	Element One		
SM-4A-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26a	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 452.5 mL	Element One		
SM-4A-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26a	0.1N NaOH and DI Rinses	Final Volume 362.7 mL Sodium thiosulfate NOT ADDED!	Element One		
SM-4B-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26a	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 449.2 mL	Element One		
SM-4B-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26a	0.1N NaOH and DI Rinses	Final Volume 366.4 mL Sodium thiosulfate NOT ADDED!	Element One		

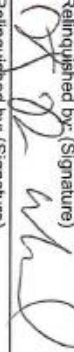
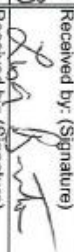
DEECO, Inc
 3404 Lake Woodard Dr.
 Raleigh, NC 27604
 919-250-0285

41766
 Date: 12/10/23
 Lab: Element One
 Train: EPA Method 26

Plant Name: Buzzi Unicem

Plant Location: Festus MO

Project Name: 23-3317

Relinquished by: (Signature)		Date/Time 12/18/23	Received by: (Signature)		Date/Time 12/18/23	Comments	
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
SM-5A-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26a	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 443.3 mL	Element One
SM-5A-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26a	0.1N NaOH and DI Rinses	Final Volume 350.4 mL Sodium thiosulfate NOT ADDED!	Element One
SM-5B-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26a	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 461.6 mL	Element One
SM-5B-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26a	0.1N NaOH and DI Rinses	Final Volume 342.7 mL Sodium thiosulfate NOT ADDED!	Element One
SM-6A-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26a	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 474.5 mL	Element One
SM-6A-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26a	0.1N NaOH and DI Rinses	Final Volume 415.9 mL Sodium thiosulfate NOT ADDED!	Element One
SM-6B-H ₂ SO ₄	12/13/23	Comp.	Fluoride ion as Hydrogen Fluoride	EPA Method 26a	0.1N H ₂ SO ₄ and DI Rinses	Final Volume 450.4 mL	Element One
SM-6B-NaOH	12/13/23	Comp.	Chloride ion as Chlorine (Cl ₂)	EPA Method 26a	0.1N NaOH and DI Rinses	Final Volume 353.1 mL Sodium thiosulfate NOT ADDED!	Element One

ANALYTICAL DATA

Analytical Calculations

HF -

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

Where-

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

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

Beginning Volume--*Sample Submission*

1.053= Correction factor for hydrogen fluoride

Cl₂ -

$$\text{Total X}_2 \text{ (mg)} = \frac{\text{X Results } (\mu\text{g/mL}) * \text{Dilution} * \text{Beginning Volume (mL)}}{1000}$$

Where-

X Results= Raw sample concentration (ppm)—*Cl₂ IC Data Sheet*

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

Beginning Volume--*Sample Submission*

Analytical Calculations

Spike Recovery-

$$\text{Spike (\%)} = \frac{(\text{Spiked Result } (\mu\text{g/mL}) - \text{Sample Result } (\mu\text{g/mL}))}{\text{Spike Amount } (\mu\text{g/mL})} \times 100$$

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-

$$\text{RPD (\%)} = \frac{(\text{Duplicate Result } (\mu\text{g/mL}) - \text{Sample Result } (\mu\text{g/mL}))}{\text{Average } (\mu\text{g/mL})} \times 100$$

Where-

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

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

elementOne

AIR TESTING SAMPLE SUBMISSION FORM

Lab ID 41760

Out of Hold 01.10.24

Analysis Due Date 12.29.23

QA/QC/Report Due Date 01.03.24

Client: Deeco, Inc.
Project No 23-3317

Date Rec 12.18.23
Time Rec 1100

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

Sample Identification

1	SM-M26A-R1A	7	SM-M26A-R1B	13	SM-M26A-FBON
2	SM-M26A-R2A	8	SM-M26A-R2B	14	SM-M26A-FBOFF
3	SM-M26A-R3A	9	SM-M26A-R3B		
	SM-M26A-R3A Spike		SM-M26A-R3B Spike		
4	SM-M26A-R4A	10	SM-M26A-R4B		
5	SM-M26A-R5A	11	SM-M26A-R5B		
6	SM-M26A-R6A	12	SM-M26A-R6B		
Analyses Requested		Samples 1-14	HF		
		Samples 1-14	Cl ₂		

Runs/FB

Lab ID	FH Impinger 1 (or Combined Imp)		FH Impinger 2		FH Impinger 3		BH Impinger 4 (or Combined Imp)		BH Impinger 5	
	BV, ml	FV, ml	BV, ml	FV, ml	BV, ml	FV, ml	BV, ml	FV, ml	BV, ml	FV, ml
1		435.8						419		
2		419.8						339.8		
3.S		452.1						332.9		
4		452.5						362.7		
5		443.3						350.4		
6		494.5						415.9		
7		401.8						338.2		
8		414.6						326.0		
9.S		417.8						356.0		
10		449.2						366.4		
11		416.6						342.7		
12		450.4						353.1		
13		411.2						344.8		
14		435.9						333.0		

Lab Communications

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

SS Page 1 of 1
SS by LLB
12/19/2023 10:02:02 AM

Imp 1, 2, & 3 Prep By / Date LAW 01:05:24
Imp 4 & 5 Prep By / Date LWS 01:04:24
Labeled By/Date PDE 12.19.23
ID Verification By/Date MMW 12.19.23

elementOne

Certification: NJ NELAP NC009
41760 Deeco M26A Report Packet
Page 18 of 28

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M26A-HF IC Data Sheet

Lab ID #: 41760

Client: Deeco

Column: IonPac AS14A

Date: 01.09.24

Eluent: 8.0 mM Na₂CO₃/ 1.0 mM NaHCO₃

Analyst: LAW

Flow Rate: 1.0 mL/min.

Detection Limit, (µg/ml): 0.10

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	0.00	1	10	< 0.001			_2024-01-05_	1/5/2024 20:59
LRB	0.00	1	10	< 0.001		NA	_2024-01-05_	1/5/2024 21:18
LRB SPK	5.27	1	10	0.055	5.00	105%	_2024-01-05_	1/5/2024 21:36
LRB SPK	5.01	1	10	0.053	5.00	100%	_2024-01-05_	1/5/2024 21:55
41760-1	0.00	5	435.8	< 0.229			_2024-01-05_	1/5/2024 22:14
41760-1 DUP	0.00	5	435.8	< 0.229		NA	_2024-01-05_	1/5/2024 22:32
41760-2	0.00	5	407.8	< 0.215			_2024-01-06_	1/6/2024 1:21
41760-2 DUP	0.00	5	407.8	< 0.215		NA	_2024-01-06_	1/6/2024 1:40
41760-3	0.00	5	452.1	< 0.238			_2024-01-05_	1/5/2024 22:51
41760-3 DUP	0.00	5	452.1	< 0.238		NA	_2024-01-05_	1/5/2024 23:10
41760-3 SPK	5.44	5	452.1	12.9	5.00	109%	_2024-01-05_	1/5/2024 23:29
41760-3 SPK DUP	5.44	5	452.1	13.0	5.00	109%	_2024-01-05_	1/5/2024 23:47
41760-4	0.00	5	452.5	< 0.238			_2024-01-06_	1/6/2024 1:59
41760-4 DUP	0.00	5	452.5	< 0.238		NA	_2024-01-06_	1/6/2024 2:17
41760-5	0.00	5	443.3	< 0.233			_2024-01-06_	1/6/2024 2:36
41760-5 DUP	0.00	5	443.3	< 0.233		NA	_2024-01-06_	1/6/2024 2:55
41760-6	0.00	5	474.5	< 0.25			_2024-01-06_	1/6/2024 3:13
41760-6 DUP	0.00	5	474.5	< 0.25		NA	_2024-01-06_	1/6/2024 3:32
41760-7	0.00	5	401.8	< 0.211			_2024-01-06_	1/6/2024 3:51
41760-7 DUP	0.00	5	401.8	< 0.211			_2024-01-06_	1/6/2024 4:10
41760-8	0.00	5	414.6	< 0.218			_2024-01-06_	1/6/2024 5:43
41760-8 DUP	0.00	5	414.6	< 0.218		NA	_2024-01-06_	1/6/2024 6:02
41760-9	0.00	5	417.8	< 0.22			_2024-01-06_	1/6/2024 6:21
41760-9 DUP	0.00	5	417.8	< 0.22		NA	_2024-01-06_	1/6/2024 6:40
41760-9 SPK	5.44	5	417.8	12.0	5.00	109%	_2024-01-06_	1/6/2024 6:58
41760-9 SPK DUP	5.36	5	417.8	11.8	5.00	107%	_2024-01-06_	1/6/2024 7:17
41760-10	0.00	5	449.2	< 0.236			_2024-01-06_	1/6/2024 7:36
41760-10 DUP	0.00	5	449.2	< 0.236		NA	_2024-01-06_	1/6/2024 7:54
41760-11	0.00	5	461.6	< 0.243			_2024-01-06_	1/6/2024 8:13
41760-11 DUP	0.00	5	461.6	< 0.243		NA	_2024-01-06_	1/6/2024 8:32
41760-12	0.00	5	450.4	< 0.237			_2024-01-06_	1/6/2024 10:06
41760-12 DUP	0.00	5	450.4	< 0.237		NA	_2024-01-06_	1/6/2024 10:24
41760-13 FB ON	0.00	5	411.2	< 0.216			_2024-01-06_	1/6/2024 10:43
41760-13 FB ON DUP	0.00	5	411.2	< 0.216		NA	_2024-01-06_	1/6/2024 11:02
41760-14 FB OFF	0.00	5	435.9	< 0.229			_2024-01-06_	1/6/2024 11:21
41760-14 FB OFF DUP	0.00	5	435.9	< 0.229		NA	_2024-01-06_	1/6/2024 11:39

HF Data 1 of 2

elementOne
e 41760-HF

elementOne

elementOne

M26A-HF IC Data Sheet

Lab ID #: 41760

Client: Deeco

Column: IonPac AS14A

Date: 01.09.24

Eluent: 8.0 mM Na₂CO₃/ 1.0 mM NaHCO₃

Analyst: LAW

Flow Rate: 1.0 mL/min.

Detection Limit, (µg/ml): 0.10

F to HF factor: 1.053

Standards	F µg/ml	Dilution	QC, µg/ml	% Relative Error	% Recovery	File Name	Date Time
0	0.00					_2024-01-05_	1/5/2024 17:14
0.1	0.10			3.0%	103%	_2024-01-05_	1/5/2024 17:33
1	0.98			-4.4%	96%	_2024-01-05_	1/5/2024 17:51
3	3.03			1.1%	101%	_2024-01-05_	1/5/2024 18:10
5	5.03			0.6%	101%	_2024-01-05_	1/5/2024 18:29
10	9.98			-0.2%	100%	_2024-01-05_	1/5/2024 18:48
0.1	0.10			3.0%	103%	_2024-01-06_	1/6/2024 13:32
1	0.97			-3.0%	97%	_2024-01-06_	1/6/2024 13:50
3	3.07			2.3%	102%	_2024-01-06_	1/6/2024 14:09
5	5.11			2.3%	102%	_2024-01-06_	1/6/2024 14:28
10	9.98			-0.2%	100%	_2024-01-06_	1/6/2024 14:47
Correlation-	0.9999						
QC	5.08		5.00		102%	_2024-01-05_	1/5/2024 19:06
QC	5.02		5.00		100%	_2024-01-05_	1/5/2024 19:25
QC	5.15		5.00		103%	_2024-01-06_	1/6/2024 0:06
QC	5.22		5.00		104%	_2024-01-06_	1/6/2024 0:25
QC	5.28		5.00		106%	_2024-01-06_	1/6/2024 4:28
QC	5.15		5.00		103%	_2024-01-06_	1/6/2024 4:47
QC	5.45		5.00		109%	_2024-01-06_	1/6/2024 8:51
QC	5.22		5.00		104%	_2024-01-06_	1/6/2024 9:09
QC	5.24		5.00		105%	_2024-01-06_	1/6/2024 12:36
QC	5.19		5.00		104%	_2024-01-06_	1/6/2024 15:05
DL	0.090		0.10		90%	_2024-01-05_	1/5/2024 20:21
DL	0.102		0.10		102%	_2024-01-05_	1/5/2024 20:40
DL	0.097		0.10		97%	_2024-01-06_	1/6/2024 12:54
DL	0.102		0.10		102%	_2024-01-06_	1/6/2024 15:24
40034-6 QC	6.87	10	71.7		101%	_2024-01-06_	1/6/2024 11:58
40034-6 QC DUP	7.00	10	71.7		103%	_2024-01-06_	1/6/2024 12:17
BLK	0.00					_2024-01-05_	1/5/2024 19:44
BLK	0.00					_2024-01-05_	1/5/2024 20:03
BLK	0.00					_2024-01-06_	1/6/2024 0:44
BLK	0.00					_2024-01-06_	1/6/2024 1:02
BLK	0.00					_2024-01-06_	1/6/2024 5:06
BLK	0.00					_2024-01-06_	1/6/2024 5:25
BLK	0.00					_2024-01-06_	1/6/2024 9:28
BLK	0.00					_2024-01-06_	1/6/2024 9:47
BLK	0.00					_2024-01-06_	1/6/2024 13:13
BLK	0.00					_2024-01-06_	1/6/2024 15:43

HF Data 2 of 2

elementOne
e 41760-HF

elementOne

elementOne

IC Sample Sheet/Digestion Worksheet

Lab ID #: 41760

Date: 1-5-24
 Analyst: LNW
 Batch name: 010524-41760

Column: IonPac AS14A
 Conc. Eluent: 8.0 mM Na₂CO₃ / 1.0mM NaHCO₃
 10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
 Regenerant: 100 mM H₃PO₄
 Flow Rate: 1.0 mL/min.

Instrument: 8611788
 Lot# 1C11-99-3
 Lot # 1C11-108-3
 Method: 300/26A

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
1	0.0			QC	none	22	
2	0.1		F	BCL10574	3am/4444	.9999	
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	LKB						
14	LKB						
15	LKB+						
16	LKB+						
17	41760-1	Deeco	HF		—	5x	
18	-1d				—		
19	-3				—		
20	-3d				—		
21	-3+				5.435		
22	-3+d				5.443		
23	QC						
24	QC						
25	BLK						

Manual integrations noted by M

Curve IC Lot # 101110-1 Comments: p4 10f 3

Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: IC ME Solution 230809-250 HPS IC NO2 Solution 230809-250 HPS

QC: Spike 50 uL from 1000 ug/mL F, Cl, Br, and SO₄ Std. to 10mL sample; lot #'s listed above.QC: Spike 20 uL from 1000 ug/mL NO₂, NO₃, and PO₄ Std. to 10mL sample; lot #'s listed above.

Submitted for QC- Date: 1-5-24 Time: 9:01 hr By: LNW QC Review- Date: 1-5-24 Time: By:

01-08-24

elementOne

Certification: NJ NELAP NC009
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elementOne

IC Sample Sheet/Digestion Worksheet

Lab ID #: 41760

Date: 1.5.24
 Analyst: LAN
 Batch name: 010524-41760

Column: IonPac AS14A
 Conc. Eluent: 8.0 mM Na₂CO₃/ 1.0mM NaHCO₃
 10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
 Regenerant: 100 mM H₃PO₄
 Flow Rate: 1.0 mL/min.

Instrument: 9611788
 Lot# 1C11-99-3
 Lot # 1C11-108-3
 Method: 300/26A

AS LOC.	Sample ID	Client	Analyte	Results (ug/mL)	Results (ug/mL)	Dilution	Wt (g) / FV (mL)
26	BLK						
27	41760-2	Deeco	HF		—	5x	
28	-2d	↓	↓		—	↓	
29	-4				—		
30	-4d				—		
31	-5				—		
32	-5d				—		
33	-6				—		
34	-6d				—		
35	-7				—		
36	-7d	↓	↓		—	↓	
37	QC						
38	QC						
39	BLK						
40	BLK						
41	41760-8	Deeco	HF		—	5x	
42	-9d	↓	↓		—	↓	
43	-9				—		
44	-9d				—		
45	-9+				8.441		
46	-9+d				5.352		
47	-10				—		
48	-10d				—		
49	-11				—		
50	-11d	↓	↓		—	↓	

Manual integrations noted by M

Curve IC Lot # _____ Comments: pg 2 of 3
 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 SO₄ Std. to 10mL sample; lot #'s listed above.
 QC: Spike 20 uL from 1000 ug/mL NO₂, NO₃, and PO₄ Std. to 10mL sample; lot #'s listed above.
 Submitted for QC- Date: _____ Time: _____ By: _____ QC Review- Date: _____ Time: _____ By: _____

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Certification: NJ NELAP NC009
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elementOne

IC Sample Sheet/Digestion Worksheet

Lab ID #: 41760

Date: 1-5-24
 Analyst: LAW
 Batch name: 010524-41760

Column: IonPac AS14A
 Conc. Eluent: 8.0 mM Na₂CO₃/ 1.0mM NaHCO₃
 10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
 Regenerant: 100 mM H₃PO₄
 Flow Rate: 1.0 mL/min.

Instrument: 861/798
 Lot# 1011-091-3
 Lot # 1011-108-3
 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	41760-12	Deeco	HF		—	5x	
56	-12d				—		
57	-13 FB on				—		
58	-13 FB on d				—		
59	-14 FB off				—		
60	-14 FB off d				—		
61	40034-16 QC				6.865	10x	TV=71.7
62	-16 QC d				6.996		
63	QC						
64	DL						
65	BLK						
66	0.1						
67	1.0						
68	3.0						
69	5.0						
70	10.0						
71	QC						
72	DL						
73	BLK						
74							
75							

Manual integrations noted by M

Curve IC Lot # _____ Comments: pg 30F3
 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 SO₄ Std. to 10mL sample; lot #'s listed above.
 QC: Spike 20 uL from 1000 ug/mL NO₂, NO₃, and PO₄ Std. to 10mL sample; lot #'s listed above.
 Submitted for QC- Date: _____ Time: _____ By: _____ QC Review- Date: _____ Time: _____ By: _____

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elementOne

M26A-Cl₂ IC Data Sheet

Lab ID #: 41760

Client: Deeco

Column: IonPac AS14A

Date: 01.09.24

Eluent: 8.0 mM Na₂CO₃/ 1.0 mM NaHCO₃

Analyst: LAW

Flow Rate: 1.0 mL/min.

Detection Limit, (µg/ml): 0.10

Sample ID	Cl ⁻ µg/ml	Dilution	Final Vol, ml	Cl ₂ , Total mg	Spike, µg/ml	% RPD/ Recovery	File Name	Date Time
LRB	-0.117	1	10	< 0.001			143a8bc6:18cd9f3ea7d:-7e38	1/4/2024 20:43
LRB	-0.113	1	10	< 0.001		NA	143a8bc6:18cd9f3ea7d:-7e36	1/4/2024 21:07
LRB SPK	5.06	1	10	0.051	5.00	104%	143a8bc6:18cd9f3ea7d:-7e34	1/4/2024 21:30
LRB SPK	5.04	1	10	0.050	5.00	103%	143a8bc6:18cd9f3ea7d:-7e32	1/4/2024 21:54
41760-1	0.022	5	419.0	< 0.21			143a8bc6:18cd9f3ea7d:-7e30	1/4/2024 22:17
41760-1 DUP	-0.115	5	419.0	< 0.21		NA	143a8bc6:18cd9f3ea7d:-7e2e	1/4/2024 22:41
41760-2	-0.108	5	339.8	< 0.17			143a8bc6:18cd9f3ea7d:-7e1c	1/5/2024 2:12
41760-2 DUP	0.008	5	339.8	< 0.17		NA	143a8bc6:18cd9f3ea7d:-7e1a	1/5/2024 2:36
41760-3	-0.107	5	332.9	< 0.166			143a8bc6:18cd9f3ea7d:-7e2c	1/4/2024 23:04
41760-3 DUP	-0.083	5	332.9	< 0.166		NA	143a8bc6:18cd9f3ea7d:-7e2a	1/4/2024 23:28
41760-3 SPK	5.06	5	332.9	8.41	5.00	101%	143a8bc6:18cd9f3ea7d:-7e28	1/4/2024 23:51
41760-3 SPK DUP	5.14	5	332.9	8.55	5.00	103%	143a8bc6:18cd9f3ea7d:-7e26	1/5/2024 0:15
41760-4	0.142	5	362.7	0.258			143a8bc6:18cd9f3ea7d:-7e18	1/5/2024 2:59
41760-4 DUP	0.142	5	362.7	0.258		0.0%	143a8bc6:18cd9f3ea7d:-7e16	1/5/2024 3:23
41760-5	0.123	5	350.4	0.215			143a8bc6:18cd9f3ea7d:-7e14	1/5/2024 3:46
41760-5 DUP	0.125	5	350.4	0.219		1.6%	143a8bc6:18cd9f3ea7d:-7e12	1/5/2024 4:10
41760-6	0.124	5	415.9	0.258			143a8bc6:18cd9f3ea7d:-7e10	1/5/2024 4:33
41760-6 DUP	0.127	5	415.9	0.264		2.4%	143a8bc6:18cd9f3ea7d:-7e0e	1/5/2024 4:57
41760-7	0.081	5	338.2	< 0.169			143a8bc6:18cd9f3ea7d:-7e0c	1/5/2024 5:20
41760-7 DUP	0.089	5	338.2	< 0.169		NA	143a8bc6:18cd9f3ea7d:-7e0a	1/5/2024 5:44
41760-8	0.147	5	326.0	0.240			756040cc:18ce984e291:-7eba	1/5/2024 15:36
41760-8 DUP	0.145	5	326.0	0.236		1.4%	756040cc:18ce984e291:-7eb8	1/5/2024 15:59
41760-9	0.025	5	356.0	< 0.178			756040cc:18ce984e291:-7eb6	1/5/2024 16:23
41760-9 DUP	0.025	5	356.0	< 0.178		NA	756040cc:18ce984e291:-7eb4	1/5/2024 16:46
41760-9 SPK	5.17	5	356.0	9.21	5.00	103%	756040cc:18ce984e291:-7eb2	1/5/2024 17:10
41760-9 SPK DUP	5.22	5	356.0	9.30	5.00	104%	756040cc:18ce984e291:-7eb0	1/5/2024 17:33
41760-10	-0.011	5	366.4	< 0.183			756040cc:18ce984e291:-7eae	1/5/2024 17:57
41760-10 DUP	-0.027	5	366.4	< 0.183		NA	756040cc:18ce984e291:-7eac	1/5/2024 18:20
41760-11	-0.098	5	342.7	< 0.171			756040cc:18ce984e291:-7eaa	1/5/2024 18:44
41760-11 DUP	-0.083	5	342.7	< 0.171		NA	756040cc:18ce984e291:-7ea8	1/5/2024 19:07
41760-12	0.016	5	353.1	< 0.177			756040cc:18ce984e291:-7e9e	1/5/2024 21:05
41760-12 DUP	-0.066	5	353.1	< 0.177		NA	756040cc:18ce984e291:-7e9c	1/5/2024 21:28
41760-13 FB ON	-0.067	5	344.8	< 0.172			756040cc:18ce984e291:-7e9a	1/5/2024 21:52
41760-13 FB ON DUP	-0.113	5	345.0	< 0.173		NA	756040cc:18ce984e291:-7e98	1/5/2024 22:15
41760-14 FB OFF	-0.054	5	333.0	< 0.167			756040cc:18ce984e291:-7e96	1/5/2024 22:39
41760-14 FB OFF DUP	-0.101	5	333.0	< 0.167		NA	756040cc:18ce984e291:-7e94	1/5/2024 23:02

Cl₂-Data 1 of 2elementOne
e 41760-Cl₂

elementOne

elementOne

M26A-Cl₂ IC Data Sheet

Lab ID #: 41760

Client: Deeco

Column: IonPac AS14A

Date: 01.09.24

Eluent: 8.0 mM Na₂CO₃/ 1.0 mM NaHCO₃

Analyst: LAW

Flow Rate: 1.0 mL/min.

Detection Limit, (µg/ml): 0.10

Standards	Cl ⁻ µg/ml	Dilution	QC µg/ml	%Relative Error	% Recovery	File Name	Date Time
0.0	0.00					756040cc:18ce984e291:-7ed4	1/4/2024 16:01
0.1	0.103			3.0%	103%	756040cc:18ce984e291:-7ed2	1/4/2024 16:24
1.0	0.955			-4.5%	96%	756040cc:18ce984e291:-7ed0	1/4/2024 16:48
3.0	3.03			1.0%	101%	756040cc:18ce984e291:-7ece	1/4/2024 17:11
5.0	5.03			0.6%	101%	756040cc:18ce984e291:-7ecc	1/4/2024 17:35
10.0	9.98			-0.2%	100%	756040cc:18ce984e291:-7eca	1/4/2024 17:58
0.1	0.095			-5.0%	95%	756040cc:18ce984e291:-7e7c	1/6/2024 3:44
1.0	0.957			-4.3%	96%	756040cc:18ce984e291:-7e86	1/6/2024 1:47
3.0	3.09			3.0%	103%	756040cc:18ce984e291:-7e84	1/6/2024 2:10
5.0	5.14			2.7%	103%	756040cc:18ce984e291:-7e82	1/6/2024 2:34
10.0	10.5			4.7%	105%	756040cc:18ce984e291:-7e80	1/6/2024 2:57
Correlation-							
	0.999970						
QC	5.03		5.00		101%	143a8bc6:18cd9f3ea7d:-7e44	1/4/2024 18:22
QC	5.10		5.00		102%	143a8bc6:18cd9f3ea7d:-7e42	1/4/2024 18:46
QC	5.14		5.00		103%	143a8bc6:18cd9f3ea7d:-7e24	1/5/2024 0:38
QC	5.11		5.00		102%	143a8bc6:18cd9f3ea7d:-7e22	1/5/2024 1:02
QC	5.17		5.00		103%	756040cc:18ce984e291:-7ec8	1/5/2024 6:07
QC	5.20		5.00		104%	756040cc:18ce984e291:-7ec6	1/5/2024 6:31
QC	5.27		5.00		105%	756040cc:18ce984e291:-7ea6	1/5/2024 19:31
QC	5.26		5.00		105%	756040cc:18ce984e291:-7ea4	1/5/2024 19:54
QC	5.28		5.00		106%	756040cc:18ce984e291:-7e8e	1/6/2024 0:13
QC	5.34		5.00		107%	756040cc:18ce984e291:-7e7e	1/6/2024 3:21
DL	0.101		0.10		101%	143a8bc6:18cd9f3ea7d:-7e3c	1/4/2024 19:56
DL	0.100		0.10		100%	143a8bc6:18cd9f3ea7d:-7e3a	1/4/24 20:20
DL	0.093		0.10		93%	756040cc:18ce984e291:-7e8c	1/6/2024 0:36
BLK	-0.124					143a8bc6:18cd9f3ea7d:-7e40	1/4/2024 19:09
BLK	-0.129					143a8bc6:18cd9f3ea7d:-7e3e	1/4/2024 19:33
BLK	-0.126					143a8bc6:18cd9f3ea7d:-7e20	1/5/2024 1:25
BLK	-0.122					143a8bc6:18cd9f3ea7d:-7e1e	1/5/2024 1:49
BLK	-0.121					756040cc:18ce984e291:-7ec4	1/5/2024 6:54
BLK	0.000					756040cc:18ce984e291:-7ec2	1/5/2024 7:18
BLK	-0.121					756040cc:18ce984e291:-7ea2	1/5/2024 20:18
BLK	-0.118					756040cc:18ce984e291:-7ea0	1/5/2024 20:41
BLK	-0.118					756040cc:18ce984e291:-7e8a	1/6/2024 1:00
BLK	-0.123					756040cc:18ce984e291:-7e7a	1/6/2024 4:08

elementOne

IC Sample Sheet/Digestion Worksheet

Lab ID #: 41760

Date: 01.04.24

Column: IonPac AS14A

Instrument: 881 1858

Analyst: LWS

Conc. Eluent: 8.0 mM Na₂CO₃/ 1.0mM NaHCO₃

Lot# 1C11-99-3

Batch name: 010424-41760

10mL Conc. Eluent Diluted to FV=1L with filtered UPDI

Regenerant: 100mM H₃PO₄

Lot # 1C11-108-3

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)
1	20			GC	MANF	P2	
2	6.1		Cl ⁻	4308759	RKLA	999997	999970
3	1.0						
4	3.0						
5	5.0						
6	10.0						
7	GC						
8	GC						
9	BK						
10	BK						
11	DL						
12	DL						
13	LRB						
14	LRB						
15	LRB						
16	LRB						
17	41760-1	Deeco	Cl ₂		---	5x	
18	-1D	↓	↓		---	↓	
19	-3	↓	↓		---	↓	
20	-3D	↓	↓		---	↓	
21	-3x	↓	↓		5.55	↓	
22	-3xD	↓	↓		5.138	↓	
23	GC						
24	GC						
25	BK						

Manual Integr

Curve IC Lot # 1C11-109-4 Sodium Thiosulfate Lot # 1C11-73-4 Comments: pg 1 of 3

Spike 50 uL from 1000 ug/mL Std. to 10mL sample Lot #'s: IC ME Solution 730329-250 Hrs

QC: Spike 50 uL from 1000 ug/mL Br Std. to 10mL sample; lot #'s listed above.

Submitted for QC- Date: 010824 Time: 16:01 By: LWS QC Review- Date: Time: By:

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Certification: NJ NELAP NC009
 41760 Deeco M26A Report Packet
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elementOne

IC Sample Sheet/Digestion Worksheet

Lab ID #: 41760

Date: 01.04.24

Analyst: LAW

Column: IonPac AS14A

Conc. Eluent: 8.0 mM Na₂CO₃/ 1.0mM NaHCO₃

Instrument: 881 1858

Lot# 1C11-99-3

Batch name:

010424-41760

10mL Conc. Eluent Diluted to FV=1L with filtered UPDI

Regenerant: 100mM H₃PO₄

Lot # 1C11-108-3

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	41760-2	Deeco	Cl ₂		—	SX	
28	-2D				—		
29	-4				0.142		
30	-4D				0.142		
31	-5				0.123		
32	-5D				0.125		
33	-6				0.124		
34	-6D				0.122		
35	-7				—		
36	-7D				—		
37	GC						
38	GC						
39	BLK						
40	BLK						
41	41760-8	Deeco	Cl ₂		0.147	SX	
42	-8D				0.145		
43	-9				—		
44	-9D				—		
45	-9+				5.172		
46	-9+D				5.223		
47	-10				—		
48	-10D				—		
49	-11				—		
50	-11D				—		

Manual integrations noted by M*

Curve IC Lot #

Sodium Thiosulfate Lot #

Comments:

pg 2053

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

Certification: NJ NELAP NC009
 41760 Deeco M26A Report Packet
 Page 27 of 28

elementOne

IC Sample Sheet/Digestion Worksheet

Lab ID #: 41760

Date: 0104-24
Analyst: LNWColumn: IonPac AS14A
Conc. Eluent: 8.0 mM Na₂CO₃/ 1.0mM NaHCO₃Instrument: 881858
Lot# 141-99-3

Batch name:

10mL Conc. Eluent Diluted to FV=1L with filtered UPDI
Regenerant: 100mM H₃PO₄

Lot # 1011-108-3

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)
51	GC						
52	GC						
53	BLK						
54	BLK						
55	41760-12		Cl ₂		---	5X	
56	-12D				---		
57	-13FB00N				---		
58	-13FB00D				---		
59	-14FB OFF				---		
60	-14FB OFF				---		
61	41034-2 -GC				4.312	20X	TV=78.0
62	-2-GC				4.352		
63	GC						
64	DL						
65	BLK						
66	0.1 water						
67	1.0						
68	3.0						
69	5.0						
70	10.0						
71	GC						
72	DL						
73	BLK						
74							
75							

Manual integr:

Curve IC Lot #

Sodium Thiosulfate Lot #

Comments:

pg 3 of 3

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:

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elementOne

Appendix D

Plant Process Data

Buzzi Unicem Signal Mountain Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
Start Run 1	
12/13/2023 08:15	115.4
12/13/2023 08:16	119.9
12/13/2023 08:17	111.8
12/13/2023 08:18	120.5
12/13/2023 08:19	116.8
12/13/2023 08:20	118.8
12/13/2023 08:21	115.8
12/13/2023 08:22	119.2
12/13/2023 08:23	117.8
12/13/2023 08:24	112.3
12/13/2023 08:25	117.2
12/13/2023 08:26	122.7
12/13/2023 08:27	113.6
12/13/2023 08:28	118.5
12/13/2023 08:29	117.2
12/13/2023 08:30	114.6
12/13/2023 08:31	120.8
12/13/2023 08:32	114.9
12/13/2023 08:33	114.6
12/13/2023 08:34	119.7
12/13/2023 08:35	119.5
12/13/2023 08:36	114.6
12/13/2023 08:37	115.8
12/13/2023 08:38	119.8
12/13/2023 08:39	116.5
12/13/2023 08:40	119.0
12/13/2023 08:41	116.7
12/13/2023 08:42	112.8
12/13/2023 08:43	118.6
12/13/2023 08:44	116.1
12/13/2023 08:45	115.0
12/13/2023 08:46	120.3
12/13/2023 08:47	118.5
12/13/2023 08:48	119.9
12/13/2023 08:49	117.1
12/13/2023 08:50	118.2
12/13/2023 08:51	121.5
12/13/2023 08:52	118.9
12/13/2023 08:53	116.4
12/13/2023 08:54	116.1

Buzzi Unicem Signal Mountian Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 08:55	122.4
12/13/2023 08:56	118.6
12/13/2023 08:57	115.9
12/13/2023 08:58	119.0
12/13/2023 08:59	119.9
12/13/2023 09:00	119.7
12/13/2023 09:01	116.7
12/13/2023 09:02	118.6
12/13/2023 09:03	116.3
12/13/2023 09:04	121.8
12/13/2023 09:05	117.0
12/13/2023 09:06	120.2
12/13/2023 09:07	118.8
12/13/2023 09:08	117.0
12/13/2023 09:09	117.9
12/13/2023 09:10	120.3
12/13/2023 09:11	120.1
12/13/2023 09:12	114.2
12/13/2023 09:13	121.1
12/13/2023 09:14	117.9
12/13/2023 09:15	120.1
12/13/2023 09:16	116.7
12/13/2023 09:17	118.5
12/13/2023 09:18	116.6
12/13/2023 09:19	121.7
12/13/2023 09:20	119.6
12/13/2023 09:21	113.2
12/13/2023 09:22	122.3
12/13/2023 09:23	115.8
12/13/2023 09:24	121.0
12/13/2023 09:25	117.1
12/13/2023 09:26	121.4
12/13/2023 09:27	116.2
12/13/2023 09:28	118.9
12/13/2023 09:29	116.7
12/13/2023 09:30	116.6
12/13/2023 09:31	124.5
12/13/2023 09:32	115.5
Run 1 Average	117.9
12/13/2023 09:33	114.9
12/13/2023 09:34	117.2

Buzzi Unicem Signal Mountain Plant Chattanooga	K1: K1_Clinker_P rod (TNHR) Expression
TN Date/Time	Value
12/13/2023 09:35	125.5
12/13/2023 09:36	116.6
12/13/2023 09:37	119.6
12/13/2023 09:38	119.2
12/13/2023 09:39	116.5
12/13/2023 09:40	120.3
12/13/2023 09:41	119.5
12/13/2023 09:42	116.8
12/13/2023 09:43	120.5
12/13/2023 09:44	120.9
12/13/2023 09:45	112.7
12/13/2023 09:46	123.1
12/13/2023 09:47	117.2
Start Run 2	
12/13/2023 09:48	119.4
12/13/2023 09:49	112.7
12/13/2023 09:50	126.0
12/13/2023 09:51	113.6
12/13/2023 09:52	123.3
12/13/2023 09:53	116.6
12/13/2023 09:54	116.1
12/13/2023 09:55	121.6
12/13/2023 09:56	116.6
12/13/2023 09:57	115.4
12/13/2023 09:58	123.0
12/13/2023 09:59	117.2
12/13/2023 10:00	117.5
12/13/2023 10:01	119.5
12/13/2023 10:02	117.3
12/13/2023 10:03	118.4
12/13/2023 10:04	120.6
12/13/2023 10:05	117.5
12/13/2023 10:06	117.8
12/13/2023 10:07	122.8
12/13/2023 10:08	116.4
12/13/2023 10:09	115.2
12/13/2023 10:10	124.9
12/13/2023 10:11	116.7
12/13/2023 10:12	114.7
12/13/2023 10:13	122.4
12/13/2023 10:14	118.3

Buzzi Unicem Signal Mountian Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 10:15	111.3
12/13/2023 10:16	121.2
12/13/2023 10:17	123.2
12/13/2023 10:18	112.5
12/13/2023 10:19	124.0
12/13/2023 10:20	116.7
12/13/2023 10:21	116.4
12/13/2023 10:22	122.2
12/13/2023 10:23	118.7
12/13/2023 10:24	113.4
12/13/2023 10:25	121.3
12/13/2023 10:26	116.5
12/13/2023 10:27	115.4
12/13/2023 10:28	125.6
12/13/2023 10:29	116.6
12/13/2023 10:30	116.3
12/13/2023 10:31	121.9
12/13/2023 10:32	115.8
12/13/2023 10:33	117.4
12/13/2023 10:34	122.9
12/13/2023 10:35	115.3
12/13/2023 10:36	120.9
12/13/2023 10:37	115.1
12/13/2023 10:38	121.7
12/13/2023 10:39	115.3
12/13/2023 10:40	119.7
12/13/2023 10:41	116.0
12/13/2023 10:42	121.2
12/13/2023 10:43	118.5
12/13/2023 10:44	116.4
12/13/2023 10:45	117.3
12/13/2023 10:46	122.9
12/13/2023 10:47	114.9
12/13/2023 10:48	118.5
12/13/2023 10:49	123.6
12/13/2023 10:50	115.2
12/13/2023 10:51	118.6
12/13/2023 10:52	119.3
12/13/2023 10:53	117.3
12/13/2023 10:54	117.3
12/13/2023 10:55	120.8

Buzzi Unicem Signal Mountian Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 10:56	116.0
12/13/2023 10:57	116.6
12/13/2023 10:58	122.1
12/13/2023 10:59	118.6
12/13/2023 11:00	118.4
12/13/2023 11:01	119.7
12/13/2023 11:02	114.6
Run 2 Average	118.4
12/13/2023 11:03	124.0
12/13/2023 11:04	118.3
12/13/2023 11:05	114.8
12/13/2023 11:06	120.3
12/13/2023 11:07	119.0
12/13/2023 11:08	115.3
12/13/2023 11:09	119.9
12/13/2023 11:10	117.3
12/13/2023 11:11	122.2
12/13/2023 11:12	116.8
12/13/2023 11:13	117.4
12/13/2023 11:14	117.1
12/13/2023 11:15	121.2
Start Run 3	
12/13/2023 11:16	120.8
12/13/2023 11:17	115.8
12/13/2023 11:18	113.7
12/13/2023 11:19	127.1
12/13/2023 11:20	114.8
12/13/2023 11:21	119.6
12/13/2023 11:22	120.2
12/13/2023 11:23	120.5
12/13/2023 11:24	119.2
12/13/2023 11:25	121.5
12/13/2023 11:26	118.6
12/13/2023 11:27	117.5
12/13/2023 11:28	123.1
12/13/2023 11:29	115.9
12/13/2023 11:30	119.3
12/13/2023 11:31	123.6
12/13/2023 11:32	114.2
12/13/2023 11:33	124.0
12/13/2023 11:34	120.2

Buzzi Unicem Signal Mountain Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 11:35	118.2
12/13/2023 11:36	116.0
12/13/2023 11:37	124.5
12/13/2023 11:38	120.5
12/13/2023 11:39	117.7
12/13/2023 11:40	119.0
12/13/2023 11:41	121.0
12/13/2023 11:42	116.2
12/13/2023 11:43	125.5
12/13/2023 11:44	117.0
12/13/2023 11:45	119.4
12/13/2023 11:46	122.7
12/13/2023 11:47	119.5
12/13/2023 11:48	118.8
12/13/2023 11:49	119.6
12/13/2023 11:50	117.5
12/13/2023 11:51	117.9
12/13/2023 11:52	124.2
12/13/2023 11:53	118.1
12/13/2023 11:54	119.9
12/13/2023 11:55	118.4
12/13/2023 11:56	121.4
12/13/2023 11:57	119.9
12/13/2023 11:58	114.1
12/13/2023 11:59	125.4
12/13/2023 12:00	119.0
12/13/2023 12:01	120.8
12/13/2023 12:02	121.0
12/13/2023 12:03	112.7
12/13/2023 12:04	123.0
12/13/2023 12:05	124.5
12/13/2023 12:06	116.7
12/13/2023 12:07	118.2
12/13/2023 12:08	121.5
12/13/2023 12:09	119.3
12/13/2023 12:10	123.5
12/13/2023 12:11	119.5
12/13/2023 12:12	114.9
12/13/2023 12:13	124.2
12/13/2023 12:14	116.4
12/13/2023 12:15	121.8

Buzzi Unicem Signal Mountain Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 12:16	117.2
12/13/2023 12:17	120.3
12/13/2023 12:18	114.9
12/13/2023 12:19	126.1
12/13/2023 12:20	119.9
12/13/2023 12:21	116.4
12/13/2023 12:22	124.9
12/13/2023 12:23	116.6
12/13/2023 12:24	114.7
12/13/2023 12:25	126.9
12/13/2023 12:26	119.2
12/13/2023 12:27	113.9
12/13/2023 12:28	126.2
Run 3 Average	119.7
12/13/2023 12:29	118.1
12/13/2023 12:30	117.7
12/13/2023 12:31	123.9
12/13/2023 12:32	115.1
12/13/2023 12:33	120.8
12/13/2023 12:34	122.0
12/13/2023 12:35	120.2
12/13/2023 12:36	117.1
12/13/2023 12:37	121.0
12/13/2023 12:38	120.6
12/13/2023 12:39	117.6
12/13/2023 12:40	118.9
12/13/2023 12:41	122.5
12/13/2023 12:42	117.9
12/13/2023 12:43	119.9
12/13/2023 12:44	123.0
12/13/2023 12:45	118.4
12/13/2023 12:46	120.5
12/13/2023 12:47	119.6
12/13/2023 12:48	115.9
12/13/2023 12:49	123.8
12/13/2023 12:50	119.8
12/13/2023 12:51	114.2
12/13/2023 12:52	123.5
12/13/2023 12:53	120.3
12/13/2023 12:54	119.4
12/13/2023 12:55	122.4

Buzzi Unicem Signal Mountian Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 12:56	115.1
12/13/2023 12:57	121.8
12/13/2023 12:58	119.7
12/13/2023 12:59	113.7
12/13/2023 13:00	124.5
12/13/2023 13:01	120.3
12/13/2023 13:02	122.7
12/13/2023 13:03	118.4
12/13/2023 13:04	117.6
12/13/2023 13:05	122.9
12/13/2023 13:06	116.6
12/13/2023 13:07	122.1
12/13/2023 13:08	121.2
12/13/2023 13:09	117.7
12/13/2023 13:10	119.9
12/13/2023 13:11	120.0
12/13/2023 13:12	114.3
12/13/2023 13:13	124.8
12/13/2023 13:14	120.9
Start Run 4	
12/13/2023 13:15	115.5
12/13/2023 13:16	122.8
12/13/2023 13:17	115.8
12/13/2023 13:18	115.3
12/13/2023 13:19	124.8
12/13/2023 13:20	114.2
12/13/2023 13:21	119.3
12/13/2023 13:22	117.0
12/13/2023 13:23	120.5
12/13/2023 13:24	121.3
12/13/2023 13:25	116.8
12/13/2023 13:26	117.1
12/13/2023 13:27	116.5
12/13/2023 13:28	119.8
12/13/2023 13:29	121.5
12/13/2023 13:30	114.5
12/13/2023 13:31	118.7
12/13/2023 13:32	120.2
12/13/2023 13:33	118.5
12/13/2023 13:34	118.7
12/13/2023 13:35	118.7

Buzzi Unicem Signal Mountian Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 13:36	112.7
12/13/2023 13:37	122.5
12/13/2023 13:38	118.0
12/13/2023 13:39	116.5
12/13/2023 13:40	122.6
12/13/2023 13:41	119.5
12/13/2023 13:42	112.7
12/13/2023 13:43	123.8
12/13/2023 13:44	113.8
12/13/2023 13:45	118.8
12/13/2023 13:46	122.5
12/13/2023 13:47	116.9
12/13/2023 13:48	114.5
12/13/2023 13:49	121.4
12/13/2023 13:50	120.3
12/13/2023 13:51	117.5
12/13/2023 13:52	116.8
12/13/2023 13:53	116.8
12/13/2023 13:54	117.2
12/13/2023 13:55	113.5
12/13/2023 13:56	124.6
12/13/2023 13:57	114.9
12/13/2023 13:58	117.0
12/13/2023 13:59	116.2
12/13/2023 14:00	116.9
12/13/2023 14:01	121.3
12/13/2023 14:02	115.3
12/13/2023 14:03	117.7
12/13/2023 14:04	115.2
12/13/2023 14:05	118.6
12/13/2023 14:06	115.7
12/13/2023 14:07	118.4
12/13/2023 14:08	118.8
12/13/2023 14:09	113.5
12/13/2023 14:10	117.7
12/13/2023 14:11	119.5
12/13/2023 14:12	112.9
12/13/2023 14:13	108.4
12/13/2023 14:14	122.5
12/13/2023 14:15	122.6
12/13/2023 14:16	116.4

Buzzi Unicem Signal Mountian Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 14:17	114.7
12/13/2023 14:18	117.6
12/13/2023 14:19	116.3
12/13/2023 14:20	121.4
12/13/2023 14:21	113.2
12/13/2023 14:22	116.3
12/13/2023 14:23	119.4
12/13/2023 14:24	114.9
12/13/2023 14:25	116.9
12/13/2023 14:26	118.6
12/13/2023 14:27	119.3
12/13/2023 14:28	115.5
Run 4 Average	117.8
12/13/2023 14:29	118.1
12/13/2023 14:30	118.0
12/13/2023 14:31	112.9
12/13/2023 14:32	117.5
12/13/2023 14:33	118.5
12/13/2023 14:34	116.8
12/13/2023 14:35	115.8
12/13/2023 14:36	119.2
12/13/2023 14:37	118.5
12/13/2023 14:38	115.4
12/13/2023 14:39	117.3
12/13/2023 14:40	118.8
12/13/2023 14:41	114.9
12/13/2023 14:42	116.1
12/13/2023 14:43	117.5
12/13/2023 14:44	116.9
Start Run 5	
12/13/2023 14:45	119.5
12/13/2023 14:46	115.2
12/13/2023 14:47	118.6
12/13/2023 14:48	114.4
12/13/2023 14:49	122.8
12/13/2023 14:50	114.0
12/13/2023 14:51	117.7
12/13/2023 14:52	116.4
12/13/2023 14:53	117.3
12/13/2023 14:54	112.7
12/13/2023 14:55	122.6

Buzzi Unicem Signal Mountain Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 14:56	118.2
12/13/2023 14:57	113.4
12/13/2023 14:58	119.8
12/13/2023 14:59	113.9
12/13/2023 15:00	117.9
12/13/2023 15:01	119.5
12/13/2023 15:02	118.1
12/13/2023 15:03	114.3
12/13/2023 15:04	115.9
12/13/2023 15:05	119.7
12/13/2023 15:06	114.8
12/13/2023 15:07	118.8
12/13/2023 15:08	115.8
12/13/2023 15:09	117.4
12/13/2023 15:10	118.6
12/13/2023 15:11	115.3
12/13/2023 15:12	115.6
12/13/2023 15:13	117.1
12/13/2023 15:14	120.6
12/13/2023 15:15	114.5
12/13/2023 15:16	117.5
12/13/2023 15:17	117.5
12/13/2023 15:18	117.7
12/13/2023 15:19	117.8
12/13/2023 15:20	119.0
12/13/2023 15:21	115.5
12/13/2023 15:22	116.3
12/13/2023 15:23	114.6
12/13/2023 15:24	119.9
12/13/2023 15:25	118.0
12/13/2023 15:26	119.0
12/13/2023 15:27	114.7
12/13/2023 15:28	116.9
12/13/2023 15:29	118.5
12/13/2023 15:30	115.0
12/13/2023 15:31	120.1
12/13/2023 15:32	115.4
12/13/2023 15:33	114.5
12/13/2023 15:34	121.4
12/13/2023 15:35	113.4
12/13/2023 15:36	118.2

Buzzi Unicem Signal Mountain Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 15:37	119.9
12/13/2023 15:38	114.9
12/13/2023 15:39	117.9
12/13/2023 15:40	118.9
12/13/2023 15:41	114.9
12/13/2023 15:42	114.1
12/13/2023 15:43	119.0
12/13/2023 15:44	119.1
12/13/2023 15:45	115.5
12/13/2023 15:46	115.7
12/13/2023 15:47	119.9
12/13/2023 15:48	112.3
12/13/2023 15:49	123.7
12/13/2023 15:50	114.9
12/13/2023 15:51	113.2
12/13/2023 15:52	123.5
12/13/2023 15:53	114.0
12/13/2023 15:54	116.1
12/13/2023 15:55	117.1
12/13/2023 15:56	119.5
12/13/2023 15:57	116.7
12/13/2023 15:58	119.3
12/13/2023 15:59	113.8
Run 5 Average	117.1
12/13/2023 16:00	117.4
12/13/2023 16:01	117.3
12/13/2023 16:02	116.2
12/13/2023 16:03	117.6
12/13/2023 16:04	120.1
12/13/2023 16:05	117.5
12/13/2023 16:06	114.2
12/13/2023 16:07	116.2
12/13/2023 16:08	117.7
12/13/2023 16:09	116.4
12/13/2023 16:10	117.1
12/13/2023 16:11	114.8
12/13/2023 16:12	121.8
Start Run 6	
12/13/2023 16:13	116.3
12/13/2023 16:14	116.6
12/13/2023 16:15	117.5

Buzzi Unicem Signal Mountain Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 16:16	115.7
12/13/2023 16:17	119.1
12/13/2023 16:18	117.9
12/13/2023 16:19	115.9
12/13/2023 16:20	120.2
12/13/2023 16:21	116.3
12/13/2023 16:22	115.2
12/13/2023 16:23	117.9
12/13/2023 16:24	118.0
12/13/2023 16:25	116.1
12/13/2023 16:26	114.0
12/13/2023 16:27	116.2
12/13/2023 16:28	122.4
12/13/2023 16:29	117.4
12/13/2023 16:30	116.8
12/13/2023 16:31	118.1
12/13/2023 16:32	117.2
12/13/2023 16:33	111.0
12/13/2023 16:34	121.8
12/13/2023 16:35	116.5
12/13/2023 16:36	118.4
12/13/2023 16:37	115.5
12/13/2023 16:38	115.1
12/13/2023 16:39	120.6
12/13/2023 16:40	112.8
12/13/2023 16:41	119.9
12/13/2023 16:42	118.3
12/13/2023 16:43	116.1
12/13/2023 16:44	116.9
12/13/2023 16:45	115.8
12/13/2023 16:46	120.6
12/13/2023 16:47	114.4
12/13/2023 16:48	113.9
12/13/2023 16:49	123.5
12/13/2023 16:50	113.6
12/13/2023 16:51	116.2
12/13/2023 16:52	119.6
12/13/2023 16:53	117.5
12/13/2023 16:54	111.7
12/13/2023 16:55	122.2
12/13/2023 16:56	116.7

Buzzi Unicem Signal Mountian Plant Chattanooga TN Date/Time	K1: K1_Clinker_P rod (TNHR) Expression Value
12/13/2023 16:57	118.6
12/13/2023 16:58	115.7
12/13/2023 16:59	116.4
12/13/2023 17:00	117.4
12/13/2023 17:01	117.6
12/13/2023 17:02	112.3
12/13/2023 17:03	122.8
12/13/2023 17:04	114.9
12/13/2023 17:05	117.1
12/13/2023 17:06	117.5
12/13/2023 17:07	116.8
12/13/2023 17:08	117.1
12/13/2023 17:09	117.0
12/13/2023 17:10	120.0
12/13/2023 17:11	117.7
12/13/2023 17:12	114.1
12/13/2023 17:13	120.5
12/13/2023 17:14	112.7
12/13/2023 17:15	120.4
12/13/2023 17:16	112.9
12/13/2023 17:17	121.9
12/13/2023 17:18	118.6
12/13/2023 17:19	113.8
12/13/2023 17:20	115.7
12/13/2023 17:21	116.0
12/13/2023 17:22	118.2
12/13/2023 17:23	122.1
12/13/2023 17:24	116.7
12/13/2023 17:25	112.9
12/13/2023 17:26	121.6
12/13/2023 17:27	113.4
12/13/2023 17:28	120.4
12/13/2023 17:29	117.9
Run 6 Average	117.2

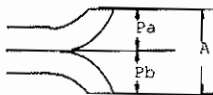
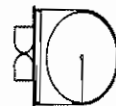
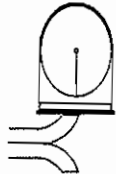
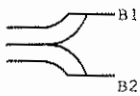
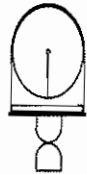
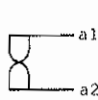
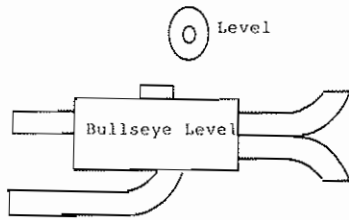
Appendix E

Calibration Documents

Probe or Pitot No:

8M

Pitot Tube Inspection Sheet



Date	12/19/22
Tube Assembly Level?	Yes
Ports Damaged?	No
-10 deg < a1 < +10 deg	1
-10 deg < a2 < +10 deg	1
-5 deg < B1 < +5 deg	1
-5 deg < B2 < +5 deg	1
Y (gamma)	1
O (theta)	1
A (alpha)	0.932
Z = A (sin y) < 0.125"?	yes
W = A (sin O) < 0.031"?	yes
Pa =	0.466
Pb =	0.466
Tube Diameter (Dt) =	0.377
Pa = Pb +/- 0.063"?	yes
(1.05 x Dt)?	0.39585
(1.50 x Dt)?	0.5655
(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	12/19/22
Barometric Pressure?	30.18	Ambient Temperature?	69

Source	Reference Temp, F	Thermocouple Temp, F	Absolute Temp Difference
cold air	37	38	-0.20%
medium air	215	214	0.15%
hot air	325	323	0.25%

Windtunnel Calibration

Pitot Reading	Reference (0.99)	8M S-Type Pitot	Cp
ΔP_1	0.31	0.44	0.84
ΔP_2	0.32	0.43	0.86
ΔP_3	0.31	0.44	0.84
Average Pitot Tube Calibration Factor-->			0.85

Thermocouple Calibration Check (EPA ALT-011 Procedure), performed on 12/19/22

Source	Ref. Temp. F	Thermocouple Temp. F	± 2 deg F?
Ambient	69	68.1	Yes

Probe or Pitot No:

8N

Pitot Tube Inspection Sheet

Date	12/20/22
Tube Assembly Level?	Yes
Ports Damaged?	No
-10 deg < a1 < +10 deg	2
-10 deg < a2 < +10 deg	2
-5 deg < B1 < +5 deg	1
-5 deg < B2 < +5 deg	2
Y (gamma)	1
0 (theta)	1
A (alpha)	0.954
Z = A (sin y) < 0.125"?	yes
W = A (sin 0) < 0.031"?	yes
Pa =	0.477
Pb =	0.477
Tube Diameter (Dt) =	0.377
Pa = Pb +/- 0.063"?	yes
(1.05 x Dt)?	0.39585
(1.50 x Dt)?	0.5655
(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	12/20/22
Barometric Pressure?	30.26	Ambient Temperature?	68.7

Source	Reference Temp, F	Thermocouple Temp, F	Absolute Temp Difference
cold air	36	38	-0.40%
medium air	215	214	0.15%
hot air	325	324	0.13%

Windtunnel Calibration

Pitot Reading	Reference (0.99)	8N S-Type Pitot	Cp
ΔP_1	0.31	0.44	0.84
ΔP_2	0.32	0.43	0.86
ΔP_3	0.31	0.44	0.84
Average Pitot Tube Calibration Factor-->			0.85

Thermocouple Calibration Check (EPA ALT-011 Procedure), performed on 12/20/22

Source	Ref. Temp. F	Thermocouple Temp. F	± 2 deg F?
Ambient	68.7	70.5	Yes

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES



- 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 PART #: M5-15		METER SERIAL #: 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 (FT ³)		TEMPERATURES °F				ELAPSED TIME (MIN)	DGM ΔH (in H ₂ O)	V _m (STD)	V _c (STD)	(3) Y	VARIATION (%)	ΔH _g	
				INITIAL	FINAL	NET (V _o)	AMBIENT	DGM INLET	DGM INLET								DGM OUTLET
12	1	0.3283															
	2																
	3																
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
	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
	3					0.000						0					1.62
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
	2	0.5047	18	371.213	377.910	6.897	76	70	72	65	66	68.25	10.00	1.3	6.7411	6.5483	0.971
	3					0.000						0					1.72
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
	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
	3					0.000						0					1.71
32	1	0.8587															
	2																
	3																

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

$$(1) \quad V_{m, std} = K' \cdot V_m \cdot \frac{P_{bar} + (\Delta H / 13.6)}{T_m}$$

$$(2) \quad V_{cr, std} = K' \cdot \frac{P_{bar} \cdot \theta}{\sqrt{T_{omb}}}$$

$$(3) \quad Y = \frac{V_{cr, std}}{V_{m, std}} = \text{DGM calibration factor}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
K₁ = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)
T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

= 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

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

AVERAGE ΔH_g = **1.68**
Potentiometer Check, °F
@ 0 F **0**
@ 500 F **496**
@ 1000 F **1000**
Avg Absolute Difference = **0.1%**

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES



- 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 SERIAL #: M5-21		CRITICAL ORIFICE SET SERIAL #: 14315		BAROMETRIC PRESSURE (in Hg):		INITIAL: 29.99		FINAL: 29.99		AVG (P _{at}): 29.99								
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 _{at}): 29.99								
ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT ³)				TEMPERATURES °F				ELAPSED TIME (MIN)	DGM ΔH (in H ₂ O)	V _m (STD)	(2)	(3)	Y	VARIATION (%)	ΔH ₁₀	
				INITIAL	FINAL	NET (V _m)	AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL									DGM AVG
12	1	0.3283																		
	2																			
	3																			
15	1	0.4094	18	58.501	63.745	5.244	67	69	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	69	10.00	0.86	5.3100	5.3499	1.008		1.69
	3																			
19	1	0.5047	18	69.109	75.825	6.716	68	70	71	69	70	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	70	10.00	1.3	6.7798	6.5953	0.973		1.68
	3																			
23	1	0.6426	18	82.595	91.263	8.668	67	70	74	69	70	70	70	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	70	70	10.00	2.1	8.7089	8.3973	0.964		1.68
	3																			
32	1	0.8587																		
	2																			
	3																			

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

$$(1) \quad V_{m_{std}} = K_1 \cdot P_{bar} \cdot \frac{P_{bar} + (\Delta H / 13.6)}{T_m}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
K₁ = 17.64 °R/in. Hg (English), 0.3858 °K/(mm Hg (Metric))
T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$(2) \quad V_{cr_{std}} = K' \cdot \frac{P_{bar} \cdot \theta}{\sqrt{T_{amb}}}$$

= 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

$$(3) \quad Y = \frac{V_{cr_{std}}}{V_{m_{std}}} = \text{DGM calibration factor}$$

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

AVERAGE ΔH₁₀ = **1.69**

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

Avg Absolute Difference = **0.1%**

Company: Buzzi Unicem; Chattanooga TN
Source: Main Stack; Mill Off
Job ID: 23-3317
Train Type: M26A

Alt-009 Alternate Post Test Calibration Data

	M5-21 4A 12/13/23 1315-1429	M5-15 4B 12/13/23 1315-1429	M5-21 5A 12/13/23 1445-1600	M5-15 5B 12/13/23 1445-1600	M5-21 6A 12/06/23 1613-1730	M5-15 6B 12/06/23 1613-1730	M5-21 Average	M5-15 Average
Vm	54.232	56.531	52.769	56.36	52.773	53.96		
Tm	535.3	535.1	540.7	543.7	540.3	538.8		
Pb	29.7	29.7	29.7	29.7	29.7	29.7		
Havg	2.48	2.67	2.35	2.64	2.32	2.45		
Hq@	1.69	1.68	1.69	1.68	1.69	1.68		
Md	31.444	31.444	31.424	31.424	31.428	31.428		
(Havg)/0.5	1.57377874	1.6314464	1.52864035	1.62239734	1.51900703	1.56334389		
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)	0.972	0.969	0.976	0.975	0.969	0.977	0.973	0.974
% difference from Actual Y	1.29%	0.57%	0.92%	0.01%	1.59%	0.22%	1.3%	0.3%

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E04NI77E15A3796	Reference Number:	122-402389886-1
Cylinder Number:	EB0070764	Cylinder Volume:	151.0 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	2015 PSIG
PGVP Number:	B22022	Valve Outlet:	590
Gas Code:	CO,CO2,O2,BALN	Certification Date:	Mar 23, 2022

Expiration Date: Mar 23, 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.

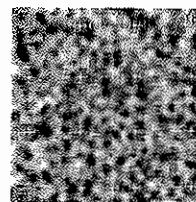
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON MONOXIDE	65.00 PPM	62.51 PPM	G1	+/- 0.6% NIST Traceable	03/23/2022
CARBON DIOXIDE	10.00 %	10.14 %	G1	+/- 0.6% NIST Traceable	03/23/2022
OXYGEN	12.00 %	12.08 %	G1	+/- 0.4% NIST Traceable	03/23/2022
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)	Mar 01, 2022
Horiba VIA510 CO 1G46EA07	Nondispersive Infrared (NDIR)	Mar 09, 2022
Siemens Oxymat 61 M3299 O2	Paramagnetic	Mar 01, 2022

Triad Data Available Upon Request



Approved for Release

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.

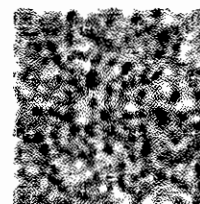
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

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



[Signature]
Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E02NI65E15A6270	Reference Number:	122-401435888-1
Cylinder Number:	EB0111760	Cylinder Volume:	142.3 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	1690 PSIG
PGVP Number:	B22019	Valve Outlet:	580
Gas Code:	CO2,BALN	Certification Date:	Mar 01, 2019

Expiration Date: Mar 01, 2027

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 volume/volume 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 DIOXIDE	35.00 %	35.31 %	G1	+/- 0.6% NIST Traceable	03/01/2019
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060810	CC415934	24.04 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	May 16, 2019

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA510 CO2 2L6YXWY0	Nondispersive Infrared (NDIR)	Feb 06, 2019

Triad Data Available Upon Request



[Signature]

Approved for Release

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



an Air Liquide company

ANALYSIS LABORATORY

CERTIFICATE OF ACCURACY: GMACS-c Calibration Standard

CUSTOMER INFORMATION

AIRGAS 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 %
Sulfur 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>

Do not use this standard if pressure is less than 200 psig.

Do not use or store this product at or below the stated dew point.

APPROVED BY: _____

BOB GRASMEDER

Client: Buzzi Signal MT

Test Location: Main Stack; Stratification Check

Date: Dec 23 Start Time: 08:15:35

Run number 1

One Minute Averages

	Reference O2 %,dry	Plant O2 %,dry
08:16:33	12.4	12.4
08:17:33	12.4	12.4
08:18:33	12.5	12.4
08:19:33	12.5	12.4
08:20:33	12.5	12.4
Point A	12.5	12.4
08:21:33	12.5	12.4
08:22:33	12.5	12.4
08:23:33	12.5	12.4
08:24:33	12.5	12.4
08:25:33	12.5	12.4
Point B	12.5	12.4
08:26:33	12.5	12.4
08:27:33	12.5	12.4
08:28:33	12.5	12.4
08:29:33	12.5	12.4
08:30:33	12.4	12.4
Point C	12.5	12.4

Buzzi Unicem Signal Mountian Plant Chattanooga TN Date/Time	K1: O2 (PCT) Raw Value
Start Run 1	
12/13/2023 08:15	12.43
12/13/2023 08:16	12.43
12/13/2023 08:17	12.43
12/13/2023 08:18	12.43
12/13/2023 08:19	12.43
12/13/2023 08:20	12.43
12/13/2023 08:21	12.43
12/13/2023 08:22	12.43
12/13/2023 08:23	12.43
12/13/2023 08:24	12.43
12/13/2023 08:25	12.43
12/13/2023 08:26	12.43
12/13/2023 08:27	12.43
12/13/2023 08:28	12.43
12/13/2023 08:29	12.43
12/13/2023 08:30	12.43

Analysis Validation Report

Sample Filename: F:\Chatanooag\December 13\SPC_006450.LAB

Filename for noise: F:\Midlothian on Rental\November 14\SPC_000837.LAB
Interferences Filenames: F:\Midlothian on Rental\November 15\SPC_001463.LAB

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F:\Midlothian on Rental\November 15\SPC_001465.LAB
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F:\Midlothian on Rental\November 15\SPC_001468.LAB
F:\Midlothian on Rental\November 15\SPC_001469.LAB
F:\Midlothian on Rental\November 15\SPC_001470.LAB

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

Gas calibration Name	Conc	MDC3	MDC2	MDC1	MAU	FMU*R	OCU	~ DL	~ CL	Bias	Sigma	Range	Span	Comment
HCN (200) PCA 191C R1 191C	1.94	1.62	-	0.3	0.42	2.31	2.31	-	1.28	-	-	0-200	-	Check it!
HF PPM (10) 191C	-0.03	0.18	0.05	0.04	0.07	0.32	0.32	0.06	0.14	0.02	0.02	0-10	-	Close to DL
SF6 (10) 191C	0	0.02	-	0	0	0.02	0.02	-	0.02	-	-	0-10	-	Close to DL
ETHYLENE (100,3000) 191C	0.99	1.28	0.33	0.17	0.29	2.23	2.23	1.08	1.1	0.75	0.11	0-3000	-	Close to DL
H2O% (40) 191C	4.97	0.06	-	0.01	0.02	0.13	0.13	-	0.1	-	-	0-40	-	Good
CO2% (40) 191C	14.09	0.19	-	0.01	0.02	0.27	0.27	-	0.28	-	-	0-40	-	Good
HCL PPM (100) 191C	1.29	0.66	0.05	0.15	0.28	1.2	1.2	0.17	0.5	0.12	0.02	0-100	-	Check it!
SO2 (1000) 191C	6.69	1.07	0.37	0.14	0.27	2.06	2.06	0.79	0.8	0.42	0.12	0-1000	-	Good
NO (350,3000) 191C	251.95	4.91	0.22	0.26	0.35	6.72	6.72	0.45	5.06	0.23	0.07	0-3000	-	Good
NH3 (300) 191C (10F2)	10.71	0.96	0.03	0.12	0.2	1.63	1.63	0.15	0.57	0.11	0.01	0-300	-	Good
CO (500) 191C (10F2)	130.57	2.2	-	0.2	0.43	4.54	4.54	-	2.61	-	-	0-500	-	Good
CO% (1) 191C (20F2)	0.01	0	0	0	0	0	0	0	0	0	0	0-1	-	Good
FORMALDEHYDE (70) 191C	1.09	1.24	0.28	0.2	0.24	1.49	1.49	0.31	1.02	0.03	0.09	0-70	-	Close to DL
ACETALDEHYDE (1000) 191C	0.14	2.51	0.28	0.35	0.38	2.74	2.74	3.04	3.04	2.76	0.09	0-1000	-	Close to DL
CH4 (250) 191C (10F2)	6.16	1.05	0.05	0.26	0.7	2.78	2.78	0.06	0.63	0.01	0.02	0-250	-	Good
PROPANE (100) 191C	0.27	0.76	0.42	0.12	0.14	0.91	0.91	0.75	0.75	0.32	0.14	0-100	-	Close to DL
HBR (100) 180C	-0.22	4.55	0.18	0.68	1.39	9.24	9.24	0.36	3.88	0.18	0.06	0-100	-	Close to DL
NO2 (150) 191C (10F2)	0.78	0.19	0.04	0.02	0.03	0.2	0.2	0.05	0.15	0.01	0.01	0-150	-	Check it!
NO2 (2000) 191C (20F2)	-0.62	5.44	2.03	0.88	1.12	6.93	6.93	3.9	4.58	1.87	0.68	0-2000	-	Close to DL
N2O (100,200,300) 191C	0.66	0.17	0.05	0.04	0.05	0.2	0.2	0.07	0.11	0.02	0.02	0-300	-	Check it!
NH3 (3000) 191C (20F2)	11.85	6.6	0.35	1.19	2.25	12.46	12.46	0.44	5.28	0.09	0.12	0-3000	-	Check it!
CH4 (3000) 191C (20F2)	6.2	5.59	0.34	1.1	1.81	9.21	9.21	0.61	4.35	0.27	0.11	0-3000	-	Check it!
ACETYLENE (1000) 191C	0.61	1.71	0.15	0.31	0.37	2.08	2.08	0.21	1.41	0.07	0.05	0-1000	-	Close to DL
PROPYLENE (200,1000) 191C	0.56	3.58	0.19	0.43	0.5	4.19	4.19	0.49	3.15	0.3	0.06	0-1000	-	Close to DL
COS (100) 150C	0.13	0.16	0.02	0.02	0.02	0.22	0.22	0.02	0.15	0	0.01	0-100	-	Close to DL
ETHANE (500) 191C	0.65	1.2	0.31	0.2	0.22	1.34	1.34	0.52	0.99	0.21	0.1	0-500	-	Close to DL
H2SO4 (50) 150C	-0.02	0.14	0.04	0.05	0.05	0.15	0.15	0.29	0.29	0.25	0.01	0-50	-	Close to DL
MEOH (10) 191C	-0.27	0.64	0.14	0.14	0.16	0.74	0.74	0.17	0.51	0.03	0.05	0-10	-	Close to DL
SO3 (150) 191C	-2.42	0.23	0.7	0.03	0.04	0.25	0.25	1.13	1.14	0.44	0.23	0-150	-	Close to DL

Analysis Validation Report

Sample Filename: F:\Chataoogal\December 13\SPC_006451.LAB

Filename for noise: F:\Midlothian on Rental\November 14\SPC_000837.LAB

Interferences Filenames: F:\Midlothian on Rental\November 15\SPC_001463.LAB

F:\Midlothian on Rental\November 15\SPC_001464.LAB

F:\Midlothian on Rental\November 15\SPC_001465.LAB

F:\Midlothian on Rental\November 15\SPC_001466.LAB

F:\Midlothian on Rental\November 15\SPC_001467.LAB

F:\Midlothian on Rental\November 15\SPC_001468.LAB

F:\Midlothian on Rental\November 15\SPC_001469.LAB

F:\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
HCN (200) PCA 191C R1 191C	2.69	1.54	-	0.3	0.42	2.2	2.2	-	1.18	-	-	0-200	-	Check it!
HF PPM (10) 191C	-0.03	0.2	0.05	0.04	0.07	0.36	0.36	0.06	0.17	0.02	0.02	0-10	-	Close to DL
SF6 (10) 191C	0.1	0.02	-	0	0	0.02	0.02	-	0.01	-	-	0-10	-	Good
ETHYLENE (100,3000) 191C	1.31	1.2	0.33	0.17	0.29	2.09	2.09	1.08	1.08	0.75	0.11	0-3000	-	Close to DL
H2O% (40) 191C	4.17	0.05	-	0.01	0.02	0.11	0.11	-	0.08	-	-	0-40	-	Good
CO2% (40) 191C	13.08	0.18	-	0.01	0.02	0.24	0.24	-	0.26	-	-	0-40	-	Good
HCL PPM (100) 191C	1.35	0.57	0.05	0.15	0.28	1.05	1.05	0.17	0.41	0.12	0.02	0-100	-	Check it!
SO2 (1000) 191C	5.96	0.94	0.37	0.14	0.27	1.82	1.82	0.79	0.8	0.42	0.12	0-1000	-	Good
NO (350,3000) 191C	197.79	3.98	0.22	0.26	0.35	5.45	5.45	0.45	3.98	0.23	0.07	0-3000	-	Good
NH3 (300) 191C (10F2)	10.07	0.88	0.03	0.12	0.2	1.49	1.49	0.15	0.51	0.11	0.01	0-300	-	Good
CO (500) 191C (10F2)	127.97	2.09	-	0.2	0.43	4.3	4.3	-	2.56	-	-	0-500	-	Good
CO% (1) 191C (20F2)	0.01	0	0	0	0	0	0	0	0	0	0	0-1	-	Good
FORMALDEHYDE (70) 191C	0.87	1.16	0.28	0.2	0.24	1.39	1.39	0.31	0.95	0.03	0.09	0-70	-	Close to DL
ACETALDEHYDE (1000) 191C	0.22	2.46	0.05	0.35	0.38	2.68	2.68	3.04	3.04	2.76	0.09	0-1000	-	Close to DL
CH4 (250) 191C (10F2)	5.19	1.06	0.05	0.26	0.7	2.79	2.79	0.06	0.66	0.01	0.02	0-250	-	Good
PROPANE (100) 191C	0.33	0.71	0.42	0.12	0.14	0.85	0.85	0.75	0.75	0.32	0.14	0-100	-	Close to DL
HBR (100) 180C	0.13	4.19	0.18	0.68	1.39	8.5	8.5	0.36	3.53	0.18	0.06	0-100	-	Close to DL
NO2 (150) 191C (10F2)	0.59	0.16	0.04	0.02	0.03	0.17	0.17	0.05	0.13	0.01	0.01	0-150	-	Check it!
NO2 (2000) 191C (20F2)	-0.72	5.37	2.03	0.88	1.12	6.84	6.84	3.9	4.51	1.87	0.68	0-2000	-	Close to DL
N2O (100,200,300) 191C	0.51	0.16	0.05	0.04	0.05	0.18	0.18	0.07	0.1	0.02	0.02	0-300	-	Close to DL
NH3 (3000) 191C (20F2)	10.7	5.72	0.35	1.19	2.25	10.78	10.78	0.44	4.43	0.09	0.12	0-3000	-	Check it!
CH4 (3000) 191C (20F2)	5.92	5	0.34	1.1	1.81	8.24	8.24	0.61	3.77	0.27	0.11	0-3000	-	Check it!
ACETYLENE (1000) 191C	0.52	1.62	0.15	0.31	0.37	1.96	1.96	0.21	1.32	0.07	0.05	0-1000	-	Close to DL
PROPYLENE (200,1000) 191C	0.5	3.17	0.19	0.43	0.5	3.72	3.72	0.49	2.75	0.3	0.06	0-1000	-	Close to DL
COS (100) 150C	0.1	0.15	0.02	0.02	0.02	0.2	0.2	0.02	0.13	0	0.01	0-100	-	Close to DL
ETHANE (500) 191C	0.45	1.13	0.31	0.2	0.22	1.26	1.26	0.52	0.93	0.21	0.1	0-500	-	Close to DL
H2SO4 (50) 150C	-0.02	0.15	0.04	0.05	0.05	0.16	0.16	0.29	0.29	0.25	0.01	0-50	-	Close to DL
MEOH (10) 191C	-0.21	0.59	0.14	0.14	0.16	0.67	0.67	0.17	0.46	0.03	0.05	0-10	-	Close to DL
SO3 (150) 191C	-1.95	0.2	0.7	0.03	0.04	0.22	0.22	1.13	1.14	0.44	0.23	0-150	-	Close to DL

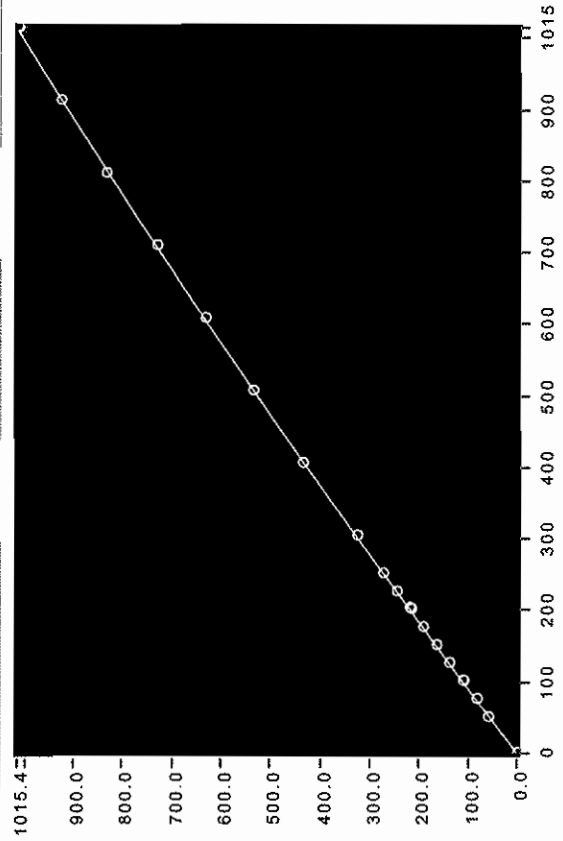
zi Unicem; Chattanooga TN
n Stack; Mill Off

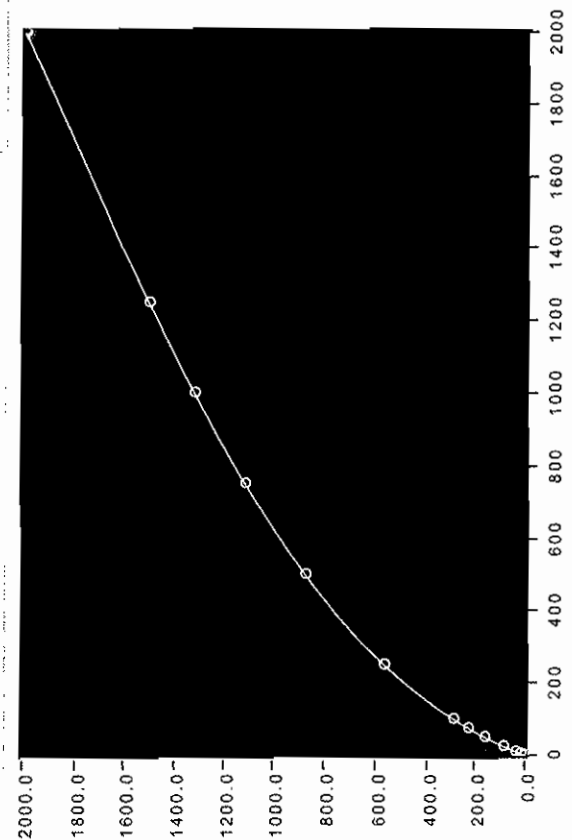
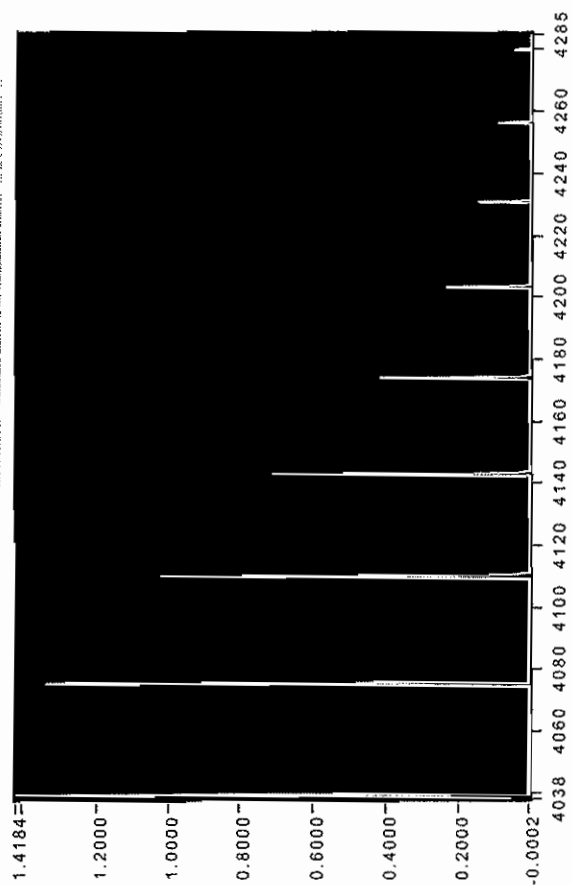
Run 3

Spectrum	Date	Time
SPC___006954.LAB	12/13/23	17:12:28.436

SNR 2500	sBeam @ 2500
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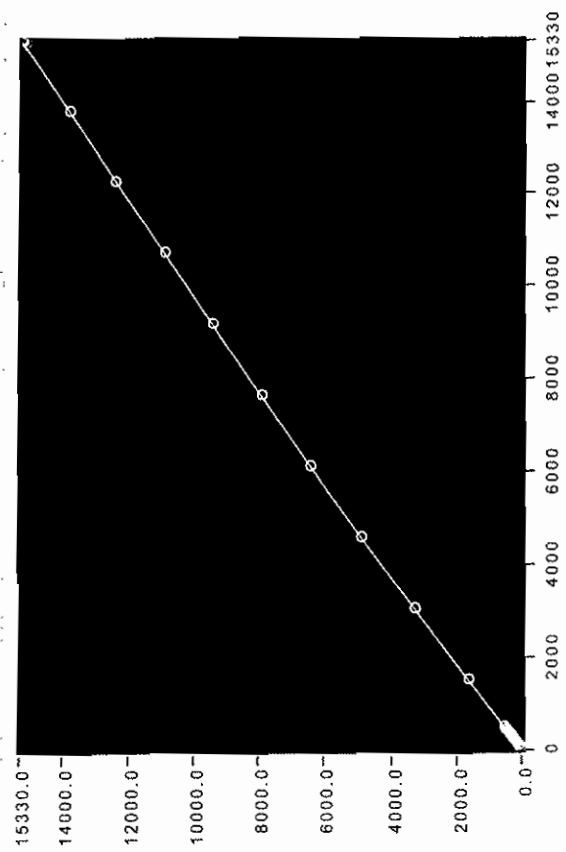
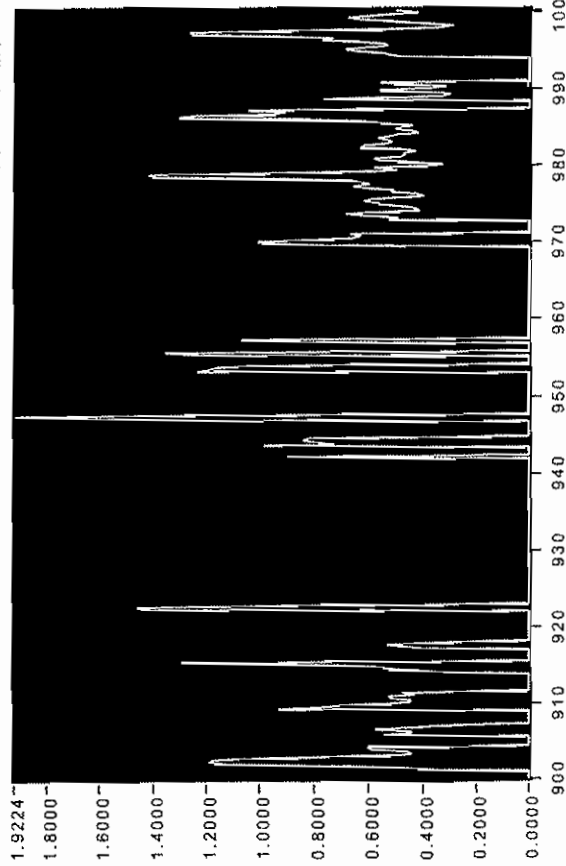
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Cal Spectra	Temp (C)	Pres (atm)	Conc (ppm-m)	Actual	Calc'd
HF 96 MNB-fz 1ppm-m (1ppm, 1.000pm,	191.000	1.000	1.000	1.000	3.620
HF 96 MNB-fz 5ppm-m (5ppm, 1.000m,	191.000	1.000	5.000	5.000	17.914
HF 96 MNB-fz 10ppm-m (10ppm, 1.000m	191.000	1.000	10.000	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, 1.00	191.000	1.000	250.000	250.000	565.147
HF 96 MNB-fz 500ppm-m (500ppm, 1.00	191.000	1.000	500.000	500.000	875.753
HF 96 MNB-fz 750ppm-m (750ppm, 1.00	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

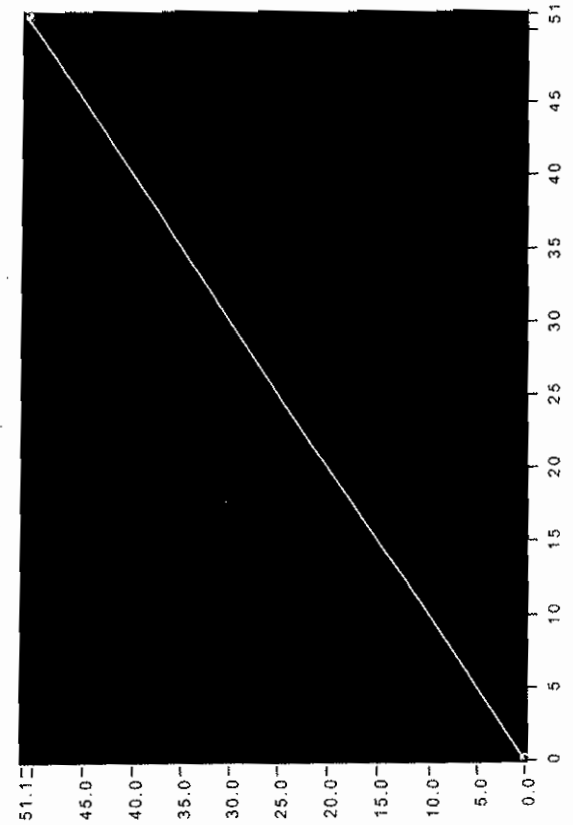
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Cal Spectra	Temp (C)	Pres (atm)	Conc (ppm-m)	Actual	Calcd
Ethylene (9.74ppm, 5.11m, 190C).lab	190.014	0.994	49.792	49.542	54.522
Ethylene (19.49ppm, 5.11m, 190C).lab	189.989	0.994	99.594	99.135	107.070
Ethylene (29.23ppm, 5.11m, 190C).lab	189.985	0.994	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

[illegible]

Mutations: FALSE

[illegible]

Appendix F

Test Participants

Scott Steinsberger

Project Manager and FTIR Operator

Lee Harris

Sample Recovery Technician

Gage Mayer

Sampling Technician

Antonio Pineda

Buzzi Plant Contact

Appendix G

RTR Sampling and Analytical Protocol



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**PROTOCOL TO PERFORM A SAMPLING
AND ANALYTICAL TESTING PROGRAM
AS PART OF
THE US EPA RISK AND TECHNOLOGY REVIEW
at
Buzzi Unicem USA, Inc.
Signal Mountain Cement Company
1201 Suck Creek Road
Chattanooga, TN 37405**

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

October 10, 2023

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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 are included in the RTR 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

Buzzi Unicem USA, Inc.
Signal Mountain Cement Company
1201 Suck Creek Road
Chattanooga, TN 37405

Antonio Pineda
Office: 610-882-5038
Mobile: 610-704-3592
E-Mail Antonio.Pineda@buzziunicemusa.com

1.3 PROCESS OF INTEREST

Signal Mountain is a 900,000 ton per year rated cement pyro-processing system. The plant operates one dry-process rotary kiln that has a preheater/precalciner (PH/PC). It has an FLS in-line calciner with one additional tertiary air duct. An in-line raw mill provides kiln feed to the system. The gases from the kiln process exhaust out of a main Kiln Stack.

1.4 AIR POLLUTION CONTROL EQUIPMENT

The Signal Mountain facility kiln has a baghouse to control particulate matter (PM).

1.5 EMISSION POINTS AND SAMPLING LOCATIONS

The Kiln Stack will be the only location sampled for the RTR program. Details of this sampling location are provided in Section 4.

1.6 POLLUTANTS TO BE MEASURED

Emission testing will be conducted for hydrogen cyanide (HCN), hydrogen fluoride (HF), and diatomic chlorine (Cl₂). Concurrent measurements to determine volumetric flow rate will be made. The sampling and analytical procedures to be followed are discussed in detail in Section 5.

1.7 EXPECTED TEST DATES

The test is currently scheduled for the week of December 11, 2023. A detailed test schedule is provided in Table 3-1.

1.8 TEST PROGRAM ORGANIZATION

The test program organizational chart is presented in Figure 1.1.

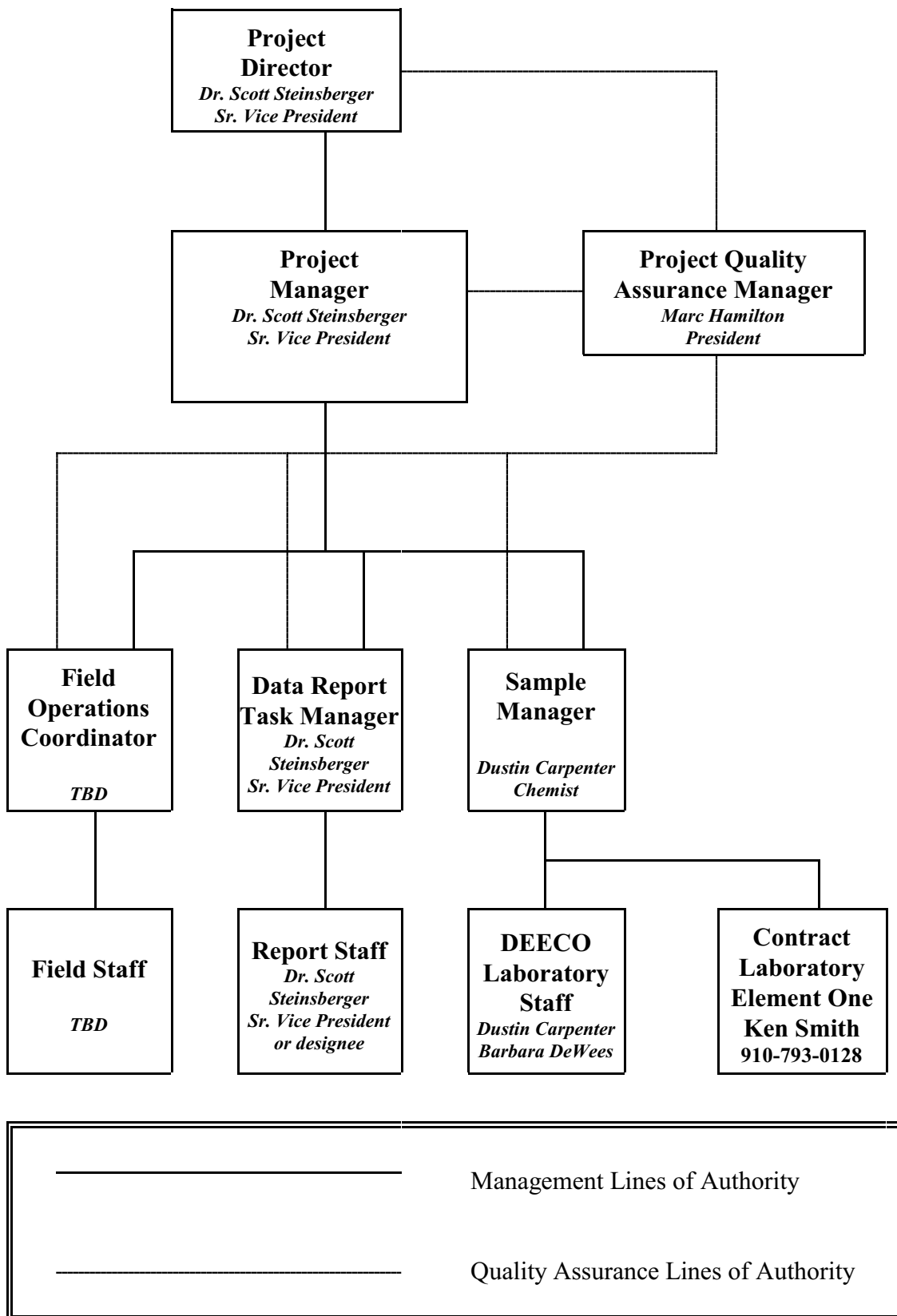


Figure 1.1 Organizational Chart

2.0 SOURCE DESCRIPTION

2.1 PROCESS DESCRIPTION

Buzzi Unicem's Signal Mountain plant operates one dry-process, rotary kiln to produce Portland cement at their facility in Chattanooga, Tennessee.

Kiln feed is introduced at the top of the kiln's preheater tower, while fuel is introduced at the burning zone or discharge end of the rotary kiln. Fuel is also introduced at the calciner burner located toward the bottom of the preheater tower. Coal, petroleum coke, and tire derived fuel are used as the fuels in the production process. Fuel oil and propane is used during startup times of the kiln. Exhaust gases from the kiln are drafted into a common duct with an induced-draft fan and ultimately vent to a baghouse.

The raw mill at the facility is an in-line mill (as defined in 40 CFR 63.1341) since a portion of the exhaust gases from the kiln system is used for processing raw materials in the mill. In the mill, raw materials are combined and ground. Kiln exhaust gas is used to dry the materials during grinding, which provides for greater fuel efficiency in the kiln system. Prepared feed is stored in silos until fed to the kiln system.

Stack gases from the kiln system are mainly composed of combustion products, carbon dioxide from calcination, excess air, and particulate matter. To remove the PM, exhaust gases from the kiln are routed through a fabric filter dust collector (i.e., the main baghouse. Once cleaned, the exhaust gases from the baghouse discharge to the atmosphere through a single exhaust stack.

2.2 CONTROL EQUIPMENT DESCRIPTION

Airflow from the kiln is routed through a fabric filter dust collection (i.e., the main baghouse) Once cleaned, the exhaust gases from the baghouse discharge to the atmosphere through a single exhaust stack.

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

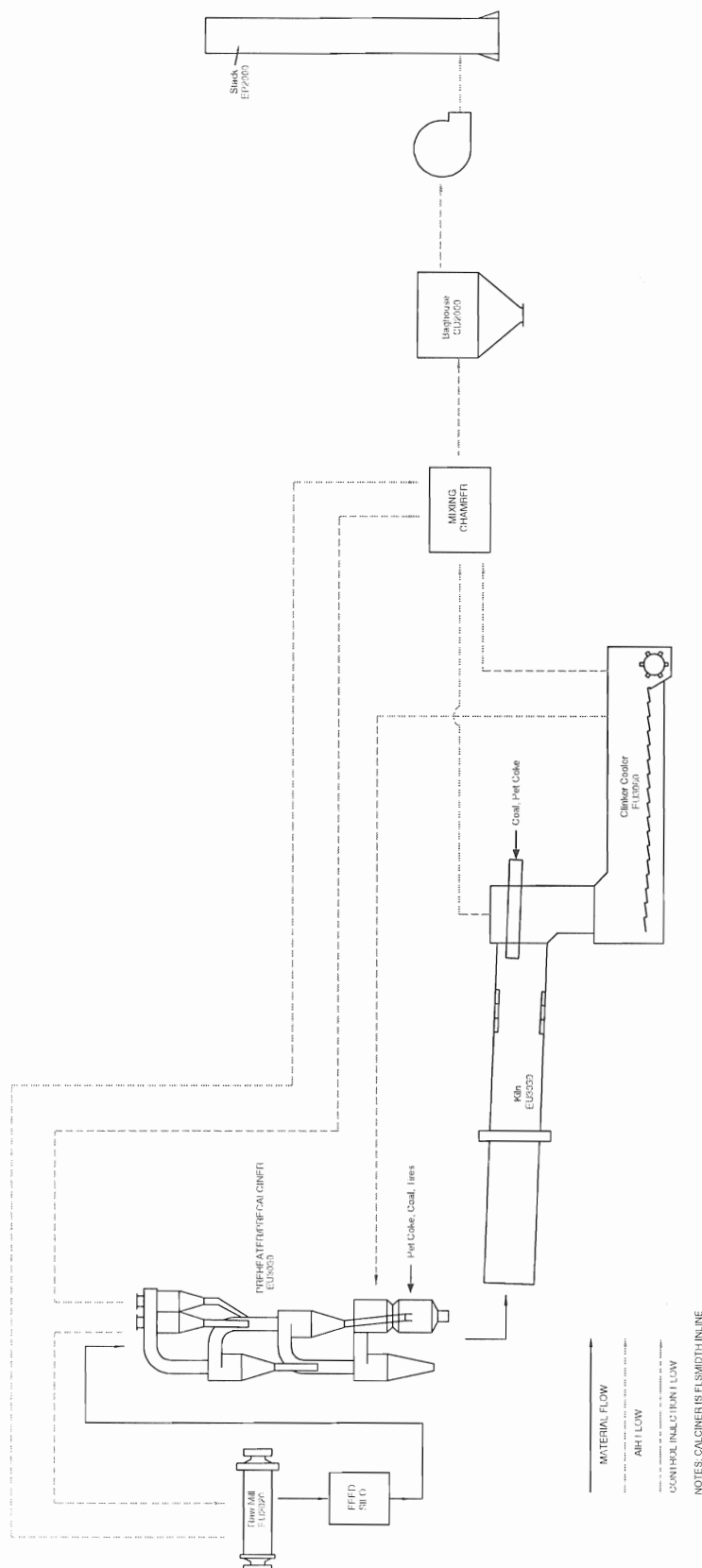


Figure 2.1 Signal Mountain Process Schematic

3.0 TEST PROGRAM

3.1 OBJECTIVES

An air emissions sampling and analytical program will be conducted on the Kiln Stack at the Buzzi Unicem USA Inc. cement facility located in Chattanooga, TN. 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 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 (Cl₂) 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.

Testing will be conducted under representative process and control system operating conditions. This facility has an inline raw mill and testing will be performed while operating in the "Mill On" and "Mill Off" conditions.

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 FOR BUZZI UNICEM USA, INC , CHATTANOOGA TN

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					
Day 2 (Raw Mill On or Off, depending on production)						
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
Day 3 (Raw Mill On or Off, depending on production)						
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
Day 4 Contingency Day/Demobilization						

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

3.3 TEST COORDINATION

Mr. Antonio Pineda, Corporate Environmental Engineer, 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.

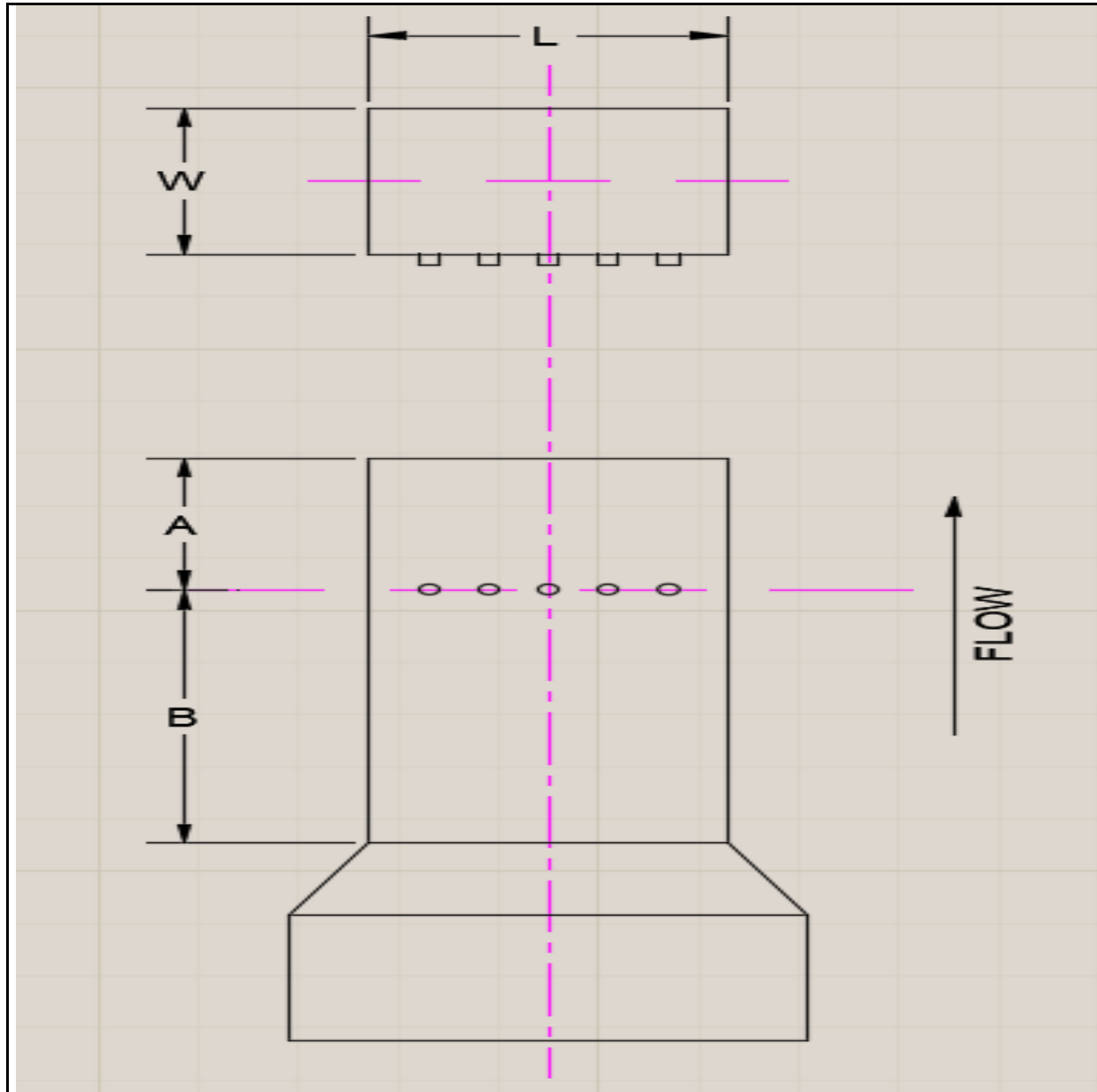
4.0 SAMPLING LOCATION DESCRIPTIONS

4.1 SAMPLING LOCATION DESCRIPTION

The measurement site for the Kiln Stack is located in a vertically-oriented rectangular duct. The duct has an inside dimension of 84" deep by 180" wide, with an equivalent diameter of 114.5". The nearest upstream disturbance is located 756" (~6.6 diameters) from the sampling ports. The nearest downstream disturbance is located 1,587" (~13.9 diameters) from the sampling ports. Five (5) 6" diameter test ports are located at equidistant across the width of the duct. A schematic of the stack sampling location is shown in Figure 4.1.

This sampling location meets the minimum specifications for selection of a measurement site as outlined in 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 Kiln Stack test location.

For the Kiln Stack, a total of 20 velocity/isokinetic traverse points will be used, with four points on each of the five ports. An S-type pitot tube is used in accordance with EPA Method 2 to measure the flue gas velocity. Gas temperatures are measured using calibrated Type K thermocouples and digital readout devices. These measurements are performed in accordance with the procedures in EPA Methods 2, 5, and 26A .



Stack Dimensions $W = 84''$ $L = 180''$. Equivalent diameter 114.5"
Distance to nearest upstream disturbance (A) = 756'', 6.6 appx. Eq. Duct Diameters
Distance to nearest downstream disturbance (B) = 1587'', appx.13.9 Eq. Duct Diameters
Sampling Ports Available = 5
Ports Diameter = 6

Figure 4.1 Schematic of Kiln 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 sent 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 O₂ gas present induces a pressure differential in the detector cell. The amount of differential pressure is proportional to the concentration of O₂ 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 proceeding..

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 $\pm 2\%$ 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, a fourth empty 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 ($\pm 10\%$) 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 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 be 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 (2nd 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 H₂SO₄ 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 1st knockout, H₂SO₄ impingers, and 2nd 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 H₂SO₄, 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 H₂SO₄ 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/Cl₂ 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.

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

- 1) Seven consecutive samples of dry nitrogen through the sampling system 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/QC Activities During Field Test Program- During the field test program, following QA/QC activities will be performed and criterion 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 375°F or 191°C (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 $\pm 20\%$ 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 meet 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 $\pm 20\%$ 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 H₂O. 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% O₂ Span is 10%, 15%, or 20% (for co-mingled stacks only) Acceptance criteria are 0.2% O₂ difference for analyzer calibration error, and 0.3% O₂ 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.

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.

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 from 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 it agrees within 2°F 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 $\pm 5.4^{\circ}\text{F}$. 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 $\pm 10\%$ 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 $\leq 67^{\circ}\text{F}$.

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 Cl₂ 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%O₂), pounds-per-hour (lbs/hr), and pounds-per-ton of clinker (lbs/ton). Additional supporting data for CO₂, O₂, and H₂O 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.