Pace® Analytical Services
1700 Elm Street SE
Minneapolis, MN 55414
Phone: 612.607.1700
pacelabs.com

RECEIVED
SEP 18 2023
AIR QUALITY DIVISION

Comprehensive Emissions Test Report

Port Inland Plant
Airflow, CO, NO_x
Relative Accuracy Testing

Testing Date(s): August 1, 2023
Report Date: August 24, 2023
Revision Date: No revision to date

ACCREDITED
Cert #3819.01 (ISO/IEC 17025:2017)
Cert #3819.02 (ASTM D7036)

Subject Facility:
Graymont Western Lime
Port Inland Plant
181 W County Road 432
Gulliver, MI 49840

Regulatory Permit No.:
ROP: MI-ROP-N7362-2020
SRN: N7362

Subject Emission Sources:
Lime Kiln Kiln 1

Test Locations:
Baghouse Exhaust SV-2

Report Prepared For:

Keith Miller
Graymont
800 Hill Avenue
Superior, WI 54880

Telephone No.: (715) 394-1719
E-mail Address: kmiller@graymont.com

Report Preparation Supervised By:

Thomas Rehling
Pace® Analytical Services
1700 Elm Street SE
Minneapolis, MN 55414
Telephone No.: (612) 759-5189
E-mail Address: thomas.rehling@pacelabs.com

Pace® Project No. 23-07242

Table of Contents

Executive Summary

Graymont Western Lime contracted Pace® Analytical Services to perform airflow, carbon monoxide (CO), and nitrogen oxides (NO_x) relative accuracy test audits (RATA) on the continuous emission monitoring systems (CEMS) for the Lime Kiln (Kiln 1) Baghouse Exhaust at the Graymont Western Lime facility located in Gulliver, Michigan. Testing was performed on August 1, 2023. Summary results are highlighted in the following table:

Test Results Summary

Lime Kiln (Kiln 1)	Ref. Method Average	CEMS Average	RA or Difference	Status
Airflow, SCFM	44,845	44,552	2.51%	Pass[1]
CO, LB/HR	32.0	32.7	1.40%	Pass[2]
NO_x, LB/HR	58.2	57.7	1.21%	Pass[3]

[1]Relative accuracy performance criteria is ≤20% based on the reference method.
[2]Relative accuracy performance criteria is ≤10% relative to the applicable standard of 113.2 LB/HR.
[3]Relative accuracy performance criteria is ≤10% relative to the applicable standard of 132.6 LB/HR.

Introduction

Pace® Analytical Services personnel conducted airflow, CO, and NO_x CEMS RATA on the Lime Kiln (Kiln 1) Baghouse Exhaust at the Graymont Western Lime facility located in Gulliver, Michigan. Andrew Radabaugh and Dylan Bune performed on-site testing activities. Tom Rehling provided administrative project management. Chuck Clark with Graymont Western Lime coordinated plant activities during testing. Lindsey Wells with the Michigan Department of Environment, Great Lakes, and Energy (EGLE) was onsite to witness testing. Pace® Analytical Services prepared a comprehensive test protocol that was submitted to the EGLE and approved prior to testing. On-site activities consisted of the following measurements:

- Carbon monoxide (CO), nitrogen oxides (NO_x), ten independent 21-minute monitoring periods.
- Gas composition (O_2/CO_2), ten independent 21-minute monitoring periods.
- Moisture, three independent one-hour samplings.
- Volumetric airflow, measurements with each constituent test run.

The project objectives were to quantify CO and NO_x concentrations and compare them to CEMS results to verify relative accuracy (RA) of the system. These measurements were performed at greater than 50% of normal load. Quality protocols comply with regulatory compliance testing requirements.

Subsequent sections summarize the test results and provide descriptions of the process and test methods. Supporting information and raw data are in the appendices.

Results Summary

Results of CEMS RA determinations are summarized in Tables 1 and 2. The airflow RA was 2.51% comparing SCFM based on the reference method average. The CO RA was 1.40% comparing LB/HR relative to the applicable standard of 113.2 LB/HR. The NO_x RA was 1.21% comparing LB/HR relative to the applicable standard of 132.6 LB/HR.

Results of moisture and airflow measurements used to calculate CO and NO_x mass rates (LB/HR) are summarized in Tables 3 and 4.

EPA Performance Specification 6 requires that CERMS RA be ≤20% of the reference method average or ≤10% of the applicable standard.

The data in this report are indicative of emission characteristics of the measured sources for process conditions at the time of the test. Representations to other sources and test conditions are beyond the scope of this report.

Summary Tables

Graymont Western Lime

Port Inland Plant
Gulliver, MI
Pace Project No. 23-07242

Table 1

CEMS Relative Accuracy Results
Lime Kiln (Kiln 1) Baghouse Stack
Test 1

Volumetric Flow Rate

Airflow, SCFM

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	8/1/23	8:50	9:11	0:21	42,732	44,811	2,079
2	8/1/23	9:12	9:33	0:21	45,013	45,036	22.4
3	8/1/23	9:34	9:55	0:21	46,487	44,903	-1,584
4	8/1/23	10:15	10:36	0:21	44,614	44,714	100
5	8/1/23	10:37	10:58	0:21	44,894	44,069	-825
7	8/1/23	11:55	12:16	0:21	45,450	44,189	-1,261
8	8/1/23	12:17	12:38	0:21	44,971	43,982	-989
9	8/1/23	12:39	13:00	0:21	44,714	44,518	-197
10	8/1/23	13:01	13:22	0:21	44,730	44,749	19.3
			Run Average		44,845	44,552	-293
			Standard Deviation				1,082
			Confidence Coefficient				831
			Relative Accuracy		(% of RM Avg)		**2.51**
			RA Requirement				≤ 20% of RM Average
			RA Status				**Pass**

RECEIVED
SEP 18 2023
AIR QUALITY DIVISION

Graymont Western Lime

Port Inland Plant
Gulliver, MI
Pace Project No. 23-07242

Table 2

CEMS Relative Accuracy Results
Lime Kiln (Kiln 1) Baghouse Stack
Test 1

Carbon Monoxide

LB/HR

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	8/1/23	8:50	9:11	0:21	34.8	37.5	2.68
2	8/1/23	9:12	9:33	0:21	25.8	27.6	1.82
3	8/1/23	9:34	9:55	0:21	32.6	33.2	0.640
4	8/1/23	10:15	10:36	0:21	36.3	35.3	-1.01
5	8/1/23	10:37	10:58	0:21	23.0	23.9	0.839
7	8/1/23	11:55	12:16	0:21	30.8	30.6	-0.188
8	8/1/23	12:17	12:38	0:21	37.4	38.7	1.31
9	8/1/23	12:39	13:00	0:21	34.0	34.3	0.298
10	8/1/23	13:01	13:22	0:21	32.8	33.2	0.360
			Run Average		32.0	32.7	0.750
			Standard Deviation				1.09
			Confidence Coefficient				0.839
			Relative Accuracy		(% of Em. Limit) [113.2]		**1.40**
			RA Requirement			≤ 10% of Emission Limit	
			RA Status				**Pass**

Nitrogen Oxides as NO2

LB/HR

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	8/1/23	8:50	9:11	0:21	54.0	56.4	2.41
2	8/1/23	9:12	9:33	0:21	58.6	58.5	-0.0885
3	8/1/23	9:34	9:55	0:21	58.6	56.6	-1.96
4	8/1/23	10:15	10:36	0:21	57.9	57.0	-0.833
5	8/1/23	10:37	10:58	0:21	59.0	57.5	-1.58
7	8/1/23	11:55	12:16	0:21	59.6	58.7	-0.849
8	8/1/23	12:17	12:38	0:21	59.6	58.4	-1.23
9	8/1/23	12:39	13:00	0:21	57.7	59.1	1.40
10	8/1/23	13:01	13:22	0:21	59.0	57.4	-1.54
			Run Average		58.2	57.7	-0.474
			Standard Deviation				1.48
			Confidence Coefficient				1.13
			Relative Accuracy		(% of Em. Limit) [132.6]		**1.21**
			RA Requirement			≤ 10% of Emission Limit	
			RA Status				**Pass**

Detail Tables

Graymont Western Lime

Port Inland Plant
Gulliver, MI
Pace Project No. 23-07242

Table 3

Major Gases and Moisture Results
Lime Kiln (Kiln 1) Baghouse Stack
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	8/1/23	8/1/23	8/1/23
Time of Run	0850-0950	1015-1115	1155-1255
Sample Duration, Minutes	60	60	60
Average Flue Gas Temperature, °F	355	370	365
Major Gas Constituents - Instrumental, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	26.28	26.00	26.16
Oxygen	6.44	6.90	6.84
Nitrogen (by difference)	67.29	67.10	67.00
Wet Basis (calculated)			
Carbon Dioxide	23.99	23.76	23.90
Oxygen	5.87	6.31	6.25
Nitrogen	61.43	61.34	61.20
Portable O_2 Monitor Average, %O_2	6.65	6.6	6.6
Sample Volume, Meter Conditions, Ft^3	32.80	32.58	32.37
Sample Volume, Dry Standard, Ft^3	31.99	31.77	31.51
Moisture Collected, ml	64.8	63.4	63.4
Moisture Content of Gas Stream, %v/v	8.71	8.59	8.65
Moisture Content if Saturated, %v/v	NA (>BP)	NA (>BP)	NA (>BP)
Relative Humidity, % rH	NA (>BP)	NA (>BP)	NA (>BP)
Molecular Weight of Flue Gas, lb/lb-mole			
Dry	32.46	32.44	32.46
Wet	31.20	31.20	31.21

Graymont Western Lime

Port Inland Plant
Gulliver, MI
Pace Project No. 23-07242

Table 4

Airflow Measurement Results
Lime Kiln (Kiln 1) Baghouse Stack
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**	**Run 7**	**Run 8**	**Run 9**	**Run 10**
Date of Run	8/1/23	8/1/23	8/1/23	8/1/23	8/1/23	8/1/23	8/1/23	8/1/23	8/1/23	8/1/23
Time of Measurement	0855	0930	0935	1020	1055	1100	1200	1235	1240	1300
Barometric Pressure, Inches Hg	29.53	29.53	29.53	29.53	29.53	29.53	29.53	29.53	29.53	29.53
Static Pressure, Inches WC	-0.43	-0.48	-0.43	-0.46	-0.40	-0.46	-0.46	-0.42	-0.42	-0.44
Absolute Gas Pressure (In. Hg)	29.50	29.50	29.50	29.50	29.50	29.50	29.50	29.50	29.50	29.50
Average Gas Temperature, °F	351	355	355	370	370	370	366	366	366	366
Corresponding M-4 Run Number	1	1	1	2	2	2	3	3	3	3
Average Moisture Content, %v/v	8.7	8.7	8.7	8.6	8.6	8.6	8.7	8.7	8.7	8.7
Gas Molecular Weight (Instrumental), lb/lb-mole										
Dry	32.48	32.45	32.45	32.45	32.43	32.43	32.44	32.47	32.47	32.47
Wet	31.22	31.19	31.19	31.21	31.19	31.19	31.19	31.22	31.22	31.22
Flue Gas Average Velocity, FPS	30.24	32.02	33.06	32.32	32.51	35.49	32.76	32.41	32.23	32.24
Duct Cross-sectional Area, Sq. Ft	36.67	36.67	36.67	36.67	36.67	36.67	36.67	36.67	36.67	36.67
Volumetric Flow Rate (Rounded to 1 CFM)										
ACFM	66,542	70,450	72,746	71,107	71,542	78,095	72,090	71,322	70,916	70,943
SCFM	42,732	45,013	46,487	44,614	44,894	48,999	45,450	44,971	44,714	44,730
DSCFM	39,011	41,094	42,440	40,783	41,038	44,791	41,518	41,080	40,846	40,860

Process Description

Graymont Western Lime operates a rotary lime kiln near Gulliver, Michigan. The operations at this facility are subject to the requirements of air quality operating permit MI-ROP-N7362-2020, issued November 19, 2020. The plant has a maximum lime production rate of 870 tons per day (TPD) and 292,000 tons of lime production per year.

A rotary kiln is a long, cylindrical, refractory-lined furnace that is slightly inclined. The limestone and hot gases pass counter-currently through the kiln. The lime plant consists of a single 235-foot long rotary kiln with a pre-heater and lime cooler. The kiln is fired with coal or a mixture of coal and petroleum coke. Coal and/or petroleum coke is burned near the discharge end of the kiln to provide the necessary heat for the process. The kiln rotates continuously to prevent the drum from sagging, to improve the product contact with the hot gases, and to move the product through the kiln. To maximize fuel efficiency, a product cooler and limestone pre-heater are used to recover heat from the product and the hot gasses. The lime product is discharged from the kiln and then conveyed to various storage silos, where it is screened to size and then shipped to the end user. Lime is used in the metallurgical, pulp and paper, construction, and waste treatment industries.

Emissions from the process consist primarily of particulate matter (PM), carbon monoxide (CO), nitrogen oxides (NO_x), and sulfur dioxide (SO_2) from fuel combustion. Emission controls for the kiln consist of a fabric filter baghouse for PM control, a fuel sulfur content limit and combustion optimization to reduce CO and NO_x emissions. The majority of the SO_2 is collected within the process, owing to reactions with calcium oxide in the kiln.

Test related operational details and plant CEMS results are included in Appendix E.

Test Procedures

EPA Method 1 specifies test location acceptability criteria and defines the minimum number of traverse points for representative sampling. Linear measurements from upstream and downstream flow disturbances and the duct equivalent diameter are compared and the distances related to number of diameters. A flow disturbance can be defined as anything that changes or upsets the direction of flow within the duct including bends, dampers, fans, shape or size transitions, and open flames. Method 1 stipulates that test ports should be located at least eight diameters downstream and two diameters upstream of any flow disturbance. The minimum acceptable criteria are two diameters downstream and 0.5 diameters upstream of flow disturbances. The test location must also be free of cyclonic or multidirectional flow. Once the distances have been determined, the values are used to select the minimum number of traverse points for representative sampling. Shorter distances require a greater number of traverse points. The test site configuration and measurement details are documented on EPA Method 1 Field Data Sheet.

Pace® FSD conducts the method as written with no routine deviations.

EPA Method 2 defines procedures used to measure linear velocity and volumetric flow rate of a confined gas stream. Using traverse points determined by EPA Method 1, multiple differential pressure measurements (pitot impact opening versus static pressure) are made using a pitot tube and differential pressure gauge. The individual measurements are averaged and combined with the gas density to calculate the average gas velocity. The velocity and duct cross-sectional area are used to calculate the volumetric flow rate. The volumetric flow rate is expressed as actual cubic feet per minute (ACFM), standard cubic feet per minute (SCFM), and dry standard cubic feet per minute (DSCFM). The technician maintains comprehensive test records on EPA Method 2 Field Data Sheet. Details of the equipment used to measure gas velocity include:

Pitot Tube:	S-Type
Differential Pressure Gauge:	Oil or Electronic Digital Manometer
Temperature Device:	Type K Thermocouple
Barometer Type:	Electronic Digital Barometer
Gas Density Determination:	EPA Method 3
Gas Moisture Determination:	EPA Method 4

Method Defined Quality Control:

- Pitot tubes are verified on an annual basis.
- Temperature device operation is confirmed for single point temperature and polarity for each test. Temperature devices undergo a full multipoint verification on an annual basis.
- Electronic barometers are verified for accuracy and calibrated on a semi-annual basis. Aneroid barometers are not used.

- Electronic Digital Manometers (EDMs) are verified for accuracy and calibrated on a semi-annual basis. EDMs are operationally confirmed and leak checked for each run.
- Sampling system leak-checks are performed before and after each run and prior to any component change during a run.

Pace® FSD conducts the method as written with no routine deviations.

EPA Method 3A defines procedures to measure carbon dioxide (CO_2) and oxygen (O_2) concentrations from stationary sources. A stainless steel sampling probe and a sampling line draw a sample of the gas stream from the duct to a thermo-electric gas conditioner to remove moisture. The conditioned gas stream is delivered to an infrared gas analyzer to quantify CO_2 concentrations and paramagnetic gas analyzer to quantify O_2 concentrations. Zero grade cylinder air or a zero gas generator provides zero gas. Span gases include varying concentrations of EPA Protocol 1 CO_2/O_2 mixed standards specific to the target calibration range. A computerized data acquisition system logs CO_2/O_2 concentrations for one-minute averages. The logged results are integrated to test periods and tabulated with standardized and validated spreadsheets in Microsoft Excel. The operator also maintains comprehensive test records in the electronic Project Results Instrumental Workbook. Equipment used for CO_2/O_2 testing includes:

Probe Material:	Stainless Steel
Moisture Removal:	Thermo-electric
Transfer Line:	Teflon™
Analytical Technique:	Non-dispersive Infrared Detector (CO_2) Paramagnetic Detector (O_2)
Calibration Gas:	EPA Protocol 1

Method Defined Quality Control:

- Sampling system leak-checks are performed before each test and following any component change. Absence of leaks is confirmed through the bias check after each run.
- Calibration gas standards of the highest quality, Protocol 1 or traceable to NIST, are used in calibrations.
- Analyzer calibration error is determined before initial run and after any failed bias or drift test.
- Analyzer bias is verified once per test.
- System bias check is performed before and after each test.
- Calibration drift test is performed after each test run.
- System response time is determined during initial sampling system bias test.
- Stratification test is performed prior to first run.
- Purge time of ≥ 2x the response time observed before starting data collection and recording stratification traverse point values.

Pace® FSD conducts the method as written with no routine deviations.

EPA Method 4 defines procedures to measure the moisture content of emission gas streams from stationary sources. A stainless steel sampling probe draws a sample of the gas stream from the duct to a series of impingers or aluminum condenser to condense the water vapor. The first two impingers initially contain deionized water and a third is dry. A condenser is initially dry. A desiccant packed drying column follows the impingers or condenser to quantitatively collect the remaining moisture. An ice bath maintains the impinger train or condenser temperature (outlet) at 68°F or less. Collected water condensate is measured and discarded. Method 4 equations convert the condensed liquid volume to a gas volume. The water vapor volume compared with the dry standard gas volume measured through a dry gas meter determines the moisture content of the emissions gas stream and is reported in percent by volume. The operator maintains comprehensive test records on EPA Method 4 Field Data Sheet, Constant Rate Moisture Sampling.

Probe Material:	Stainless Steel
Filter Media:	Glass or Quartz Fiber or Glass Wool
Impinger Train Material:	Borosilicate Glass or aluminum
Desiccant:	Drierite
Condensate Measure:	Graduated Cylinder or Electronic Scale
Desiccant Measure:	Electronic Scale

Method Defined Quality Control:

- Dry gas meters are verified by wet test meter comparison for a three-point "as found" determination and a full five-point calibration every 500 CF, or 90 days (first occurring). The Pace® standard "as left" calibration factor is within ± 1% (the method standard is ± 2%).
- Sample rate orifices are calibrated every 500 CF, or 90 days (first occurring).
- Temperature device operation is confirmed for single point temperature and polarity for each test. Temperature devices undergo a full multipoint verification on an annual basis.
- Electronic barometers are verified for accuracy and calibrated on a semi-annual basis. Aneroid barometers are not used.
- Sampling system leak-checks are performed before and after each run and prior to any component change during a run.
- Field scales are verified for accuracy over the entire range of use on an annual basis and verified before each use using stainless steel reference weights traceable to national standards maintained by NIST.

Pace® FSD conducts the method with the following sampling deviations:

The gas sample is extracted from the source from a single point in the centroid of the stack using an unheated probe with an in-stack filter. Water vapor is condensed using aluminum condensers followed by a drierite dry column. The metering system verification cited above is a method QC alternative but considered more rigorous.

EPA Method 7E defines procedures to measure nitrogen oxide (NO_x) emissions from stationary sources. A stainless steel sampling probe and a heat-traced Teflon™ sampling line draw a sample of the gas stream from the duct to a thermo-electric gas conditioner to remove moisture. The sample gas stream is delivered to a chemiluminescence NO-NO_2-NO_x analyzer to quantify NO_x emissions. Zero grade cylinder air or a zero gas generator provides zero gas. Span gases include varying concentrations of EPA NO_x standards specific to the target calibration range. A computerized data acquisition system logs NO_x concentrations for one-minute averages. The logged results are integrated to test periods and tabulated with standardized and validated spreadsheets in Microsoft Excel. The operator also maintains comprehensive test records in the electronic Project Results Instrumental Workbook. Equipment used for NO_x testing includes:

Probe Material:	Stainless Steel
Moisture Removal:	Thermo-electric
Transfer Line:	Teflon™
Analytical Technique:	Chemiluminescence
Calibration Gas:	EPA Protocol 1

Method Defined Quality Control:

- Sampling system leak-checks are performed before each test and following any component change. Absence of leaks is confirmed through the bias check after each run.
- Calibration gas standards of the highest quality, Protocol 1 or traceable to NIST, are used in calibrations.
- Analyzer calibration error is determined before initial run and after any failed bias or drift test.
- Analyzer bias is verified once per test.
- System bias check is performed before and after each test.
- Calibration drift test is performed after each test run.
- System response time is determined during initial sampling system bias test.
- Stratification test is performed prior to first run.
- Purge time of ≥ 2x the response time observed before starting data collection and recording stratification traverse point values.
- NO2 to NO converter efficiency verified ≥ 90% before or after each test.

Pace® FSD conducts the method as written with no routine deviations.

In-Stack Method: Method 10 defines procedures to measure carbon monoxide (CO) emissions from stationary sources. A stainless steel sampling probe and a heat-traced

Teflon™ sampling line draw a sample of the gas stream from the duct to a thermo-electric gas conditioner to remove moisture. The sample gas stream is delivered to a gas filter correlation non-dispersive infrared analyzer to quantify CO concentrations. Zero grade cylinder air or a zero gas generator provides zero gas. Span gases include varying concentrations of EPA Protocol 1 CO standards specific to the target calibration range. A computerized data acquisition system logs CO concentrations for one-minute averages. The logged results are integrated to test periods and tabulated with standardized and validated spreadsheets in Microsoft Excel. The operator also maintains comprehensive test records in the electronic Project Results Instrumental Workbook. Equipment used to conduct Method 10 stack method testing includes:

Probe Material:	Stainless Steel
Moisture Removal:	Thermo-electric
Transfer Line:	Teflon™
Analytical Technique:	Non-dispersive Infrared
Calibration Gas:	EPA Protocol 1

Method Defined Quality Control:

- Sampling system leak-checks are performed before each test and following any component change. Absence of leaks is confirmed through the bias check after each run.
- Calibration gas standards of the highest quality, Protocol 1 or traceable to NIST, are used in calibrations.
- Analyzer calibration error is determined before initial run and after any failed bias or drift test.
- System bias check is performed before and after each test.
- Analyzer bias is verified once per test.
- Calibration drift test is performed after each test run.
- System response time is determined during initial sampling system bias test.
- Stratification test is performed prior to first run.
- Purge time of ≥ 2x the response time observed before starting data collection and recording stratification traverse point values.

Pace® FSD conducts the method as written with no routine deviations.

PS 6 defines procedures for evaluating the acceptability of continuous emission rate monitoring systems (CERMS). Calibration drift (CD) and relative accuracy (RA) tests are conducted to determine that the CEMS conforms to specifications. Reference method (RM) tests produce results representative of the emissions from the source and are correlated to data produced by the CEMS. The Performance Specification defines requirements for:

- CEMS Placement
- CEMS Measurement Location

- RM Test Location and Measurement Points
- Stratification Determination
- CEMS Zero and Calibration Drift Test (7 Day)
- Relative Accuracy Test Audit (RATA)
- Calibration Gas Audit (CGA)

CERMS placement, measurement location and drift tests are generally verified at installation. Relative Accuracy Test Audits (RATAs) and Calibration Gas Audits (CGAs) are performed periodically to verify on-going performance. When conducting a RATA, it is preferable to conduct the diluent (if applicable), moisture (if needed), and pollutant measurements simultaneously. For most PS-6 RATAs, Pace® FSD uses EPA Method 2, as the reference methods (RM) for the determination of volumetric flow rate. The A method cited for compliance test purposes, or its approved alternatives, is the RM for the pollutant gas. RATAs consist of nine test runs where the CERMS results are compared to the reference method results to determine the CERMS Relative Accuracy (RA). Measurement results are collected for simultaneous test periods and compared on units of the emission or reporting standard. The absolute mean difference plus a single-tailed 2.5% confidence coefficient divided by the reference method average is the RA value. When compared to the RM, the RA must be 20% or less. For low concentrations, the emission limit may be substituted as the divisor. In these cases, the RA must be 10% or less.

Method Defined Quality Control:

- Quality control related to relative accuracy testing is defined within the appropriate test method.

Pace® FSD conducts RATAs and CGAs as written with no routine deviations. Installation and manufacturers specifications are performed by others but may be included in FSD reports, as documented by the operator or manufacturer.

Reference Standards. Pace® implements a comprehensive program to verify and validate reference standards to further enhance and support method standards. Primary reference standards are directly comparable to a reference base. The National Institute of Standards and Technology (NIST) maintains primary reference materials or very closely traceable secondary standards. These materials are then used to certify secondary or transfer standards for use in quality management programs. Secondary reference standards are calibrated with primary standards using a high precision comparator. Materials that have a documented path to the primary standard are often referred to as traceable to NIST or NIST traceable. Where commercially and feasibly available, Pace® uses primary reference standards to perform calibrations and verifications. In other cases, Pace® maintains traceable secondary reference standards. Primary and secondary reference standards are used to calibrate and verify equipment and materials. Pace® reference standards are calibrated by external vendors that have a formal, registered quality system. Calibrations are performed with equipment and materials that are traceable to NIST.

Quality Controls (not defined in test methods):

- Sampling/Recovery Reagents are Reagent Grade or better.
- Reference Temperature Simulator is calibrated annually.
- Reference Pressure Transducer is calibrated annually.
- Reference DryCal airflow meter is calibrated annually.
- Mercury Barometer is a primary reference standard.
- Liquid Manometers are primary reference standards.
- Angle Blocks, Gauge Blocks, and Measuring Rods are verified every five years.
- Angle Gauges are verified each day of use.
- Calipers are verified annually.
- Stainless steel reference weights are verified every five years.
- Analytical balances are calibrated annually and verified at each use.
- Field balances are calibrated annually and verified at each use.

Quality Management System. To produce data that is complete, representative, and of known precision and accuracy, Pace® Analytical Field Services Division has designed and implemented a rigorous and innovative quality management system. The system was initially based on the USEPA Quality Assurance Handbook for Air Pollution Measurement Systems and continually developed as procedural complexities and standards progressed. The Field Services Division Quality Management System (Pace® FSD QMS) is now accredited by the American Association of Laboratory Accreditation (A2LA) to comply with three national accreditation standards:

- ASTM D7036 - Standard Practice for Competence of Air Emission Testing Bodies (AETB).
- ISO 17025 - General Requirements for the Competence of Testing and Calibration Laboratories
- The NELAC Institute - General Requirements for Field Sampling and Measurement Organizations (FSMO)

The Pace® FSD QMS includes:

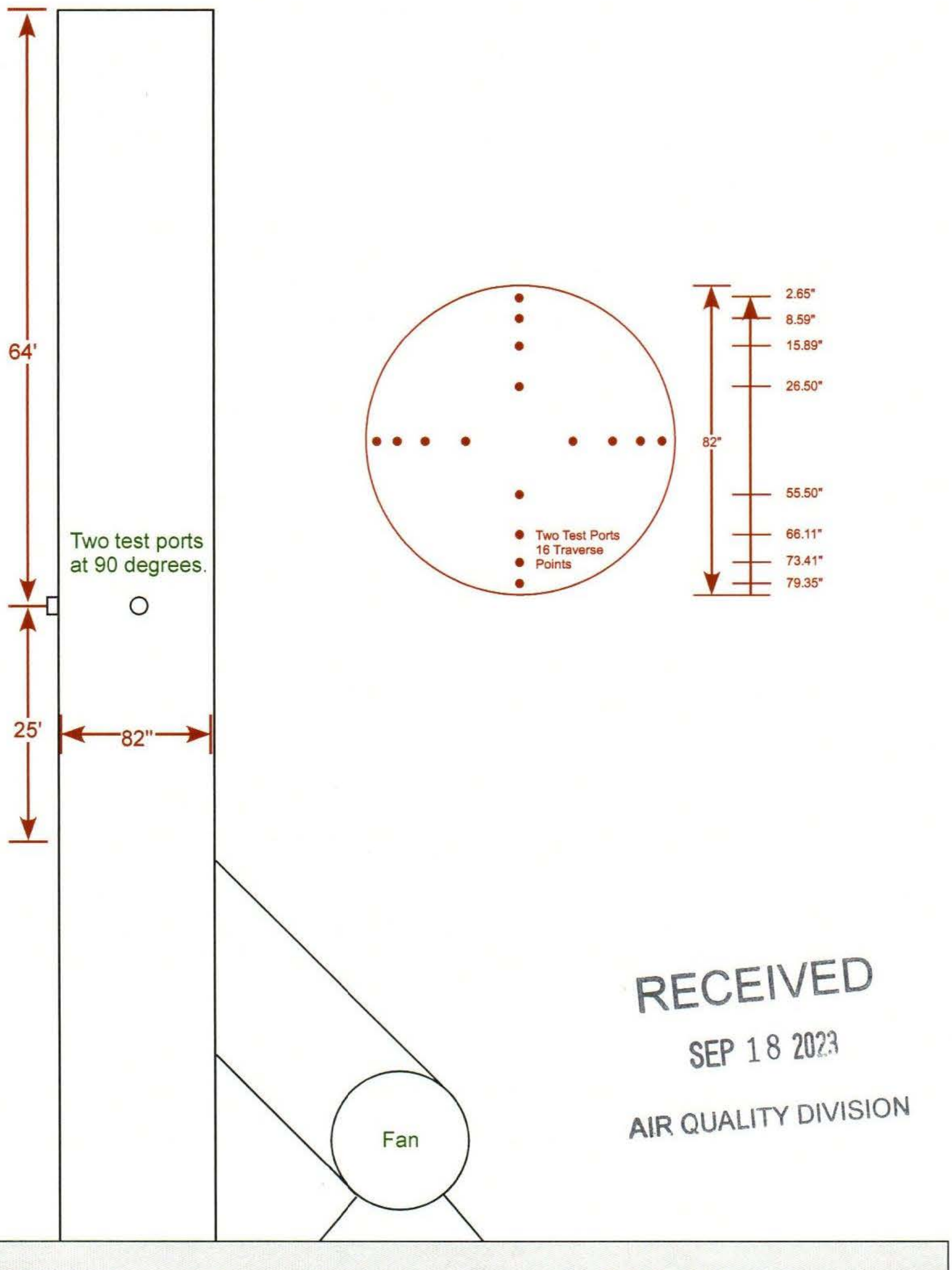
- Quality Programs
  - Ethics policy and training.
  - Corrective Action and Preventative Action (CAPA).
  - Continuous Process Improvement.
  - Documented Demonstrations of Capability.
  - Internal and third party proficiency testing.
  - Qualified Individual program (QI)
  - Internal and external audits.
  - Annual management reviews.
- Documentation and Traceability
  - High quality traceable standards and reagents.
  - Reagent tracking and management system.
  - Use of matrix spikes, duplicate analysis, internal standards, and blanks.

- Validated workbooks for data collection and results reporting.
- Electronic quality, training, and safety documents available in-field.
- Sample security and preservation procedures.
- Chain of custody maintained from sample collection through laboratory analysis.

▪ Equipment Calibration
  - Full time staff dedicated to equipment maintenance and calibration.
  - All equipment and instruments are calibrated by trained personnel on a frequency that meets or exceeds method requirements.

ANALYTICAL SERVICES

Figure 1
Graymont Western Lime
Gulliver, MI
Lime Kiln Exhaust (Kiln 1)
JTD \ 07/09



Report Signatures

Field Testing and Reporting Performed by: Pace® Analytical Services
Field Services Division
1700 Elm Street SE
Minneapolis, MN 55414

Field Testing Affirmation

All field testing was performed in accordance with stated test methods subject to modifications and deviations listed herein. Raw field data presented in this report accurately reflects results and information as recorded at the time of tests or otherwise noted.

Date 8/22/2023

Andrew J. Radabaugh, QSTI
Field Scientist 1

Report Affirmation

To the best of my knowledge, this report accurately represents the compiled field and laboratory information with no material omissions, alterations or misrepresentations.

Date 8/22/2023

Beth Kelm
Project Manager

Responsible Charge Affirmation

I have reviewed the information herein and it is approved for distribution.

Date 8/22/2023

Thomas M. Rehling, QSTI
Manager – Air Department