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Comprehensive Emissions Test Report

Grede, LLC - Iron Mountain
Particulate, PM-10, CO, SO_2, VOC
Compliance Testing

Testing Date(s): Dec. 8-10 & 15-17, 2020
Report Date: February 5, 2021
Revision Date: No revision to date

Subject Facility:

Grede, LLC - Iron Mountain
801 South Carpenter Avenue
Kingsford, MI 49802

Regulatory Permit No.:
MI-ROP-B1577-2020
SRN: B1577

Subject Emission Sources:

Cupola	EU-P009
Module Pouring & Cooling	EU-P036
Main Plant Pouring & Cooling	EU-P016

Test Locations:

Cupola Baghouse Exhaust	324644
Module Pouring & Cooling	2 Stacks
Main Plant Pouring & Cooling	6 Stacks

Report Prepared For:

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Pace Project No. 20-04074

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Regulatory Summary

Subject Facility:	Grede, LLC – Iron Mountain
Plant Address:	801 South Carpenter Avenue Kingsford, MI 49802
Air Permit No.:	MI-ROP-B1577-2020
Facility ID No.:	SRN: B1577

Emission Unit IDs	Emission Unit Name	Regulated Constituent	Regulatory Citations	Regulatory Limit	Average Test Result
324484	Main Plant Pouring & Cooling Disa Pouring	Particulate (filterable)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF	0.0026 GR/DSCF
324632	Main Plant Pouring & Cooling No. 6 HMP	Particulate (filterable)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF	0.0025 GR/DSCF
324662	Main Plant Pouring & Cooling No. 7 HMP	Particulate (filterable)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF	0.0072 GR/DSCF
324678	Main Plant Pouring & Cooling Disa Pouring	Particulate (filterable)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF	0.0043 GR/DSCF
324682	Main Plant Pouring & Cooling Disa Pouring	Particulate (filterable)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF	0.0012 GR/DSCF
324848	Main Plant Pouring & Cooling No. 5 HMP	Particulate (filterable)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF	0.0041 GR/DSCF
334116	Module Pouring & Cooling Exhaust	Particulate (filterable)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF	0.0032 GR/DSCF
334176	Module Pouring & Cooling Exhaust	Particulate (filterable)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF	0.0032 GR/DSCF

Emission Unit IDs	Emission Unit Name	Regulated Constituent	Regulatory Citations	Regulatory Limit	Average Test Result
EU-P009 324644	Cupola Baghouse Exhaust	Carbon Monoxide	R 336.1201(3)	≤21.0 LB/HR	0.811 LB/HR
				≤250.0 mg/m^3, corrected to 70°F and 29.92” Hg	14.5 mg/dscm (70°F : 29.92”Hg)
		Particulate (filterable)	R 336.1331	≤0.011 LB/1000 LB exhaust gas	0.0026 LB/1000 LB exhaust gas
			40 CFR 63.7690(a)(2)	≤0.006 GR/DSCF	0.0014 GR/DSCF
		PM-10	R 336.1331	≤1.30 LB/HR	2.50 LB/HR
		Sulfur Dioxide	R 336.1201(3)	≤170 mg/m^3, corrected to 70°F and 29.92” Hg	29.5 mg/dscm (70°F : 29.92”Hg)
				≤13.8 LB/HR	1.65 LB/HR
		Volatile Organic HAP (VOHAP)	40 CFR 63.7690(a)(8)	≤20 PPMv @ 10% O_2 as hexane	<0.11 PPM, dry @ 10% O_2
		Opacity (fugitive)	40 CFR 63.7690(a)(7)	≤20% 6-minute average, except for one 6-minute average per hour that does not exceed 27%	3.8% Highest 6-minute average

Introduction

Pace Analytical Services, LLC personnel conducted source emission compliance testing at the Grede, LLC – Iron Mountain facility located in Kingsford, Michigan. Cupola testing included particulate, carbon monoxide (CO), total hydrocarbon (THC), sulfur dioxide (SO_2), and opacity. Particulate emission testing was performed on eight Main Plant and Module Plant pouring and cooling exhaust stacks. Terry Borgerding, Zack Eckstrom, Andrew Radabaugh, Jake Geis, Stanley Broome, Josh Price, and Lucas Ruhland performed on-site testing activities on December 8-10 and 15-17, 2020. Terry Borgerding provided administrative project management. Tom White and Tyler Hill with Grede, LLC – Iron Mountain coordinated plant activities during testing. Jeremy Howe and Michael Conklin with the Michigan Department of Environment, Great Lakes, and Energy (EGLE) were on-site to witness testing. Pace Analytical Services, LLC prepared a comprehensive test protocol that was submitted to the EGLE prior to testing. On-site activities consisted of the following measurements:

- Particulate, three independent 72-96 minute samplings on the Main Plant and Module Plant pouring stacks
- Particulate, three independent two-hour samplings on the Cupola baghouse exhaust.
- CO, SO_2, THC, three independent one-hour monitoring periods on the Cupola baghouse inlet.
- Gas composition (O_2/CO_2), integrated bags collected concurrent with Cupola testing at the baghouse inlet and exhaust.
- Volumetric airflow, measurements collected in conjunction with isokinetic testing.
- Visible emissions (fugitive), three independent one-hour monitoring periods on the Cupola building.

The project objectives were to quantify particulate, CO, THC, and SO_2 emission constituents and compare them to applicable air emissions regulations stipulated by Iron and Steel Foundry MACT and the facility permit. These measurements were performed at the highest achievable melt rate. 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 particulate determinations are summarized in Tables 1-9 and in the regulatory summary. The filterable particulate emission concentration from all the Main Plant and Module Plant exhaust stacks ranged from 0.0012 GR/DSCF to 0.0072 GR/DSCF and were below the particulate emission concentration limit of 0.010 GR/DSCF for these sources. Subsequent to previous testing, modifications were made to exhaust stacks to mitigate cyclonic flow effect and establish EPA Method 1 compliance with upstream/downstream distances. All of the stacks met EPA Method 1 distance and cyclonic flow (less than 20 degrees) criteria. Standard EPA Method 5 testing procedures were followed. Current stack schematics are included.

The filterable particulate emission concentration from the cupola averaged 0.0014 GR/DSCF and 0.0026 LB/1000 LB exhaust gas. The operating permit limits for this source are 0.006 GR/DSCF and 0.011 LB/1000 LB exhaust gas. The PM-10 emission rate averaged 2.50 LB/HR. The PM-10 operating permit emission limit for this source is 1.30 LB/HR. Subsequent tables provide expanded detail of the testing results.

Particulate matter and PM-10 were collected with a single sampling train under the assumption that all particulate is less than 10 microns. The particulate dry catch (EPA Method 5) was used to report filterable matter. The dry catch (EPA Method 5), organic wet catch and inorganic wet catch (EPA Method 202) and EPA Method 5D dilution factors were combined to report PM-10 mass rate (LB/HR) on the cupola baghouse exhaust.

Particulate testing on the Cupola baghouse exhaust was performed following the procedures of EPA Method 5D. Sampling on the Cupola exhaust is performed from an area above the baghouse compartments and accessed from an open area along the top side of the baghouse. Airflow and temperature measurements collected from the inlet to the baghouse and temperatures from the baghouse exhaust were used to calculate dilution flow rate and the total flow rate at the baghouse exhaust to set isokinetic sampling rates and exhaust mass emission rates following equations in section 12.2, 12.3 and 12.4 of EPA Method 5D. The isokinetic sampling rate for Run 2 (111.7%) was slightly outside of the Method criteria of 90-110% but should not have a significant bias on the particulate result. Baghouse outlet particulate is small enough to behave as an aerosol and largely unaffected by isokinetic sampling. Runs 1 and 3 isokinetic variation were acceptable but below 100% so if any bias existed, it would likely average out.

Results of THC, SO_2, and CO determinations measured from the cupola baghouse inlet are reported in Table 10. The THC concentration averaged <0.11 PPM as hexane @ 10% O_2. The VOC emission limit for this source is 20 PPM as hexane @ 10% O_2. The SO_2 concentration averaged 29.5 mg/dscm with a mass emission rate of 1.65 LB/HR. The SO_2 emission limit for this source is 170 mg/dscm corrected to 70°F and 29.92 inches Hg and 13.8 LB/HR. The CO concentration averaged 14.5 mg/dscm with a mass emission rate of 0.811 LB/HR. The CO emission limit for this source is 250 mg/dscm corrected to 70°F and 29.92 inches Hg and 21.0 LB/HR. An unusually low moisture value (7.3%) was measured for Run 1. After discussion with Jeremy Howe (EGLE), this value was used in calculations as it would only bias the mass rate result higher. Test runs on the cupola were halted when the cupola was in by-pass mode and resumed after the cupola returned to steady state in the blast mode. Down times are recorded on the Gas Monitoring Log included in Appendix B.

Results of opacity observations from the Cupola building are reported in Tables 31-33. The high six-minute average was 3.8%. The opacity limit for this source is ≤20% 6-minute average, except for one 6-minute average per hour that does not exceed 27%.

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

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Table 1

Results Summary
Main Plant Pouring & Cooling Disa Pouring - 324484
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	12/9/20	12/9/20	12/9/20	
Time of Run	0826-0954	1015-1144	1205-1334	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	8,320	8,460	8,470	8,420
DSCFM	7,430	7,530	7,550	7,500
Gas Temperature, °F	90	89	91	90
Gas Moisture Content, %v/v	1.7	2.3	1.7	1.9
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	0.0	0.0	0.0	0.0
Oxygen, O_2	21.0	21.0	21.0	21.0
Nitrogen, N_2 (by difference)	79.0	79.0	79.0	79.0
Particulate Mass Rate, LB/HR				
Filterable Particulate	0.14	0.16	0.20	0.17
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0021	0.0025	0.0031	0.0026

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Table 2

Results Summary
Main Plant Pouring & Cooling No. 6 HMP - 324632
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	12/10/20	12/10/20	12/10/20	
Time of Run	0720-0856	0925-1052	1210-1339	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	4,370	4,550	4,480	4,470
DSCFM	4,030	4,150	4,070	4,080
Gas Temperature, °F	84	89	94	89
Gas Moisture Content, %v/v	0.9	0.9	0.4	0.7
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	0.0	0.0	0.0	0.0
Oxygen, O_2	21.0	21.0	21.0	21.0
Nitrogen, N_2 (by difference)	79.0	79.0	79.0	79.0
Particulate Mass Rate, LB/HR				
Filterable Particulate	0.073	0.080	0.106	0.087
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0021	0.0023	0.0030	0.0025

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Table 3

Results Summary
Main Plant Pouring & Cooling No. 7 HMP - 324662
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	12/8/20	12/8/20	12/8/20	
Time of Run	0748-0927	0959-1200	1225-1341	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	8,650	8,830	8,740	8,740
DSCFM	7,870	7,980	7,880	7,910
Gas Temperature, °F	91	95	96	94
Gas Moisture Content, %v/v	0.8	0.8	0.9	0.8
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	0.04	0.04	0.04	0.04
Oxygen, O_2	21.0	21.0	21.0	21.0
Nitrogen, N_2 (by difference)	79.0	79.0	79.0	79.0
Particulate Mass Rate, LB/HR				
Filterable Particulate	0.49	0.54	0.43	0.49
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0073	0.0079	0.0063	0.0072

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Table 4

Results Summary
Main Plant Pouring & Cooling Disa Pouring - 324678
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	12/9/20	12/9/20	12/9/20	
Time of Run	1052-1210	1251-1406	1435-1550	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	17,700	17,400	17,500	17,500
DSCFM	16,700	16,700	16,700	16,700
Gas Temperature, °F	71	61	66	66
Gas Moisture Content, %v/v	0.4	0.1	0.1	0.2
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	0.04	0.04	0.04	0.04
Oxygen, O_2	21.0	21.0	21.0	21.0
Nitrogen, N_2 (by difference)	79.0	79.0	79.0	79.0
Particulate Mass Rate, LB/HR				
Filterable Particulate	0.63	0.51	0.70	0.61
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0044	0.0036	0.0049	0.0043

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Table 5

Results Summary
Main Plant Pouring & Cooling Disa Pouring - 324682
Test 1

Parameter	**Run 2**	**Run 3**	**Run 4**	**Average**
Date of Run	12/8/20	12/8/20	12/8/20	
Time of Run	0935-1153	1215-1342	1400-1527	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	14,800	14,700	14,900	14,800
DSCFM	14,200	14,000	14,100	14,100
Gas Temperature, °F	63	66	67	65
Gas Moisture Content, %v/v	0.6	0.7	1.1	0.8
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	0.0	0.0	0.0	0.0
Oxygen, O_2	21.0	21.0	21.0	21.0
Nitrogen, N_2 (by difference)	79.0	79.0	79.0	79.0
Particulate Mass Rate, LB/HR				
Filterable Particulate	0.15	0.14	0.16	0.15
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0012	0.0012	0.0013	0.0012

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Table 6

Results Summary
Main Plant Pouring & Cooling No. 5 HMP - 324848
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	12/8/20	12/8/20	12/8/20	
Time of Run	0750-0916	0935-1150	1206-1332	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	10,800	11,000	11,000	10,900
DSCFM	10,100	10,200	10,200	10,200
Gas Temperature, °F	77	79	80	79
Gas Moisture Content, %v/v	0.4	0.6	0.6	0.5
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	0.0	0.0	0.0	0.0
Oxygen, O_2	21.0	21.0	21.0	21.0
Nitrogen, N_2 (by difference)	79.0	79.0	79.0	79.0
Particulate Mass Rate, LB/HR				
Filterable Particulate	0.40	0.35	0.34	0.36
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0046	0.0039	0.0039	0.0041

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Table 7

Results Summary
Module Pouring & Cooling Exhaust - 334116
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	12/10/20	12/10/20	12/10/20	
Time of Run	0750-0917	0940-1168	1226-1352	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	7,590	7,440	7,470	7,500
DSCFM	6,980	6,810	6,740	6,840
Gas Temperature, °F	86	92	97	92
Gas Moisture Content, %v/v	0.9	0.2	0.8	0.6
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	0.0	0.0	0.0	0.0
Oxygen, O_2	21.0	21.0	21.0	21.0
Nitrogen, N_2 (by difference)	79.0	79.0	79.0	79.0
Particulate Mass Rate, LB/HR				
Filterable Particulate	0.20	0.23	0.14	0.19
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0034	0.0040	0.0024	0.0032

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Table 8

Results Summary
Module Pouring & Cooling Exhaust - 334176
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	12/9/20	12/9/20	12/9/20	
Time of Run	0815-0942	1035-1205	1228-1354	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	3,920	4,080	4,100	4,030
DSCFM	3,630	3,740	3,770	3,710
Gas Temperature, °F	80	82	85	82
Gas Moisture Content, %v/v	0.5	1.0	0.4	0.6
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	0.0	0.0	0.0	0.0
Oxygen, O_2	21.0	21.0	21.0	21.0
Nitrogen, N_2 (by difference)	79.0	79.0	79.0	79.0
Particulate Mass Rate, LB/HR				
Filterable Particulate	0.122	0.088	0.094	0.101
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0039	0.0027	0.0029	0.0032

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Table 9

Results Summary
Cupola Baghouse Exhaust
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	12/16/20	12/16/20	12/17/20	
Time of Run	0830-1056	1230-1456	0753-1017	
Volumetric Flow Rate (Rounded to 1000 CFM)				
ACFM	188,000	178,000	171,000	179,000
DSCFM	146,000	139,000	133,000	139,000
Gas Temperature, °F	172	176	175	175
Gas Moisture Content, %v/v	3.4	2.8	3.0	3.1
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	3.1	2.4	2.7	2.7
Oxygen, O_2	17.9	18.5	18.3	18.2
Nitrogen, N_2 (by difference)	79.1	79.2	79.1	79.1
Particulate Mass Rate, LB/HR				
Filterable Particulate	3.18	0.75	1.26	1.73
Filterable+Organic Cond.	3.40	1.00	1.60	2.00
Total Particulate (PM-10 Eq.)	3.89	1.67	1.95	2.50
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0025	0.0006	0.0011	0.0014
Filterable+Organic Cond.	0.0027	0.0008	0.0014	0.0017
Total Particulate (PM-10 Eq.)	0.0031	0.0014	0.0017	0.0021
Regulatory Units, LB/1000 LBS of Flue Gas				
Filterable Particulate	0.0047	0.0012	0.0020	0.0026
Filterable+Organic Cond.	0.0050	0.0016	0.0026	0.0031
Total Particulate (PM-10 Eq.)	0.0057	0.0026	0.0032	0.0038

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Table 10

Gas Monitoring Results
Cupola Baghouse Inlet
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	12/15/20	12/15/20	12/15/20	
Time of Run	0855-0955	1045-1145	1230-1401	
Sample Duration (Minutes)	60	60	60	
Stack Temperature (°F)	682	695	713	697
Duct Moisture Content (%v/v)	13.9	20.4	22.1	18.8
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	40,000	42,900	42,500	41,800
SCFM	17,900	19,000	18,500	18,500
DSCFM	15,400	15,100	14,500	15,000
Constituent Concentration, PPMv - Dry				
Carbon Monoxide	13.9	10.2	13.1	12.4
Sulfur Dioxide	13.3	10.4	9.37	11.0
Total Hydrocarbons (as Hexane)	<0.12	<0.13	<0.13	<0.12
Constituent Mass Rate, LB/HR				
Carbon Monoxide	0.935	0.673	0.825	0.811
Sulfur Dioxide	2.04	1.57	1.35	1.65
Total Hydrocarbons (as Hexane)	<0.024	<0.025	<0.025	<0.025
Corrected Constituent Concentrations, PPM, dry @ 10% Oxygen				
Carbon Monoxide	12.9	9.31	11.4	11.2
Sulfur Dioxide	12.3	9.50	8.17	9.99
Total Hydrocarbons (as Hexane)	<0.11	<0.11	<0.11	<0.11
Constituent Concentration, mg/dscm (Std to 70°F)				
Carbon Monoxide	16.3	11.9	15.3	14.5
Sulfur Dioxide	35.5	27.8	25.1	29.5

Detail Tables

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Table 11

Major Gases and Moisture Results
Main Plant Pouring & Cooling Disa Pouring - 324484
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/9/20	12/9/20	12/9/20
Time of Run	0826-0954	1015-1144	1205-1334
Major Gas Constituents - Ambient, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.95	20.95	20.95
Nitrogen (by difference)	79.01	79.01	79.01
Wet Basis (calculated)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.60	20.47	20.59
Nitrogen	77.68	77.21	77.65
Portable Oxygen Monitor Result			
Time Weighted Average, %O_2	20.9	20.9	20.9
Moisture Collected, ml	25.0	34.8	26.2
Moisture Content, %v/v	1.68	2.28	1.73
Moisture Content if Saturated, %v/v	5.03	4.89	5.24
Relative Humidity, % rH	33%	47%	33%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.78	28.71	28.77

[1] Dry molecular weight reflects ambient gas proportions: 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and 0.038% Carbon Dioxide.

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Table 12

Major Gases and Moisture Results
Main Plant Pouring & Cooling No. 6 HMP - 324632
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/10/20	12/10/20	12/10/20
Time of Run	0720-0856	0925-1052	1210-1339
Major Gas Constituents - Ambient, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.95	20.95	20.95
Nitrogen (by difference)	79.01	79.01	79.01
Wet Basis (calculated)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.76	20.77	20.87
Nitrogen	78.30	78.31	78.70
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	15.7	15.8	7.0
Moisture Content, %v/v	0.90	0.88	0.40
Moisture Content if Saturated, %v/v	4.06	4.88	5.64
Relative Humidity, % rH	22%	18%	7%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.86	28.86	28.92

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[1] Dry molecular weight reflects ambient gas proportions: 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and 0.038% Carbon Dioxide.

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Table 13

Major Gases and Moisture Results
Main Plant Pouring & Cooling No. 7 HMP - 324662
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/8/20	12/8/20	12/8/20
Time of Run	0748-0927	0959-1200	1225-1341
Major Gas Constituents - Ambient, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.95	20.95	20.95
Nitrogen (by difference)	79.01	79.01	79.01
Wet Basis (calculated)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.79	20.78	20.77
Nitrogen	78.41	78.38	78.32
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	13.6	10.8	11.6
Moisture Content, %v/v	0.77	0.80	0.87
Moisture Content if Saturated, %v/v	5.07	5.72	5.94
Relative Humidity, % rH	15%	14%	15%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.88	28.87	28.86

[1] Dry molecular weight reflects ambient gas proportions: 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and 0.038% Carbon Dioxide.

Table 14

Major Gases and Moisture Results
Main Plant Pouring & Cooling Disa Pouring - 324678
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/9/20	12/9/20	12/9/20
Time of Run	1052-1210	1251-1406	1435-1550
Major Gas Constituents - Ambient, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.95	20.95	20.95
Nitrogen (by difference)	79.01	79.01	79.01
Wet Basis (calculated)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.87	20.94	20.94
Nitrogen	78.70	78.97	78.96
Portable Oxygen Monitor Result			
Time Weighted Average, %O_2	20.9	20.9	20.9
Moisture Collected, ml	5.5	0.7	1.0
Moisture Content, %v/v	0.39	0.05	0.07
Moisture Content if Saturated, %v/v	2.65	1.91	2.24
Relative Humidity, % rH	15%	3%	3%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.92	28.95	28.95

[1] Dry molecular weight reflects ambient gas proportions: 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and 0.038% Carbon Dioxide.

Table 15

Major Gases and Moisture Results
Main Plant Pouring & Cooling Disa Pouring - 324682
Test 1

Parameter	**Run 2**	**Run 3**	**Run 4**
Date of Run	12/8/20	12/8/20	12/8/20
Time of Run	0935-1153	1215-1342	1400-1527
Major Gas Constituents - Ambient, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.95	20.95	20.95
Nitrogen (by difference)	79.01	79.01	79.01
Wet Basis (calculated)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.83	20.80	20.72
Nitrogen	78.55	78.46	78.16
Portable Oxygen Monitor Result			
Time Weighted Average, %O_2	20.9	20.9	20.9
Moisture Collected, ml	8.2	9.7	15.1
Moisture Content, %v/v	0.59	0.70	1.08
Moisture Content if Saturated, %v/v	2.06	2.26	2.30
Relative Humidity, % rH	28%	31%	47%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.90	28.88	28.84

[1] Dry molecular weight reflects ambient gas proportions: 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and 0.038% Carbon Dioxide.

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Table 16

Major Gases and Moisture Results
Main Plant Pouring & Cooling No. 5 HMP - 324848
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/8/20	12/8/20	12/8/20
Time of Run	0750-0916	0935-1150	1206-1332
Major Gas Constituents - Ambient, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.95	20.95	20.95
Nitrogen (by difference)	79.01	79.01	79.01
Wet Basis (calculated)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.86	20.82	20.83
Nitrogen	78.68	78.52	78.57
Portable Oxygen Monitor Result			
Time Weighted Average, %O_2	20.9	20.9	20.9
Moisture Collected, ml	5.8	8.8	7.8
Moisture Content, %v/v	0.42	0.62	0.55
Moisture Content if Saturated, %v/v	3.33	3.48	3.67
Relative Humidity, % rH	12%	18%	15%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.91	28.89	28.90

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[1] Dry molecular weight reflects ambient gas proportions: 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and 0.038% Carbon Dioxide.

Table 17

Major Gases and Moisture Results
Module Pouring & Cooling Exhaust - 334116
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/10/20	12/10/20	12/10/20
Time of Run	0750-0917	0940-1168	1226-1352
Major Gas Constituents - Ambient, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.95	20.95	20.95
Nitrogen (by difference)	79.01	79.01	79.01
Wet Basis (calculated)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.76	20.91	20.79
Nitrogen	78.29	78.87	78.40
Portable Oxygen Monitor Result			
Time Weighted Average, %O_2	20.9	20.9	20.9
Moisture Collected, ml	15.3	2.9	12.5
Moisture Content, %v/v	0.91	0.18	0.77
Moisture Content if Saturated, %v/v	4.33	5.29	6.22
Relative Humidity, % rH	21%	3%	12%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.86	28.94	28.88

[1] Dry molecular weight reflects ambient gas proportions: 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and 0.038% Carbon Dioxide.

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Table 18

Major Gases and Moisture Results
Module Pouring & Cooling Exhaust - 334176
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/9/20	12/9/20	12/9/20
Time of Run	0815-0942	1035-1205	1228-1354
Major Gas Constituents - Ambient, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.95	20.95	20.95
Nitrogen (by difference)	79.01	79.01	79.01
Wet Basis (calculated)			
Carbon Dioxide	0.04	0.04	0.04
Oxygen	20.85	20.73	20.86
Nitrogen	78.64	78.19	78.68
Portable Oxygen Monitor Result			
Time Weighted Average, %O_2	20.9	20.9	20.9
Moisture Collected, ml	6.1	14.2	5.7
Moisture Content, %v/v	0.47	1.04	0.42
Moisture Content if Saturated, %v/v	3.64	3.90	4.27
Relative Humidity, % rH	13%	27%	10%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.91	28.85	28.91

[1] Dry molecular weight reflects ambient gas proportions: 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and 0.038% Carbon Dioxide.

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Table 19

Major Gases and Moisture Results
Cupola Baghouse Exhaust
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/16/20	12/16/20	12/17/20
Time of Run	0830-1056	1230-1456	0753-1017
Major Gas Constituents - Instrumental, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	3.09	2.38	2.69
Oxygen	17.85	18.45	18.25
Nitrogen (by difference)	79.06	79.17	79.06
Wet Basis (calculated)			
Carbon Dioxide	2.99	2.31	2.61
Oxygen	17.25	17.93	17.71
Nitrogen	76.39	76.94	76.72
Portable Oxygen Monitor Result			
Time Weighted Average, %O_2	18.2	18.3	18.0
Moisture Collected, ml	75.0	70.8	60.1
Moisture Content, %v/v	3.38	2.82	2.95
Moisture Content if Saturated, %v/v	44.63	48.85	47.05
Relative Humidity, % rH	8%	6%	6%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry	29.21	29.12	29.16
Wet	28.83	28.81	28.83

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Table 20

Major Gases and Moisture Results
Cupola Baghouse Inlet
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/15/20	12/15/20	12/15/20
Time of Run	0905-0955	1047-1157	1317-1400
Sample Duration, Minutes	40	56	45
Average Flue Gas Temperature, °F	680	680	696
Major Gas Constituents - Instrumental, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	11.37	11.78	12.30
Oxygen	9.16	8.95	8.40
Nitrogen (by difference)	79.47	79.27	79.30
Wet Basis (calculated)			
Carbon Dioxide	10.54	9.37	9.38
Oxygen	8.49	7.12	6.40
Nitrogen	73.66	63.06	60.48
Sample Volume, Meter Conditions, Ft^3	21.75	30.29	25.21
Sample Volume, Dry Standard, Ft^3	22.61	30.71	25.38
Moisture Collected, ml	37.9	167.7	167.8
Moisture Content of Gas Stream, %v/v	7.31	20.45	23.73
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	30.19	30.24	30.30
Wet	29.29	27.74	27.38

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Table 21

Major Gases and Moisture Results
Cupola Baghouse Inlet
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/16/20	12/16/20	12/17/20
Time of Run	0845-0955	1240-1336	0800-0910
Sample Duration, Minutes	45	46	60
Average Flue Gas Temperature, °F	687	693	679
Major Gas Constituents - Instrumental, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	11.60	11.10	10.79
Oxygen	8.95	9.55	9.75
Nitrogen (by difference)	79.45	79.35	79.46
Wet Basis (calculated)			
Carbon Dioxide	9.96	9.52	9.38
Oxygen	7.69	8.19	8.47
Nitrogen	68.24	68.05	69.05
Sample Volume, Meter Conditions, Ft^3	25.27	25.12	33.95
Sample Volume, Dry Standard, Ft^3	25.28	25.02	33.31
Moisture Collected, ml	88.2	88.3	106.7
Moisture Content of Gas Stream, %v/v	14.11	14.24	13.10
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	30.21	30.16	30.12
Wet	28.49	28.43	28.53

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Table 22

Particulate Results
Main Plant Pouring & Cooling Disa Pouring - 324484
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/9/20	12/9/20	12/9/20
Time of Run	0826-0954	1015-1144	1205-1334
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	90.1	89.2	91.4
Moisture Content of Flue Gas, %v/v	1.7	2.3	1.7
Particulate Collected, mg			
Dry Catch	9.53	11.58	14.26
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	8,320	8,460	8,470
SCFM	7,560	7,710	7,690
DSCFM	7,430	7,530	7,550
Sample Volume, Meter Conditions, Ft^3	70.38	73.54	73.85
Sample Volume, Dry Standard, Ft^3	68.84	70.23	70.08
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0021	0.0025	0.0031
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.14	0.16	0.20

NR=Not required or not requested.

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Table 23

Particulate Results
Main Plant Pouring & Cooling No. 6 HMP - 324632
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/10/20	12/10/20	12/10/20
Time of Run	0720-0856	0925-1052	1210-1339
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	83.7	89.5	94.1
Moisture Content of Flue Gas, %v/v	0.9	0.9	0.4
Particulate Collected, mg			
Dry Catch	11.25	12.19	16.17
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	4,370	4,550	4,480
SCFM	4,060	4,180	4,090
DSCFM	4,030	4,150	4,070
Sample Volume, Meter Conditions, Ft^3	82.92	84.98	85.33
Sample Volume, Dry Standard, Ft^3	81.63	83.48	82.04
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0021	0.0023	0.0030
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.073	0.080	0.106

NR=Not required or not requested.

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Table 24

Particulate Results
Main Plant Pouring & Cooling No. 7 HMP - 324662
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/8/20	12/8/20	12/8/20
Time of Run	0748-0927	0959-1200	1225-1341
Sample Duration, Minutes	96	72	72
Average Flue Gas Temperature, °F	90.7	94.5	95.8
Moisture Content of Flue Gas, %v/v	0.8	0.8	0.9
Particulate Collected, mg			
Dry Catch	39.06	32.48	25.37
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	8,650	8,830	8,740
SCFM	7,930	8,040	7,950
DSCFM	7,870	7,980	7,880
Sample Volume, Meter Conditions, Ft^3	86.19	66.30	66.20
Sample Volume, Dry Standard, Ft^3	82.86	63.12	62.16
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0073	0.0079	0.0063
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.49	0.54	0.43

NR=Not required or not requested.

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Table 25

Particulate Results
Main Plant Pouring & Cooling Disa Pouring - 324678
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/9/20	12/9/20	12/9/20
Time of Run	1052-1210	1251-1406	1435-1550
Sample Duration, Minutes	72	72	72
Average Flue Gas Temperature, °F	70.6	61.1	65.6
Moisture Content of Flue Gas, %v/v	0.4	0.1	0.1
Particulate Collected, mg			
Dry Catch	18.78	15.16	20.93
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	17,700	17,400	17,500
SCFM	16,700	16,700	16,800
DSCFM	16,700	16,700	16,700
Sample Volume, Meter Conditions, Ft^3	70.50	70.98	71.23
Sample Volume, Dry Standard, Ft^3	65.89	65.52	65.80
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0044	0.0036	0.0049
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.63	0.51	0.70

NR=Not required or not requested.

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Table 26

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Particulate Results
Main Plant Pouring & Cooling Disa Pouring - 324682
Test 1

Parameter	**Run 2**	**Run 3**	**Run 4**
Date of Run	12/8/20	12/8/20	12/8/20
Time of Run	0935-1153	1215-1342	1400-1527
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	63.5	66.0	66.6
Moisture Content of Flue Gas, %v/v	0.6	0.7	1.1
Particulate Collected, mg			
Dry Catch	5.10	4.89	5.56
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	14,800	14,700	14,900
SCFM	14,300	14,100	14,300
DSCFM	14,200	14,000	14,100
Sample Volume, Meter Conditions, Ft^3	66.45	66.05	66.63
Sample Volume, Dry Standard, Ft^3	65.40	64.48	65.26
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.00120	0.00117	0.00131
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.15	0.14	0.16

NR=Not required or not requested.

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Table 27

Particulate Results
Main Plant Pouring & Cooling No. 5 HMP - 324848
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/8/20	12/8/20	12/8/20
Time of Run	0750-0916	0935-1150	1206-1332
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	77.4	78.8	80.4
Moisture Content of Flue Gas, %v/v	0.4	0.6	0.6
Particulate Collected, mg			
Dry Catch	19.55	16.92	16.57
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	10,800	11,000	11,000
SCFM	10,100	10,300	10,200
DSCFM	10,100	10,200	10,200
Sample Volume, Meter Conditions, Ft^3	66.14	67.42	67.75
Sample Volume, Dry Standard, Ft^3	65.38	66.15	65.95
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0046	0.0039	0.0039
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.40	0.35	0.34

NR=Not required or not requested.

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Table 28

Particulate Results
Module Pouring & Cooling Exhaust - 334116
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/10/20	12/10/20	12/10/20
Time of Run	0750-0917	0940-1168	1226-1352
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	85.8	92.1	97.3
Moisture Content of Flue Gas, %v/v	0.9	0.2	0.8
Particulate Collected, mg			
Dry Catch	17.36	19.57	11.73
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	7,590	7,440	7,470
SCFM	7,040	6,830	6,790
DSCFM	6,980	6,810	6,740
Sample Volume, Meter Conditions, Ft^3	79.59	78.35	78.90
Sample Volume, Dry Standard, Ft^3	78.61	76.33	75.92
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0034	0.0040	0.0024
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.20	0.23	0.14

NR=Not required or not requested.

Table 29

Particulate Results
Module Pouring & Cooling Exhaust - 334176
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/9/20	12/9/20	12/9/20
Time of Run	0815-0942	1035-1205	1228-1354
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	80.1	82.3	85.0
Moisture Content of Flue Gas, %v/v	0.5	1.0	0.4
Particulate Collected, mg			
Dry Catch	15.63	11.30	12.09
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	3,920	4,080	4,100
SCFM	3,650	3,780	3,780
DSCFM	3,630	3,740	3,770
Sample Volume, Meter Conditions, Ft^3	63.41	66.27	66.85
Sample Volume, Dry Standard, Ft^3	61.41	63.66	63.74
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0039	0.0027	0.0029
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.122	0.088	0.094

NR=Not required or not requested.

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Table 30

Particulate Results
Cupola Baghouse Exhaust
Test 1

Parameter		**Run 1**	**Run 2**	**Run 3**
Date of Run		12/16/20	12/16/20	12/17/20
Time of Run		0830-1056	1230-1456	0753-1017
Sample Duration, Minutes		120	120	120
Average Flue Gas Temperature, °F		172.5	176.5	174.7
Moisture Content of Flue Gas, %v/v		3.4	2.8	3.0
Particulate Collected, mg				
Dry Catch		16.6	4.7	6.6
Inorganic Wet Catch		2.6	4.2	1.9
Organic Wet Catch		1.1	1.6	1.8
Volumetric Flow Rate	(Rounded to 1000 CFM)			
ACFM		188,000	178,000	171,000
SCFM		151,000	143,000	137,000
DSCFM		146,000	139,000	133,000
Sample Volume, Meter Conditions, Ft^3		106.70	123.14	98.98
Sample Volume, Dry Standard, Ft^3		100.96	114.85	92.94
Particulate Concentration, GR/DSCF				
Filterable Particulate		0.0025	0.0006	0.0011
Inorganic Condensables		0.0004	0.0006	0.0003
Organic Condensables		0.0002	0.0002	0.0003
Filterable+Organic Cond.		0.0027	0.0008	0.0014
Total Particulate (PM-10 Eq.)	(F+I+O)	0.0031	0.0014	0.0017
Particulate Emission Rate, LB/HR				
Filterable Particulate		3.18	0.75	1.26
Inorganic Condensables		0.49	0.67	0.35
Organic Condensables		0.22	0.25	0.34
Filterable+Organic Cond.		3.40	1.00	1.60
Total Particulate (PM-10 Eq.)	(F+I+O)	3.89	1.67	1.95

NR=Not required or not requested.

Table 31

Opacity Observations
Cupola Building - East Side
Test 1, Run 1

	Percent Opacity	**Optical Density**		**Relative Frequency**
	0	0.000		99.17
	5	0.022		0.83
	10	0.046		0.00
	15	0.071		0.00
	20	0.097		0.00
	25	0.125		0.00
	30	0.155		0.00
	35	0.187		0.00
	40	0.222		0.00
	45	0.260		0.00
	50	0.301		0.00
	55	0.347		0.00
	60	0.398		0.00
	65	0.456		0.00
	70	0.523		0.00
	75	0.602		0.00
	80	0.699		0.00
	85	0.824		0.00
	90	1.000		0.00
	95	1.301		0.00
	99	2.000		0.00
Average >	0.0	0.000	**Total >**	100

Average Opacity Per Sequential Six Minute Period:

Period	**Opacity**	**Period**	**Opacity**
1	0.2	6	0.0
2	0.0	7	0.0
3	0.2	8	0.0
4	0.0	9	0.0
5	0.0	10	0.0

High Six Minute Average:	0.2
Maximum reading:	5.0
Minumum reading:	0.0

Observer: Zachary Eckstrom
Date of test: 12/16/2020
Time of test: 1010-1110

NOTE: The high six-minute average opacity is the maximum value for any consecutive 24 readings.

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Table 32

Opacity Observations
Cupola Building - South Side
Test 1, Run 2

	Percent Opacity	Optical Density		Relative Frequency
	0	0.000		100.00
	5	0.022		0.00
	10	0.046		0.00
	15	0.071		0.00
	20	0.097		0.00
	25	0.125		0.00
	30	0.155		0.00
	35	0.187		0.00
	40	0.222		0.00
	45	0.260		0.00
	50	0.301		0.00
	55	0.347		0.00
	60	0.398		0.00
	65	0.456		0.00
	70	0.523		0.00
	75	0.602		0.00
	80	0.699		0.00
	85	0.824		0.00
	90	1.000		0.00
	95	1.301		0.00
	99	2.000		0.00
Average >	0.0	0.000	**Total >**	100

Average Opacity Per Sequential Six Minute Period:

Period	**Opacity**	**Period**	**Opacity**
1	0.0	6	0.0
2	0.0	7	0.0
3	0.0	8	0.0
4	0.0	9	0.0
5	0.0	10	0.0

High Six Minute Average: 0.0
Maximum reading: 0.0
Minumum reading: 0.0

Observer: Zachary Eckstrom
Date of test: 12/16/2020
Time of test: 1010-1110

NOTE: The high six-minute average opacity is the maximum value for any consecutive 24 readings.

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Table 33

Opacity Observations
Cupola Building - West Side
Test 1, Run 3

Percent Opacity	**Optical Density**	**Relative Frequency**
0	0.000	71.67
5	0.022	27.50
10	0.046	0.83
15	0.071	0.00
20	0.097	0.00
25	0.125	0.00
30	0.155	0.00
35	0.187	0.00
40	0.222	0.00
45	0.260	0.00
50	0.301	0.00
55	0.347	0.00
60	0.398	0.00
65	0.456	0.00
70	0.523	0.00
75	0.602	0.00
80	0.699	0.00
85	0.824	0.00
90	1.000	0.00
95	1.301	0.00
99	2.000	0.00
Average > 1.5	0.006	**Total >** 100

Average Opacity Per Sequential Six Minute Period:

Period	**Opacity**	**Period**	**Opacity**
1	0.8	6	0.0
2	1.9	7	1.9
3	2.3	8	3.3
4	0.0	9	3.1
5	0.2	10	1.0

High Six Minute Average: 3.8
Maximum reading: 10.0
Minumum reading: 0.0

Observer: Zachary Eckstrom
Date of test: 12/16/2020
Time of test: 1355-1455

NOTE: The high six-minute average opacity is the maximum value for any consecutive 24 readings.

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Table 34

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Preliminary Airflow Measurements
Main Plant Pouring & Cooling Disa Pouring - 324484
Test 1

Parameter		**Run 1**
Date of Run		12/9/20
Time of Measurement		0730
Barometric Pressure, Inches Hg		28.43
Static Pressure, Inches WC		-1.50
Absolute Gas Pressure (In. Hg)		28.32
Average Gas Temperature, °F		84
Moisture Determination Procedure	Wet/Dry Bulb	
Average Moisture Content, %v/v		1.0
Gas Molecular Weight (Ambient), lb/lb-mole		
Dry		29.0
Wet		28.9
Flue Gas Average Velocity, FPS		43.34
Duct Cross-sectional Area, Sq. Ft.		3.14
Volumetric Flow Rate (Rounded to 100 CFM)		
ACFM		8,200
SCFM		7,500
DSCFM		7,400

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Table 35

Preliminary Airflow Measurements
Main Plant Pouring & Cooling No. 6 HMP - 324632
Test 1

Parameter		**Run 1**
Date of Run		12/7/20
Time of Measurement		1500
Barometric Pressure, Inches Hg		28.64
Static Pressure, Inches WC		-0.35
Absolute Gas Pressure (In. Hg)		28.61
Average Gas Temperature, °F		92
Moisture Determination Procedure	Wet/Dry Bulb	
Average Moisture Content, %v/v		1.0
Gas Molecular Weight (Ambient), lb/lb-mole		
Dry		29.0
Wet		28.9
Flue Gas Average Velocity, FPS		23.54
Duct Cross-sectional Area, Sq. Ft.		3.14
Volumetric Flow Rate (Rounded to 10 CFM)		
ACFM		4,440
SCFM		4,060
DSCFM		4,020

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Table 36

Preliminary Airflow Measurements
Main Plant Pouring & Cooling No. 7 HMP - 324662
Test 1

Parameter		**Run 1**
Date of Run		12/8/20
Time of Measurement		0830
Barometric Pressure, Inches Hg		28.65
Static Pressure, Inches WC		-0.50
Absolute Gas Pressure (In. Hg)		28.61
Average Gas Temperature, °F		85
Moisture Determination Procedure	Wet/Dry Bulb	
Average Moisture Content, %v/v		1.0
Gas Molecular Weight (Ambient), lb/lb-mole		
Dry		29.0
Wet		28.9
Flue Gas Average Velocity, FPS		41.40
Duct Cross-sectional Area, Sq. Ft.		3.41
Volumetric Flow Rate (Rounded to 100 CFM)		
ACFM		8,500
SCFM		7,800
DSCFM		7,800

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Table 37

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Preliminary Airflow Measurements
Main Plant Pouring & Cooling Disa Pouring - 324678
Test 1

Parameter		**Run 1**
Date of Run		12/9/20
Time of Measurement		0730
Barometric Pressure, Inches Hg		28.45
Static Pressure, Inches WC		-0.25
Absolute Gas Pressure (In. Hg)		28.43
Average Gas Temperature, °F		71
Moisture Determination Procedure	Wet/Dry Bulb	
Average Moisture Content, %v/v		1.0
Gas Molecular Weight (Ambient), lb/lb-mole		
Dry		29.0
Wet		28.9
Flue Gas Average Velocity, FPS		32.56
Duct Cross-sectional Area, Sq. Ft.		9.62
Volumetric Flow Rate (Rounded to 100 CFM)		
ACFM		18,800
SCFM		17,800
DSCFM		17,600

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Table 38

Preliminary Airflow Measurements
Main Plant Pouring & Cooling Disa Pouring - 324682
Test 1

Parameter		**Run 1**
Date of Run		12/7/20
Time of Measurement		0730
Barometric Pressure, Inches Hg		28.63
Static Pressure, Inches WC		-0.45
Absolute Gas Pressure (In. Hg)		28.60
Average Gas Temperature, °F		69
Moisture Determination Procedure	Wet/Dry Bulb	
Average Moisture Content, %v/v		1.0
Gas Molecular Weight (Ambient), lb/lb-mole		
Dry		29.0
Wet		28.9
Flue Gas Average Velocity, FPS		23.83
Duct Cross-sectional Area, Sq. Ft.		9.62
Volumetric Flow Rate (Rounded to 100 CFM)		
ACFM		13,800
SCFM		13,100
DSCFM		13,000

Table 39

Preliminary Airflow Measurements
Main Plant Pouring & Cooling No. 5 HMP - 324848
Test 1

Parameter		**Run 1**
Date of Run		12/7/20
Time of Measurement		1435
Barometric Pressure, Inches Hg		28.64
Static Pressure, Inches WC		2.00
Absolute Gas Pressure (In. Hg)		28.79
Average Gas Temperature, °F		75
Moisture Determination Procedure	Wet/Dry Bulb	
Average Moisture Content, %v/v		1.0
Gas Molecular Weight (Ambient), lb/lb-mole		
Dry		29.0
Wet		28.9
Flue Gas Average Velocity, FPS		61.68
Duct Cross-sectional Area, Sq. Ft.		3.14
Volumetric Flow Rate (Rounded to 100 CFM)		
ACFM		11,600
SCFM		11,000
DSCFM		10,900

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Table 40

Preliminary Airflow Measurements
Module Pouring & Cooling Exhaust - 334116
Test 1

Parameter		**Run 1**
Date of Run		12/10/20
Time of Measurement		0730
Barometric Pressure, Inches Hg		28.69
Static Pressure, Inches WC		-0.07
Absolute Gas Pressure (In. Hg)		28.68
Average Gas Temperature, °F		75
Moisture Determination Procedure	Wet/Dry Bulb	
Average Moisture Content, %v/v		1.0
Gas Molecular Weight (Ambient), lb/lb-mole		
Dry		29.0
Wet		28.9
Flue Gas Average Velocity, FPS		24.54
Duct Cross-sectional Area, Sq. Ft.		4.91
Volumetric Flow Rate (Rounded to 100 CFM)		
ACFM		7,200
SCFM		6,800
DSCFM		6,800

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Table 41

Preliminary Airflow Measurements
Module Pouring & Cooling Exhaust - 334176
Test 1

Parameter		**Run 1**
Date of Run		12/9/20
Time of Measurement		0750
Barometric Pressure, Inches Hg		28.47
Static Pressure, Inches WC		-0.14
Absolute Gas Pressure (In. Hg)		28.46
Average Gas Temperature, °F		75
Moisture Determination Procedure	Wet/Dry Bulb	
Average Moisture Content, %v/v		1.0
Gas Molecular Weight (Ambient), lb/lb-mole		
Dry		29.0
Wet		28.9
Flue Gas Average Velocity, FPS		11.89
Duct Cross-sectional Area, Sq. Ft.		4.91
Volumetric Flow Rate (Rounded to 100 CFM)		
ACFM		3,500
SCFM		3,300
DSCFM		3,300

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Table 42

Airflow Measurement Results
Cupola Baghouse Inlet
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Run 4**
Date of Run	12/15/20	12/15/20	12/15/20	12/15/20
Time of Measurement	0845	1030	1200	1400
Barometric Pressure, Inches Hg	29.11	29.11	29.11	29.11
Static Pressure, Inches WC	-1.25	-1.26	-1.93	-1.14
Absolute Gas Pressure (In. Hg)	29.01	29.01	28.96	29.02
Average Gas Temperature, °F	684	680	710	715
Corresponding M-4 Run Number	1	2	2	3
Average Moisture Content, %v/v	7.3	20.4	20.4	23.7
Gas Molecular Weight (Gas Data?), lb/lb-mole				
Dry	30.19	30.24	30.24	30.30
Wet	29.29	27.74	27.74	27.38
Flue Gas Average Velocity, FPS	51.83	54.25	59.50	53.19
Duct Cross-sectional Area, Sq. Ft.	12.57	12.57	12.57	12.57
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	39,100	40,900	44,900	40,100
SCFM	17,500	18,400	19,600	17,500
DSCFM	16,200	14,600	15,600	13,300

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Table 43

Airflow Measurement Results
Cupola Baghouse Inlet
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	12/16/20	12/16/20	12/17/20
Time of Measurement	0730	1200	0730
Barometric Pressure, Inches Hg	28.86	28.86	28.82
Static Pressure, Inches WC	-1.62	-1.34	-1.25
Absolute Gas Pressure (In. Hg)	28.74	28.76	28.73
Average Gas Temperature, °F	735	684	694
Corresponding M-4 Run Number	1	2	3
Average Moisture Content, %v/v	14.1	14.2	13.1
Gas Molecular Weight (Instrumental), lb/lb-mole			
Dry	30.21	30.16	30.12
Wet	28.49	28.43	28.53
Flue Gas Average Velocity, FPS	55.76	53.54	50.69
Duct Cross-sectional Area, Sq. Ft.	12.57	12.57	12.57
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	42,000	40,400	38,200
SCFM	17,900	17,900	16,800
DSCFM	15,300	15,400	14,600

Process Description

The Grede, LLC - Iron Mountain (Grede) facility produces gray iron castings, typically for industrial machinery and various transportation industry customers. The major processes at Grede include raw material handling (metals, fluxes, and metallurgical coke), metal melting, mold and core production, casting and finishing.

Grede operates a main foundry and a module foundry under one roof. A single WRIB Company high efficiency cupola (EU-P009) provides all of the molten iron used by the main and module foundry. The cupola has a maximum melt rate of 20 tons per hour. Molten iron is stored in an electric holding furnace with a capacity of 28 tons prior to pouring. Emission control equipment for the cupola exhaust includes four natural gas afterburners for VOC and CO, a low efficiency scrubber (quench tank) for SO_2, and a Hartzell Engineering Corp. baghouse for particulate.

Test related process and operational details were recorded by Grede personnel and included in Appendix E of the report.

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 3 Ambient Provision allows the use of published or ambient gas concentrations (dry molecular weight of 28.96 LB/LB-mole) in cases where the source gas is free of combustion components. Ambient gas concentrations result in a dry molecular weight of 28.96 (29.0) LB/LB-mole.

Gas Constituent	% v/v	Molecular Weight	LB/LB -mole
Nitrogen, N_2	78.08	28.01	21.87
Oxygen, O_2	20.95	32	6.70
Argon, Ar	0.93	39.95	0.37
Carbon Dioxide, CO_2	0.038	44.01	0.02
Sum of Gas Constituents			28.96

Modified EPA Method 3/3A defines procedures to quantify carbon dioxide (CO_2) and oxygen (O_2) concentrations from stationary combustion sources. An integrated gas sample is collected simultaneously with other emissions testing. Sample gases are extracted from an emission stream at a constant rate over the course of a test period equal to other test constituents. A Tedlar™, aluminized Mylar™, or other inert material bag contains the collected gas sample prior to sample analyses. Instrumental gas analyzers compliant to EPA Method 3A quantify the CO_2 and O_2 concentrations. Three point instrument calibrations (zero, mid, and high span) are performed to certify the instruments for gas analyses. The technician maintains comprehensive test records on EPA Method 3 and Gas Analysis Field Data Sheets. Equipment used for measuring gas composition includes:

Filter Material:	Glass-fiber Filter or equivalent
Moisture removal:	Condenser and/or sorbent
Bag Material:	Tedlar™ or Aluminized Mylar™ or equivalent
Gas Analyzer:	Non-dispersive Infrared Detector (CO_2) Paramagnetic Detector (O_2)
Calibration Gases:	EPA Protocol 1

Method Defined Quality Control:

- Sampling bag leak check.

Pace FSD conducts the method as written with the following routine sampling deviation:

In the field, the gas sample is analyzed within two hours of collection using a portable O_2 detector. At a later time, potentially outside of the eight hour hold period, the gas sample is re-analyzed using an EPA Method 3A (Orsat) gas analyzer to quantify CO_2 and O_2 concentrations.

The preliminary analysis result from the portable O_2 detector is used to validate the Orsat results. The results are acceptable when the O_2 result from the field and the O_2 result from the lab differ by ≤ 0.3%.

EPA Method 4 - Isokinetic defines procedures to measure the moisture content of emission gas streams from stationary sources. The moisture content of the gas stream is determined in conjunction with an isokinetic sampling train. Collected water condensate is measured from the back half of the isokinetic train. Method 4 equations convert the condensed liquid volume to a gas volume. The water vapor volume compared with the dry standard gas volume collected through the isokinetic train determines the moisture content of the emissions gas stream and is reported in percent by volume. Test records are included on the associated isokinetic method data sheet. Equipment used for measuring moisture content includes:

Probe Material:	Borosilicate glass or Stainless Steel
Filter Media:	Glass or Quartz fiber
Impinger Train Material:	Borosilicate Glass
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%).
- Gas meter volumes are verified at each traverse point by calculating the expected gas volume for each interval and comparing the gas volume metered during the interval.
- 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.

The metering system verification cited above is a method QC alternative but considered more rigorous. Pace FSD conducts the method as written with no routine sampling deviations.

EPA Method 5 defines procedures to measure particulate emissions from stationary sources. Using traverse points determined from EPA Method 1 and incorporating procedures from EPA Methods 2, 3, and 4, a sample gas stream is isokinetically drawn from the emission stream. The particulate dry fraction collects in the sampling probe and on a quartz or glass-fiber filter. The probe and filter components of the sampling train are heated to 248°F (±25°F) to prevent moisture condensation and preserve sample integrity. The filtered sample gas stream passes through a series of impingers to condense water vapor and collect gaseous constituents. The first two impingers initially contain deionized water, and the third impinger is empty. A desiccant packed drying column follows the impingers to quantitatively collect the remaining moisture. An ice bath maintains the impinger train temperature (outlet) at 68°F or less. The impinger contents can be discarded or saved for additional analyses. Sample recovery and train clean up are performed after each run using procedures to ensure sample integrity and quantitative recovery. The train operator maintains comprehensive test records on EPA Method 5 Field Data Sheet, Isokinetic Particulate Sampling. Details of particulate testing are outlined below:

Nozzle/Probe Material:	Stainless Steel and Borosilicate Glass
Filter Holder Material:	Borosilicate Glass with glass or Teflon support
Filter Media:	Quartz or Glass-fiber, >99.95% efficient at 0.3µm
Impinger Train Material:	Borosilicate Glass
Impinger Reagents:	Deionized Water
Recovery Reagents:	Acetone Deionized water
Control Train:	Gas meter, orifice, differential pressure gauges, pump, valves, temperature monitors and controllers
Analytical Techniques:	Gravimetric

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).

- Gas meter volumes are verified at each traverse point by calculating the expected gas volume for each interval and comparing the gas volume metered during the interval.
- 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.
- Sampling is performed at an isokinetic rate between 90 and 110%.
- A field blank is collected to verify site conditions to be non-contaminating.
- Sampling and recovery reagents are reagent grade or better.
- Analytical balances are calibrated and certified on an annual basis by an external service provider and verified before each use using stainless steel reference weights traceable to national standards maintained by NIST.
- 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.

The metering system verification cited above is a method QC alternative but considered more rigorous. Pace FSD conducts the method as written with no routine sampling deviations.

EPA Method 5D defines procedures to measure particulate emissions from positive pressure fabric filters in terms of concentration (mg/dscm or GR/DSCF) and emission rate (kg/HR or LB/HR). Using traverse points determined using EPA Method 1 or the alternative measurement sites specified in Method 5D, a sample gas stream is isokinetically withdrawn from the emission stream. For monovent sampling, the isokinetic rate is calculated from fabric filter inlet airflows. The particulate dry fraction collects on a glass-fiber filter. The probe and filter components of the sampling train are maintained at a temperature at or above the exhaust gas temperature up to 248°F (±25°F) to prevent moisture condensation and preserve sample integrity. The filtered sample gas stream passes through a series of impingers to condense water vapor and collect gaseous constituents. The first two impingers initially contain deionized water, and the third impinger is dry. A desiccant packed drying column follows the impingers to quantitatively collect the remaining moisture. An ice bath maintains the impinger train temperature (outlet) at 68°F or less. Sample recovery and train clean up are performed after each run using procedures to ensure sample integrity and quantitative recovery.

The train operator maintains comprehensive test records on EPA Method 5 Field Data Sheet, Isokinetic Particulate Sampling. Details of particulate testing are outlined below:

Nozzle/Probe Material:	Stainless Steel and Borosilicate Glass
Filter Holder Material:	Borosilicate Glass
Filter Media:	Glass-fiber, >99.95% efficient at 0.3 µm
Impinger Train Material:	Borosilicate Glass
Impinger Reagents:	Deionized Water
Recovery Reagents:	Acetone Deionized Water
Control Train:	Gas meter, orifice, differential pressure gauges, pump, valves, temperature monitors & controllers
Analytical Techniques:	Gravimetric

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).
- Gas meter volumes are verified at each traverse point by calculating the expected gas volume for each interval and comparing the gas volume metered during the interval.
- 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.
- Sampling is performed at an isokinetic rate between 90 and 110%.
- A field blank is collected to verify site conditions to be non-contaminating.
- Sampling and recovery reagents are reagent grade or better.
- Analytical balances are calibrated and certified on an annual basis by an external service provider and verified before each use using stainless steel reference weights traceable to national standards maintained by NIST.

- 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.

The metering system verification cited above is a method QC alternative but considered more rigorous. Pace FSD conducts the method as written with no routine sampling deviations.

Pace FSD conducted this method with the following project situational deviations:
Mass rates were calculated from inlet airflow measurements.

EPA Method 202 defines procedures to determine organic and inorganic condensable particulate matter (CPM) emissions from stationary sources. The CPM is collected in a condensate knock-out impinger and Teflon filter after filterable PM has been collected by either Method 5 or Method 201A. The gas stream is sample isokinetically following EPA Method 5 or Method 201A procedures. The gas stream is initially cooled with a spiral condenser using recirculated cool water to maintain a sample gas temperature of 85°F or less. Condensate from the spiral condenser collects in glass, stemless, dropout impingers. The intent of the condenser and dropout impinger is to minimize gas/water contact to reduce collection of unintended artifacts. The dropout impinger is followed by a second impinger to provide overflow capacity. A Teflon^{TM} filter, also maintained at 85°F or less is used to collect any remaining organic CPM. The filter is followed by an iced, water prepared impinger and desiccant packed drying column to quantitatively collect remaining moisture. Immediately after sampling, the Method 202 CPM condensate is purged with nitrogen (N_2) to liberate dissolved sulfur dioxide (SO_2) gases. The contents of the dropout and backup impingers prior to the CPM filter are measured, weighed, and transferred to an appropriate sample bottle. CPM is quantitatively recovered with water, acetone, and hexane rinses. The CPM filter and water are extracted with hexane and combined with solvent rinses to determine the organic CPM. Following extraction, the water is dried and the residue measured as the inorganic CPM. The combination of both fractions represents the total condensable particulate matter (CPM). The train operator maintains comprehensive test records on appropriate Field Data Sheets.

Filter Holder Material:	Glass, Stainless Steel (316 or equivalent), or Fluoropolymer-coated Stainless Steel
Filter Media:	Teflon, >99.95% efficient at 0.3 um
Impinger Train Material:	Borosilicate Glass
Impinger Reagents:	Deionized Water
Recovery Reagents:	Acetone Hexane Deionized Water
Control Train:	EPA Method 5
Analytical Technique:	Gravimetric

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).
- Gas meter volumes are verified at each traverse point by calculating the expected gas volume for each interval and comparing the gas volume metered during the interval.
- 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.
- Sampling is performed at an isokinetic rate between 90 and 110%.
- A field blank is collected to verify site conditions to be non-contaminating.
- Sampling and recovery reagents are reagent grade or better.
- Analytical balances are calibrated and certified on an annual basis by an external service provider and verified before each use using stainless steel reference weights traceable to national standards maintained by NIST.

The metering system verification cited above is a method QC alternative but considered more rigorous. Pace FSD conducts the method as written with no routine sampling deviations.

EPA Method 6C defines procedures to measure sulfur dioxide (SO_2) 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 fluorescence gas analyzer to quantify SO_2 emissions. Zero grade cylinder air or a zero gas generator provides zero gas. Span gases include varying concentrations of EPA Protocol 1 SO_2 standards specific to the target calibration range. A computerized data acquisition system logs SO_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 on the electronic Project Results Instrumental Workbook. Equipment used for SO_2 testing includes:

Probe Material:	Stainless Steel

Moisture Removal:	Thermo-electric
Transfer Line:	Teflon™
Analytical Technique:	Fluorescence Detector
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.

EPA Method 9 defines procedures to evaluate the opacity of the plume emitted from a source stack. An independently certified visible emissions observer visually estimates the opacity of the non-moisture plume from the source. The observer positions themselves with the sun (or other light source) at their back and perpendicular to the plume when directly facing the emission point. The observer must also ensure a clear and contrasting background behind the plume. The certified observer then estimates (based on certification trials) the percentage of the background blocked by the source plume (plume opacity) in increments of 5%. Observed opacity readings are recorded at 15-second intervals throughout the run. Tabulated results include run average and successive six-minute averages. The spreadsheet software also searches the data set for any group of 24 consecutive readings that yield the highest possible six-minute average. The train operator maintains comprehensive test records on the Visible Emission Observation Form. Details of the opacity evaluation are outlined below:

Evaluation Period:	One hour
Observation Frequency:	15 Seconds
No. of Observations:	240
No. of Six-minutes Averages:	10
Observer Certifications:	Semi-annual

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.

EPA Method 25A defines procedures used to measure total hydrocarbons from stationary sources. A stainless steel sampling probe and heat-traced Teflon™ sampling line draw a sample of the gas stream from the duct directly to the analytical system. A total hydrocarbon monitor utilizing a flame ionization detector (FID) quantifies total hydrocarbon concentrations. Zero grade cylinder air or a zero gas generator provides zero gas. Span gases include varying concentrations of EPA Protocol 1 propane (C_3H_8) standards specific to the target calibration range. A computerized data acquisition system logs THC concentrations for one-minute averages. The logged results are integrated to test periods and tabulated with standardized and validated spreadsheets in Microsoft Excel. The analyzer results are multiplied by 3 to report results as carbon (C_1). The operator also maintains comprehensive test records in the electronic Project Results Instrumental Workbook. Equipment used for THC testing includes:

Probe Material:	Stainless Steel
Transfer Line:	Teflon™, (heated)
Analytical Technique:	Flame Ionization Detector (FID)
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.
- 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 conducted the method as written with the following project deviations.
Hexane was used as the calibration gas in place of propane to report results as hexane.

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.

Figure 1
Grede, LLC - Iron Mountain
Kingsford, MI
Main Plant Pouring & Cooling Disa Pouring (324484)
tjb \ 12/2020

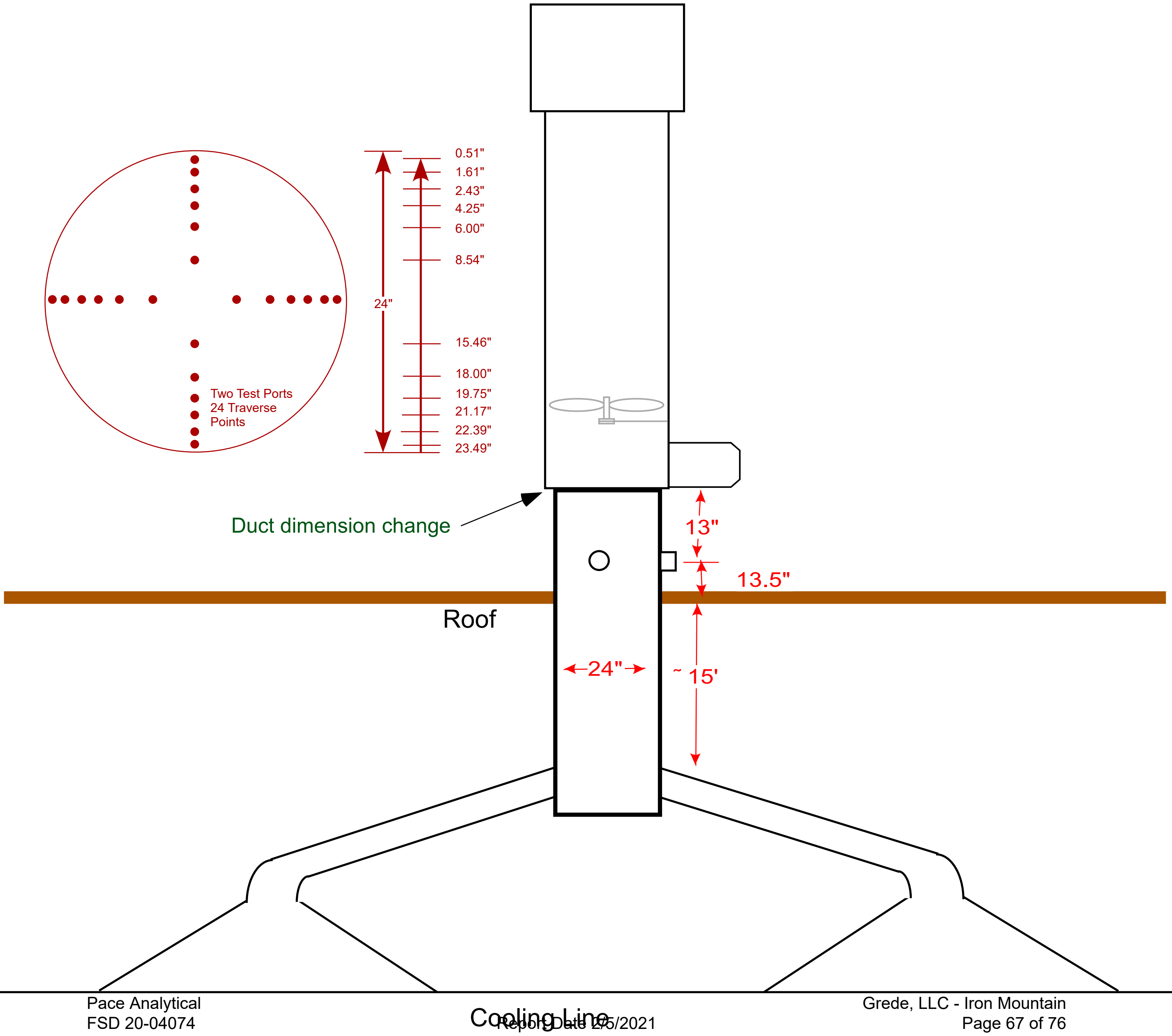
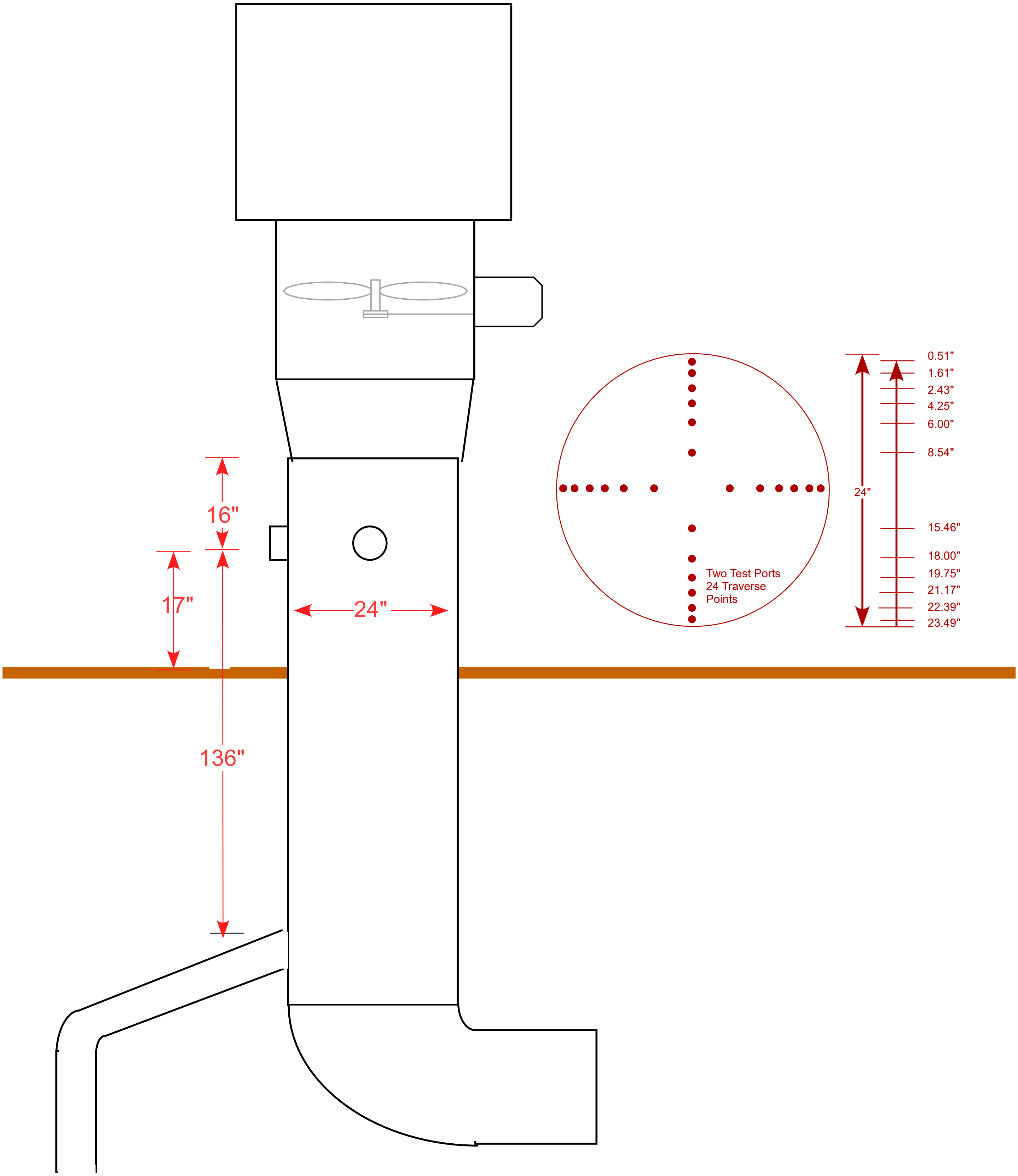


Figure 2
Grede, LLC - Iron Mountain
Kingsford, MI
Main Plant Pouring & Cooling No. 6 HMP (324632)
tjb \ 12/2020



Pace Analytical
Field Services Division

Figure 3
Grede, LLC - Iron Mountain
Kingsford, MI
Main Plant Pouring & Cooling No. 7 HMP (324662)
tjb\ 11/4/2019

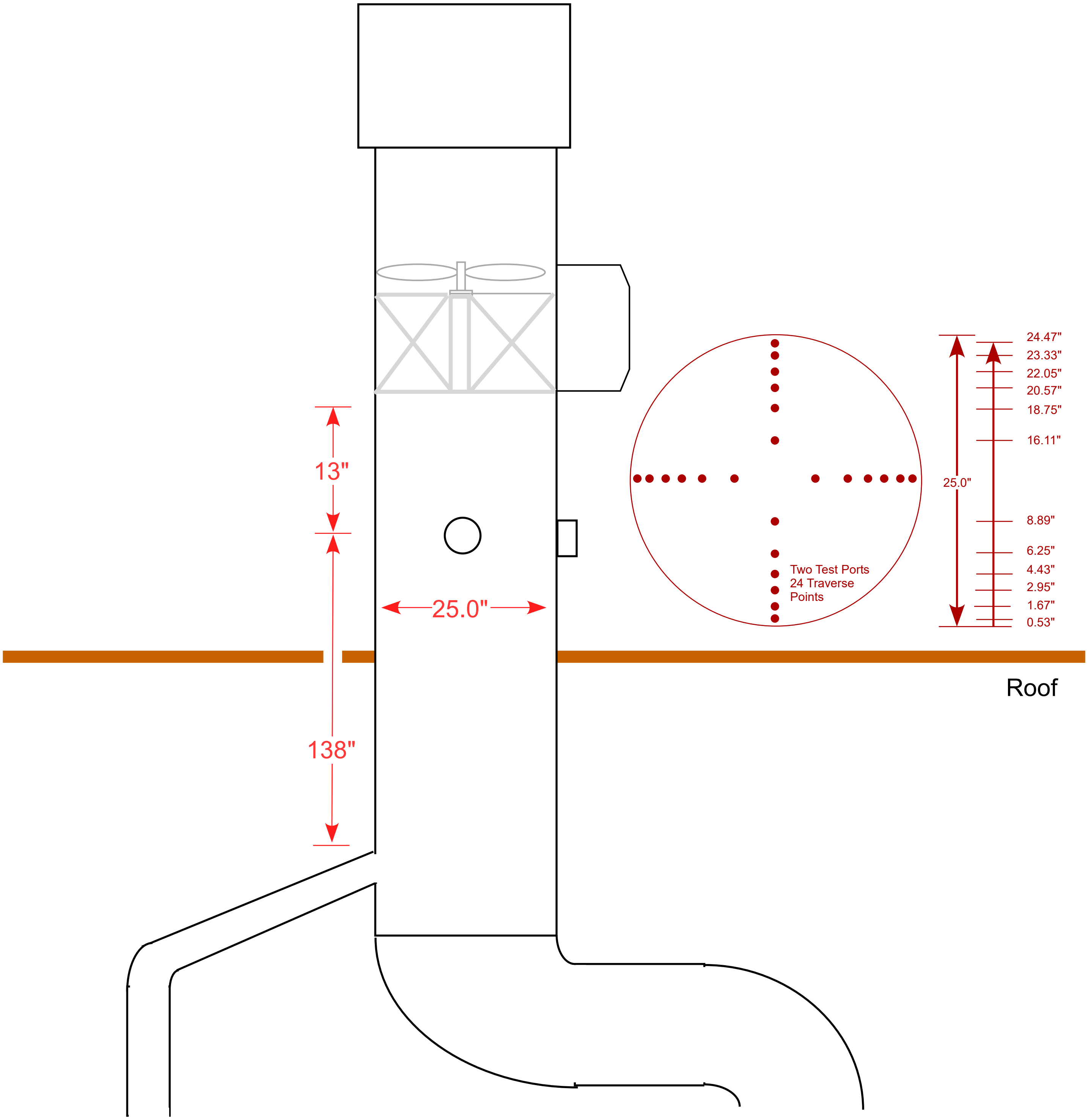


Figure 4

Grede, LLC - Iron Mountain

Kingsford, MI

Main Plant Pouring & Cooling Disa Pouring (324678)

tjb \ 11/4/2019

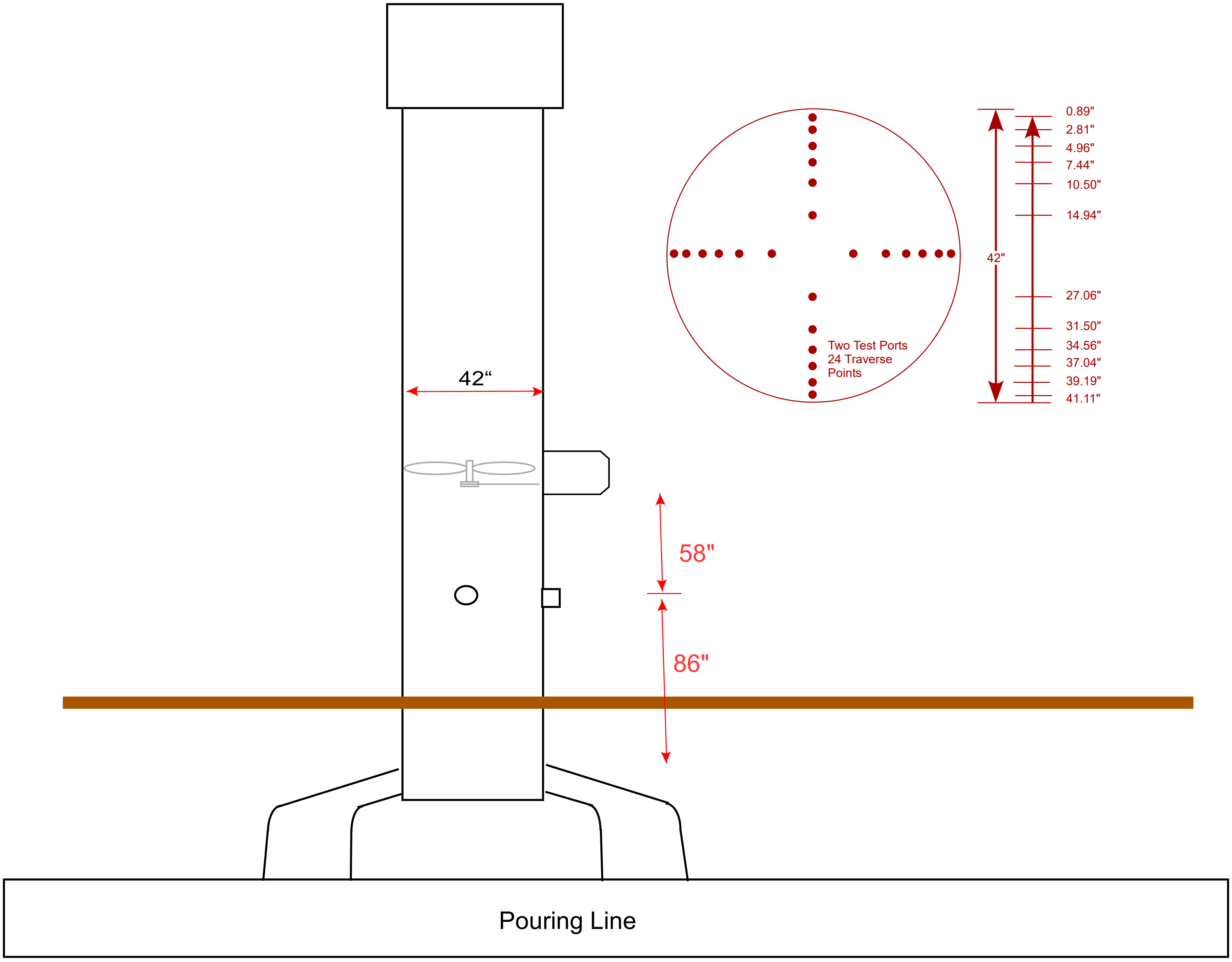


Figure 5

Grede, LLC - Iron Mountain

Kingsford, MI

Main Plant Pouring & Cooling Disa Pouring (324682)

tjb \ 12/2020

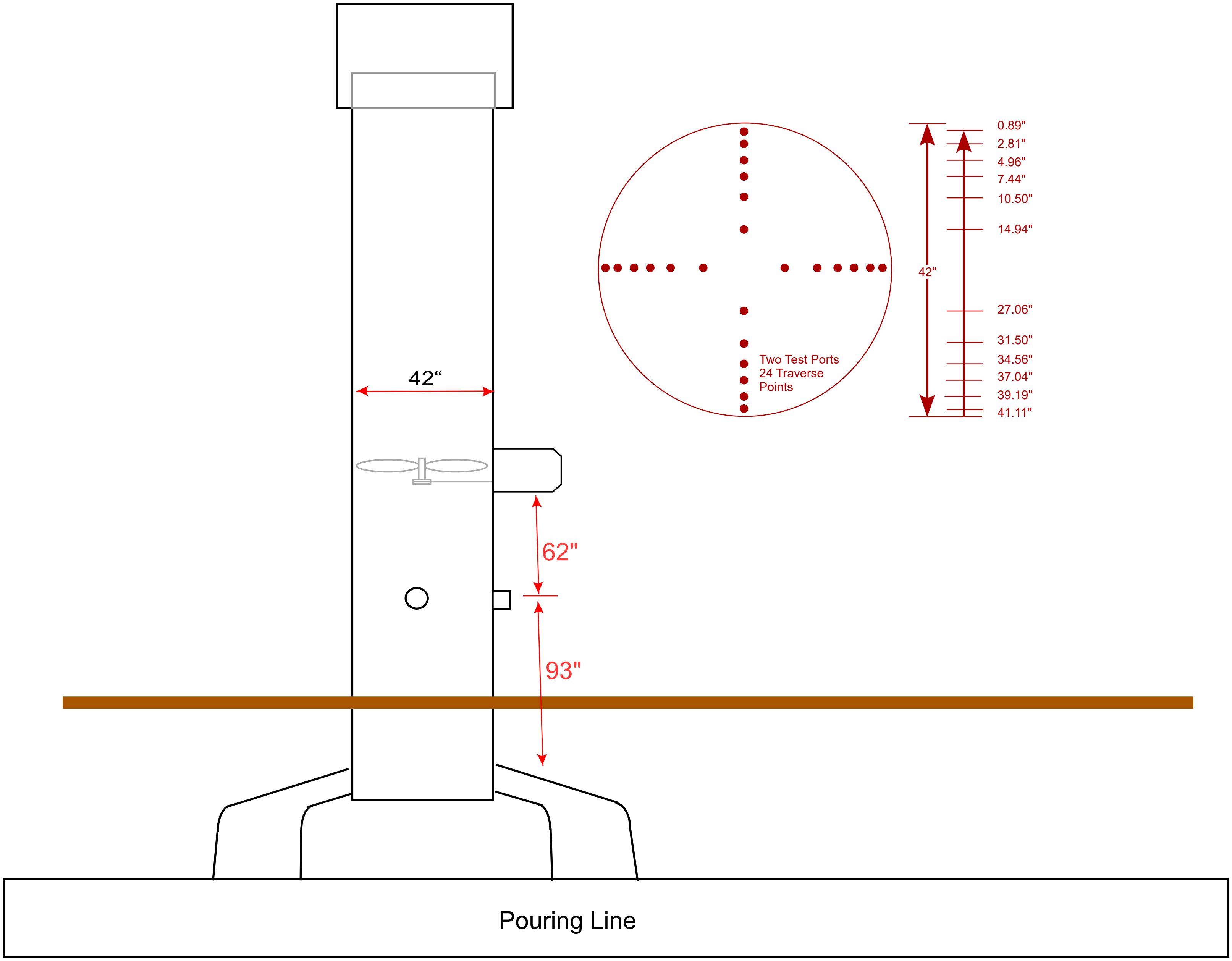
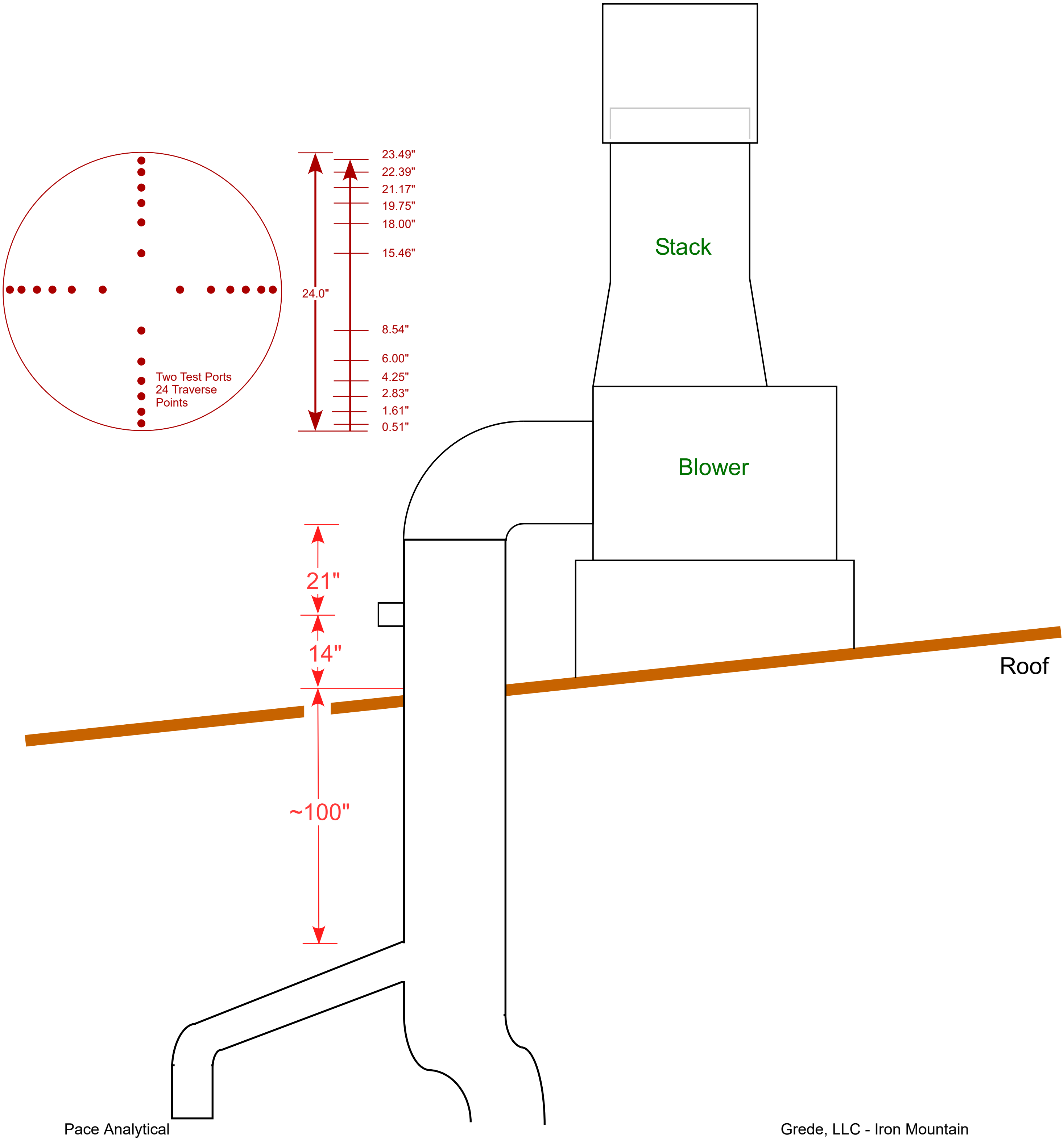


Figure 6
Grede, LLC - Iron Mountain
Kingsford, MI
Main Plant Pouring & Cooling No. 5 HMP (324848)
tjb \ 12/2020



Pace Analytical
Field Services Division

Figure 7
Grede, LLC - Iron Mountain
Kingsford, MI
Module Pouring & Cooling Exhaust (334116)
tjb/ 12/2020

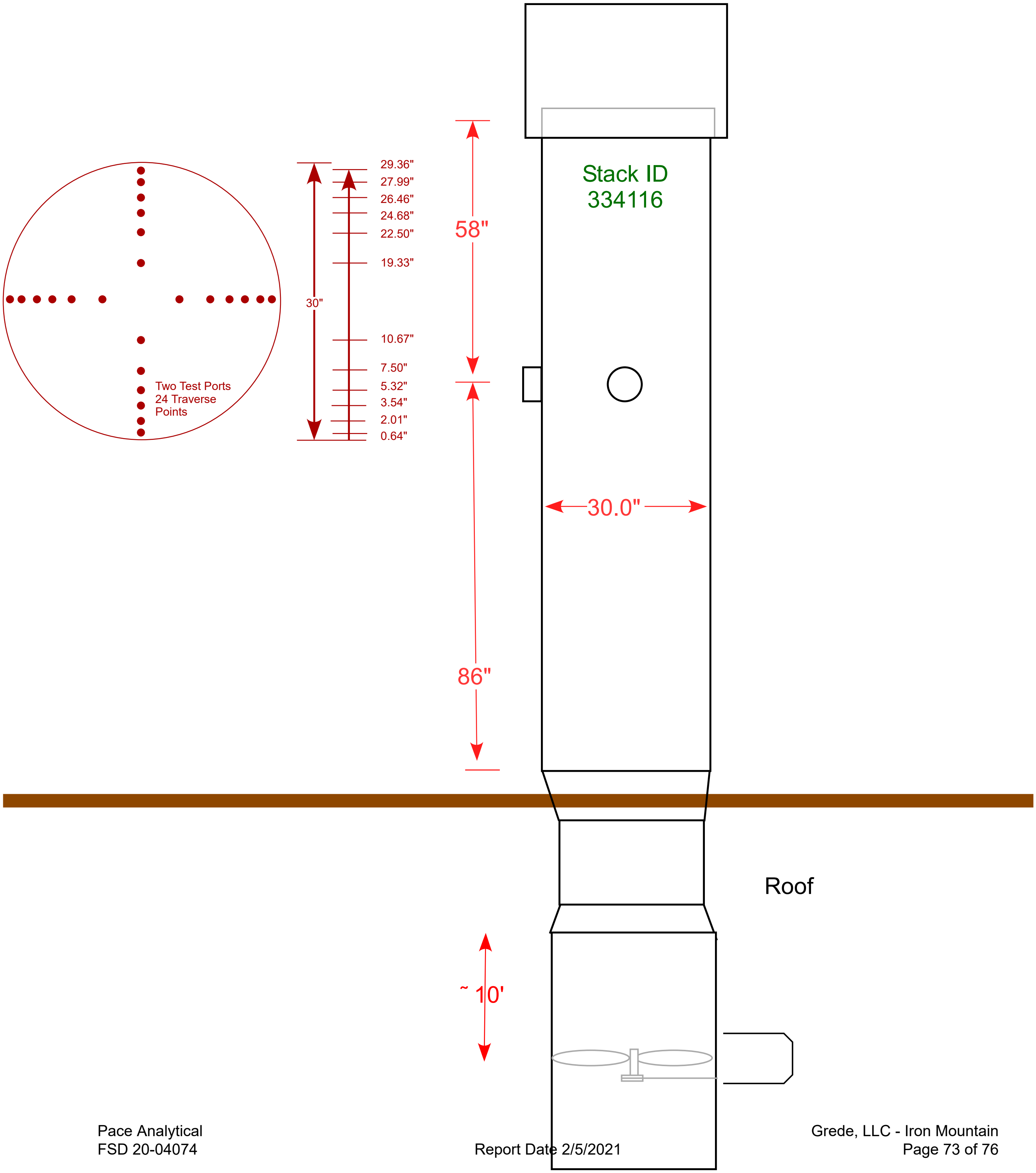


Figure 8
Grede, LLC - Iron Mountain
Kingsford, MI
Module Pouring & Cooling Exhaust (334176)
tjb/ 11/4/2019

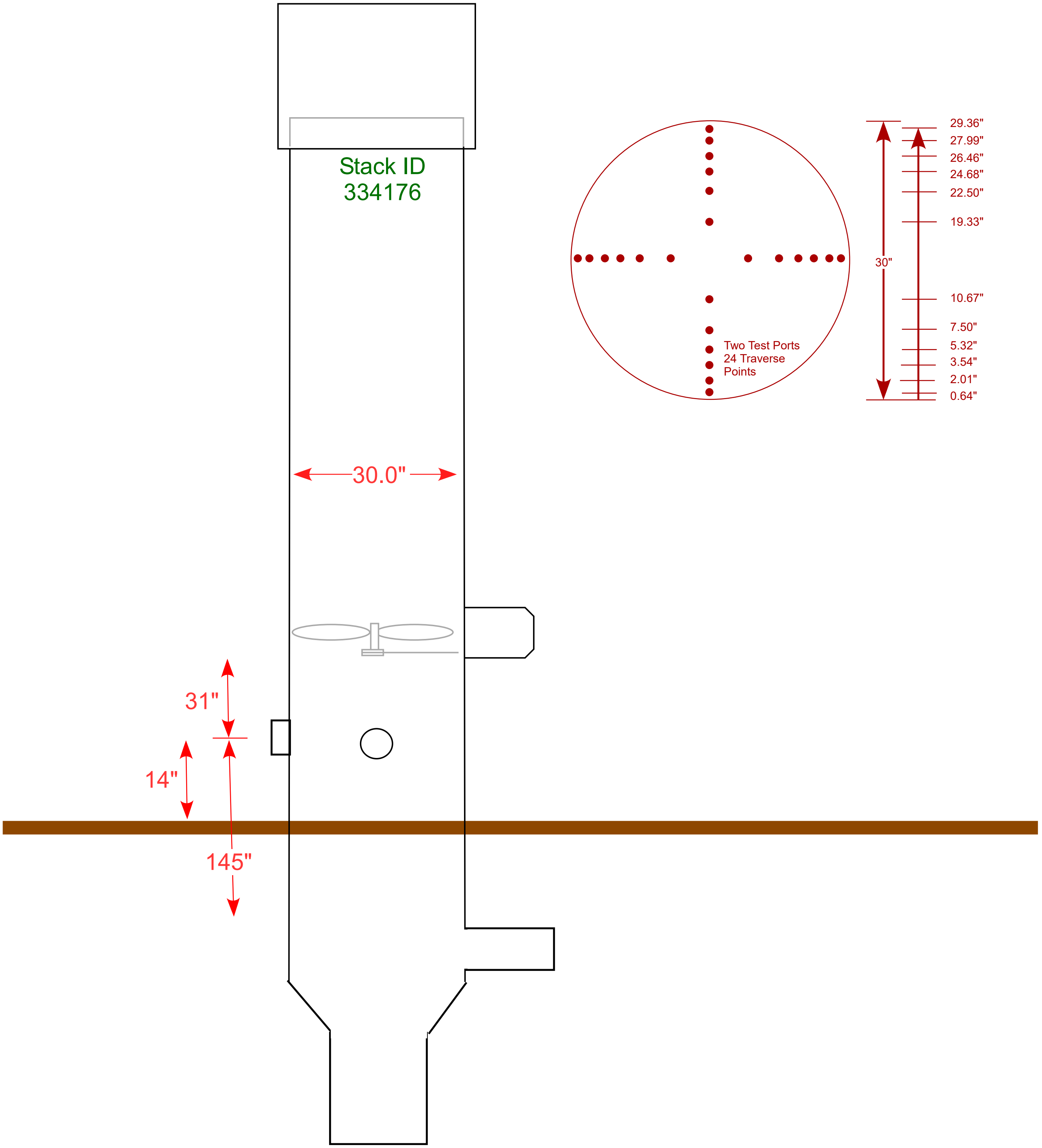


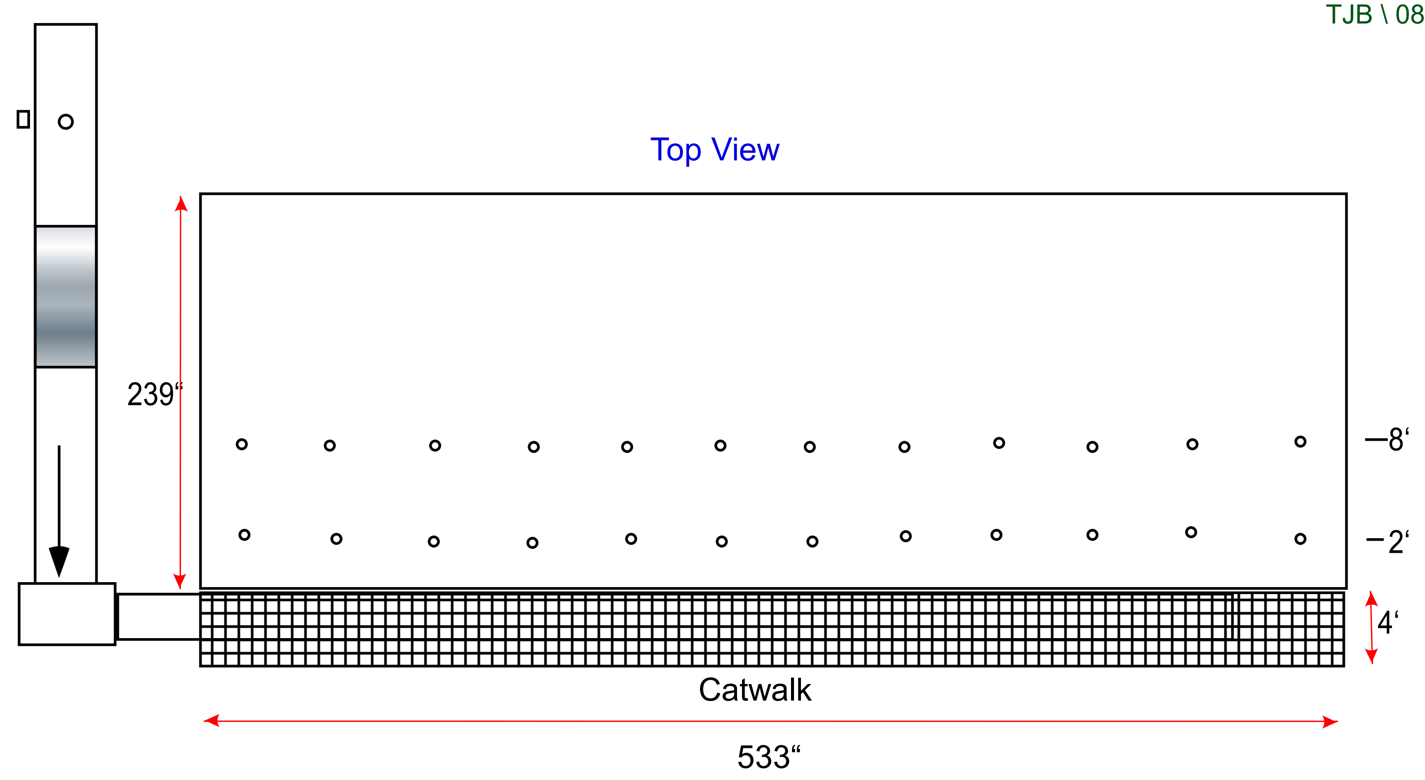
Figure 9

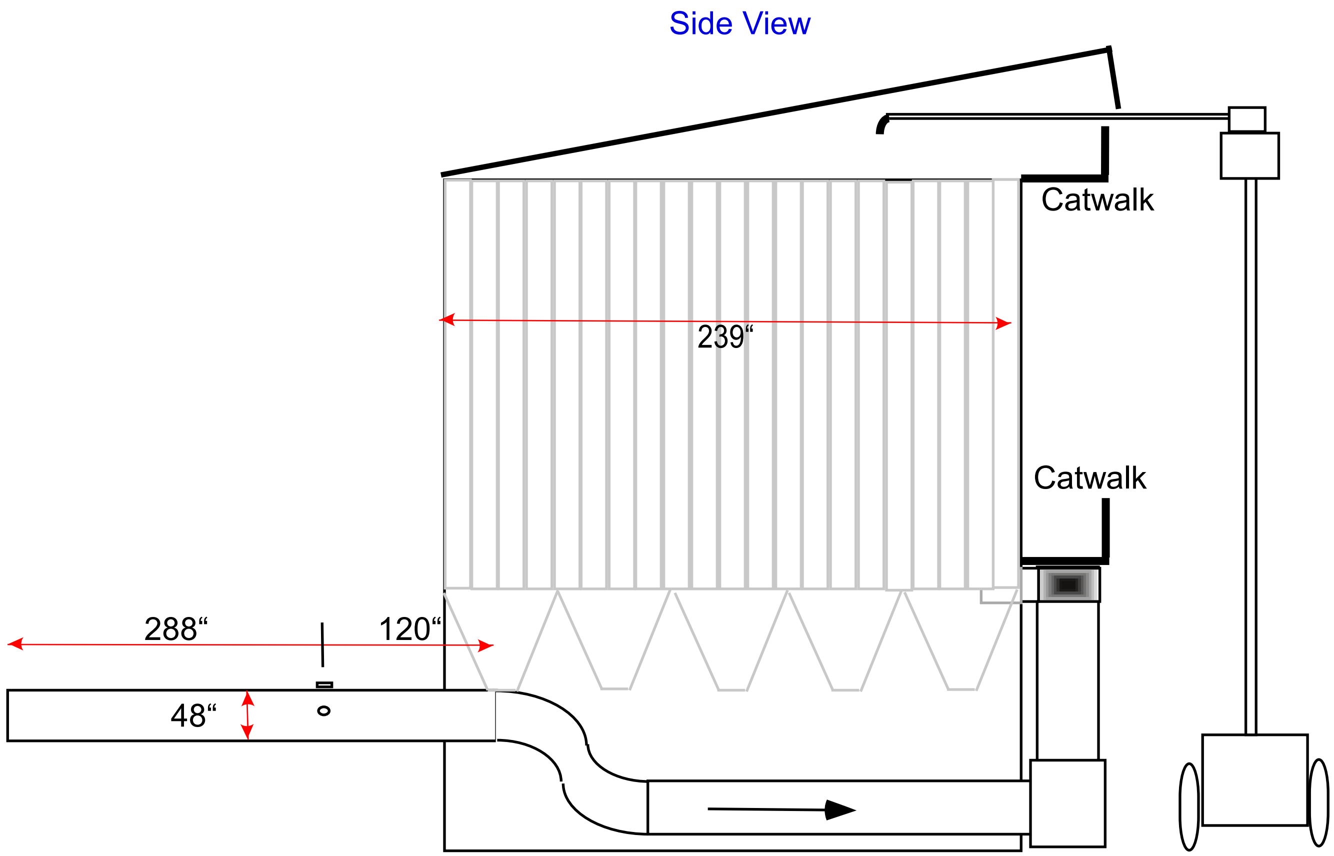
Grede, LLC - Iron Mountain

Kingsford, MI

Cupola Baghouse Exhaust (EU-P009)

TJB \ 08/05





Report Signatures

Field Testing and Reporting Performed by: Pace Analytical Services, LLC
Field Services Division
1700 Elm Street, Suite 200
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 1/20/2021

Terence J. Borgerding, QSTI
Team Lead

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 1/20/2021

Terence J. Borgerding, QSTI
Project Manager

Responsible Charge Affirmation

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

Date 1/20/2021

Donald B. Stock, QEP, QSTI
General Manager, Field Services Division

Appendix A

Field Data Sheets and Documentation

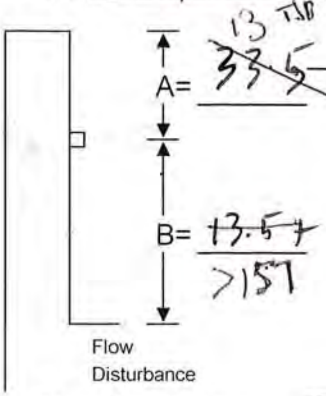
Field Data Sheets - 324484

EPA Method 1 Field Data Sheet

Test Site and Traverse Point Selection

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location Disa Pouring (324484)
Date 12/9/20 Test/Run T1 R 0
Tech(s) ZHE / LMR

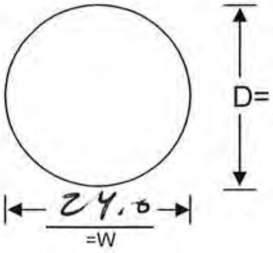
☐ New Sketch Created With Dimensions
☐ File Drawing Verified and Attached
☐ Cyclonic Flow Measured (See M-2 Sheet)



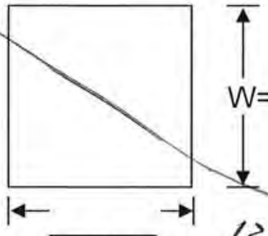
Disturbance Type

Before (B)		After (A)
☐	Elbow	☐
☐	Conjunction	☐
☐	Fan (cent)	☐
☐	Axial Fan	☐
☐	Transition	☐
☐	Damper	☐
☐	Exit	☐
☐	Other ________	☐

☐ Round



☐ Rectangular



ZHE 12/9/20

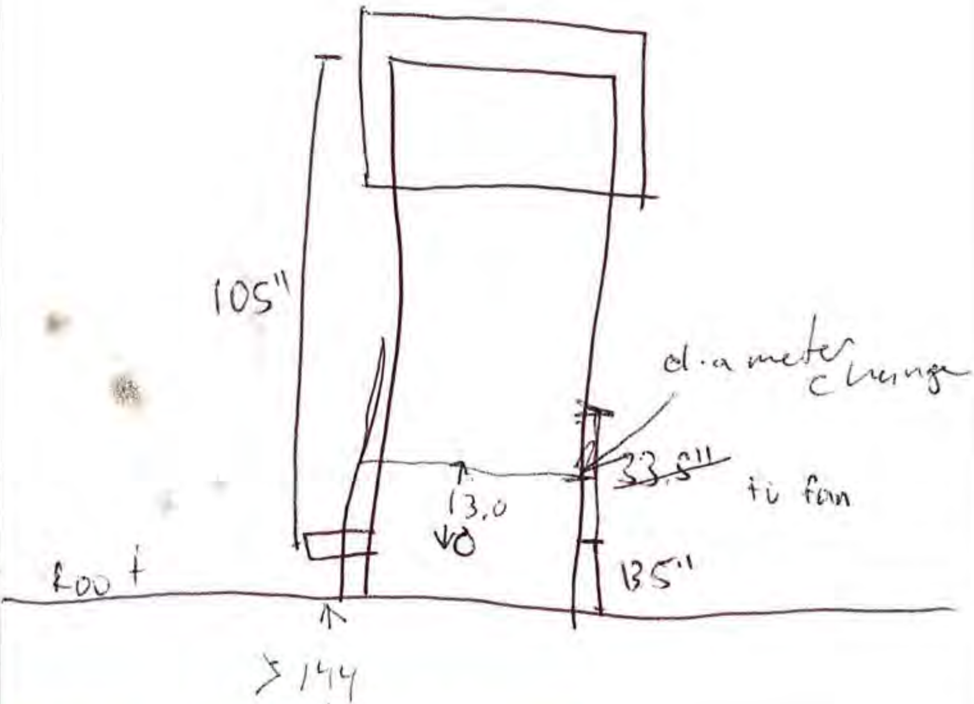
Duct Orientation

☐ Vertical
☐ Horizontal
☐ Diagonal
No. of Traverses

A= ____ Diameters to downstream
B= ____ Diameters to upstream
T_R= ____ Min. Traverse Points (iso)
T_A= ____ Traverse Points Used

Traverse Points (from wall)

Sketch of test location with dimensions and process equipment.



If file drawing, correct or circle dimensions as they are verified.

Pace Analytical®
Field Services Division

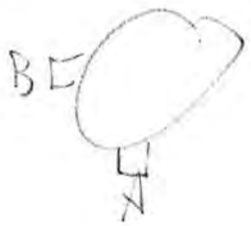
EPA Method 2 Field Data Sheet

Volumetric Airflow Determinations

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location Disa Pouring (324484)
Date 12/9/20 Test/Run T1 R
Duct Dimensions 24 x 24 Inches
Port Length 6 Inches
Pitot Leak Check - Pos ✓ Neg ✓

Manometer Type and ID CM-5
Barometer Type and ID DB-60
Thermocouple Sensor ID TC-38
Pitot Tube No. 3-01 Cp 0.84
Technicians ZHE / LMR
#REF!
FSD PN: 20-04074

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From		Flow	Run 1	Run 2	Run 3	Run 4	Run 1	Run 2	Run 3	Run 4
	Wall	Port	°Yaw	ΔP	ΔP	ΔP	ΔP	°F	°F	°F	°F
A1	.51	6.51	5	0.46							
2	1.61	7.61	0	0.47							
3	2.83	8.43	0	0.50				82			
4	4.25	10.25	5	0.49							
5	6.00	12.00	5	0.46							
6	8.54	14.54	12	0.45		ZHE				ZHE	
7	15.46	21.46	5	0.41				83			
8	18.00	24.0	0	0.45		12/9/20					
9	19.75	25.75	-5	0.68						12/9/20	
10	21.17	27.17	-7	0.70							
11	22.34	28.59	-7	0.80				84			
12	23.49	29.45	-7	0.81							
B 1			15								
2			0								
3			0								
4			0								
5			5								
6	Same		5								
7	as		0				ZHE				
8	above		-10								
9			-10								
10			-10				12/9/20				
11			-12								
12			-12								
			ZHE								
			12/9/20								



Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	28.431				"Hg
Static Pressure	-1.50				"H_2O
Dry Bulb Temp.	84		ZHE		°F
Wet Bulb Temp.	—				°F
Moisture Content	1		12/9/20		%v/v
320 P Oxygen	20.9				%v/v
Time of Meas.	730				(24 Hour)

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project	Grede-Iron Mountain 2020 Compliance w/	Module ID	CM-5	Pitot No.	3-01 C_p 0.84
Manometer ID	CM-5				
Sample Location	Disa Pouring (324484)	Meter Coef. γ	0.9916	Bar. Pres.	28.431 In. Hg
TC Sensor ID	TC-38				
Date	12/9/20 Test/Run T1 R 1	Orifice Coef. ΔH@	2.074	Static Pres.	-1.5 In. H_2O
Barometer ID	DB-60				
Operators/Techs	ZHE/LMR	Nozzle No.	55 D_n 0.250	Est. Moist.	1 %v/v
Scale ID	DS-45				

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(826)	775.25													
12	3.5	778.55	0.76	3.42	778.72	3.47	3.5	87	249	259	NA	40	51	57	20.9
11	7	781.99	0.75	3.36	782.14	3.42	3.3	86	254	260		40	48	55	
10	10.5	785.38	0.75	3.33	785.54	3.40	3.4	87	254	245		43	44	54	
9	14	788.72	0.66	2.91	788.71	3.17	3.3	89	254	265		47	44	54	
8	17.5	791.89	0.58	2.56	791.68	2.97	3.4	89	256	275		49	44	54	
7	21	794.68	0.50	2.21	794.44	2.76	2.9	88	255	241		51	45	53	
6	24.5	797.41	0.46	2.03	797.09	2.65	2.7	89	254	227		52	44	53	
5	28	799.98	0.49	2.15	799.81	2.73	2.1	90	254	270		52	46	53	
4	31.5	802.63	0.48	2.12	802.52	2.71	2.2	89	256	280		52	45	53	
3	35	805.29	0.50	2.20	805.28	2.76	2.3	90	255	261		54	46	53	
2	38.5	808.08	0.52	2.29	808.09	2.81	2.5	90	254	223		54	46	53	
1	42	810.86	0.48	2.14	810.81	2.72	2.5	82	254	220		57	47	54	
12	45.5	814.02	0.68	2.96	814.[illegible]	3.18	3.1	97	255	245		62	48	54	
11	49	817.26	0.66	2.88	817.18	3.16	3.1	96	256	250		57	49	54	
10	52.5	820.44	0.63	2.76	820.27	3.09	3.1	95	256	290		54	50	55	
9	56	823.63	0.65	2.86	823.43	3.16	3.2	93	254	274		57	51	55	
8	58.5	825.76	0.67	2.95	826.63	3.20	3.0	94	254	220		58	51	56	
7	63	829.81	0.64	2.82	829.77	3.14	3.1	93	253	255		58	52	57	
6	66.5	832.58	0.46	2.04	832.44	2.67	2.5	91	257	276		58	53	57	
5	70	835.18	0.42	1.87	834.99	2.56	2.2	90	256	268		59	53	57	
4	73.5	837.59	0.44	1.95	837.61	2.61	2.0	91	253	222		59	55	59	
3	77	840.22	0.45	2.01	840.26	2.65	2.1	91	254	249		60	56	59	
2	80.5	843.10	0.50	2.25	843.07	2.81	2.5	87	255	279		60	57	60	
1	84	845.63	0.43	1.93	845.68	2.61	2.4	88	256	268		59	52	60	
	(954)		0.7604												
Tot/Avg	θ= 84	V_m=70.38	√ΔP=~~0.2482~~	ΔH=2.50				t_s= 90.1						t_m=52.3	O_2= 20.9

Samples Recovered: Filter 0-1177 ; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other ________

Sampling Train Leak Checks:
Pretest 0.00 @ 5.5 "Hg
Posttest 0.00 @ 5.0 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	89.4	114.8	3.8			1299.5	
Initial Volume	100	100	0			1282.5	
Difference	-10.6	14.8	3.8			17.0	25.0

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/(
Sample Location Disa Pouring (324484)
Date 12/9/20 Test/Run T1 R 2
Operators/Techs ZITE/LMR

Module ID CM-5
Meter Coef. γ 0.9916
Orifice Coef. ΔH@ 2.074
Nozzle No. 55 D_n 0.250

Pitot No. 3-01 C_p 0.84
Bar. Pres. 28.431 In. Hg
Static Pres. -1.50 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-5
TC Sensor ID TC-38
Barometer ID PB-60
Scale ID DS-45

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1015)	846.00													
12	3.5	849.25	0.68	3.02	849.26	3.26	3.6	94	225	263	NA	49	59	65	20.9
11	7	852.56	0.65	2.93	852.48	3.22	3.6	91	228	268		47	58	65	
10	10.5	855.97	0.67	3.01	855.74	3.26	3.7	92	238	284		47	58	65	
9	14	859.08	0.65	2.93	858.96	3.22	3.5	89	246	282		48	58	64	
8	17.5	862.41	0.70	3.15	862.30	3.33	3.8	91	250	222		50	60	64	
7	21	865.67	0.69	3.11	865.62	3.32	3.8	90	254	275		51	60	65	
6	24.5	868.90	0.52	2.35	868.51	2.89	3.7	90	257	281		50	60	66	
5	28	871.57	0.48	2.04	871.19	2.69	2.6	89	257	263		52	59	66	
4	31.5	874.12	0.50	2.26	874.02	2.83	2.5	90	253	216		53	60	66	
3	35	876.80	0.41	1.86	876.59	2.57	2.5	88	254	274		52	62	67	
2	38.5	879.35	0.52	2.37	879.49	2.90	2.9	88	258	286		52	61	67	
1	42	882.19	0.46	2.12	882.24	2.75	2.9	80	255	267		53	62	68	
12	45.5	885.62	0.75	3.39	885.72	3.48	4.1	92	254	262		52	62	68	
11	49	889.20	0.75	3.39	889.14	3.48	4.0	92	255	252		55	62	68	
10	52.5	892.62	0.73	3.31	892.62	3.43	4.0	91	258	274		56	61	69	
9	56	895.97	0.70	3.23	896.02	3.39	4.1	88	258	239		60	62	69	
8	51.5	899.37	0.63	2.86	899.21	3.19	4.0	91	253	214		61	63	70	
7	63	902.42	0.55	2.50	902.20	2.99	3.3	90	253	249		62	64	70	
6	66.5	905.36	0.53	2.41	905.14	2.94	3.5	90	256	279		63	64	71	
5	70	908.21	0.51	2.33	908.03	2.89	3.0	88	257	259		63	65	70	
4	73.5	910.89	0.47	2.15	910.80	2.77	2.6	89	255	223		63	65	71	
3	77	913.82	0.52	2.38	913.72	2.92	2.9	89	253	280		63	66	71	
2	80.5	916.52	0.47	2.16	916.50	2.78	3.0	87	255	244		63	66	71	
1	84	919.54	0.50	2.32	919.38	2.89	3.1	81	255	232		64	67	72	
	(1144)														
Tot/Avg	θ= 84	V_m=73.54	√ΔP=0.7611	ΔH= 2.65				t_s= 89.12						t_m=64.8	O_2= 20.9

Samples Recovered: Filter 0-1179; ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 5.5 "Hg
Posttest 0.00 @ 6.0 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	96.1	113.1	3.9			1450.8	
Initial Volume	100	100	0			1429.1	
Difference	-3.9	13.1	3.9			21.7	34.8

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/(

Sample Location Disa Pouring (324484)

Date 12/9/20 Test/Run T1 R 3

Operators/Techs ZHE/LMR

Module ID CM-5

Meter Coef. γ 0.9916

Orifice Coef. ΔH@ 2.074

Nozzle No. 55 D_n 0.250

Pitot No. 3-01 C_p 0.84

Bar. Pres. 28.431 In. Hg

Static Pres. -1.5 In. H_2O

Est. Moist. 1 %v/v

Manometer ID CM-5

TC Sensor ID TC-38

Barometer ID DB-60

Scale ID DS-45

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incre-mental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1205)	919.90													
12	3.5	923.39	0.77	3.40	923.40	3.50	3.2	91	225	263	NA	54	68	74	20.9
11	7	926.94	0.75	3.44	926.92	3.52	3.3	91	234	269		51	67	74	
10	10.5	930.42	0.72	3.29	930.36	3.44	3.2	91	244	280		49	67	74	
9	14	933.85	0.70	3.20	933.76	3.40	3.3	91	251	267		49	66	74	
8	17.5	937.04	0.62	2.84	936.96	3.20	3.1	90	252	221		48	65	74	
7	21	940.12	0.55	2.53	939.47	3.01	3.0	88	254	264		49	65	74	
6	24.5	942.96	0.49	2.24	942.81	2.84	2.9	90	257	280		48	65	73	
5	28	945.84	0.52	2.37	945.72	2.92	2.6	91	256	248		47	64	74	
4	31.5	948.83	0.54	2.46	948.70	2.97	2.5	91	253	225		48	64	74	
3	35	951.68	0.50	2.28	951.56	2.86	2.5	92	253	268		49	64	74	
2	38.5	954.53	0.48	2.22	954.38	2.82	2.5	84	254	279		49	62	72	
1	42	957.26	0.46	2.12	957.13	2.75	2.3	83	256	261		49	62	72	
12	45.5	960.57	0.66	2.98	960.40	3.27	3.0	94	251	274		53	62	70	
11	49	963.83	0.68	3.07	963.71	3.31	3.1	94	254	274		47	63	70	
10	52.5	967.16	0.70	3.17	967.08	3.37	3.1	92	258	239		47	62	71	
9	56	970.51	0.70	3.16	970.44	3.36	3.2	95	254	220		47	63	72	
8	59.5	973.74	0.68	3.08	973.76	3.32	3.1	94	258	285		46	63	71	
7	63	976.97	0.67	3.02	977.04	3.29	2.9	95	255	225		47	64	72	
6	66.5	979.78	0.46	2.08	979.77	2.73	3.2	95	254	275		47	64	72	
5	70	982.57	0.46	2.09	982.51	2.73	2.3	93	253	269		47	63	72	
4	73.5	985.32	0.47	2.13	985.27	2.76	2.3	94	254	220		48	64	72	
3	77	988.13	0.50	2.26	988.12	2.85	2.4	94	254	263		48	63	72	
2	80.5	990.94	0.49	2.23	990.94	2.83	2.5	91	255	283		48	63	72	
1	84	993.75	0.48	2.19	993.74	2.80	2.4	89	255	263		49	61	71	
	(1334)														
Tot/Avg	θ= 84	V_m=73.85	√ΔP=0.7613	ΔH=2.66				t_s= 91.4						t_m=68.2	O_2=20.9

Samples Recovered: Filter 0-1176 ; ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:

Pretest 0.00 @ 6.0 "Hg

Posttest 0.00 @ 9.0 "Hg

Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	103.9	110.8	4.2			1306.8	
Initial Volume	100	100	0			~~1306~~	
Difference	3.9	10.8	4.2			7.3	~~25.2~~ 26.2

1299.5

RE

ZHE 12/9/20

Pace Analytical®
Field Services Division

Field Calculation Summary

Computer Initialization and Run Summary

The data on this form is preliminary and includes estimates.
It is not intended to reflect final results.

Project Grede-Iron Mountain 2020 Co Site Date 12/9/20
Sample Location Disa Pouring (324484) Tech. ZHE

Initialization Parameters						
Parameter	**Initial**	**Run_1**	**Run_2**	**Run_3**	**Run_4**	**Run_5**
Meter Coefficient - Υ	0.9916					
Orifice Coefficient - ΔH@	2.074					
Pitot Coefficient - C_p	0.84					
Nozzle Diameter - D_n	0.250					
Barometric Pressure - P_b	28.431	→				
Static Pressure - P_g	-1.5	→				
Oxygen Estimate - $\%O_2$	20.9	→				
Moisture Estimate - %MC	1	1	1	1		
No. of Traverse Points	24					
Point Duration - ΔT	3.5					
Meter Start Temp, °F - t_m	58	58	58	72		
Initial Meter Volume - V_i	775.25	775.25	846.00	919.90		
Duct Shape (Rnd/Rect)	Rnd					
Duct Width, Inches	24					
Duct Depth, Inches	24					
Final Volume - V_f		845.63	919.54	993.75		
Total Run Time - θ		84	84	84		
Condensate Volume, ml (g)		25.0	34.8	26.2		
End of Run Summary						
Average Sq. Rt. of the ΔP	√ΔP	0.7482	0.7611	0.7613		
Average Orifice Meter	ΔH	2.60	2.65	2.66		
Average Stack Temperature	t_s	90.1	89.2	91.4		
Average Meter Temperature	t_m	52.3	64.8	68.2		
Sample Volume, Actual	V_m	70.38	73.54	73.85		
Sample Volume, Dry Standar	V_{std}	68.79	70.19	70.04		
Moisture Content	MC	1.68	2.28	1.73		
Estimated Mole. Wt., dry	M_d					
Estimated Mole. Wt., wet	M_w					
Average Gas Velocity	V_s	44.23	45.01	45.06		
Isokinetic Variation	%I	101.4	102.1	101.6		
Volumetric Airflow, Actual	ACFM	8340	8480	8490		
Volumetric Airflow, Standard	SCFM	7580	7720	7700		
Volumetric Airflow, Dry Std.	DSCFM	7450	7540	7570		

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Field Services Division

Equipment & Method Summary

Isokinetic and Associated Testing

Group 1 QI ZHE Group 4 QI ____

Project Name: Grede-Iron Mountain 2020 Compliance w/(Test Date: 12/9/20
Sampling Location: Disa Pouring (324484) Recorded By: ZHE

Airflow Determination EPA Method: ☒ 2 ☐ 2C ☐ Other ____________ Initials

Pitot Tube No.: 3-01 Coef.: 0.84 Next Ver. Date: 1/1/21 Pre-Use Insp.: ZHE
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: CM-5 ☒ Oil ☐ Digital Next Ver. Date: 2/11/21 Pre-Use Insp.: ZHE
Manometer ID: ____ ☐ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
Barometer ID: DB-60 ☐ Aneroid ☒ Digital Next Ver. Date: 2/22/21 Pre-Use Insp.: ZHE
Barometer ID: ____ ☐ Aneroid ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout TC-44 ☐ Single ☒ Dual Next Ver. Date: 10/31/21 Pre-Use Insp.: ZHE
T/C Readout ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____

Gas Composition EPA Method: ☐ 3 ☐ 3/3A ☐ 3B ☐ 3C ☒ Ambient ☐ ____ Initials

Container Type: ☐ Tedlar ☐ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ____
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☐ Instrumental: Instrument ID: ______ Cal Range ______
Ambient Provision Oxygen Verification: Portable O2 ID ______ Ambient Cal Reading: ______
Note: Portable O2 results are not reported as test data.

Moisture Content EPA Method: ☒ 4, back-half of iso train ☐ Other ___ Explain in Options/Deviations Section Initials

Wt. Scale ID: DS-46 ☒ Digital ☐ Beam Next Ver. Date: ____ Pre-Use Insp.: ____
Std. Weight ID: ____ Std. Weight (g): ____ Scale Reading: ____ ☐ Pass ☐ Fail

Isokinetic EPA Method: ☒ 5 __ ☐ 8 ☐ 17 ☐ 23 ☐ 26A ☐ 29 ☐ Other ___ Initials

Nozzle ID: 0.250 Type: ☒ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ______

Nozzle Cal.:	1 0.250	2 0.250	3 0.250	4 0.250	5 0.25	Avg 0.250	Pre-Use Insp.: ZHE

Nozzle ID: ____ Type: ☐ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ______

Nozzle Cal.:	1	2	3	4	5	Avg	Pre-Use Insp.: ____

Probe Length: 3 ft. Liner: ☐ SS ☒ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: 3-01 Coef.: 0.84 Next Ver. Date: ____ Pre-Use Insp.: ____
Probe Length: ____ ft. Liner: ☐ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Control Mod ID: CM-5 ϒ: 0.9916 ΔH@: 2,074 Next Ver. Date: 2/4/21 Pre-Use Insp.: ZHE
Control Mod ID: ____ ϒ: ____ ΔH@: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Filter Type: ☐ 2½" Round ☒ 4" Round ☐ Thimble ☐ Other ______
Filter Media: ☒ Glass Fiber ☐ Quartz Fiber ☐ Paper ☐ Teflon ☐ SS ☐ Other ____
Wet Catch: ☐ EPA 202 ☐ EPA 8 ☐ EPA 23 ☐ EPA 26A ☐ EPA 29 ☐ Other ___
WC Options/Deviations: ______________________________

Field Data Sheets - 324632

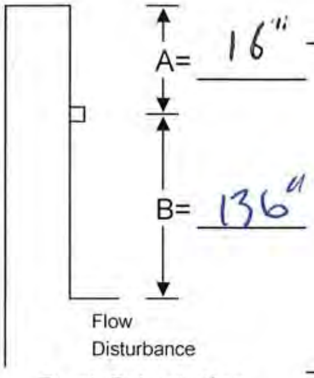
Pace Analytical®
Field Services Division

EPA Method 1 Field Data Sheet

Test Site and Traverse Point Selection

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location No. 6 HMP - East Hunter (324632)
Date 12/10/20 Test/Run T1 R 1
Tech(s) ZHE / LMR

☐ New Sketch Created With Dimensions
☐ File Drawing Verified and Attached
☐ Cyclonic Flow Measured (See M-2 Sheet)

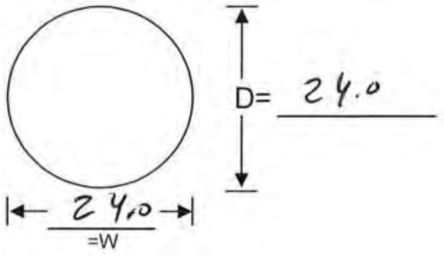


A= 16"
B= 136"

Disturbance Type

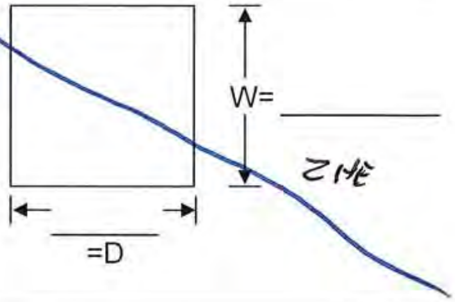
Before (B)		After (A)
☐	Elbow	☐
☐	Conjunction	☐
☐	Fan (cent)	☐
☐	Axial Fan	☐
☐	Transition	☐
☐	Damper	☐
☐	Exit	☐
☐	Other ______	☐

☒ Round



D= 24.0
24.0 =W

☐ Rectangular



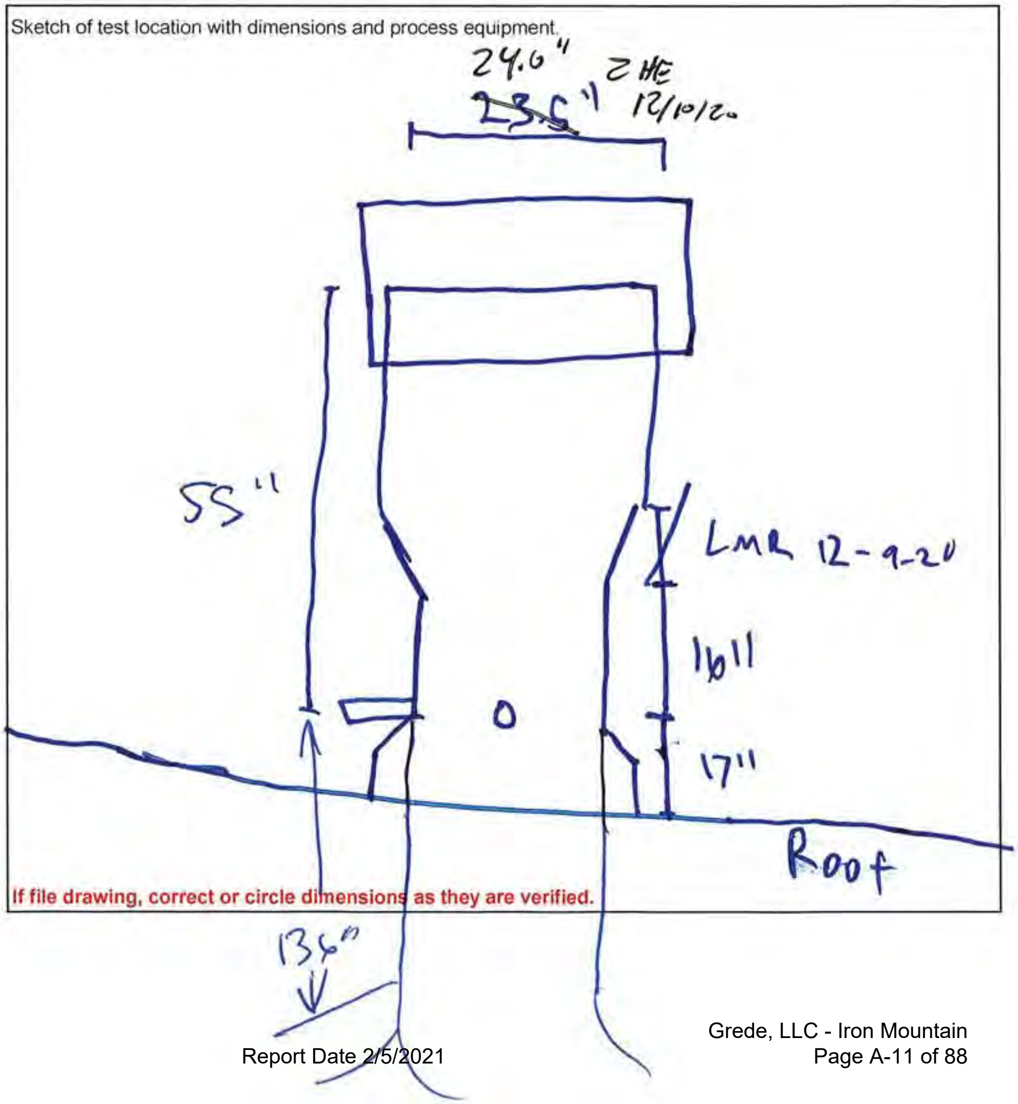
W= ______
=D
ZHE

Duct Orientation
☒ Vertical
☐ Horizontal
☐ Diagonal
______ No. of Traverses

A= ______ Diameters to downstream
B= ______ Diameters to upstream
T_R= ______ Min. Traverse Points (iso)
T_A= ______ Traverse Points Used

Traverse Points (from wall)

Sketch of test location with dimensions and process equipment.



If file drawing, correct or circle dimensions as they are verified.

Pace Analytical®
Field Services Division

EPA Method 2 Field Data Sheet

Volumetric Airflow Determinations

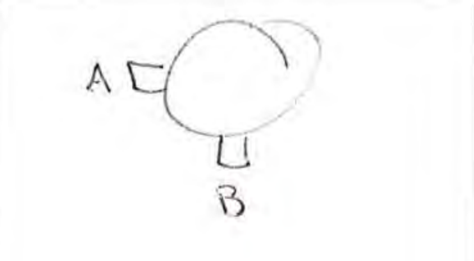
Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location No. 6 HMP - East Hunter (324632)
Date 12/7/20 Test/Run T1 R
Duct Dimensions 24.0 Inches
Port Length 6.0 Inches
Pitot Leak Check - Pos ✓ Neg ✓

Manometer Type and ID CM-5
Barometer Type and ID DB-60
Thermocouple Sensor ID TC-44
Pitot Tube No. 3-01 Cp 0.84
Technicians TJB / JWG
#REF!
FSD PN: 20-04074

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From Wall	Inches From Port	Flow °Yaw	Run 1 ΔP	Run 2 ΔP	Run 3 ΔP	Run 4 ΔP	Run 1 °F	Run 2 °F	Run 3 °F	Run 4 °F
A-1	0.51	6.51	5	0.13							
2	1.61	7.61	10	0.14							
3	2.83	8.63	15	0.15							
4	4.25	10.25	7	0.18							
5	6.00	12.00	5	0.18							
6	8.54	14.54	5	0.19							
7	15.46	21.46	0	0.19							
8	18.00	24.00	-5	0.18							
9	19.75	25.75	0	0.17							
10	21.17	27.17	0	0.15							
11	22.39	28.39	-5	0.14							
12	23.49	29.49	-3	0.14							
B-1			5								
2			20								
3			12								
4			5								
5		same	0								
6		as	0								
7		above	0								
8			-5								
9			-5								
10			-5								
11			-5								
12			-7								

ZHE 12/9/20

ZHE 12/9/20



Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	2864				"Hg
Static Pressure	-0.35				"H_2O
Dry Bulb Temp.	92				°F
Wet Bulb Temp.	—				°F
Moisture Content	1				%v/v
320 P Oxygen	209				%v/v
Time of Meas.	1500				(24 Hour)

ZHE 12/9/20

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project: Grede-Iron Mountain 2020 Compliance w/(
Sample Location: No. 6 HMP - East Hunter (324632)
Date: 12/10/20
Test/Run: T1 R1
Operators/Techs: ZHE/LMR

Module ID: CM-5
Meter Coef. γ: 0.9916
Orifice Coef. ΔH@: 2.074
Nozzle No.: 55
D_n: 0.371

Pitot No.: 3-01
C_p: 0.84
Bar. Pres.: 28.66 In. Hg
Static Pres.: -0.35 In. H_2O
Est. Moist.: 1 %v/v

Manometer ID: CM-5
TC Sensor ID: TC-44
Barometer ID: DB-60
Scale ID: DS-45

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incre-mental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(720)	994.85													
12	3.5	998.38	0.17	3.73	998.47	3.62	4.2	85	255	270	NA	42	61	65	20.9
11	7	1002.08	0.18	3.98	1002.21	3.74	4.6	81	255	253		37	57	63	
10	10.5	1005.96	0.18	3.96	1005.92	3.72	4.9	81	253	249		46	62	62	
9	14	1009.60	0.18	3.92	1009.61	3.69	4.9	83	255	263		37	50	61	
8	17.5	1013.19	0.17	3.71	1013.19	3.58	4.3	81	255	237		35	53	60	
7	21	1016.88	0.18	3.93	1016.88	3.69	4.6	81	254	241		40	50	61	
6	24.5	1020.71	0.19	4.13	1020.66	3.78	4.9	83	255	279		36	50	61	
5	28	1024.14	0.16	3.47	1024.13	3.47	4.1	82	255	242		45	50	60	
4	31.5	1027.50	0.15	3.27	1027.49	3.36	3.8	80	254	228		60	48	58	
3	35	1030.65	0.13	2.92	1030.61	3.12	3.4	80	255	270		59	49	59	
2	38.5	1033.53	0.11	2.40	1033.49	2.88	3.0	79	257	275		54	50	58	
1	42	1036.31	0.10	2.18	1036.23	2.74	2.6	79	255	261		47	48	59	
12	45.5	1039.63	0.16	3.43	1039.67	3.44	4.0	88	257	252		30	53	59	
11	49	1043.06	0.15	3.24	1043.02	3.35	3.6	87	253	261		28	48	57	
10	52.5	1046.56	0.17	3.64	1046.55	3.54	4.0	88	256	272		32	49	56	
9	56	1050.14	0.17	3.61	1050.08	3.52	4.1	92	255	228		31	49	55	
8	59.5	1053.81	0.17	3.63	1053.61	3.53	4.0	88	254	260		30	51	59	
7	63	1057.20	0.17	3.63	1057.15	3.54	4.0	92	254	286		28	50	58	
6	66.5	1060.75	0.18	3.85	1060.80	3.65	4.2	89	253	228		38	47	53	
5	70	1064.39	0.18	3.88	1064.44	3.64	4.2	81	253	250		38	50	59	
4	73.5	1067.94	0.17	3.68	1068.01	3.57	4.2	83	255	276		39	51	59	
3	77	1071.42	0.16	3.47	1071.47	3.46	4.0	83	256	260		41	47	52	
2	80.5	1074.67	0.13	2.80	1074.57	3.09	3.3	82	255	249		46	46	53	
1	84	1077.77	0.12	2.59	1077.54	2.98	3.1	80	254	246		36	47	54	
	(856)														
Tot/Avg	θ= 84	V_m= 82.92	√ΔP= 0.3982	ΔH= 3.46				t_s= 83.7						t_m= 54.3	O_2= 20.9

Samples Recovered: Filter 0-1175 ; ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other ______

Sampling Train Leak Checks:
Pretest 0.00 @ 7.0 "Hg
Posttest 0.00 @ 8.0 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	71.1	107.4	4.2			1315.5	
Initial Volume	100	100	0			1282.5	
Difference	-28.9	7.4	4.2			33	15.7

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project	Grede-Iron Mountain 2020 Compliance w/	Module ID	CM-5	Pitot No. 3-01	C_p 0.84
Sample Location	No. 6 HMP - East Hunter (324632)	Meter Coef. γ	0.9916	Bar. Pres. 28.66 In. Hg	Manometer ID CM-5
Date 12/10/20	Test/Run T1 R 2	Orifice Coef. ΔH@	2.074	Static Pres. -0.35 In. H_2O	TC Sensor ID TC-44
Operators/Techs	ZHE / LMR	Nozzle No. 55	D_n 0.374	Est. Moist. 1 %v/v (ZHE RE 1/7/21)	Barometer ID DB-6
					Scale ID DS-45

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incre-mental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(925)	78.11													
12	3.5	81.58	0.17	3.60	81.64	3.53	3.7	96	220	250	NA	47	54	58	20.9
11	7	85.01	0.16	3.43	85.09	3.45	3.8	90	225	263		49	50	56	
10	10.5	88.53	0.16	3.40	88.51	3.42	3.6	93	234	221		51	52	57	
9	14	92.11	0.17	3.59	92.03	3.52	3.9	97	242	254		50	52	57	
8	17.5	95.60	0.17	3.59	95.55	3.52	3.9	97	252	284		50	52	57	
7	21	99.13	0.17	3.59	99.07	3.52	3.9	98	254	233		50	53	58	
6	24.5	102.96	0.18	3.82	102.70	3.63	4.1	96	254	219		59	52	57	
5	28	106.40	0.18	3.84	106.34	3.64	4.0	92	253	236		56	52	57	
4	31.5	109.84	0.16	3.44	109.79	3.44	3.8	88	255	286		58	51	55	
3	35	113.18	0.15	3.24	113.12	3.34	3.8	84	255	227		60	54	58	
2	38.5	116.37	0.14	3.02	116.36	3.23	3.0	87	255	219		58	51	58	
1	42	119.60	0.14	3.05	119.60	3.24	3.0	81	250	224		58	51	58	
12	45.5	123.14	0.18	3.89	123.27	3.67	4.0	84	252	279		64	55	59	
11	49	126.82	0.17	3.68	126.84	3.57	4.1	86	255	263		61	53	58	
10	52.5	130.43	0.18	3.89	130.51	3.67	3.9	85	255	225		59	53	58	
9	56	133.98	0.18	3.86	134.17	3.65	3.9	90	255	275		56	52	57	
8	59.5	137.73	0.19	4.09	137.92	3.76	4.3	87	255	244		59	54	57	
7	63	141.51	0.18	3.87	141.58	3.66	4.1	89	254	230		62	53	56	
6	66.5	145.04	0.18	3.44	145.02	3.44	3.9	88	254	272		57	56	59	
5	70	148.83	0.19	4.09	148.79	3.77	4.2	90	255	249		54	57	61	
4	73.5	152.57	0.18	3.89	152.47	3.68	4.0	89	254	232		57	55	58	
3	77	156.22	0.19	4.10	156.24	3.77	4.3	88	254	268		53	56	59	
2	80.5	159.61	0.15	3.23	159.59	3.35	3.6	90	254	234		54	57	60	
1	84	163.09	0.16	3.50	163.08	3.49	3.8	82	253	225		53	56	60	
	(1052)														
Tot/Avg	θ= 84	V_m= 84.98	√ΔP=0.4169	ΔH=3.63				t_s=89.5						t_m=55.6	O_2=20.9

Samples Recovered: Filter 0-1144; ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:

Pretest 0.00 @ 10.0 "Hg

Posttest 0.00 @ 8.0 "Hg

Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	66.0	114.4	5.4			1431.5	
Initial Volume	100	100	0			1401.5	
Difference	-34.0	14.4	5.4			30	15.8

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project	Grede-Iron Mountain 2020 Compliance w/i	Module ID	CM-5	Pitot No.	3-01 Cp 0.84
Sample Location	No. 6 HMP - East Hunter (324632)	Meter Coef. γ	0.9916	Bar. Pres.	~~0.35~~ 28.66 ZHE 12/10/20 In. Hg
Date 12/10/20	Test/Run T1 R3	Orifice Coef. ΔH@	2.074	Static Pres.	-0.35 In. H₂O
Operators/Techs	ZHE/LMR	Nozzle No. 55	Dn 0.370	Est. Moist.	1 %v/v ZHE (RE) 1/7/21

Manometer ID CM-5

TC Sensor ID TC-44

Barometer ID DB-60

Scale ID DS-45

Trav. Point No.	Time ΔT 1210	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1112)	163.35													
12	3.5	166.98	0.17	3.65	166.92	3.57	4.0	94	255	220	NA	52	67	70	20.9
11	7	170.65	0.18	3.93	170.65	3.73	4.4	94	255	235		48	64	69	
10	10.5	174.39	0.18	3.92	174.37	3.72	4.5	93	255	285		48	62	68	
9	14	178.10	0.18	3.92	178.09	3.71	4.5	92	254	262		53	62	68	
8	17.5	181.93	0.18	3.90	181.80	3.71	4.5	94	253	236		52	63	70	
7	21	185.55	0.18	3.91	185.51	3.72	4.3	94	255	275		53	60	70	
6	24.5	189.24	0.18	3.85	189.20	3.68	4.3	101	255	251		54	63	70	
5	28	193.18	0.20	4.31	193.10	3.90	5.0	99	255	233		58	61	66	
4	31.5	196.74	0.16	3.45	196.58	3.48	4.1	95	257	270		55	61	67	
3	35	200.34	0.17	3.70	200.19	3.61	4.1	90	255	239		55	61	68	
2	38.5	203.63	0.13	2.86	203.36	3.17	3.2	86	254	227		58	63	69	
1	42	207.18	0.16	3.50	206.88	3.52	3.8	90	255	221		57	62	69	
12	45.5	210.49	0.15	3.25	210.26	3.38	3.7	95	260	290		59	64	69	
11	49	213.85	0.15	3.25	213.65	3.39	3.8	95	254	241		58	64	70	
10	52.5	218.11	0.16	3.44	217.14	3.49	3.6	100	248	265		58	63	69	
9	56	220.56	0.17	3.65	220.73	3.59	3.8	100	247	273		60	64	69	
8	59.5	224.36	0.18	3.86	224.43	3.69	3.9	102	257	224		60	65	71	
7	63	228.15	0.18	3.88	228.13	3.71	4.5	101	259	269		62	65	70	
6	66.5	231.93	0.18	3.89	231.84	3.71	4.6	99	258	229		62	65	70	
5	70	235.46	0.16	3.51	235.37	3.53	4.2	90	253	239		63	66	71	
4	73.5	238.92	0.15	3.29	238.78	3.42	4.0	91	255	271		64	66	71	
3	77	242.18	0.14	3.07	242.08	3.30	3.9	92	244	243		63	68	74	
2	80.5	245.53	0.14	3.10	245.41	3.33	2.3	88	243	225		65	67	71	
1	84	248.68	0.12	2.67	248.48	3.08	3.0	84	251	220		64	66	72	
	(1339)														
Tot/Avg	θ= 84	V_m= 85.33	√ΔP= 0.4050	ΔH= 3.57				t_s= 94.1						t_m= 66.7	O_2= 20.9

Samples Recovered: Filter 0-1148 ; ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:

Pretest 0.00 @ 9.0 "Hg

Posttest 0.00 @ 8.0 "Hg

Pitot - Pos. ✓ Neg. ✓

Comments:

ready to start @ 1110 told to wait start time for change #REF! in plant

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	64.8	113.2	5.7			1328.8	
Initial Volume	100	100	0			1315.5	
Difference	-35.2	13.2	5.7			13.3	7

Pace Analytical®
Field Services Division

Field Calculation Summary

Computer Initialization and Run Summary

The data on this form is preliminary and includes estimates.
It is not intended to reflect final results.

Project Grede-Iron Mountain 2020 Co Site
Sample Location No. 6 HMP - East Hunter (3246
Date 12/10/20
Tech. ZHE

Initialization Parameters						
Parameter	**Initial**	**Run_1**	**Run_2**	**Run_3**	**Run_4**	**Run_5**
Meter Coefficient - ϒ	0.9916					
Orifice Coefficient - ΔH@	2.074					
Pitot Coefficient - C_p	0.84					
Nozzle Diameter - D_n	0.370					
Barometric Pressure - P_b	28.66	→	→	→		
Static Pressure - P_g	-0.35	→	→	→		
Oxygen Estimate - %O_2	20.9	→	→	→		
Moisture Estimate - %MC	1	1	1	1		
No. of Traverse Points	24					
Point Duration - ΔT	3.5					
Meter Start Temp, °F - t_m	63	63	55	60		
Initial Meter Volume - V_i	994.85	994.85	78.11	163.35		
Duct Shape (Rnd/Rect)	Rnd					
Duct Width, Inches	24					
Duct Depth, Inches	24					
Final Volume - V_f		1077.77	163.09	248.68		
Total Run Time - θ		84	84	84		
Condensate Volume, ml (g)		15.7	15.8	7		
End of Run Summary						
Average Sq. Rt. of the ΔP	√ΔP	0.3982	0.4109	0.4050		
Average Orifice Meter	ΔH	3.46	3.63	3.57		
Average Stack Temperature	t_s	83.7	89.5	94.1		
Average Meter Temperature	t_m	54.3	55.6	66.7		
Sample Volume, Actual	V_m	82.92	84.98	85.33		
Sample Volume, Dry Standar	V_{std}	81.57	83.43	81.99		
Moisture Content	MC	0.90	0.88	0.40		
Estimated Mole. Wt., dry	M_d					
Estimated Mole. Wt., wet	M_w					
Average Gas Velocity	V_s	23.24	24.11	23.84		
Isokinetic Variation	%I	101.3	100.9	100.7		
Volumetric Airflow, Actual	ACFM	4380	4540	4490		
Volumetric Airflow, Standard	SCFM	4070	4180	4090		
Volumetric Airflow, Dry Std.	DSCFM	4030	4140	4070		

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Equipment & Method Summary

Isokinetic and Associated Testing

Group 1 QI ZHE Group 4 QI ____

Project Name: Grede-Iron Mountain 2020 Compliance w/(Test Date: ____
Sampling Location: No. 6 HMP - East Hunter (324632) Recorded By: ____

Airflow Determination EPA Method: ☒ 2 ☐ 2C ☐ Other ____ Initials

Pitot Tube No.: 3-01 Coef.: 0.84 Next Ver. Date: 1/1/21 Pre-Use Insp.: ZHE
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: CM-5 ☒ Oil ☐ Digital Next Ver. Date: 2/11/21 Pre-Use Insp.: ZHE
Manometer ID: ____ ☐ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
Barometer ID: DB-60 ☐ Aneroid ☒ Digital Next Ver. Date: 2/22/21 Pre-Use Insp.: ZHE
Barometer ID: ____ ☐ Aneroid ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout TC-44 ☐ Single ☒ Dual Next Ver. Date: 10/31/20 Pre-Use Insp.: ZHE
T/C Readout ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____

Gas Composition EPA Method: ☐ 3 ☐ 3/3A ☐ 3B ☐ 3C ☒ Ambient ☐ ____ Initials

Container Type: ☐ Tedlar ☐ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ____
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☐ Instrumental: Instrument ID: ____ Cal Range ____
Ambient Provision Oxygen Verification: Portable O2 ID ____ Ambient Cal Reading: ____
Note: Portable O2 results are not reported as test data

Moisture Content EPA Method: ☒ 4, back-half of iso train ☐ Other ____ Explain in Options/Deviations Section Initials

Wt. Scale ID: DS-45 ☒ Digital ☐ Beam Next Ver. Date: 7/7/21 Pre-Use Insp.: ZHE
Std. Weight ID: ____ Std. Weight (g): ____ Scale Reading: ____ ☐ Pass ☐ Fail

Isokinetic EPA Method: ☒ 5 ____ ☐ 8 ☐ 17 ☐ 23 ☐ 26A ☐ 29 ☐ Other ____ Initials

Nozzle ID: ____ Type: ☒ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____
Nozzle Cal.: 1 .370 | 2 .371 | 3 .373 | 4 .372 | 5 .371 | Avg .3.71 Pre-Use Insp.: TJB
Nozzle ID: ____ Type: ☐ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____
Nozzle Cal.: 1 | 2 | 3 | 4 | 5 | Avg Pre-Use Insp.: ____
Probe Length: 3 ft. Liner: ☐ SS ☒ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: 3-01 Coef.: 0.84 Next Ver. Date: 1/1/21 Pre-Use Insp.: ZHE
Probe Length: ____ ft. Liner: ☐ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Control Mod ID: CM-5 ϒ: 0.9916 ΔH@: 2.074 Next Ver. Date: 2/11/21 Pre-Use Insp.: ZHE
Control Mod ID: ____ ϒ: ____ ΔH@: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Filter Type: ☐ 2½" Round ☒ 4" Round ☐ Thimble ☐ Other ____
Filter Media: ☒ Glass Fiber ☐ Quartz Fiber ☐ Paper ☐ Teflon ☐ SS ☐ Other ____
Wet Catch: ☐ EPA 202 ☐ EPA 8 ☐ EPA 23 ☐ EPA 26A ☐ EPA 29 ☐ Other ____
WC Options/Deviations: ____

Field Data Sheets - 324662

EPA Method 1 Field Data Sheet

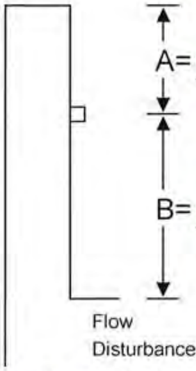
Test Site and Traverse Point Selection

Pace Analytical®
Field Services Division

SB

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location No. 7 HMP - West Hunter (324662)
Date 12-8-20 Test/Run T1 R 1
Tech(s) SB / JP

☐ New Sketch Created With Dimensions
☒ File Drawing Verified and Attached
☒ Cyclonic Flow Measured (See M-2 Sheet)



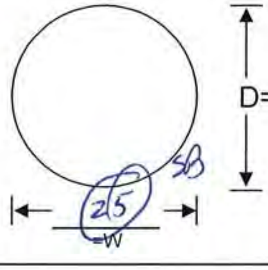
A= 13 SB

B= 138 SB

Disturbance Type

Before (B)		After (A)
☐	Elbow	☐
☐	Conjunction	☐
☐	Fan (cent)	☐
☐	Axial Fan	☒
☐	Transition	☐
☐	Damper	☐
☐	Exit	☐
☐	Other ________	☐

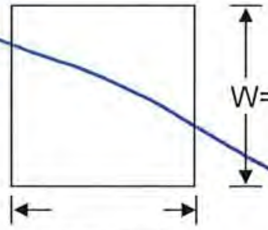
☒ Round



D= 25 SB

25 SB =W

☐ Rectangular



W= ________

=D

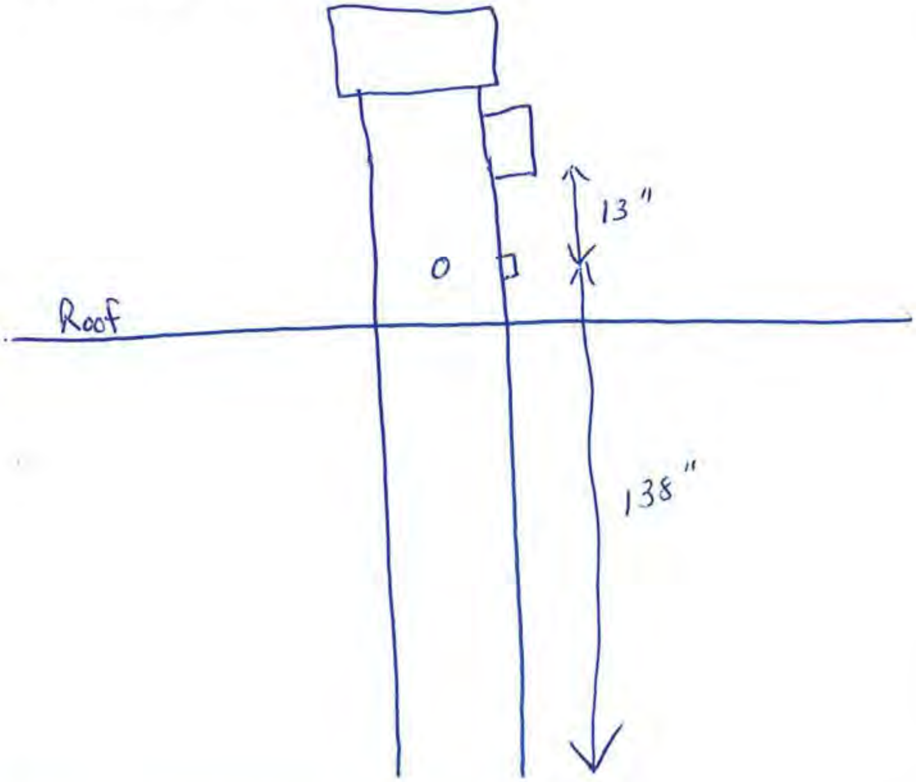
Duct Orientation

☒ Vertical
☐ Horizontal
☐ Diagonal
2 No. of Traverses

A= 0.5 Diameters to downstream
B= 5.5 Diameters to upstream
T_R= 24 Min. Traverse Points (iso)
T_A= 24 Traverse Points Used

Traverse Points (from wall)

Sketch of test location with dimensions and process equipment.



If file drawing, correct or circle dimensions as they are verified.

Pace Analytical®
Field Services Division

EPA Method 2 Field Data Sheet

Volumetric Airflow Determinations

(53)

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location No. 7 HMP - West Hunter (324662)
Date 12-8-20 Test/Run T1 R1
Duct Dimensions 25" round Inches
Port Length 6" Inches
Pitot Leak Check - Pos ✓ Neg ✓

Manometer Type and ID CM-1
Barometer Type and ID DB-35
Thermocouple Sensor ID CM-1
Pitot Tube No. 3-01 Cp 0.84
Technicians SB / JP
#REF!
FSD PN: 20-04074

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From Wall	Inches From Port	Flow °Yaw	Run 1 ΔP	Run 2 ΔP	Run 3 ΔP	Run 4 ΔP	Run 1 °F	Run 2 °F	Run 3 °F	Run 4 °F
A-1	0.53	6.53	5	0.50				85			
2	1.67	7.67	0	0.53							
3	2.95	8.95	0	0.55							
4	4.43	10.43	0	0.53							
5	6.25	12.25	0	0.50							
6	8.89	14.89	0	0.43							
7	16.11	20.11	0	0.38							
8	18.75	24.75	0	0.36							
9	20.57	26.57	0	0.50							
10	22.05	28.05	0	0.53							
11	23.33	29.33	0	0.63							
12	24.47	30.47	0	0.65							
B-1	0.53	6.53	0								
2	1.67	7.67	0								
3	2.95	8.95	0								
4	4.43	10.43	0								
5	6.25	12.25	0								
6	8.89	14.89	3								
7	16.11	20.11	0								
8	18.75	24.75	0								
9	20.57	26.57	0								
10	22.05	28.05	0								
11	23.33	29.33	0								
12	24.47	30.47	0								

SB SB SB SB

Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	28.65				"Hg
Static Pressure	-0.5				"H_2O
Dry Bulb Temp.	85				°F
Wet Bulb Temp.	—	—	—	—	°F
Moisture Content	1				%v/v
320 P Oxygen	20.9	20.9	20.9		%v/v
Time of Meas.	0830				(24 Hour)

SB

Pace Analytical® *Field Services Division*

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

(5B)

Project Grede-Iron Mountain 2020 Compliance w/(
Sample Location No. 7 HMP - West Hunter (324662)
Date 12-8-20 Test/Run T1 R1
Operators/Techs SB / JP

Module ID CM-1
Meter Coef. γ 0.9959
Orifice Coef. ΔH@ 1.821
Nozzle No. 12 D_n .260

Pitot No. ~~28.65~~ 3-01(3) C_p 0.84
Bar. Pres. 28.65 In. Hg
Static Pres. -0.5 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-1
TC Sensor ID CM-1
Barometer ID DB-35
Scale ID DS-42

	Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
		(0748)	744.152													
A	1	4	747.40	0.45	2.03	747.34	3.19	2.0	88	245	244	N/A	41	63	65	20.9
	2	8	750.93	0.50	2.35	750.83	3.49	2.0	85	245	244		41	63	65	
	3	12	754.50	0.53	2.49	754.43	3.60	2.0	85	249	251		42	63	65	
	4	16	758.20	0.53	2.47	758.01	3.58	2.0	90	249	255		44	65	64	
	5	20	761.75	0.51	2.39	761.53	3.52	2.0	89	250	245		44	66	64	
	6	24	765.20	0.47	2.21	764.92	3.39	2.0	87	250	248		44	67	64	
	7	28	769.00	0.62	2.89	768.80	3.88	3.0	92	250	249		44	68	64	
	8	32	773.10	0.68	3.18	772.87	×4.07	3.0	90	250	249		44	69	65	
	9	36	777.40	0.72	3.36	777.06	4.19	3.5	93	251	251		45	69	65	
	10	40	781.22	0.65	3.02	781.03	3.97	3.0	95	250	247		46	70	65	
	11	44	785.09	0.57	2.64	784.75	3.72	3.0	97	251	247		46	70	66	
	12	48	788.90	0.42	1.95	787.94	3.14	2.0	98	249	246		47	70	66	
B	1	52	791.78	0.44	2.05	791.21	3.27	2.0	95	251	245		47	67	66	
	2	56	795.00	0.46	2.15	794.56	3.35	2.0	92	249	242		47	67	67	
	3	60	797.95	0.36	1.68	797.52	2.96	2.0	93	249	251		47	69	67	
	4	64	801.40	0.48	2.24	800.93	3.42	2.0	95	249	252		47	70	67	
	5	68	804.90	0.46	2.15	804.29	3.35	2.0	94	250	254		47	70	67	
	6	72	808.40	0.48	2.25	807.72	3.43	2.0	92	249	246		46	71	67	
	7	76	812.00	0.56	2.65	808.48	3.72	3.0	88	250	249		47	71	67	
	8	80	815.90	0.60	2.85	815.30	3.86	3.0	87	250	254		46	71	67	
	9	84	819.90	0.61	2.89	819.19	3.89	3.0	87	249	255		47	72	68	
	10	88	823.63	0.57	2.68	822.94	3.75	3.0	91	250	254		47	72	68	
	11	92	827.00	0.45	2.13	826.29	3.34	2.0	88	249	246		47	73	69	
	12	96	830.346	0.45	2.15	829.65	3.36	3.0	85	250	246		47	72	69	
		(0927)	.	.	.			.								
			.	.	.			.								
	Tot/Avg	θ= 96	V_m= 86.19	√ΔP=0.72	ΔH=2.45				t_s= 90.7						t_m=67.4	O_2= 20.9

Samples Recovered: Filter 0-1147 (0.50564) ; ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 10 "Hg
Posttest 0.00 @ 6 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	81.9	112.4	2.8	/	/	1282.1	
Initial Volume	100	100	0	/	/	1265.6	
Difference	-18.1	12.4	2.8	/	/	16.5	13.6

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

54

Project	Grede-Iron Mountain 2020 Compliance w/	Module ID	CM-1	Pitot No.	3-61 C_p 0.84	Manometer ID	CM-1
Sample Location	No. 7 HMP - West Hunter (324662)	Meter Coef. γ	0.9959	Bar. Pres.	28.65 In. Hg	TC Sensor ID	CM-1
Date	12-8-20 Test/Run T1 R2	Orifice Coef. $\Delta H@$	1.821	Static Pres.	-0.50 In. H_2O	Barometer ID	DB-35
Operators/Techs	SB / JP	Nozzle No.	12 D_n .260	Est. Moist.	1 %v/v	Scale ID	DS-42

	Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
		(0959)	831.200													
A	1	3	833.400	0.40	1.78	833.44	2.24	2.0	95	250	249	N/A	41	68	67	20.9
	2	6	836.05	0.49	2.25	836.01	2.57	2.0	100	249	246		41	66	67	
	3	9	838.75	0.51	2.36	838.64	2.63	2.0	97	249	246		41	68	68	
	4	12	841.40	0.51	2.38	841.29	2.65	2.0	93	249	248		41	69	68	
	5	15	844.05	0.51	2.35	843.92	2.63	2.0	101	249	246		42	70	68	
	6	18	846.70	0.51	2.39	846.58	2.66	2.0	92	249	255		43	71	68	
	7	21	849.50	0.57	2.65	849.38	2.80	3.0	97	248	250		43	72	68	
	8	24	852.48	0.61	2.88	852.29	2.91	3.0	90	249	250		43	73	69	
	9	27	855.50	0.64	3.01	855.28	2.99	3.0	92	250	250		44	75	69	
	10	30	858.25	0.52	2.47	857.98	2.71	3.0	88	250	246		44	75	70	
	11	33	860.95	0.50	2.36	860.63	2.65	3.0	92	250	254		45	75	70	
	12	36	863.67	0.52	2.46	863.33	2.70	3.0	92	250	255		45	76	71	
B	1	39	866.35	0.52	2.46	866.03	2.70	3.0	92	250	254		46	72	71	
	2	42	869.10	0.51	2.40	868.70	2.68	3.0	94	250	250		45	74	72	
	3	45	871.80	0.45	2.12	871.21	2.57	3.0	93	249	246		45	75	72	
	4	48	874.50	0.55	2.61	873.99	2.78	3.0	91	250	251		45	77	72	
	5	51	877.20	0.51	2.43	876.68	2.69	3.0	90	250	245		45	78	72	
	6	54	879.85	0.49	2.32	879.31	2.63	3.0	93	249	246		45	79	73	
	7	57	882.80	0.62	2.94	882.27	2.96	3.0	94	249	251		44	75	75	
	8	60	885.90	0.68	3.19	885.35	3.08	3.0	98	248	253		43	76	75	
	9	63	889.17	0.70	3.29	888.49	3.13	3.0	98	250	245		44	77	75	
	10	66	892.10	0.67	3.12	891.54	3.05	3.0	104	249	253		44	78	75	
	11	69	894.93	0.55	2.61	894.33	2.79	3.0	94	250	246		44	80	76	
	12	72	897.500	0.45	2.12	896.85	2.52	3.0	99	250	247		45	80	76	
		(1200)	.	.	.			.								
			.	.	.			.								
	Tot/Avg	θ= 72	V_m= 66.30	$\sqrt{\Delta P}$=0.73	ΔH=2.54				t_s=94.5						t_m=72.6	O_2=20.9

Samples Recovered: Filter 9-1040 (0.50387); ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other ______

Sampling Train Leak Checks:
Pretest 0.00 @ 6 "Hg
Posttest 0.00 @ 5 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	91.7	105.6	1.8	/	/	1293.8	
Initial Volume	100	100	0	/	/	1282.1	
Difference	-8.3	5.6	1.8	/	/	11.7	10.8

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

SB

Project Grede-Iron Mountain 2020 Compliance w/ Module ID CM-1 Pitot No. 3-01 C_p 0.84 Manometer ID CM-1
Sample Location No. 7 HMP - West Hunter (324662) Meter Coef. γ 0.9959 Bar. Pres. 28.65 In. Hg TC Sensor ID CM-1
Date 12-8-20 Test/Run T1 R3 Orifice Coef. ΔH@ 1.821 Static Pres. -0.5 In. H_2O Barometer ID DB-35
Operators/Techs SB/JP Nozzle No. 12 D_n .260 Est. Moist. 1 %v/v Scale ID DS-42

	Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
		(1225)	897.800													
A	1	3	900.300	0.45	2.13	900.31	2.51	2.0	90	244	232	NA	46	77	76	20.9
	2	6	903.18	0.55	2.61	903.10	2.79	2.0	94	245	240		46	75	76	
	3	9	906.00	0.55	2.60	905.89	2.79	2.0	94	245	244		44	77	76	
	4	12	908.80	0.55	2.61	908.68	2.79	2.0	94	241	247		44	77	76	
	5	15	911.50	0.51	2.42	911.37	2.69	2.0	94	244	255		44	78	76	
	6	18	914.24	0.51	2.42	914.06	2.69	2.0	95	248	250		44	79	76	
	7	21	917.20	0.60	2.85	916.98	2.92	2.0	93	249	246		44	80	77	
	8	24	920.30	0.68	3.19	920.08	3.09	3.0	102	250	255		44	81	77	
	9	27	923.20	0.55	2.62	922.88	2.80	3.0	94	250	247		45	82	77	
	10	30	926.25	0.67	3.14	925.95	3.07	3.0	103	251	245		45	82	78	
	11	33	929.06	0.55	2.57	928.74	2.78	3.0	105	250	246		46	83	78	
	12	36	931.70	0.48	2.26	931.35	2.61	2.0	101	250	248		47	82	78	
B	1	39	934.30	0.48	2.30	933.98	2.63	2.0	92	250	247		46	80	79	
	2	42	937.00	0.50	2.39	936.66	2.68	2.0	92	249	250		46	80	79	
	3	45	939.60	0.50	2.35	939.32	2.66	2.0	101	249	244		45	81	80	
	4	48	942.35	0.50	2.38	942.00	2.68	2.0	96	249	253		45	82	80	
	5	51	945.10	0.50	2.37	944.67	2.67	2.0	98	249	255		46	83	80	
	6	54	947.80	0.51	2.44	947.39	2.72	2.0	93	250	246		46	84	81	
	7	57	950.65	0.58	2.76	950.27	2.89	3.0	99	250	244		46	85	81	
	8	60	953.40	0.50	2.41	952.97	2.70	2.5	91	250	248		46	85	81	
	9	63	956.35	0.60	2.85	955.91	2.94	3.0	99	249	255		47	85	81	
	10	66	958.94	0.47	2.26	958.52	2.61	2.0	93	249	243		47	85	82	
	11	69	961.48	0.45	2.16	961.08	2.56	2.0	94	250	246		48	85	82	
	12	72	964.00	0.45	2.17	963.65	2.56	2.0	91	250	256		48	86	82	
		(1341)	.	.	.			.								
			.	.	.			.								
	Tot/Avg	θ= 72	V_m= 66.20	√ΔP=0.73	ΔH= 2.51				t_s=95.8						t_m=80.1	O_2=20.9

Samples Recovered: Filter 0-1141 (0.50609); ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 8 "Hg
Posttest 0.00 @ 6 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	87.2	109.2	2.7	—	—	1306.3	
Initial Volume	100	100	0	—	—	1293.8	
Difference	-12.8	9.2	2.7	—	—	12.5	11.6

Pace Analytical®
Field Services Division

Field Calculation Summary

Computer Initialization and Run Summary

The data on this form is preliminary and includes estimates.
It is not intended to reflect final results.

Project Grede-Iron Mountain 2020 Co Site ____________ Date 12-8-20
Sample Location No. 7 HMP - West Hunter (324662) Tech. SB/JP

Initialization Parameters						
Parameter	**Initial**	**Run_1**	**Run_2**	**Run_3**	**Run_4**	**Run_5**
Meter Coefficient - Υ	0.9959					
Orifice Coefficient - ΔH@	1.821					
Pitot Coefficient - C_p	0.84					
Nozzle Diameter - D_n	.240					
Barometric Pressure - P_b	28.65	→	→	→		
Static Pressure - P_g	-0.5	→	→	→		
Oxygen Estimate - %O_2	20.9	→	→	→		
Moisture Estimate - %MC	1	→	→	→		
No. of Traverse Points	24					
Point Duration - ΔT	3					
Meter Start Temp, °F - t_m	64	64.0	67.5	76.5		
Initial Meter Volume - V_i	744.152	744.152 ~~831.20~~	831.20	897.800		
Duct Shape (Rnd/Rect)	Rnd					
Duct Width, Inches	25					
Duct Depth, Inches	25					
Final Volume - V_f		830.35	897.50	964.00		
Total Run Time - θ		96	72	72		
Condensate Volume, ml (g)		13.6	10.8	11.6		
End of Run Summary						
Average Sq. Rt. of the ΔP	√ΔP	0.7212	0.7340	0.726		
Average Orifice Meter	ΔH	2.45	2.54	2.51		
Average Stack Temperature	t_s	90.7	94.5	95.8		
Average Meter Temperature	t_m	67.4	72.6	80.1		
Sample Volume, Actual	V_m	86.19	66.30	66.20		
Sample Volume, Dry Standar	V_{std}	82.81	63.08	62.12		
Moisture Content	MC	0.77	0.80	0.87		
Estimated Mole. Wt., dry	M_d	29.0	29.0	29.0		
Estimated Mole. Wt., wet	M_w					
Average Gas Velocity	V_s	42.37	43.27	42.85		
Isokinetic Variation	%I	101.2	101.4	101.0		
Volumetric Airflow, Actual	ACFM	8670	8850	8760		
Volumetric Airflow, Standard	SCFM	7950	8060	7960		
Volumetric Airflow, Dry Std.	DSCFM	7890	8000	7890		

Pace Analytical®
Field Services Division

Equipment & Method Summary

Isokinetic and Associated Testing

Group 1 QI SB Group 4 QI ____

Project Name: Grede-Iron Mountain 2020 Compliance w/(Test Date: 12-8-20
Sampling Location: No. 7 HMP - West Hunter (324662) Recorded By: SB

Airflow Determination

EPA Method: ☒ 2 ☐ 2C ☐ Other ________ Initials

Pitot Tube No.: 3-01 Coef.: 0.84 Next Ver. Date: 1-1-21 Pre-Use Insp.: ✓
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: CM-1 ☒ Oil ☐ Digital Next Ver. Date: 1-13-21 Pre-Use Insp.: ✓
Manometer ID: ____ ☐ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
Barometer ID: DB-35 ☐ Aneroid ☒ Digital Next Ver. Date: 3-22-21 Pre-Use Insp.: ✓
Barometer ID: ____ ☐ Aneroid ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout CM-1 ☒ Single ☐ Dual Next Ver. Date: 1-13-21 Pre-Use Insp.: ✓
T/C Readout ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____

Gas Composition

EPA Method: ☐ 3 ☐ 3/3A ☐ 3B ☐ 3C ☒ Ambient ☐ ____ Initials

Container Type: ☐ Tedlar ☐ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ____
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☐ Instrumental: Instrument ID: ____ Cal Range ____
Ambient Provision Oxygen Verification: Portable O2 ID ____ Ambient Cal Reading: ____
Note: Portable O2 results are not reported as test data

Moisture Content

EPA Method: ☒ 4, back-half of iso train ☐ Other ___ Explain in Options/Deviations Section Initials

Wt. Scale ID: DS-42 ☒ Digital ☐ Beam Next Ver. Date: 4-6-21 Pre-Use Insp.: ✓
Std. Weight ID: ____ Std. Weight (g): ____ Scale Reading: ____ ☐ Pass ☐ Fail

Isokinetic

EPA Method: ☒ 5 __ ☐ 8 ☐ 17 ☐ 23 ☐ 26A ☐ 29 ☐ Other __ Initials

Nozzle ID: 12 Type: ☒ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____

Nozzle Cal.:

1	2	3	4	5	Avg
.260	.260	.260	.260	.260	.260

Pre-Use Insp.: ✓

Nozzle ID: ____ Type: ☐ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____

Nozzle Cal.:

1	2	3	4	5	Avg

Pre-Use Insp.: ____

Probe Length: 3 ft. Liner: ☐ SS ☒ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: 3-01 Coef.: 0.84 Next Ver. Date: 1-1-21 Pre-Use Insp.: ✓
Probe Length: ____ ft. Liner: ☐ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Control Mod ID: CM-1 ϒ: 0.9959 ΔH@: 1.821 Next Ver. Date: 1-13-21 Pre-Use Insp.: ✓
Control Mod ID: ____ ϒ: ____ ΔH@: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Filter Type: ☐ 2½" Round ☒ 4" Round ☐ Thimble ☐ Other ________
Filter Media: ☒ Glass Fiber ☐ Quartz Fiber ☐ Paper ☐ Teflon ☐ SS ☐ Other ____
Wet Catch: ☐ EPA 202 ☐ EPA 8 ☐ EPA 23 ☐ EPA 26A ☐ EPA 29 ☐ Other ___
WC Options/Deviations: ________

Field Data Sheets - 324678

Pace Analytical®
Field Services Division

EPA Method 1 Field Data Sheet

Test Site and Traverse Point Selection

SB

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location Disa Exhaust (324678)
Date 12-9-20 Test/Run T1 R 1
Tech(s) SB / JP

☐ New Sketch Created With Dimensions
☒ File Drawing Verified and Attached
☒ Cyclonic Flow Measured (See M-2 Sheet)

A= 58 SB
B= 86 SB
Flow Disturbance

Disturbance Type

Before (B)		After (A)
☐	Elbow	☐
☐	Conjunction	☐
☐	Fan (cent)	☐
☐	Axial Fan	☒
☐	Transition	☐
☐	Damper	☐
☐	Exit	☐
☐	Other ______	☐

☒ Round
D= 42 SB
42 =W SB

☐ Rectangular
W= ______
=D ______
SB

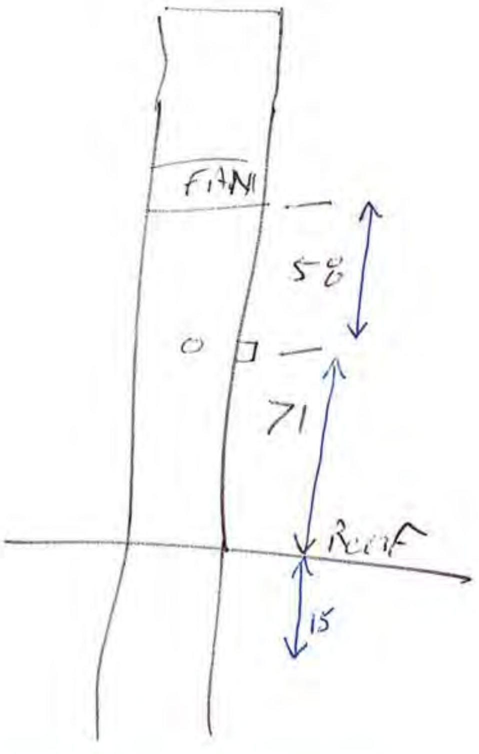
Duct Orientation
☒ Vertical
☐ Horizontal
☐ Diagonal
2 No. of Traverses

A= 1.4 Diameters to downstream
B= 2.0 Diameters to upstream
T_R= 24 Min. Traverse Points (iso)
T_A= 24 Traverse Points Used

Traverse Points (from wall)

A	1	0.89
	2	2.81
	3	4.96
	4	7.44
	5	10.50
	6	14.94
	7	27.06
	8	31.50
	9	34.56
	10	37.04
	11	39.19
	12	41.11
B	1	0.89
	2	2.81
	3	4.96
	4	7.44
	5	10.50
	6	14.94
	7	27.06
	8	31.50
	9	34.56
	10	37.04
	11	39.19
	12	41.11

Sketch of test location with dimensions and process equipment.



If file drawing, correct or circle dimensions as they are verified.

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EPA Method 2 Field Data Sheet

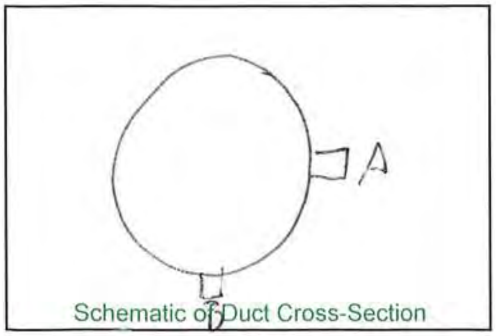
Volumetric Airflow Determinations

SB

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location Disa Exhaust (324678)
Date 12-9-20 Test/Run T1 R1
Duct Dimensions 42 x 42 Inches
Port Length 6 Inches
Pitot Leak Check - Pos ✓ Neg ✓

Manometer Type and ID CM-1
Barometer Type and ID DB-35
Thermocouple Sensor ID CM-1
Pitot Tube No. 4-06 Cp 0.84
Technicians SB / JP
#REF!
FSD PN: 20-04074

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From Wall	Inches From Port	Flow °Yaw	Run 1 ΔP	Run 2 ΔP	Run 3 ΔP	Run 4 ΔP	Run 1 °F	Run 2 °F	Run 3 °F	Run 4 °F
A 1	0.89	6.89	10	.32				71			
2	2.81	8.81	10	.32							
3	4.96	10.96	5	.32							
4	7.44	13.44	0	.32							
5	10.50	16.50	5	.30		SB					
6	14.94	20.94	5	.30						SB	
7	27.06	33.06	10	.28							
8	31.50	37.50	0	.30							
9	34.56	40.56	-5	.31							
10	37.04	43.04	-25	.34							
11	39.19	45.19	-30	.35							
12	41.11	47.11	-25	.30							
B 1	0.89	6.89	5								
2	2.81	8.81	5								
3	4.96	10.96	10								
4	7.44	13.44	7								
5	10.50	16.50	5				SB				
6	14.94	20.94	5								
7	27.06	33.06	-5								
8	31.50	37.50	-5								
9	34.56	40.56	-10								
10	37.04	43.04	-10								
11	39.19	45.19	-5								
12	41.11	47.11	0								
						SB					



Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	28.45				"Hg
Static Pressure	-0.25				"H_2O
Dry Bulb Temp.	71		SB		°F
Wet Bulb Temp.	—				°F
Moisture Content	1				%v/v
320 P Oxygen	20.9				%v/v
Time of Meas.	0730				(24 Hour)

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

SB

Project Grede-Iron Mountain 2020 Compliance w/(
Sample Location Disa Exhaust (324678)
Date 12-9-20 Test/Run T1 R1
Operators/Techs SB / JP

Module ID CM-1
Meter Coef. γ 0.9959
Orifice Coef. ΔH@ 1.821
Nozzle No. D_n .310

Pitot No. 4-06 C_p 0.84
Bar. Pres. 28.45 In. Hg
Static Pres. -0.25 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-1
TC Sensor ID CM-1
Barometer ID DB-35
Scale ID DS-42

	Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
		(1052)	965.100													
A	1	3	968.12	0.32	3.04	968.08	2.98	4.0	83	251	250	N/A	56	71	73	20.9
	2	6	970.40	0.17	1.65	970.30	2.22	2.0	82	250	250		56	72	73	
	3	9	973.55	0.34	3.30	973.44	3.14	4.0	83	249	261		54	73	73	
	4	12	976.63	0.32	3.11	976.49	3.05	4.0	83	248	251		54	75	73	
	5	15	979.70	0.32	3.11	979.54	3.05	4.0	83	249	241		59	75	73	
	6	18	982.60	0.28	2.75	982.40	2.87	4.0	79	250	251		59	76	74	
	7	21	985.70	0.31	3.11	985.46	3.05	4.0	68	252	254		60	77	75	
	8	24	988.70	0.30	3.01	988.47	3.01	4.0	68	249	251		60	78	75	
	9	27	991.95	0.34	3.51	991.71	3.25	4.0	55	248	246		59	79	76	
	10	30	995.00	0.31	3.14	994.79	3.05	4.0	65	249	254		60	80	76	
	11	33	998.100	0.30	3.03	997.82	3.02	4.0	67	250	231		60	81	77	
	12	36	1000.90	0.25	2.61	1000.62	2.81	3.5	52	250	240		60	82	77	
B	1	39	1003.60	0.25	2.54	1003.39	2.77	3.0	65	248	260		60	79	78	
	2	42	1006.50	0.27	2.66	1006.23	2.83	3.5	82	249	260		60	81	79	
	3	45	1009.30	0.25	2.46	1008.95	2.73	3.5	84	251	255		61	83	79	
	4	48	1012.00	0.25	2.46	1011.69	2.73	3.5	84	249	251		61	85	80	
	5	51	1014.60	0.20	1.97	1014.13	2.45	3.0	84	250	258		60	85	80	
	6	54	1017.20	0.22	2.20	1016.72	2.59	3.0	76	249	251		59	85	81	
	7	57	1019.95	0.25	2.54	1019.51	2.78	3.0	68	249	248		63	86	81	
	8	60	1023.20	0.35	3.64	1022.84	3.33	4.0	57	251	243		64	87	82	
	9	63	1026.60	0.37	3.86	1026.27	3.44	4.0	56	251	255		65	88	82	
	10	66	1029.60	0.28	2.93	1029.26	2.99	4.0	56	251	246		63	88	83	
	11	69	1032.74	0.31	3.24	1032.41	3.15	4.0	57	251	259		65	88	83	
	12	72	1035.60	0.25	2.61	1035.24	2.83	3.5	57	250	246		66	88	84	
		(1210)	.	.	.			.								
			.	.	.			.								
	Tot/Avg	θ= 72	V_m= 70.50	√ΔP= 0.53	ΔH= 2.85				t_s= 70.6						t_m= 79.3	O_2= 20.9

Samples Recovered: Filter 0-1142 (0.50329) ; ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 8 "Hg
Posttest 0.00 @ 8 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	88	109	0			1314.8	
Initial Volume	100	100	0			1306.3	
Difference	-12	9	0			8.5	5.5

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

5B

Project Grede-Iron Mountain 2020 Compliance w/i
Sample Location Disa Exhaust (324678)
Date 12-9-20 Test/Run T1 R2
Operators/Techs SB/JP

Module ID CM-1
Meter Coef. γ 0.9959
Orifice Coef. ΔH@ 1.821
Nozzle No. D_n .310

Pitot No. 4-06 C_p 0.84
Bar. Pres. 28.45 In. Hg
Static Pres. -0.25 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-1
TC Sensor ID CM-1
Barometer ID DB-35
Scale ID DS-42

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1251)	35.800													
A 1	3	38.70	0.28	2.82	38.72	2.92	4.0	71	228	241	N/A	55	85	84	20.9
2	6	41.60	0.25	2.59	41.53	2.81	3.5	61	229	242		56	84	83	
3	9	44.30	0.23	2.41	44.24	2.71	3.5	54	229	242		54	84	84	
4	12	47.30	0.28	2.91	47.22	2.98	4.0	58	232	245		58	85	84	
5	15	50.04	0.23	2.39	49.92	2.70	3.5	58	228	246		53	86	84	
6	18	52.80	0.23	2.40	52.63	2.71	3.5	57	235	248		52	87	84	
7	21	55.35	0.20	2.09	55.16	2.53	3.0	57	243	249		51	87	84	
8	24	58.60	0.35	3.66	58.50	3.34	3.5	57	247	250		51	87	84	
9	27	61.90	0.38	3.98	61.99	3.49	5.0	56	250	246		59	88	84	
10	30	65.00	0.35	3.62	65.32	3.33	5.0	63	251	256		58	88	84	
11	33	67.25	0.14	1.42	67.40	2.09	2.5	72	249	249		58	88	85	
12	36	70.00	0.25	2.51	70.18	2.77	3.5	79	249	251		59	88	85	
B 1	39	73.00	0.30	3.06	73.24	3.06	4.0	70	251	250		59	86	85	
2	42	75.80	0.25	2.59	76.06	2.82	3.5	61	249	246		58	86	85	
3	45	79.10	0.34	3.54	79.34	3.29	4.5	59	248	249		58	87	85	
4	48	82.40	0.32	3.34	82.54	3.20	4.5	58	249	250		57	88	85	
5	51	85.55	0.32	3.35	85.74	3.20	4.0	57	250	251		57	89	85	
6	54	88.60	0.29	3.03	88.79	3.05	4.0	58	250	251		57	89	85	
7	57	91.65	0.29	3.03	91.84	3.05	4.0	58	251	248		56	89	85	
8	60	94.70	0.29	3.03	94.89	3.05	4.0	58	251	248		56	90	85	
9	63	97.75	0.29	3.04	97.95	3.05	4.0	57	251	249		57	90	85	
10	66	100.90	0.30	3.14	101.05	3.11	4.0	57	250	249		59	90	85	
11	69	103.80	0.27	2.78	103.97	2.92	4.0	67	250	247		59	90	85	
12	72	106.78	0.28	2.90	106.96	2.98	4.0	64	250	247		58	91	86	
	(1406)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 72	V_m= 70.98	√ΔP= 0.53	ΔH= 2.90				t_s= 61.1						t_m= 86.1	O_2= 20.9

Samples Recovered: Filter 0-1145 (0.49984); ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 8 "Hg
Posttest 0.00 @ 8 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	85.9	107.8	6.0	/	/	1315.8	
Initial Volume	100	100	0	/	/	1314.8	
Difference	-14.1	7.8	6.0	/	/	1.0	0.7

Pace Analytical® *Field Services Division*

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

SB

Project Grede-Iron Mountain 2020 Compliance w/(Module ID CM-1 Pitot No. 4-06 C_p 0.84 Manometer ID CM-1
Sample Location Disa Exhaust (324678) Meter Coef. γ 0.9959 Bar. Pres. 28.45 In. Hg TC Sensor ID CM-1
Date 12-9-20 Test/Run T1 R3 Orifice Coef. ΔH@ 1.821 Static Pres. -0.25 In. H_2O Barometer ID DB-35
Operators/Techs SB/JP Nozzle No. D_n .310 Est. Moist. 1 %v/v Scale ID DS-42

	Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
		(1435)	~~[illegible]~~ 107.00													
A	1	3	110.05	0.29	2.99	110.01	3.01	3.5	58	228	248	N/A	55	87	84	20.9
	2	6	113.25	0.31	3.23	113.15	3.14	3.5	58	229	247		56	84	84	
	3	9	116.30	0.31	3.21	116.28	3.13	3.5	60	230	248		56	84	84	
	4	12	119.45	0.32	3.31	119.46	3.18	3.5	60	232	247		56	86	84	
	5	15	122.55	0.30	3.11	122.54	3.08	3.5	61	235	249		56	87	84	
	6	18	125.62	0.30	3.11	125.63	3.08	3.5	61	235	249		56	87	84	
	7	21	128.70	0.31	3.13	128.72	3.10	3.5	74	245	249		56	87	84	
	8	24	131.70	0.28	2.90	131.70	2.98	3.5	61	247	250		57	87	84	
	9	27	135.00	0.34	3.54	135.00	3.29	4.0	58	250	250		58	87	84	
	10	30	138.05	0.30	3.13	138.09	3.10	3.5	57	250	251		58	88	84	
	11	33	140.92	0.25	2.62	140.92	2.83	3.5	56	250	251		58	88	84	
	12	36	143.72	0.24	2.52	143.70	2.78	3.0	55	250	252		55	88	84	
B	1	39	146.47	0.25	2.53	146.49	2.79	3.0	73	247	252		55	85	83	
	2	42	149.25	0.25	2.46	149.22	2.74	3.0	88	245	251		56	85	83	
	3	45	152.00	0.25	2.45	151.96	2.73	3.0	90	246	251		56	86	83	
	4	48	154.50	0.21	2.06	154.46	2.51	3.0	90	247	252		57	87	83	
	5	51	156.65	0.15	1.47	156.58	2.12	2.0	89	249	251		52	88	83	
	6	54	159.20	0.21	2.10	159.12	2.54	3.0	79	252	251		53	88	84	
	7	57	162.20	0.29	2.95	162.12	3.00	3.5	72	252	251		53	89	84	
	8	60	165.55	0.37	3.86	165.56	3.44	4.0	58	251	246		53	89	84	
	9	63	168.95	0.37	3.89	169.02	3.45	4.0	55	250	247		53	90	84	
	10	66	172.20	0.33	3.48	172.28	3.27	4.0	54	250	247		53	90	85	
	11	69	175.22	0.28	2.95	175.29	3.01	3.5	54	251	248		54	90	85	
	12	72	178.227	0.28	2.95	178.30	3.01	3.5	54	249	250		52	90	86	
		(1550)	.	.	.			.								
			.	.	.			.								
	Tot/Avg	θ= 72	V_m= 71.23	√ΔP=0.53	ΔH=2.92				t_s=65.6						t_m=85.7	O_2=20.9

Samples Recovered: Filter 0-1146 (0.50377); ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 8 "Hg
Posttest 0.00 @ 6 "Hg
Pitot - Pos. ____ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	90.8	106.5	2.4	/	/	1317.1	
Initial Volume	100	100	0	/	/	1315.8	
Difference	-9.2	6.5	2.4	/	/	1.3	1.0

Pace Analytical®
Field Services Division

Field Calculation Summary

Computer Initialization and Run Summary

The data on this form is preliminary and includes estimates.
It is not intended to reflect final results.

Project Grede-Iron Mountain 2020 Co Site
Sample Location Disa Exhaust (324678)
Date 12-9-20
Tech. SB

Initialization Parameters						
Parameter	**Initial**	**Run_1**	**Run_2**	**Run_3**	**Run_4**	**Run_5**
Meter Coefficient - ϒ	0.9959					
Orifice Coefficient - ΔH@	1.821					
Pitot Coefficient - C_p	0.84					
Nozzle Diameter - D_n	.310					
Barometric Pressure - P_b	28.45	→	→	→		
Static Pressure - P_g	-0.25	→	→	→		
Oxygen Estimate - %O_2	20.9	→	→	→		
Moisture Estimate - %MC	1	→	→	→		
No. of Traverse Points	24					
Point Duration - ΔT	3					
Meter Start Temp, °F - t_m	72	72	84.5	85.5		
Initial Meter Volume - V_i	965.100	965.100	35.800	107.000		
Duct Shape (Rnd/Rect)	Rnd					
Duct Width, Inches	42					
Duct Depth, Inches	42					
Final Volume - V_f		1035.60	106.78	178.227		
Total Run Time - θ		72	72	72		
Condensate Volume, ml (g)		5.5	0.7	1.0		
End of Run Summary						
Average Sq. Rt. of the ΔP	√ΔP	0.5306	0.5263	0.5296		
Average Orifice Meter	ΔH	2.85	2.90	2.92		
Average Stack Temperature	t_s	70.6	61.1	65.6		
Average Meter Temperature	t_m	79.3	86.1	85.7		
Sample Volume, Actual	V_m	70.50	70.98	71.23		
Sample Volume, Dry Standar	V_{std}	65.85	65.48	65.76		
Moisture Content	MC	0.39	0.05	0.07		
Estimated Mole. Wt., dry	M_d	29.0	29.0	29.0		
Estimated Mole. Wt., wet	M_w					
Average Gas Velocity	V_s	30.67	30.13	30.46		
Isokinetic Variation	%I	100.7	99.8	100.0		
Volumetric Airflow, Actual	ACFM	17710	17390	17580		
Volumetric Airflow, Standard	SCFM	16750	16740	16780		
Volumetric Airflow, Dry Std.	DSCFM	16680	16730	16770		

Pace Analytical®
Field Services Division

Equipment & Method Summary
Isokinetic and Associated Testing

Group 1 QI: SB Group 4 QI: ____

Project Name: Grede-Iron Mountain 2020 Compliance w/(Test Date: 12-9-20
Sampling Location: Disa Exhaust (324678) Recorded By: SB

Airflow Determination EPA Method: ☒ 2 ☐ 2C ☐ Other ______ Initials ↓ ✓

Pitot Tube No.: 4-06 Coef.: 0.84 Next Ver. Date: 1-2-21 Pre-Use Insp.: ✓
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: CM-1 ☒ Oil ☐ Digital Next Ver. Date: 1-13-21 Pre-Use Insp.: ✓
Manometer ID: ____ ☐ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
Barometer ID: DB-35 ☐ Aneroid ☒ Digital Next Ver. Date: 3-22-21 Pre-Use Insp.: ✓
Barometer ID: ____ ☐ Aneroid ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout: CM-1 ☒ Single ☐ Dual Next Ver. Date: 1-13-21 Pre-Use Insp.: ✓
T/C Readout: ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____

Gas Composition EPA Method: ☐ 3 ☐ 3/3A ☐ 3B ☐ 3C ☒ Ambient ☐ ____ Initials ↓

Container Type: ☐ Tedlar ☐ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ____
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☐ Instrumental: Instrument ID: ____ Cal Range ____
Ambient Provision Oxygen Verification: Portable O2 ID ____ Ambient Cal Reading: ____
Note: Portable O2 results are not reported as test data

Moisture Content EPA Method: ☒ 4, back-half of iso train ☐ Other ____ Explain in Options/Deviations Section Initials ↓

Wt. Scale ID: DS-42 ☒ Digital ☐ Beam Next Ver. Date: 4-6-21 Pre-Use Insp.: ✓
Std. Weight ID: ____ Std. Weight (g): ____ Scale Reading: ____ ☐ Pass ☐ Fail

Isokinetic EPA Method: ☒ 5 __ ☐ 8 ☐ 17 ☐ 23 ☐ 26A ☐ 29 ☐ Other ____ Initials ↓

Nozzle ID: ____ Type: ☒ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____

Nozzle Cal.:	1	2	3	4	5	Avg	Pre-Use Insp.:
	.310	.310	.310	.310	.310	.310	✓

Nozzle ID: ____ Type: ☐ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____

Nozzle Cal.:	1	2	3	4	5	Avg	Pre-Use Insp.:

Probe Length: 4 ft. Liner: ☐ SS ☒ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: 4-06 Coef.: 0.84 Next Ver. Date: 1-2-21 Pre-Use Insp.: ✓
Probe Length: ____ ft. Liner: ☐ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Control Mod ID: CM-1 ϒ: 0.9959 ΔH@: 1.821 Next Ver. Date: 1-13-21 Pre-Use Insp.: ✓
Control Mod ID: ____ ϒ: ____ ΔH@: ____ Next Ver. Date: ____ Pre-Use Insp.: ____

Filter Type: ☐ 2½" Round ☒ 4" Round ☐ Thimble ☐ Other ____
Filter Media: ☒ Glass Fiber ☐ Quartz Fiber ☐ Paper ☐ Teflon ☐ SS ☐ Other ____
Wet Catch: ☐ EPA 202 ☐ EPA 8 ☐ EPA 23 ☐ EPA 26A ☐ EPA 29 ☐ Other ____
WC Options/Deviations: ____

Field Data Sheets - 324682

EPA Method 1 Field Data Sheet

Test Site and Traverse Point Selection

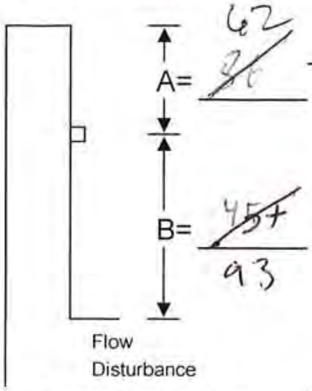
Project Grede-Iron Mountain 2020 Compliance w/Cu

Test Location Disa CC Exhaust (324682)

Date 12/7/20 Test/Run T1 R 0

Tech(s) ZHE

☒ New Sketch Created With Dimensions
☐ File Drawing Verified and Attached
☐ Cyclonic Flow Measured (See M-2 Sheet)



Before (B)	Disturbance Type	After (A)
☐	Elbow	☐
☐	Conjunction	☐
☐	Fan (cent)	☐
☐	Axial Fan	☐
☐	Transition	☐
☐	Damper	☐
☐	Exit	☐
☐	Other ______	☐

☒ Round

D= 42.0"

42.0" =W

☐ Rectangular

W= ______

=D

~~ZHE 12/7/20~~

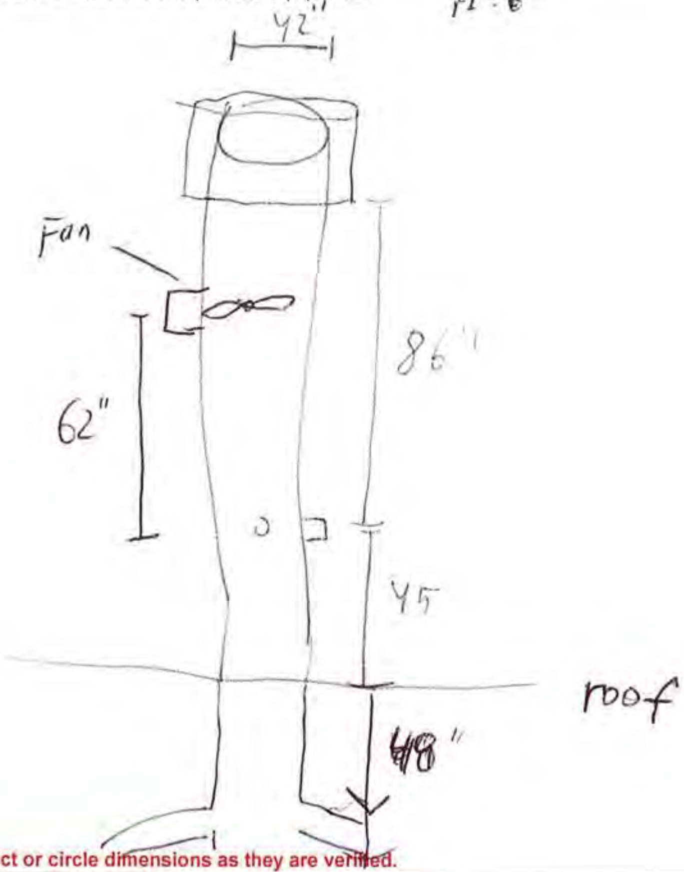
Duct Orientation
☐ Vertical
☐ Horizontal
☐ Diagonal
______ No. of Traverses

A= ______ Diameters to downstream
B= ______ Diameters to upstream
T_R= ______ Min. Traverse Points (iso)
T_A= ______ Traverse Points Used

Traverse Points (from wall)

Sketch of test location with dimensions and process equipment.

pl = 6''



If file drawing, correct or circle dimensions as they are verified.

EPA Method 2 Field Data Sheet

Volumetric Airflow Determinations

Pace Analytical® Field Services Division

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location Disa CC Exhaust (324682)
Date 12/7/20 Test/Run T1 R 1
Duct Dimensions 42 x 42 Inches
Port Length 6 x 6 Inches
Pitot Leak Check - Pos ✓ Neg ✓

Manometer Type and ID CM-5
Barometer Type and ID DB-6
Thermocouple Sensor ID CM-5
Pitot Tube No. 4-02 Cp 0.84
Technicians ZHE / LMR
#REF!
FSD PN: 20-04074

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From Wall	Inches From Port	Flow °Yaw	Run 1 ΔP	Run 2 ΔP	Run 3 ΔP	Run 4 ΔP	Run 1 °F	Run 2 °F	Run 3 °F	Run 4 °F
A 1	0.89	6.89	0	0.20	12/7/20 0.20			69			
2	2.81	8.81	0	0.21							
3	4.96	10.96	0	0.18							
4	7.44	13.44	5	0.19	0.18			68			
5	10.50	16.50	0	0.15							
6	14.94	20.94	5	0.16							
7	27.06	33.06	0	0.18				69			
8	31.50	37.50	0	0.17							
9	34.56	40.56	0	0.17							
10	37.04	43.04	-5	0.17							
11	39.19	45.19	-5	0.150	0.20			69			
12	41.11	47.11	-5	0.140							
B 1			0	0.45	12/8/20						
2			5	0.46							
3			0	0.50							
4			0	0.49							
5			0	0.48							
6	Same		0	0.48	pitot leak						
7	as		-5	0.48	Bias High						
8			-5	0.48							
9	above		-5	0.48							
10			0	0.47							
11			0	0.47							
12			0	0.48				60			

ZHE 12/8/20

ZHE 12/8/20

ZHE 12/8/20

Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	28.634				"Hg
Static Pressure	-0.450				"H_2O
Dry Bulb Temp.	69				°F
Wet Bulb Temp.	—				°F
Moisture Content	1				%v/v
320 P Oxygen	20.9				%v/v
Time of Meas.	730				(24 Hour)

ZHE 12/8/20

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/i
Sample Location Disa CC Exhaust (324682)
Date 12/8/20 Test/Run T1 R1
Operators/Techs ZHE/LMR

Module ID CM-5
Meter Coef. γ 0.9916
Orifice Coef. ΔH@ 2.074
Nozzle No. 53 D_n 0.26

Pitot No. 4-02 C_p 0.84
Bar. Pres. 28.634 In. Hg
Static Pres. -0.450 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-5
TC Sensor ID CM-5
Barometer ID DB-60
Scale ID DS-45

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incre-mental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(743)	509.65													
12	3	512.23	0.50	2.79	512.34	2.69	3.2	62	257	258	NA	63	58	64	20.9
11	6	515.09	0.49	2.73	514.99	2.65	3.4	61	260	270		54	54	64	
10	9	517.59	0.49	2.72	517.62	2.64	3.3	62	261	270		51	52	64	
9	12	520.20	0.50	2.78	520.29	2.66	3.2	60	259	240		49	50	63	
8	15	522.85	0.48	2.65	522.65	2.60	3.2	61	251	230		50	50	63	
7	18	525.44	0.47	2.59	525.46	2.57	3.1	63	257	220		48	50	63	
6	21	528.06	0.48	2.65	528.06	2.60	3.1	61	258	263		48	50	62	
5	24	530.81	0.50	2.75	530.71	2.65	3.2	63	260	284		47	50	62	
4	27	533.33	0.50	2.75	533.35	2.65	3.2	63	261	290		47	50	62	
3	30	535.95	0.49	2.70	535.98	2.62	3.2	62	259	235		47	49	61	
2	33	538.49	0.45	2.48	538.49	2.51	3.1	62	257	221		47	49	61	
1	36	541.06	0.45	2.48	540.99	2.51	3.0	62	257	223		47	49	60	
12	39	543.62	0.49	2.69	543.61	2.61	3.2	63	247	270		48	50	60	
11	42	546.22	0.49	2.69	546.22	2.62	3.1	63	257	238		45	49	60	
10	45	548.91	0.50	2.75	548.86	2.64	3.2	62	258	220		45	49	60	
9	48	551.56	0.51	2.81	551.53	2.67	3.2	61	258	225		45	49	59	
8	51	554.29	0.51	2.81	554.20	2.67	3.2	61	259	263		45	48	59	
7	54	557.06	0.52	2.85	556.89	2.69	3.4	62	259	280		46	48	59	
6	57	559.68	0.51	2.79	559.55	2.66	3.4	64	259	285		45	48	59	
5	60	562.16	0.51	2.80	562.21	2.66	3.3	62	258	230		46	49	59	
4	63	564.81	0.51	2.80	564.88	2.67	3.3	62	258	220		46	48	58	
3	66	567.47	0.50	2.75	567.51	2.64	3.3	61	258	228		46	48	57	
2	69	570.08	0.48	2.62	570.09	2.58	3.2	63	259	276		45	47	57	
1	72	572.80	0.46	2.51	572.61	2.52	3.3	63	260	280		45	47	57	
	(400)														
Tot/Avg	θ= 72	V_m= 63.15	√ΔP=0.7008	ΔH=2.71				t_s=62.0						t_m=55.1	O_2=20.9

Samples Recovered: Filter 0-0624; ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 8.0 "Hg
Posttest 0.00 @ 6.0 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:
Possible crack in pitot lines during run to lead to higher air flows
#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	76.4	109.1	4.0			1413.8	
Initial Volume	100	100	0			1399.0	
Difference	-23.6	9.1	4.0			14.8	4.3

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

0.310

Project Grede-Iron Mountain 2020 Compliance w/ Module ID CM-5 Pitot No. 4-02 C_p 0.84 Manometer ID CM-5
Sample Location Disa CC Exhaust (324682) Meter Coef. γ 0.9916 Bar. Pres. 28.634 In. Hg TC Sensor ID CM-5
Date 12/8/20 Test/Run T1 R2 Orifice Coef. ΔH@ 2.074 Static Pres. -0.45 In. H_2O Barometer ID DB-6
Operators/Techs ZHE/LMR Nozzle No. 55 D_n ~~0.265~~ Est. Moist. 1 %v/v Scale ID DS-45

ZHE
RE
12/8/20

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired $ΔV_m$ Cubic Feet	Incre-mental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(935)	573.1													
12	~~3~~ 3.5	575.56	0.17	1.88	575.65	2.55	2.0	64	225	270	NA	36	49	57	20.9
11	~~6~~ 7	578.18	0.18	1.99	578.27	2.62	2.0	63	248	269		42	48	56	
10	~~9~~ 10.5	580.76	0.19	2.10	580.96	2.69	2.1	62	251	223		41	46	56	
9	~~12~~ 14	583.54	0.19	2.09	583.64	2.68	2.0	63	255	221		40	46	55	
8	~~15~~ 17.5	586.29	0.20	2.20	586.39	2.75	2.1	63	260	267		40	46	55	
7	~~18~~ 21	589.07	0.19	2.09	589.06	2.67	2.0	64	261	278		41	45	55	
6	~~21~~ 24.5	591.74	0.19	2.08	591.73	2.67	2.1	64	260	245		43	46	55	
5	~~24~~ 28	594.62	0.21	2.31	594.55	2.81	2.2	63	258	222		43	46	55	
4	~~27~~ 31.5	597.52	0.22	2.42	597.43	2.88	2.4	64	258	220		44	47	55	
3	~~30~~ 35	600.55	0.25	2.75	600.50	3.07	2.8	64	260	267		45	47	55	
2	~~33~~ 38.5	603.62	0.24	2.64	603.51	3.01	2.8	64	258	275		46	47	55	
1	~~36~~ 42	606.55	0.24	2.64	606.52	3.01	2.7	64	264	280		47	46	55	
12	~~39~~ 45.5	609.14	0.19	2.08	609.18	2.67	2.1	66	227	276		46	49	56	
11	~~42~~ 49	611.83	0.19	2.10	611.87	2.69	2.2	63	240	233		45	48	55	
10	~~45~~ 52.5	614.71	0.18	1.98	614.48	2.61	2.1	63	244	221		43	48	56	
9	~~48~~ 56	617.22	0.19	2.10	617.17	2.69	2.1	62	252	230		44	48	56	
8	~~51~~ 59.5	619.85	0.20	2.21	619.93	2.76	2.0	62	257	270		43	49	56	
7	~~54~~ 63	622.50	0.18	1.99	622.55	2.62	2.0	63	259	280		46	48	56	
6	~~57~~ 66.5	626.12	0.18	1.98	625.16	2.61	2.0	64	257	252		48	49	56	
5	~~60~~ 70	627.87	0.20	2.21	627.92	2.76	2.1	62	254	239		48	50	57	
4	~~63~~ 73.5	630.81	0.21	2.31	630.74	2.83	2.1	65	253	232		50	51	57	
3	~~66~~ 77	633.60	0.23	2.55	633.71	2.97	2.5	63	255	210		40	55	60	
2	~~69~~ 80.5	636.69	0.22	2.45	636.63	2.92	2.5	64	253	215		40	54	60	
1	~~72~~ 84	639.55	0.21	2.33	639.47	2.85	2.4	64	256	251		42	53	61	
	(1153)														
Tot/Avg	θ= 84	V_m=6645	√ΔP=0.448	ΔH= 2.23				t_s=63.5						t_m= 52.3	O_2=20.9

Samples Recovered: Filter ________; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other ________

Sampling Train Leak Checks:
Pretest 0.00 @ 6.0 "Hg
Posttest 0.00 @ 7.0 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:
pause @ 1052 for
client break
#REF!
start back up @ 1142

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	82.4	107.4	2.2			1269.2	
Initial Volume	100	100	0			1253.0	
Difference	-17.6	7.4	2.2			16.2	8.2

Pace Analytical® *Field Services Division*

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/i
Sample Location Disa CC Exhaust (324682)
Date 12/8/20 Test/Run T1 R3
Operators/Techs ZHE/LMR

Module ID CM-5
Meter Coef. γ 0.9916
Orifice Coef. ΔH@ 2.074
Nozzle No. SS D_n 0.310

Pitot No. 4-02 C_p 0.84
Bar. Pres. 28.634 In. Hg
Static Pres. -0.450 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-5
TC Sensor ID CM-5
Barometer ID DB-6
Scale ID 03-4

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incre-mental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1215)	639.86													
12	3.5	642.34	0.16	1.78	642.34	2.49	2.0	67	229	275	NA	45	57	63	20.9
11	7	644.99	0.17	1.90	644.92	2.57	2.1	65	229	280		41	54	62	
10	10.5	647.42	0.18	1.99	647.55	2.62	2.1	67	240	285		40	52	61	
9	14	649.90	0.16	1.77	650.03	2.48	2.0	66	246	235		40	52	61	
8	17.5	652.56	0.18	1.98	652.65	2.62	2.1	68	249	230		40	52	61	
7	21	655.25	0.19	2.11	655.36	2.70	2.2	65	254	235		41	52	61	
6	24.5	657.93	0.19	2.10	658.06	2.70	2.6	67	256	256		42	52	61	
5	28	660.84	0.20	2.20	660.82	2.77	2.6	68	257	274		42	52	61	
4	31.5	663.61	0.21	2.32	663.66	2.84	2.6	67	254	234		43	52	61	
3	35	666.33	0.23	2.54	666.63	2.97	2.9	67	253	228		44	52	61	
2	38.5	669.38	0.23	2.54	669.59	2.97	3.0	68	253	222		44	52	60	
1	42	672.48	0.24	2.65	672.62	3.03	3.0	67	255	234		44	52	60	
12	45.5	675.20	0.18	1.99	675.25	2.63	2.4	65	257	265		45	52	60	
11	49	677.90	0.18	1.99	677.88	2.63	2.4	65	255	274		46	52	60	
10	52.5	680.44	0.19	2.10	680.58	2.70	2.5	65	250	280		47	52	60	
9	56	683.17	0.20	2.22	683.36	2.77	2.6	64	254	250		47	52	60	
8	59.5	685.99	0.20	2.22	686.13	2.77	2.8	64	254	234		47	52	60	
7	63	689.02	0.20	2.22	688.91	2.77	2.8	64	257	238		47	52	60	
6	66.5	691.86	0.20	2.22	691.68	2.77	2.8	67	257	260		47	53	60	
5	70	694.64	0.20	2.21	694.45	2.77	2.9	66	258	271		47	53	59	
4	73.5	697.46	0.20	2.21	697.22	2.77	2.9	67	256	246		48	52	60	
3	77	700.27	0.23	2.54	700.19	2.97	2.8	66	251	237		49	53	60	
2	80.5	703.17	0.23	2.54	703.16	2.97	2.9	66	252	233		49	53	60	
1	84	705.90	0.22	2.43	706.06	2.90	2.9	67	259	257		49	53	60	
	(1342)														
Tot/Avg	θ= 84	V_m=66.05	√ΔP=0.4457	ΔH= 2.20				t_s=66.0						t_m=56.3	O_2=20.9

Samples Recovered: Filter 0-1180 ; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 6.5 "Hg
Posttest 0.00 @ 7.0 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	83.1	107.9	2.4			1429.1	
Initial Volume	100	100	0			1413.8	
Difference	-16.9	7.9	3.4			15.3	9.7

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/ Module ID CM-5 Pitot No. 4-02 C_p 0-84 Manometer ID CM-5
Sample Location Disa CC Exhaust (324682) Meter Coef. γ 0.9916 Bar. Pres. 28.634 In. Hg TC Sensor ID CM-5
Date 12/8/20 Test/Run T1 R4 Orifice Coef. ΔH@ 2.074 Static Pres. -0.460 In. H_2O Barometer ID DB-60
Operators/Techs ZHE Nozzle No. 55 D_n 0.316 Est. Moist. 1 %v/v Scale ID DSC45

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1400)	706.20													
12	3.5	709.07	0.20	2.20	708.97	2.77	2.2	71	225	235	NA	51	54	60	20.9
11	7	711.82	0.19	2.10	711.66	2.70	2.3	68	227	238		51	51	59	
10	10.5	714.21	0.19	2.09	714.36	2.69	2.0	67	224	233		49	51	59	
9	14	716.99	0.20	2.20	717.12	2.76	2.0	67	225	220		48	51	59	
8	17.5	719.65	0.20	2.20	719.88	2.76	2.0	67	226	221		48	51	59	
7	21	722.52	0.20	2.21	722.64	2.76	2.1	66	227	220		48	51	59	
6	24.5	725.02	0.19	2.10	725.37	2.69	2.1	66	233	223		48	51	59	
5	28	728.20	0.20	2.21	728.10	2.76	2.0	66	237	225		48	51	58	
4	31.5	730.67	0.22	2.43	730.99	2.90	2.0	65	242	226		48	50	58	
3	35	733.72	0.24	2.65	734.02	3.02	2.6	65	243	228		50	51	58	
2	38.5	736.81	0.24	2.65	737.04	3.03	2.7	65	245	225		50	51	59	
1	42	739.99	0.23	2.54	740.01	2.97	2.7	65	253	226		52	51	59	
12	45.5	742.57	0.19	2.10	742.71	2.70	2.0	65	252	227		51	52	59	
11	49	745.32	0.19	2.10	745.40	2.70	2.1	65	255	223		51	51	59	
10	52.5	748.10	0.19	2.10	748.10	2.70	2.1	65	255	224		51	51	59	
9	56	750.83	0.20	2.20	750.86	2.76	2.1	67	254	221		52	51	59	
8	59.5	753.57	0.19	2.08	753.54	2.69	2.1	69	254	224		52	51	59	
7	63	756.28	0.18	1.98	756.16	2.62	2.1	68	255	223		51	51	58	
6	66.5	759.11	0.18	1.98	758.78	2.62	2.1	67	256	224		51	51	58	
5	70	761.64	0.19	2.09	761.46	2.69	2.1	68	252	223		51	51	59	
4	73.5	764.24	0.20	2.20	764.22	2.76	2.1	67	254	226		50	50	58	
3	77	767.00	0.23	2.53	767.18	2.95	2.0	67	258	221		49	50	58	
2	80.5	769.95	0.22	2.42	770.07	2.89	2.0	67	255	220		50	51	59	
1	84	772.83	0.21	2.32	772.90	2.83	2.1	66	255	221		50	50	58	
	(1527)														
Tot/Avg	θ= 84	V_m= 66.63	√ΔP=0.454	ΔH=2.24				t_s=66.6						t_m=58.8	O_2=20.9

Samples Recovered: Filter 0-1178 ; ☒ Probe Wash; ☐ Wet Catch; ☐ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 6.0 "Hg
Posttest 0.00 @ 6.5 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	91.2	108.1	2.5			282.5	
Initial Volume	100	100	0			269.2	
Difference	-8.8	8.1	2.5			13.3	15.1

Pace Analytical®
Field Services Division

Field Calculation Summary

Computer Initialization and Run Summary

The data on this form is preliminary and includes estimates.
It is not intended to reflect final results.

Project Grede-Iron Mountain 2020 Co Site
Sample Location Disa CC Exhaust (324682)
Date 12/8/20
Tech. ZHE

Initialization Parameters						
Parameter	**Initial**	**Run_1**	**Run_2**	**Run_3**	**Run_4**	**Run_5**
Meter Coefficient - ϒ	0.9916					
Orifice Coefficient - ΔH@	2.074					
Pitot Coefficient - C_p	0.84					
Nozzle Diameter - D_n	0.260	0.260	0.310	0.310	0.310	
Barometric Pressure - P_b	28.634	—	—	→	→	
Static Pressure - P_g	-0.450	—	—	→	→	
Oxygen Estimate - %O_2	20.9	—	—	→	→	
Moisture Estimate - %MC	1	1	1	1	1	
No. of Traverse Points	24					
Point Duration - ΔT	3					
Meter Start Temp, °F - t_m	62	62	55	60	58	
Initial Meter Volume - V_i	509.65	509.65	573.10	639.85	706.2	
Duct Shape (Rnd/Rect)	Rnd					
Duct Width, Inches	42					
Duct Depth, Inches	42					
Final Volume - V_f		572.80	639.55	705.90	772.83	
Total Run Time - θ		72	84	84	84	
Condensate Volume, ml (g)		4.3	8.2	9.7	15.1	
End of Run Summary						
Average Sq. Rt. of the ΔP	√ΔP	0.7008	0.4489	0.4451	0.4501	
Average Orifice Meter	ΔH	2.71	2.23	2.20	2.24	
Average Stack Temperature	t_s	62.0	63.5	66.0	66.6	
Average Meter Temperature	t_m	55.1	52.3	56.5	54.8	
Sample Volume, Actual	V_m	63.15	66.45	66.05	66.63	
Sample Volume, Dry Standar	V_{std}	61.86	65.36	64.44	65.22	
Moisture Content	MC	0.33	0.59	0.70	1.08	
Estimated Mole. Wt., dry	M_d					
Estimated Mole. Wt., wet	M_w					
Average Gas Velocity	V_s	40.06	25.71	25.56	25.88	
Isokinetic Variation	%I	100.7	100.5	100.2	100.7	
Volumetric Airflow, Actual	ACFM	23120	14840	14750	14940	
Volumetric Airflow, Standard	SCFM	22350	14310	14150	14320	
Volumetric Airflow, Dry Std.	DSCFM	22280	14230	14050	14170	

Pace Analytical®
Field Services Division

Equipment & Method Summary

Isokinetic and Associated Testing

Group 1 QI ZHE Group 4 QI ____

Project Name: Grede-Iron Mountain 2020 Compliance w/(Test Date: 12/8/20
Sampling Location: Disa CC Exhaust (324682) Recorded By: ZHE

Airflow Determination EPA Method: ☒ 2 ☐ 2C ☐ Other ________ Initials

Pitot Tube No.: 4-02 Coef.: 0.84 Next Ver. Date: ____ Pre-Use Insp.: ____
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: CM-5 ☐ Oil ☒ Digital Next Ver. Date: 2/11/21 Pre-Use Insp.: ZHE
Manometer ID: ____ ☐ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
Barometer ID: DB-60 ☐ Aneroid ☒ Digital Next Ver. Date: 2/22/21 Pre-Use Insp. ZHE
Barometer ID: ____ ☐ Aneroid ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout TC-38 ☐ Single ☒ Dual Next Ver. Date: 3/8/21 Pre-Use Insp. ZHE
T/C Readout ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____

Gas Composition EPA Method: ☐ 3 ☐ 3/3A ☐ 3B ☐ 3C ☒ Ambient ☐ ____ Initials

Container Type: ☐ Tedlar ☐ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ____
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☐ Instrumental: Instrument ID: ____ Cal Range ____
Ambient Provision Oxygen Verification: Portable O2 ID ____ Ambient Cal Reading: ____
Note: Portable O2 results are not reported as test data.

Moisture Content EPA Method: ☒ 4, back-half of iso train ☐ Other ____ Explain in Options/Deviations Section Initials

Wt. Scale ID: PS-45 ☒ Digital ☐ Beam Next Ver. Date: 7/7/21 Pre-Use Insp. ZHE
Std. Weight ID: ____ Std. Weight (g): ____ Scale Reading: ____ ☐ Pass ☐ Fail

Isokinetic EPA Method: ☒ 5 __ ☐ 8 ☐ 17 ☐ 23 ☐ 26A ☐ 29 ☐ Other __ Initials

Nozzle ID: 0.260 Type: ☒ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ________

Nozzle Cal.:	1 0.260	2 0.260	3 0.260	4 0.260	5 0.260	Avg 0.260	Pre-Use Insp.: ZHE

Nozzle ID: 0.310 Type: ☐ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ________

Nozzle Cal.:	1 0.310	2 0.310	3 0.310	4 0.310	5 0.310	Avg 0.310	Pre-Use Insp.: ZHE

Probe Length: 4 ft. Liner: ☐ SS ☒ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: 4-02 Coef.: 0.84 Next Ver. Date: ____ Pre-Use Insp.: ____
Probe Length: ____ ft. Liner: ☐ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Control Mod ID: CM-5 Ɣ: 0.9916 ΔH@: 2074 Next Ver. Date: 2/11/21 Pre-Use Insp. ZHE
Control Mod ID: ____ Ɣ: ____ ΔH@: ____ Next Ver. Date: ____ Pre-Use Insp.: ____

Filter Type: ☐ 2½" Round ☒ 4" Round ☐ Thimble ☐ Other ________
Filter Media: ☒ Glass Fiber ☐ Quartz Fiber ☐ Paper ☐ Teflon ☐ SS ☐ Other ____
Wet Catch: ☐ EPA 202 ☐ EPA 8 ☐ EPA 23 ☐ EPA 26A ☐ EPA 29 ☐ Other ____
WC Options/Deviations: ________

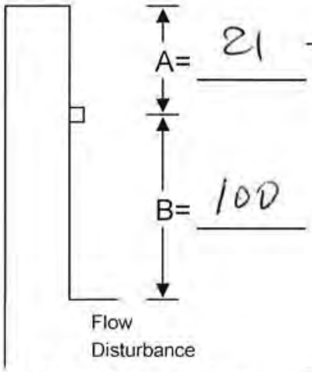
Field Data Sheets - 324848

Pace Analytical®
Field Services Division

EPA Method 1 Field Data Sheet
Test Site and Traverse Point Selection

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location No. 5 HMP - TC Fan (324848)
Date 12/8/2020 Test/Run T1 R
Tech(s) TJB, JWG

☐ New Sketch Created With Dimensions
☐ File Drawing Verified and Attached
☐ Cyclonic Flow Measured (See M-2 Sheet)

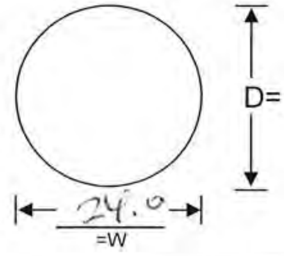


A= 21
B= 100

Disturbance Type

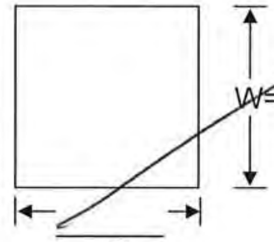
Before (B)		After (A)
☐	Elbow	☐
☐	Conjunction	☐
☐	Fan (cent)	☐
☐	Axial Fan	☐
☐	Transition	☐
☐	Damper	☐
☐	Exit	☐
☐	Other	☐

☐ Round



D= 24.0
24.0 =W
6" Port

☐ Rectangular

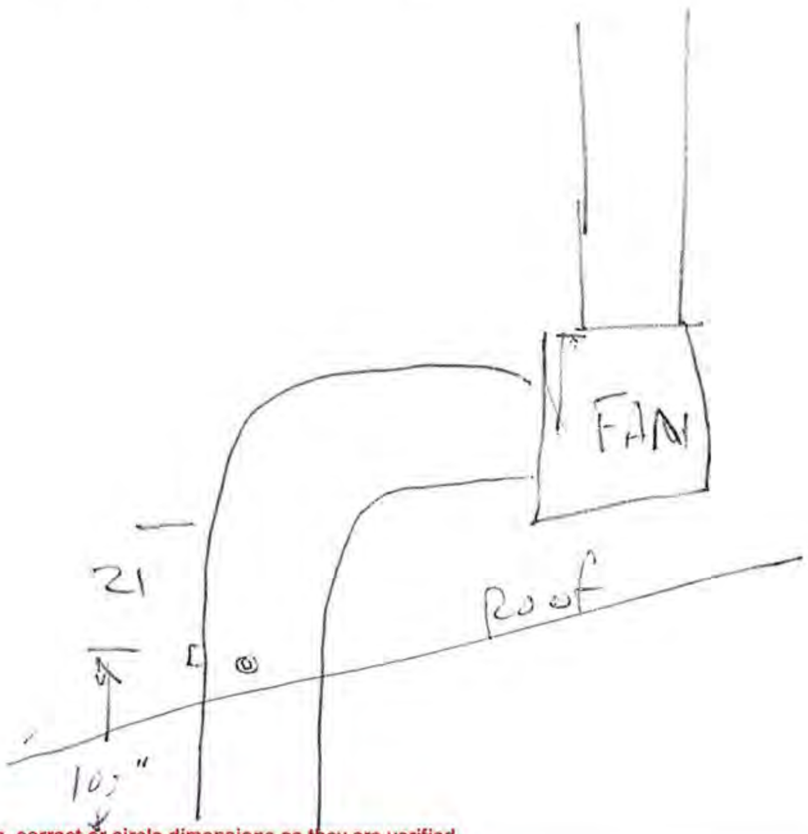


Duct Orientation
☑ Vertical
☐ Horizontal
☐ Diagonal
2 No. of Traverses

A= Diameters to downstream
B= Diameters to upstream
T_R= Min. Traverse Points (iso)
T_A= Traverse Points Used

Traverse Points (from wall)

Sketch of test location with dimensions and process equipment.



If file drawing, correct or circle dimensions as they are verified.

Pace Analytical®
Field Services Division

EPA Method 2 Field Data Sheet

Volumetric Airflow Determinations

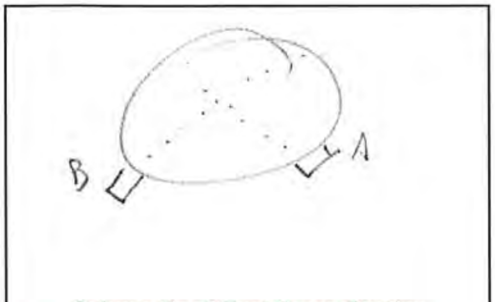
Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location No. 5 HMP - TC Fan (324848)
Date 12/7/20 Test/Run T1 R
Duct Dimensions 24.0 Inches
Port Length 6.0 Inches
Pitot Leak Check - Pos ✓ Neg ✓

Manometer Type and ID DM-48
Barometer Type and ID ~~DM-48~~ DB-72
Thermocouple Sensor ID CM-4
Pitot Tube No. 3-41 Cp 0.84
Technicians TJD, JWG
#REF!
FSD PN: 20-04074

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From Wall	Inches From Port	Flow °Yaw	Run 1 ΔP	Run 2 ΔP	Run 3 ΔP	Run 4 ΔP	Run 1 °F	Run 2 °F	Run 3 °F	Run 4 °F
A 1	0.51	6.51	5	1.0							
2	1.61	7.61	0	0.90							
3	2.83	8.83	0	0.73							
4	4.25	10.25	0	0.84							
5	6.00	12.0	0	0.89							
6	8.54	14.54	0	1							
7	15.46	21.46	0	1.3							
8	18.0	24.0	0	1.4							
9	19.75	25.75	0	1.4							
10	21.17	27.17	3	1.4							
11	22.39	28.39	3	1.4							
12	23.44	29.44	0	1.35							
B 1	SAME		3								
2			0								
3			0								
4			0								
5			0								
6			0								
7			0								
8			0								
9			3								
10			3								
11			3								
12			0								

TJB

TJB



Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	28.64				"Hg
Static Pressure	-2.0				"H_2O
Dry Bulb Temp.	75				°F
Wet Bulb Temp.	–				°F
Moisture Content	1				%v/v
320 P Oxygen	20.9				%v/v
Time of Meas.	1435				(24 Hour)

TJB

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/(
Sample Location No. 5 HMP - TC Fan (324848)
Date 12/8/20 Test/Run T1 R1
Operators/Techs TJB, JWG

Module ID CM-11
Meter Coef. γ .9958
Orifice Coef. ΔH@ 2.079
Nozzle No. 55 D_n .210

Pitot No. 3.41 C_p .840
Bar. Pres. 28.64 In. Hg
Static Pres. -2.0 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-11
TC Sensor ID CM-11
Barometer ID DB-72
Scale ID DS-38

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F CPM	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(750)	325.10													
A-12	3.5	328.09	1.30	29.5	316	826	3.0	75	251	217	NA	56	51	51	20.9
11	7.0	331.32	1.30	2.96	317	143	3.2	74	247	210		58	51	50	
10	10.5	334.51	1.25	2.84	310	454	.	75	250	194		61	52	50	
9	14	337.58	1.25	2.84	311	764	3.2	75	252	190		64	52	50	
8	17.5	340.65	1.20	2.71	303	067	.	79 ~~78~~	252	188		64	53	50	
7	21	343.73	1.20	2.73	305	372	3.3	75	251	191		64	53	50	
6	24.5	346.82	1.20	2.75	305	677	.	72	249	196		64	54	51	
5	28	349.60	0.96	2.18	272	949	2.9	78	250	205		64	54	51	
4	31.5	352.11	0.82	1.86	251	201	.	79	252	219		64	54	51	
3	35.	354.32	0.69	1.53	228	429	.	81	250	238		63	54	51	
2	38.5	356.60	0.67	1.53	228	657	2.0	75	251	240		63	54	51	
1	42	358.49	0.65	1.48	223	880	.	83	250	248		63	54	51	
B-12	45.5	361.65	1.10	2.50	292	172	3.0	76	250	260		61	54	51	
11	49	364.72	1.20	2.72	304	476	.	78	253	244		61	54	51	
10	52.5	367.76	1.20	2.73	305	781	3.2	77	252	238		61	55	51	
9	56	370.90	1.25	2.83	311	092	3.3	79	250	235		62	55	51	
8	59.5	373.95	1.20	2.72	304	396	.	79	249	233		62	55	51	
7	63	377.04	1.20	2.73	305	701	3.3	77	251	230		62	55	51	
6	66.5	379.82	0.98	2.22	275	976	.	78	251	223		62	55	51	
5	70	382.48	0.91	2.07	265	241	2.6	78	250	236		62	55	51	
4	73.5	384.92	0.77	1.76	245	486	.	75	250	242		62	55	52	
3	77	387.21	0.67	1.52	228	714	.	79	249	247		61	55	52	
2	80.5	389.22	0.55	1.24	206	916	2.2	82	252	251		61	55	52	
1	84.0	391.24	0.53	1.30	202	122	.	79	251	255		60	54	52	
	(916)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 84	V_m= 66.14	√ΔP= .9916	ΔH= 2.27				t_s= 77.5						t_m= 52.9	O_2= 20.9

Samples Recovered: Filter 0648 ; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☑ Other M4

Sampling Train Leak Checks:
Pretest 0.00 @ 8 "Hg
Posttest 0.00 @ 9 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume		190.4				1354.4	
Initial Volume	100	100	0			1329	
Difference		-19.6				25.4	5.8

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/I
Sample Location No. 5 HMP - TC Fan (324848)
Date 12/8/20 Test/Run T1 R 2
Operators/Techs TB, JWG

Module ID CM-11
Meter Coef. γ 0.9958
Orifice Coef. ΔH@ 2.019
Nozzle No. SS D_n .210

Pitot No. 3-41 C_p .840
Bar. Pres. 28.64 In. Hg
Static Pres. -2.0 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-11
TC Sensor ID CM-11
Barometer ID DB-72
Scale ID DS-38

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(0935)	391.40									CPM				
B-12	3.5	394.50	1.20	2.71	304	444	3.2	81	227	234	N/A	43	54	53	20.9
11	7	397.58	1.20	2.75	306	750	.	74	232	230		44	54	53	
10	10.5	400.62	1.20	2.71	304	054	3.2	81	232	217		44	55	53	
9	14	403.69	1.25	2.83	311	364	.	81	239	219		45	56	53	
8	17.5	406.77	1.20	2.73	305	670	.	78	245	221		47	57	53	
7	21	409.83	1.20	2.72	305	975	3.2	80	252	223		48	58	53	
6	24.5	412.36	0.82	1.87	253	228	.	78	254	226		49	58	54	
5	28	414.91	0.85	1.95	258	487	3.7	76	249	234		49	59	54	
4	31.5	417.48	0.85	1.94	258	745	.	078	249	239		50	59	54	
3	35	419.77	0.67	1.52	228	973	.	82	252	242		50	59	54	
2	38.5	421.96	0.62	1.42	221	194	2.7	77	253	247		50	59	54	
1	42	424.08	0.60	1.37	216	410	.	80	250	251		51	59	54	
A-12	45.5	427.37	1.40	3.21	332	742	3.6	76	251	260		52	59	55	
11	49	430.68	1.35	3.07	324	066	.	82	251	237		51	59	55	
10	52.5	433.97	1.35	3.09	326	392	3.7	78	250	233		53	59	55	
9	56	437.16	1.30	2.98	320	712	.	77	250	237		54	59	55	
8	59.5	440.40	1.30	2.96	319	031	.	80	251	236		55	59	55	
7	63	443.51	1.25	2.83	312	343	3.4	83	250	236		55	60	55	
6	66.5	446.44	1.15	2.64	301	644	3.1	77	251	229		56	59	55	
5	70	449.20	0.97	2.19	274	918	.	85	250	236		56	60	56	
4	73.5	451.81	0.85	1.94	259	176	2.7	79	252	242		56	61	56	
3	77	454.22	0.73	1.68	241	417	.	76	250	266		50	58	57	
2	80.5	456.58	0.71	1.64	237	654	2.5	74	250	258		49	58	57	
1	84	458.82	0.65	1.49	226	880	.	78	250	244		49	58	57	
	(1150)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 84	V_m= 67.42	√ΔP= 1.0047	ΔH= 2.34				t_s= 78.9						t_m= 56.4	O_2= 20.9

down @ 15.6 1053

Samples Recovered: Filter 0091 ; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☑ Other M4

Sampling Train Leak Checks:
Pretest 0.02 @ 9 "Hg
Posttest 0.00 @ 6 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:
Plant Lunch Break
1053-1141
#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	191.8					1258.4	
Initial Volume	100	100	0			1241.4	
Difference		-82				17.0	3.8

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/i
Sample Location No. 5 HMP - TC Fan (324848)
Date 12|8|20 Test/Run T1 R 3
Operators/Techs TJB , JWG

Module ID CM-11
Meter Coef. γ 0.9958
Orifice Coef. ΔH@ 2.074
Nozzle No. 55 D_n .210

Pitot No. 3-41 C_p .84
Bar. Pres. 28.64 In. Hg
Static Pres. -2.0 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-11
TC Sensor ID CM-11
Barometer ID DB72
Scale ID DS-38

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	CPM Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1206)	459.00													
A-12	3.5	462.28	1.40	3.18	331	231	3.5	81	229	221	NA	45	58	57	20.9
11	7	465.54	1.35	3.06	324	535	.	83	231	228		44	58	57	
10	10.5	468.81	1.35	3.10	327	882	3.5	76	230	229		46	58	57	
9	14	472.07	1.30	3.00	321	203	.	73	238	224		47	59	57	
8	17.5	475.26	1.30	2.99	321	524	3.3	76	237	224		48	60	57	
7	21	478.43	1.25	2.86	314	837	.	80	235	227		50	61	57	
6	24.5	481.36	1.10	2.53	245	133	.	77	241	229		52	62	58	
5	28	484.11	0.95	2.18	274	407	3.0	80	246	232		53	62	58	
4	31.5	486.65	0.83	1.88	255	662	.	85	251	227		54	62	58	
3	35	488.97	0.67	1.53	230	892	2.5	83	253	239		56	63	58	
2	38.5	491.22	0.63	1.44	223	115	.	82	252	242		56	63	58	
1	42	493.32	0.60	1.36	217	332	2.1	85	249	247		57	63	59	
B-12	45.5	496.51	1.30	3.00	322	654	3.5	77	252	261		57	63	59	
11	49	499.75	1.30	2.98	321	975	.	81	252	243		56	63	59	
10	52.5	502.92	1.25	2.85	314	289	.	83	251	233		57	63	59	
9	56	506.06	1.25	2.87	315	605	3.4	80	249	230		58	63	60	
8	59.5	509.23	1.25	2.86	315	919	.	83	250	229		59	63	60	
7	63	512.31	1.20	2.75	309	228	.	82	252	231		60	63	60	
6	66.5	515.11	0.97	2.22	277	505	.	82	252	233		60	64	60	
5	70	517.67	0.82	1.88	255	760	2.7	82	250	239		60	64	60	
4	73.5	520.13	0.80	1.83	252	012	.	82	250	246		60	64	61	
3	77	522.45	0.65	1.50	228	240	2.4	80	251	252		60	64	61	
2	80.5	524.62	0.59	1.37	218	458	.	77	250	256		59	64	61	
1	84	526.75	0.59	1.36	217	675	.	79	251	257		58	64	61	
	(1332)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 84	V_m= 67.75	√ΔP= 1.0035	ΔH= 2.36				t_s= 80.4						t_m= 60.5	O_2= 20.9

Samples Recovered: Filter ______; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☑ Other MY

Sampling Train Leak Checks:
Pretest 0.00 @ 8 "Hg
Posttest 0.00 @ 7 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	190.7						
Initial Volume	100	100	0			1354~~454~~	
Difference		-9.3					7.8

1371.5
1354.4
17.1

Pace Analytical®
Field Services Division

Field Calculation Summary

Computer Initialization and Run Summary

The data on this form is preliminary and includes estimates.
It is not intended to reflect final results.

Project Grede-Iron Mountain 2020 Co Site Stack Date 12/8/2020
Sample Location No. 5 HMP - TC Fan (324848) Tech. TJS

Initialization Parameters						
Parameter	**Initial**	**Run_1**	**Run_2**	**Run_3**	**Run_4**	**Run_5**
Meter Coefficient - ϒ	0.9958					
Orifice Coefficient - ΔH@	2.079					
Pitot Coefficient - C_p	.84					
Nozzle Diameter - D_n	.210					
Barometric Pressure - P_b	28.64					
Static Pressure - P_g	-2.0					
Oxygen Estimate - $\%O_2$	20.9			→		
Moisture Estimate - %MC	1	1	1	1		
No. of Traverse Points	24					
Point Duration - ΔT	3.5					
Meter Start Temp, °F - t_m		51	53	57		
Initial Meter Volume - V_i		325.10	391.40	459.00		
Duct Shape (Rnd/Rect)						
Duct Width, Inches						
Duct Depth, Inches						
Final Volume - V_f		391.24	458.82	526.75		
Total Run Time - θ		84	84	84		
Condensate Volume, ml (g)		5.8	8.8	7.8		
End of Run Summary						
Average Sq. Rt. of the ΔP	√ΔP	.9915	1.0047	1.0053		
Average Orifice Meter	ΔH	2.27	2.34	2.36		
Average Stack Temperature	t_s	77.5	78.8	80.4		
Average Meter Temperature	t_m	52.4	56.4	60.5		
Sample Volume, Actual	V_m	66.14	67.42	67.75		
Sample Volume, Dry Standar	V_{std}	65.34	66.11	65.91		
Moisture Content	MC	0.42	0.62	0.55		
Estimated Mole. Wt., dry	M_d	28.84	28.84	28.84		
Estimated Mole. Wt., wet	M_w					
Average Gas Velocity	V_s	57.49	58.35	58.36		
Isokinetic Variation	%I	100.2	100.4	100.3		
Volumetric Airflow, Actual	ACFM	10840	11000	11000		
Volumetric Airflow, Standard	SCFM	10190	10310	10280		
Volumetric Airflow, Dry Std.	DSCFM	10150	10250	10220		

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Equipment & Method Summary

Isokinetic and Associated Testing

Group 1 QI: TJB Group 4 QI: ____

Project Name: Grede-Iron Mountain 2020 Compliance w/(Test Date: 12/8/2020
Sampling Location: No. 5 HMP - TC Fan (324848) Recorded By: TJB

Airflow Determination EPA Method: ☑ 2 ☐ 2C ☐ Other ____ Initials

Pitot Tube No.: 3-41 Coef.: .840 Next Ver. Date: ____ Pre-Use Insp.: TJB
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: CM-11 ☑ Oil ☐ Digital Next Ver. Date: 2/8/21 Pre-Use Insp.: TJB
Manometer ID: ____ ☐ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
Barometer ID: DB-72 ☐ Aneroid ☑ Digital Next Ver. Date: 2/15/21 Pre-Use Insp.: TJB
Barometer ID: ____ ☐ Aneroid ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout CM-11 ☑ Single ☐ Dual Next Ver. Date: 2/8/21 Pre-Use Insp.: TJB
T/C Readout ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____

Gas Composition EPA Method: ☐ 3 ☐ 3/3A ☐ 3B ☐ 3C ☑ Ambient ☐ ____ Initials

Container Type: ☐ Tedlar ☐ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ____
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☐ Instrumental: Instrument ID: ____ Cal Range ____
Ambient Provision Oxygen Verification: Portable O2 ID ____ Ambient Cal Reading: 20.9
Note: Portable O2 results are not reported as test data.

Moisture Content EPA Method: ☑ 4, back-half of iso train ☐ Other ____ Explain in Options/Deviations Section Initials

Wt. Scale ID: DS-38 ☑ Digital ☐ Beam Next Ver. Date: ____ Pre-Use Insp.: ____
Std. Weight ID: ____ Std. Weight (g): ____ Scale Reading: ____ ☐ Pass ☐ Fail

Isokinetic EPA Method: ☑ 5 ____ ☐ 8 ☐ 17 ☐ 23 ☐ 26A ☐ 29 ☐ Other ____ Initials

Nozzle ID: 56 Type: ☑ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____

Nozzle Cal.:	1	2	3	4	5	Avg	Pre-Use Insp.:
	.210	.208	.210	.210	.211	.210	TJB

Nozzle ID: ____ Type: ☐ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____

Nozzle Cal.:	1	2	3	4	5	Avg	Pre-Use Insp.:

Probe Length: 3 ft. Liner: ☐ SS ☑ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: 3-41 Coef.: .840 Next Ver. Date: ____ Pre-Use Insp.: TJB
Probe Length: ____ ft. Liner: ☐ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Control Mod ID: CM-11 Y: 0.9958 ΔH@: 2.079 Next Ver. Date: 2/8/21 Pre-Use Insp.: TJB
Control Mod ID: ____ Y: ____ ΔH@: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Filter Type: ☐ 2½" Round ☑ 4" Round ☐ Thimble ☐ Other ____
Filter Media: ☑ Glass Fiber ☐ Quartz Fiber ☐ Paper ☐ Teflon ☐ SS ☐ Other ____
Wet Catch: ☐ EPA 202 ☐ EPA 8 ☐ EPA 23 ☐ EPA 26A ☐ EPA 29 ☑ Other MY
WC Options/Deviations: ____

Field Data Sheets - 334116

EPA Method 1 Field Data Sheet

Test Site and Traverse Point Selection

Project Grede-Iron Mountain 2020 Compliance w/Cu

Test Location Module Plant Exhaust (334116)

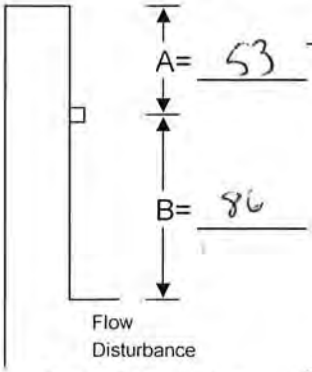
Date 12/10/202 Test/Run T1 R

Tech(s) TJB, JWG

☐ New Sketch Created With Dimensions

☐ File Drawing Verified and Attached

☐ Cyclonic Flow Measured (See M-2 Sheet)



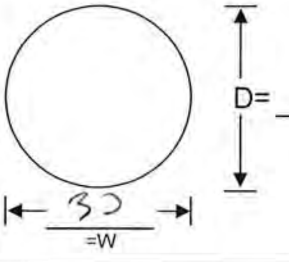
A= 53

B= 86

Disturbance Type

Before (B)		After (A)
☐	Elbow	☐
☐	Conjunction	☐
☐	Fan (cent)	☐
☐	Axial Fan	☐
☐	Transition	☐
☐	Damper	☐
☐	Exit	☐
☐	Other ______	☐

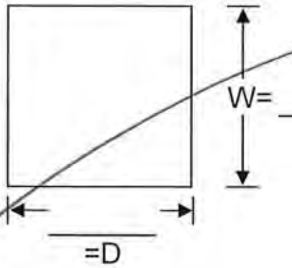
☐ Round



D= 30

30 =W

☐ Rectangular



W= ______

=D

Duct Orientation

☑ Vertical

☐ Horizontal

☐ Diagonal

2 No. of Traverses

A= 1.6 Diameters to downstream

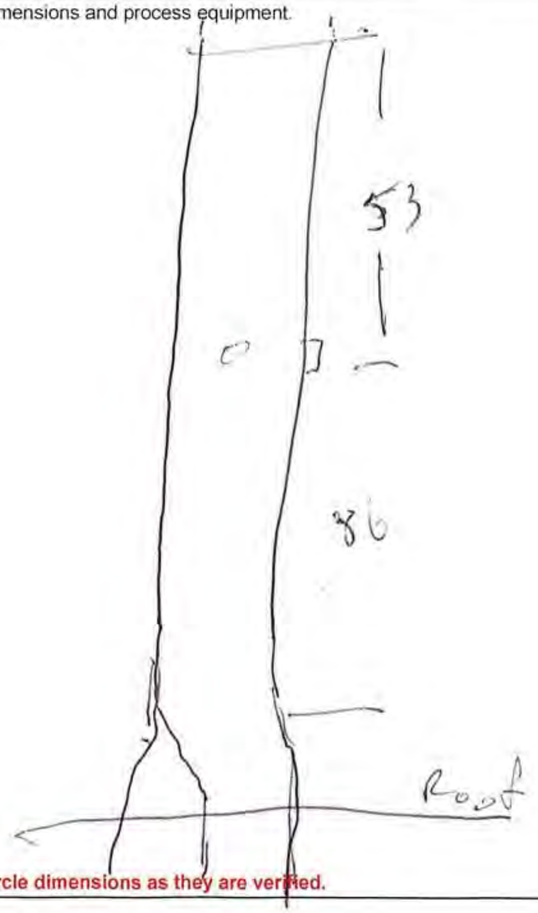
B= 2.8 Diameters to upstream

T_R= 24 Min. Traverse Points (iso)

T_A= 24 Traverse Points Used

Traverse Points (from wall)

Sketch of test location with dimensions and process equipment.



If file drawing, correct or circle dimensions as they are verified.

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EPA Method 2 Field Data Sheet

Volumetric Airflow Determinations

Project: Grede-Iron Mountain 2020 Compliance w/Cu
Test Location: Module Plant Exhaust (334116)
Date: 12/10/20 Test/Run: T1 R 0
Duct Dimensions: 30 x 30 Inches
Port Length: 6 Inches
Pitot Leak Check - Pos: ✓ Neg: ✓

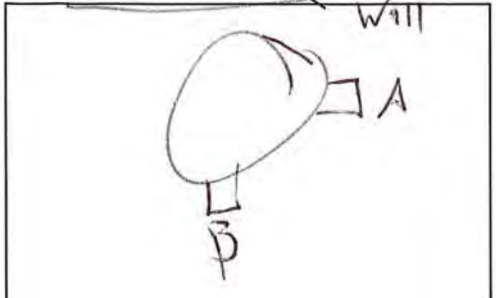
Manometer Type and ID: cm-11
Barometer Type and ID: DB-72
Thermocouple Sensor ID: cm-11
Pitot Tube No.: 3-41 Cp: .840
Technicians: TJB, JWG
#REF!
FSD PN: 20-04074

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From Wall	Inches From Port	Flow °Yaw	Run 1 ΔP	Run 2 ΔP	Run 3 ΔP	Run 4 ΔP	Run 1 °F	Run 2 °F	Run 3 °F	Run 4 °F
A 12	0.64	6.64	20	0.24							
11	2.01	8.01	22	0.24							
10	354	9.54	22	0.23							
9	5.32	11.32	20	0.19							
8	7.50	13.50	15	0.19							
7	10.67	16.67	10	0.18							
6	19.33	25.33	-10	0.16							
5	22.55	28.55	-10	0.16							
4	24.68	30.68	-10	0.15							
3	26.46	32.46	-15	0.15							
2	27.99	33.99	-15	0.15							
1	29.36	35.36	-15	0.15							
B 12	SAME		25								
11			25								
10			20								
9			20								
8			15								
7			10								
6			-10								
5			-10								
4			-15								
3			-20								
2			-20								
1			-15								

Ave 16.6

TJB

TJB



Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	28.69				"Hg
Static Pressure	-.07				"H_2O
Dry Bulb Temp.	75				°F
Wet Bulb Temp.					°F
Moisture Content	1				%v/v
320 P Oxygen	20.9				%v/v
Time of Meas.	0730				(24 Hour)

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/i
Sample Location Module Plant Exhaust (334116)
Date 12|10|20 Test/Run T1 R 1
Operators/Techs TJB

Module ID CM-11
Meter Coef. γ 0.9958
Orifice Coef. ΔH@ 2.079
Nozzle No. 55 D_n .346

Pitot No. 3-41 C_p .84
Bar. Pres. 28.69 In. Hg
Static Pres. -.07 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-11
TC Sensor ID CM-11 / TC-41
Barometer ID DB 72
Scale ID DS 38

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F CPM	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(0750)	737.85													
A 12	3.5	741.44	0.23	3.90	366	151	3.3	75	254	248	N/A	56	53	55	20.9
11	7	744.97	0.23	3.86	362	513	.	78	251	239		54	51	54	
10	10.5	748.54	0.22	3.68	353	866	3.3	78	248	245		54	51	54	
9	14	752.01	0.21	3.44	342	208	.	89	249	240		54	52	54	
8	17.5	755.45	0.21	3.49	341	549	3.2	93	252	237		54	53	53	
7	21	758.85	0.20	3.31	335	884	.	84	252	229		55	54	54	
6	24.5	762.10	0.18	2.94	317	201	.	92	250	226		54	54	54	
5	28	765.21	0.18	2.96	317	518	2.6	89	249	232		54	54	54	
4	31.5	768.26	0.16	2.59	297	815	.	98	251	231		54	54	54	
3	35	771.14	0.15	2.52	293	108	.	77	251	243		54	54	54	
2	38.5	774.10	0.15	2.45	289	397	.	92	251	253		55	55	54	
1	42	776.86	0.14	2.30	280	677	2.3	90	251	260		54	55	54	
B-12	45.5	780.58	0.26	4.18	377	054	3.5	102	250	262		55	55	54	
11	49	784.31	0.25	4.07	373	427	.	94	250	239		53	55	54	
10	52.5	788.09	0.25	4.16	377	804	3.5	82	250	234		57	55	55	
9	56	791.65	0.22	3.71	356	160	.	76	250	233		55	57	55	
8	59.5	795.11	0.21	3.53	348	507	.	78	251	224		56	57	56	
7	63	798.47	0.19	3.17	329	836	2.7	84	250	221		56	57	56	
6	66.5	801.75	0.19	3.21	331	188	.	77	251	227		58	57	56	
5	70	804.91	0.19	3.13	327	495	.	90	250	240		57	58	57	
4	73.5	808.15	0.18	2.96	318	813	.	93	251	247		57	58	57	
3	77	811.33	0.19	3.15	329	142	.	87	250	258		57	58	57	
2	80.5	814.51	0.17	2.85	313	455	.	81	251	260		58	59	57	
1	84	817.44	0.16	2.70	304	759	.	79	250	262		58	59	58	
	(0917)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 84	V_m= 79.59	√ΔP= .4419	ΔH= 3.26				t_s= 85.8						t_m= 55.1	O_2=

Samples Recovered: Filter ______; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☑ Other MY

Sampling Train Leak Checks:
Pretest 0.00 @ 6 "Hg
Posttest 0.00 @ 6 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume		196.2				1357	
Initial Volume	100	100	0			1337.9	
Difference		-3.8				19.1	15.3

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/ Module ID CM-11 Pitot No. 3-41 C_p .840 Manometer ID CM-11
Sample Location Module Plant Exhaust (334116) Meter Coef. γ .9958 Bar. Pres. 28.69 In. Hg TC Sensor ID CM-11 / TC-41
Date 12/10/20 Test/Run T1 R 2 Orifice Coef. ΔH@ 2.079 Static Pres. -.07 In. H_2O Barometer ID DB-72
Operators/Techs TJB, JWG Nozzle No. 55 D_n .346 Est. Moist. 1 %v/v Scale ID DS 38

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incre-mental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F CPM	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(940)	817.65													
B-12	3.5	821.41	0.25	4.17	378	143	3.5	84	236	218	NA	49	55	58	20.9
11	7	825.17	0.25	4.07	373	516	3.5	96	238	222		48	55	58	
10	10.5	828.80	0.24	3.91	366	882	.	96	245	240		50	56	58	
9	14	832.52	0.23	3.82	362	244	.	86	254	224		51	59	59	
8	17.5	835.98	0.21	3.53	349	593	3.0	81	253	221		52	60	59	
7	21	839.24	0.19	3.11	327	920	2.9	96	250	228		53	60	59	
6	24.5	842.52	0.19	3.09	326	247	.	100	248	229		53	61	60	
5	28	845.80	0.19	3.18	331	578	2.9	86	252	235		54	61	60	
4	31.5	849.05	0.18	3.03	323	901	.	83	253	241		54	62	60	
3	35	852.10	0.17	2.87	315	216	.	81	250	253		53	62	61	
2	38.5	855.25	0.16	2.71	306	532	2.8	80	250	257		55	62	61	
1	42	858.30	0.17	2.79	311	833	.	87	250	262		55	63	61	
A-12	45.5	861.67	0.23	3.87	366	199	3.3	84	250	244		55	61	61	
11	49	865.56	0.23	3.84	364	563	.	88	252	221		57	63	62	
10	52.5	869.02	0.21	3.43	345	907	.	101	250	220		54	64	63	
9	56	872.27	0.19	3.09	329	235	3.0	104	251	225		55	65	63	
8	59.5	875.55	0.19	3.15	331	566	.	94	251	232		55	65	63	
7	63	878.86	0.18	3.02	324	890	.	88	250	234		55	65	64	
6	66.5	881.95	0.16	2.65	304	193	.	95	257	232		56	65	64	
5	70	884.88	0.15	2.47	293	486	.	99	251	228		56	66	64	
4	73.5	887.73	0.14	2.33	285	771	2.5	93	250	227		57	66	65	
3	77	890.62	0.14	2.33	284	055	.	97	251	246		56	66	65	
2	80.5	893.35	0.13	2.14	273	329	.	101	251	260		57	66	65	
1	84	896.00	0.13	2.14	273	601	.	100	251	271		57	67	65	
	(1108)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 84	V_m= 78.35	√ΔP=.4314	ΔH=3.12				t_s=92.1						t_m=60.8	O_2=

Samples Recovered: Filter ________; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☑ Other MH

Sampling Train Leak Checks:
Pretest 0.000 @ 6 "Hg
Posttest 0.000 @ 6 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume		199.4				1290.9	
Initial Volume	100	100	0			1287.4	
Difference		-.6				3.5	2.9

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/i
Sample Location Module Plant Exhaust (334116)
Date 12|10|20 Test/Run T1 R3
Operators/Techs TJB, JWG

Module ID CM-11
Meter Coef. γ 0.9958
Orifice Coef. ΔH@ 2.079
Nozzle No. 55 D_n .346

Pitot No. 3-41 C_p .840
Bar. Pres. 28.69 In. Hg
Static Pres. -.07 In. H_2O
Est. Moist. 1 %v/v

Manometer ID CM-11
TC Sensor ID CM-11 / TC-41
Barometer ID DB-72
Scale ID DS-38

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incre-mental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1226)	846.25													
A-12	3.5	849.80	0.24	3.58	353	978	3.2	80	250	239	N/A	60	63	65	20.9
11	7	903.26	0.22	3.64	353	333	.	96	252	234		58	63	65	
10	10.5	906.71	0.21	3.54	350	684	.	86	250	232		59	63	65	
9	14	910.20	0.20	3.36	341	025	.	88	249	224		60	65	65	
8	17.5	913.59	0.19	3.41	329	357	3.0	102	252	222		61	66	65	
7	21	916.86	0.19	3.10	329	683	.	105	252	220		62	66	65	
6	24.5	919.98	0.17	2.78	311	994	.	103	251	222		63	67	66	
5	28	923.03	0.16	2.64	304	298	2.7	99	250	223		64	68	66	
4	31.5	925.96	0.15	2.49	295	593	.	96	250	224		64	68	66	
3	35	928.82	0.14	2.31	287	877	.	101	251	226		65	69	66	
2	38.5	931.86	0.13	2.14	274	151	.	102	251	228		65	70	66	
1	42	934.29	0.13	2.15	274	425	2.2	100	250	230		64	70	67	
B-12	45.5	938.00	0.24	4.03	376	801	.	92	250	231		64	70	68	
11	49	941.80	0.24	4.01	375	176	3.5	95	251	229		62	71	68	
10	52.5	945.51	0.24	4.02	376	552	.	94	251	233		62	72	68	
9	56	949.21	0.23	3.79	365	916	.	105	250	234		62	72	68	
8	59.5	952.42	0.21	3.48	350	266	.	101	250	237		62	72	69	
7	63	956.04	0.19	3.16	334	600	.	99	251	239		62	73	69	
6	66.5	959.32	0.19	3.18	334	934	3.0	97	250	238		62	73	69	
5	70	962.62	0.18	2.98	325	258	.	102	252	236		63	73	70	
4	73.5	965.89	0.18	2.99	325	583	.	101	250	235		63	74	70	
3	77	969.07	0.17	2.85	317	900	.	96	251	229		63	74	70	
2	80.5	972.20	0.17	2.84	317	217	.	98	250	228		63	74	70	
1	84	975.15	0.15	2.51	297	514	.	98	251	224		63	73	70	
	(1352)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 84	V_m= 78.90	√ΔP=.4308	ΔH= 3.11				t_s=97.3						t_m=68.4	O_2=

Samples Recovered: Filter ________; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☑ Other MY

Sampling Train Leak Checks:
Pretest 0.00 @ 6 "Hg
Posttest 0.00 @ 6 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume		199.5				1370.0	
Initial Volume	100	100	0			1357.0	
Difference		-.5				13	12.5

Pace Analytical®
Field Services Division

Field Calculation Summary

Computer Initialization and Run Summary

The data on this form is preliminary and includes estimates.
It is not intended to reflect final results.

Project Grede-Iron Mountain 2020 Co Site Stack Date 12/10/20
Sample Location Module Plant Exhaust (334116 Tech. TJB

Initialization Parameters						
Parameter	**Initial**	**Run_1**	**Run_2**	**Run_3**	**Run_4**	**Run_5**
Meter Coefficient - ϒ	.9958					
Orifice Coefficient - ΔH@	2.079					
Pitot Coefficient - C_p	.84					
Nozzle Diameter - D_n	.346					
Barometric Pressure - P_b	28.49	→				
Static Pressure - P_g	-.07	→				
Oxygen Estimate - %O_2	20.9	→				
Moisture Estimate - %MC		1	1	1		
No. of Traverse Points						
Point Duration - ΔT						
Meter Start Temp, °F - t_m		~~737.85~~ 57	57	66		
Initial Meter Volume - V_i		737.85	817.65	896.25		
Duct Shape (Rnd/Rect)						
Duct Width, Inches						
Duct Depth, Inches						
Final Volume - V_f		817.44	896.00	975.15		
Total Run Time - θ		84	84	87		
Condensate Volume, ml (g)		15.3	7.9	12.5		
End of Run Summary						
Average Sq. Rt. of the ΔP	√ΔP	.4419	.4314	.4308		
Average Orifice Meter	ΔH	3.26	3.12	3.11		
Average Stack Temperature	t_s	85.8	92.1	97.3		
Average Meter Temperature	t_m	55.1	60.8	68.4		
Sample Volume, Actual	V_m	79.59	78.35	78.90		
Sample Volume, Dry Standar	V_{std}	78.55	76.45	75.88		
Moisture Content	MC	0.91	0.18	0.77		
Estimated Mole. Wt., dry	M_d	28.84	28.94	28.84		
Estimated Mole. Wt., wet	M_w					
Average Gas Velocity	V_s	25.82	25.32	25.43		
Isokinetic Variation	%I	100.6	100.3	100.7		
Volumetric Airflow, Actual	ACFM	7600	7460	7490		
Volumetric Airflow, Standard	SCFM	7050	6840	6800		
Volumetric Airflow, Dry Std.	DSCFM	6990	6830	6750		

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Equipment & Method Summary

Isokinetic and Associated Testing

Group 1 QI TJJ Group 4 QI ____

Project Name: Grede-Iron Mountain 2020 Compliance w/(Test Date: 12/10/20
Sampling Location: Module Plant Exhaust (334116) Recorded By: TJJ

Airflow Determination EPA Method: ☐ 2 ☐ 2C ☐ Other ______ Initials

Pitot Tube No.: 3-41 Coef.: .84 Next Ver. Date: 1 Pre-Use Insp.: TJB
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: ~~DM-4~~ ☐ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: CM-4 ☑ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: TJB
Barometer ID: DB-72 ☐ Aneroid ☑ Digital Next Ver. Date: 2/24/21 Pre-Use Insp.: TJB
Barometer ID: ____ ☐ Aneroid ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____

Gas Composition EPA Method: ☐ 3 ☐ 3/3A ☐ 3B ☐ 3C ☑ Ambient ☐ ____ Initials

Container Type: ☐ Tedlar ☐ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ____
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☐ Instrumental: Instrument ID: ____ Cal Range ____
Ambient Provision Oxygen Verification: Portable O2 ID ____ Ambient Cal Reading: ____
Note: Portable O2 results are not reported as test data.

Moisture Content EPA Method: ☐ 4, back-half of iso train ☐ Other __ Explain in Options/Deviations Section Initials

Wt. Scale ID: DS-38 ☑ Digital ☐ Beam Next Ver. Date: ____ Pre-Use Insp.: ____
Std. Weight ID: ____ Std. Weight (g): ____ Scale Reading: ____ ☐ Pass ☐ Fail

Isokinetic EPA Method: ☐ 5 __ ☐ 8 ☐ 17 ☐ 23 ☐ 26A ☐ 29 ☐ Other __ Initials

Nozzle ID: SS Type: ☑ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ______
Nozzle Cal.: 1 .346 | 2 .346 | 3 .346 | 4 .347 | 5 .347 | Avg .346 Pre-Use Insp.: TJB
Nozzle ID: ____ Type: ☐ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ______
Nozzle Cal.: 1 | 2 | 3 | 4 | 5 | Avg Pre-Use Insp.: ____
Probe Length: 3 ft. Liner: ☑ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: 3-41 Coef.: .840 Next Ver. Date: ____ Pre-Use Insp.: TJB
Probe Length: ____ ft. Liner: ☐ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Control Mod ID: CM-11 ϒ: 0.9958 ΔH@: 2.079 Next Ver. Date: ____ Pre-Use Insp.: TJB
Control Mod ID: ____ ϒ: ____ ΔH@: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Filter Type: ☐ 2½" Round ☑ 4" Round ☐ Thimble ☐ Other ______
Filter Media: ☑ Glass Fiber ☐ Quartz Fiber ☐ Paper ☐ Teflon ☐ SS ☐ Other ____
Wet Catch: ☐ EPA 202 ☐ EPA 8 ☐ EPA 23 ☐ EPA 26A ☐ EPA 29 ☐ Other ___
WC Options/Deviations: ______

Field Data Sheets - 334176

EPA Method 1 Field Data Sheet

Test Site and Traverse Point Selection

Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location Module Plant Exhaust (334176)
Date 12/9/20 Test/Run T1 R 0
Tech(s) Dh, JWG

☐ New Sketch Created With Dimensions
☐ File Drawing Verified and Attached
☑ Cyclonic Flow Measured (See M-2 Sheet)

A= 31
B= 145
Flow Disturbance

Disturbance Type

Before (B)		After (A)
☐	Elbow	☐
☐	Conjunction	☐
☐	Fan (cent)	☐
☐	Axial Fan	☐
☐	Transition	☐
☐	Damper	☐
☐	Exit	☐
☐	Other ________	☐

☐ Round
D= 30.0
30.0 =W

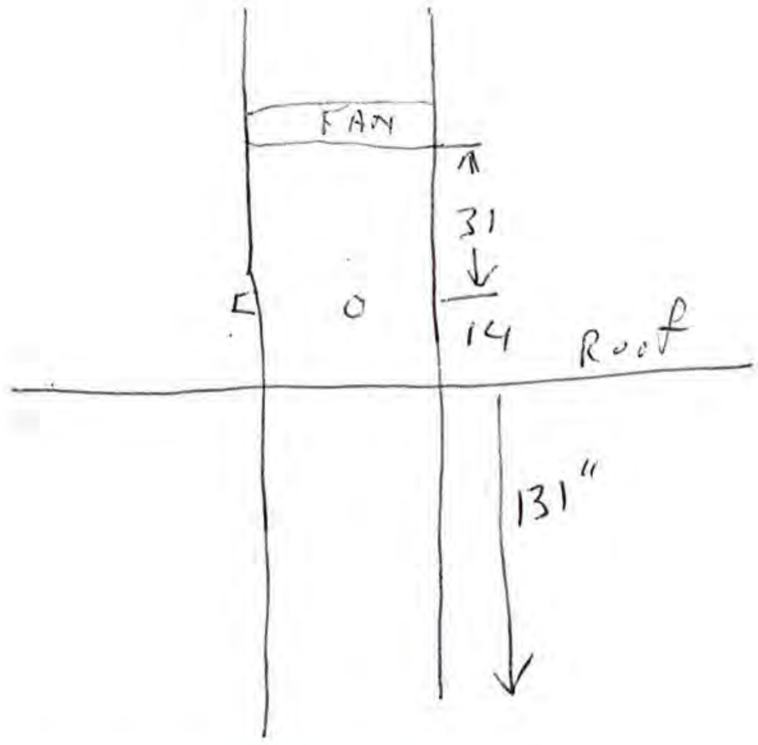
☐ Rectangular
W=
=D

Duct Orientation
☑ Vertical
☐ Horizontal
☐ Diagonal
No. of Traverses

A= 1 Diameters to downstream
B= 4.8 Diameters to upstream
T_R= 42 Min. Traverse Points (iso)
T_A= 12 Traverse Points Used

Traverse Points (from wall)

Sketch of test location with dimensions and process equipment.



If file drawing, correct or circle dimensions as they are verified.

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Field Services Division

EPA Method 2 Field Data Sheet

Volumetric Airflow Determinations

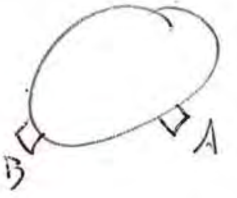
Project Grede-Iron Mountain 2020 Compliance w/Cu
Test Location Module Plant Exhaust (334176)
Date 12/9/20 Test/Run T1 R 0
Duct Dimensions 30.0 Inches
Port Length 6.0 Inches
Pitot Leak Check - Pos ✓ Neg –

Manometer Type and ID DM-48
Barometer Type and ID DB-72
Thermocouple Sensor ID CM-4
Pitot Tube No. 3-41 Cp .84
Technicians TJB, JWG
#REF!
FSD PN: 20-04074

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From		Flow	Run 1	Run 2	Run 3	Run 4	Run 1	Run 2	Run 3	Run 4
	Wall	Port	°Yaw	ΔP	ΔP	ΔP	ΔP	°F	°F	°F	°F
A-12	0.64	6.64	0	0.065							
11	2.01	8.01	0	0.066							
10	3.54	9.54	5	0.065							
9	5.32	11.32	5	0.063							
8	7.50	13.50	5	0.059							
7	10.67	16.67	5	0.049							
6	19.33	25.33	-10	0.030							
5	22.50	28.50	-5	0.030							
4	24.68	30.68	0	0.025							
3	26.46	32.46	0	0.025							
2	27.99	33.99	0	0.021							
1	29.36	35.36	0	0.028							
B-12			5								
11			5								
10			5								
9			0								
8			0								
7			0								
6			10								
5			20								
4			20								
3			22								
2			22								
1			20								

TJB

TJB



Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	28.47				"Hg
Static Pressure	-.139				"H_2O
Dry Bulb Temp.	75				°F
Wet Bulb Temp.					°F
Moisture Content	1				%v/v
320 P Oxygen	20.9				%v/v
Time of Meas.	730				(24 Hour)

Pace Analytical® Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/ Module ID cm V Pitot No. 341 C_p .840 Manometer ID cm-11 / Dm-48
Sample Location Module Plant Exhaust (334176) Meter Coef. γ .9958 Bar. Pres. 28.47 In. Hg TC Sensor ID cm-4 TC49
Date 12/9/20 Test/Run T1 R1 Orifice Coef. ΔH@ 2.079 Static Pres. -.14 In. H_2O Barometer ID DB72
Operators/Techs TDG, JWG Nozzle No. 25 D_n .425 Est. Moist. 1 %v/v Scale ID DS-38

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired $ΔV_m$ Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(815)	540.03													
A-12	3.5	543.10	0.068	~~2.60~~ 2.63	302	305	2.7	77	250	249	NA	45	58	57	20.9
11	7	546.05	0.066	~~2.59~~ 2.54	296	601	.	77				47	60	57	
10	10.5	548.95	0066	2.53	296	897	.	80	252	248		47	60	57	
9	14.	551.89	.062	2.38	287	104	2.7	80	254	249		47	61	57	
8	17.5	554.50	.054	2.08	268	452	.	79	250	256		49	61	58	
7	21	557.11	.048	1.85	255	705	2.5	79	250	256		51	61	58	
6	24.5	559.70	.051	1.96	261	966	.	80	249	259		52	62	58	
5	28	561.72	.032	1.22	206	172	2.0	83	250	260		54	62	58	
4	31.5	563.51	.022	0.86	172	345	.	74	250	260		65	57	59	
3	35	565.33	.026	1.00	186	531	.	76	252	266		55	57	59	
2	38.5	567.17	.024	0.93	174	710	1.8	75	252	268		55	58	59	
1	42	568.99	.026	1.00	188	896	.	81	250	249		57	58	54	
B-12	45.5	571.84	.061	2.36	286	182	.	75	250	250		57	59	59	
11	49	574.69	.060	2.32	283	465	2.7	77	249	259		57	60	60	
10	52.5	577.69	.060	2.30	283	748	.	81	249	261		57	60	60	
9	56	580.70	.059	2.25	280	028	.	84	250	263		57	60	60	
8	59.5	582.86	.050	1.93	259	286	.	79	250	265		58	60	61	
7	63	585.27	.045	1.72	244	531	.	85	245	266		58	60	61	
6	66.5	588.09	.055	2.09	270	820	.	86	250	260		58	61	61	
5	70	590.90	.061	2.34	285	080	.	83	252	249		58	61	61	
4	73.5	594.12	.075	2.88	317	402	.	81	252	244		59	61	61	
3	77	597.29	.077	2.93	319	722	2.9	87	250	250		60	61	61	
2	80.5	600.45	.076	2.91	318	040	.	87	251	250		60	61	62	
1	84	603.44	.067	2.52	299	339	.	84	250	255		60	62	62	
	(942)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 84	V_m= 63.41	√ΔP=.2287	ΔH= 2.07				t_s= 80.1						t_m= 59.7	O_2=20.9

Samples Recovered: Filter ________; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☑ Other cr+6

Sampling Train Leak Checks:
Pretest 0.00 @ 7 "Hg
Posttest 0.00 @ 6 "Hg
Pitot - Pos. ✓ Neg. —

Comments:

#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume		198.8				1277.9	
Initial Volume	100	200	0			1268.4	
Difference		-1.2				8.3	6.1

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/
Sample Location Module Plant Exhaust (334176)
Date 12/9/20 Test/Run T1 R 2
Operators/Techs DB, JWG

Module ID CM-11
Meter Coef. γ 0.9958
Orifice Coef. ΔH@ 2.079
Nozzle No. SS D_n 0.425

Pitot No. 3-41 C_p .840
Bar. Pres. 28.47 In. Hg
Static Pres. -.14 In. H_2O
Est. Moist. 1 %v/v

Manometer ID DM-48
TC Sensor ID CM-11 / TC-41
Barometer ID DB-72
Scale ID DS-38

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	CPM Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1035)	604.10													
B-12	3.5	607.22	0.073	2.74	308	718	2.5	77	254	247	NA	51	57	60	20.9
11	7	610.25	0.067	2.57	298	017	.	80	247	249		51	58	60	
10	10.5	613.28	0.071	2.74	308	324	2.7	78	250	236		52	59	61	
9	14	616.33	0.069	2.65	307	628	.	80	250	236		52	60	61	
8	17.5	619.25	0.062	2.35	288	914	2.2	88	254	232		52	60	60	
7	21	621.89	0.055	2.12	272	186	.	79	252	236		53	61	61	
6	24.5	624.18	0.039	1.50	229	414	2.0	80	248	245		54	62	62	
5	28	626.40	0.037	1.43	223	638	.	79	249	255		55	62	62	
4	31.5	628.51	0.033	1.27	210	848	.	82	252	256		55	63	62	
3	35	630.78	0.038	1.47	226	074	2.0	81	252	259		55	63	63	
2	38.5	632.52	0.022	0.85	172	246	.	81	250	254		55	63	63	
1	42	634.18	0.020	0.77	164	411	.	81	249	257		56	63	63	
A-12	45.5	637.10	0.062	2.40	289	700	.	80	252	254		56	64	64	
11	49	639.99	0.065	2.49	295	995	2.6	87	248	239		56	66	64	
10	52.5	643.07	0.068	2.62	303	298	.	85	250	237		56	67	65	
9	56	646.11	0.068	2.64	304	602	.	82	252	230		57	67	66	
8	59.5	648.92	0.058	2.23	280	882	.	86	251	239		57	68	66	
7	63	651.57	0.052	2.01	266	148	.	85	251	248		58	68	67	
6	66.5	654.33	0.058	2.24	281	429	2.5	85	249	242		59	68	67	
5	70	657.52	0.074	2.87	318	747	.	84	250	241		59	68	67	
4	73.5	660.78	0.079	3.08	329	076	.	83	251	242		59	68	68	
3	77	664.19	0.084	3.27	339	415	.	82	251	248		60	68	68	
2	80.5	667.35	0.069	2.67	307	722	.	85	250	250		61	68	68	
1	84	670.37	0.066	2.56	300	022	.	84	249	252		61	68	69	
	(1205)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 84	V_m=66.27	$\sqrt{\Delta P}$=.2372	ΔH= 2.23				t_s= 82.3						t_m=62.9	O_2=20.9

Samples Recovered: Filter ________; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☑ Other M4

Sampling Train Leak Checks:
Pretest 0.00 @ 7 "Hg
Posttest 0.00 @ 6 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:
#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	198.3					1337.9	
Initial Volume	100	100	0			1322.0	
Difference	-1.7					15.9	14.2

Pace Analytical®
Field Services Division

FSD PN: 20-04074

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede-Iron Mountain 2020 Compliance w/I
Sample Location Module Plant Exhaust (334176)
Date 12/9/20 Test/Run T1 R3
Operators/Techs DB

Module ID CM-11
Meter Coef. γ .9958
Orifice Coef. ΔH@ 2.079
Nozzle No. 55 D_n .425

Pitot No. 3.41 C_p .840
Bar. Pres. 28.47 In. Hg
Static Pres. ~~-.14~~ -.14 In. H_2O
Est. Moist. 1 %v/v

Manometer ID DM-48
TC Sensor ID CM-11 / TC-4
Barometer ID DB-72
Scale ID DS-38

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	CPM Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1228)	670.75													
12	3.5	673.70	0.067	2.59	302	377	2.5	85	239	270	NA	56	65	68	20.9
11	7.0	676.80	0.074	2.86	317	645	.	84	241	269		54	64	68	
10	10.5	680.01	0.069	2.67	306	001	.	83	248	267		54	64	69	
9	14	682.88	0.063	2.44	293	244	.	82	255	262		54	65	69	
8	17.5	685.70	0.057	2.20	278	572	.	86	253	269		56	66	69	
7	21	688.51	0.056	2.16	276	848	.	86	249	268		57	66	68	
6	24.5	691.35	0.065	2.51	297	145	.	86	248	264		58	67	68	
5	28	694.52	0.071	2.74	311	456	2.9	85	251	260		58	67	69	
4	31.5	697.72	0.075	2.90	320	775	.	86	253	267		59	67	69	
3	35	701.20	0.088	3.41	347	122	.	84	230	264		61	68	69	
2	38.5	704.35	0.071	2.76	312	434	3.0	83	248	266		61	68	69	
1	42	707.62	0.074	2.87	318	753	.	84	250	264		62	68	69	
12	45.5	710.74	0.072	2.82	316	069	.	78	253	279		65	67	69	
11	49	714.00	0.073	2.82	316	384	.	85	250	268		63	68	69	
10	52.5	716.97	0.070	2.71	309	693	.	85	248	250		63	68	69	
9	56	720.07	0.067	2.60	303	996	.	84	252	242		64	68	69	
8	59.5	722.90	0.064	2.46	295	291	.	88	251	240		65	68	69	
7	63	725.61	0.052	2.01	266	558	.	87	252	238		65	68	69	
6	66.5	727.99	0.042	1.62	239	796	.	88	250	252		65	69	69	
5	70	730.15	0.034	1.31	215	012	.	87	249	258		65	69	~~69~~ 69	
4	73.5	732.06	0.026	1.01	189	201	.	83	252	252		66	69	69	
3	77	734.13	0.030	1.16	202	403	.	87	252	260		66	69	69	
2	80.5	735.98	0.026	1.00	188	592	.	87	251	266		66	70	69	
1	84	737.60	0.020	0.77	165	757	.	88	250	267		66	70	69	
	(1354)	.	.	.			.								
		.	.	.			.								
Tot/Avg	θ= 84	V_m= 66.85	√ΔP=.2383	ΔH= 2.27				t_s=85.0						t_m=68.1	O_2=

Samples Recovered: Filter ________; ☑ Probe Wash; ☐ Wet Catch; ☐ M-202; ☑ Other M-4

Sampling Train Leak Checks:
Pretest 0.00 @ 6 "Hg
Posttest 0.00 @ 5.5 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:
#REF!

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	~~196.2~~	~~98.8~~				~~1277.9~~ 1287.4	
Initial Volume	100	100	0			1277.9	
Difference	196.2	-3.8				9.5	5.7

Pace Analytical®
Field Services Division

Field Calculation Summary

Computer Initialization and Run Summary

The data on this form is preliminary and includes estimates.
It is not intended to reflect final results.

Project Grede-Iron Mountain 2020 Co Site Stack Date 12/9/20
Sample Location Module Plant Exhaust (334176 Tech. TJB

Initialization Parameters						
Parameter	**Initial**	**Run_1**	**Run_2**	**Run_3**	**Run_4**	**Run_5**
Meter Coefficient - ϒ	.9958					
Orifice Coefficient - ΔH@	2.079					
Pitot Coefficient - C_p	.840					
Nozzle Diameter - D_n	.425					
Barometric Pressure - P_b	28.41	→	→	→		
Static Pressure - P_g	-.14	→	→	→		
Oxygen Estimate - %O_2	20.9	→	→	→		
Moisture Estimate - %MC	1					
No. of Traverse Points	24					
Point Duration - ΔT	3.5					
Meter Start Temp, °F - t_m		57	60	68		
Initial Meter Volume - V_i		540.03	604.10	670.75		
Duct Shape (Rnd/Rect)						
Duct Width, Inches						
Duct Depth, Inches						
Final Volume - V_f		603.44	670.37	737.60		
Total Run Time - θ		84	84	84		
Condensate Volume, ml (g)		6.1	14.2	5.7		
End of Run Summary						
Average Sq. Rt. of the ΔP	√ΔP	.2287	.2378	.2383		
Average Orifice Meter	ΔH	2.07	2.23	2.27		
Average Stack Temperature	t_s	80.1	82.3	85.0		
Average Meter Temperature	t_m	59.7	62.9	68.1		
Sample Volume, Actual	V_m	63.41	66.27	66.85		
Sample Volume, Dry Standar	V_{std}	61.37	63.77	63.80		
Moisture Content	MC	0.47	1.04	.42		
Estimated Mole. Wt., dry	M_d	~~17.73~~				
Estimated Mole. Wt., wet	M_w					
Average Gas Velocity	V_s	13.33	13.87	13.96		
Isokinetic Variation	%I	101.2	101.1	100.2		
Volumetric Airflow, Actual	ACFM	3930	4090	4110		
Volumetric Airflow, Standard	SCFM	3650	3790	3790		
Volumetric Airflow, Dry Std.	DSCFM	3630	3750	3770		

Pace Analytical®
Field Services Division

Equipment & Method Summary

Isokinetic and Associated Testing

Group 1 QI TJB Group 4 QI ____

Project Name: Grede-Iron Mountain 2020 Compliance w/(Test Date: 12/9/20
Sampling Location: Module Plant Exhaust (334176) Recorded By: TJB

Airflow Determination EPA Method: ☑ 2 ☐ 2C ☐ Other ____ Initials

Pitot Tube No.: 341 Coef.: .84 Next Ver. Date: 1/1/21 Pre-Use Insp.: TJB
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: DM-48 ☐ Oil ☑ Digital Next Ver. Date: 3/30/21 Pre-Use Insp.: TJB
Manometer ID: ____ ☐ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
Barometer ID: DB-72 ☐ Aneroid ☑ Digital Next Ver. Date: 2/21/21 Pre-Use Insp.: ____
Barometer ID: ____ ☐ Aneroid ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout CM-M ☑ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____

Gas Composition EPA Method: ☐ 3 ☐ 3/3A ☐ 3B ☐ 3C ☑ Ambient ☐ ____ Initials

Container Type: ☐ Tedlar ☐ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ____
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☐ Instrumental: Instrument ID: ____ Cal Range ____
Ambient Provision Oxygen Verification: Portable O2 ID ____ Ambient Cal Reading: ____
Note: Portable O2 results are not reported as test data.

Moisture Content EPA Method: ☐ 4, back-half of iso train ☐ Other ____ Explain in Options/Deviations Section Initials

Wt. Scale ID: DS-38 ☑ Digital ☐ Beam Next Ver. Date: ____ Pre-Use Insp.: TJB
Std. Weight ID: ____ Std. Weight (g): ____ Scale Reading: ____ ☐ Pass ☐ Fail

Isokinetic EPA Method: ☐ 5 ____ ☐ 8 ☐ 17 ☐ 23 ☐ 26A ☐ 29 ☐ Other ____ Initials

Nozzle ID: 05 Type: ☑ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____
Nozzle Cal.: [redacted] Pre-Use Insp.: TJB
Nozzle ID: 55 Type: ☑ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ____
Nozzle Cal.: 1 0.424 | 2 0.425 | 3 0.425 | 4 0.426 | 5 0.426 | Avg 0.425 Pre-Use Insp.: TJB
Probe Length: 3 ft. Liner: ☐ SS ☑ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: 3-41 Coef.: .840 Next Ver. Date: 1-1-21 Pre-Use Insp.: TJB
Probe Length: ____ ft. Liner: ☐ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ____
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Control Mod ID: CM-M ϒ: .9958 ΔH@: 2.079 Next Ver. Date: ____ Pre-Use Insp.: TJB
Control Mod ID: ____ ϒ: ____ ΔH@: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Filter Type: ☐ 2½" Round ☑ 4" Round ☐ Thimble ☐ Other ____
Filter Media: ☑ Glass Fiber ☐ Quartz Fiber ☐ Paper ☐ Teflon ☐ SS ☐ Other ____
Wet Catch: ☐ EPA 202 ☐ EPA 8 ☐ EPA 23 ☐ EPA 26A ☐ EPA 29 ☐ Other ____
WC Options/Deviations: ____

Field Data Sheets - Cupola Inlet

Pace Analytical®
Field Services Division

EPA Method 2 Field Data Sheet

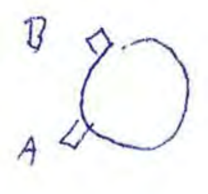
Volumetric Airflow Determinations

Project: Grede
Test Location: Cupola BH Inlet
Date: 12/15/20 Test/Run: T1 R1
Duct Dimensions: 48 x 48 Inches
Port Length: 3.25 Inches
Pitot Leak Check - Pos: ✓ Neg: ✓

Manometer Type and ID: EM DM-46
Barometer Type and ID: DB-60
Thermocouple Sensor ID: TC-47
Pitot Tube No.: 6-10 Cp: 0.84
Technicians: ZHE/AJR

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From Wall	Inches From Port	Flow °Yaw	Run 1 ΔP	Run 2 ΔP	Run 3 ΔP	Run 4 ΔP	Run 1 °F	Run 2 °F	Run 3 °F	Run 4 °F
1	1.55	4.80		0.361	0.348	0.590	0.463			683	675
2	5.02	8.28		0.405	0.451	0.509	0.401			712	693
3	9.30	12.55		0.349	0.391	0.566	0.431			753	706
4	15.51	18.76		0.412	0.433	0.525	0.409			721	711
5	32.49	35.74		0.507	0.490	0.420	0.390			723	727
6	38.70	41.95		0.483	0.524	0.436	0.407			735	731
7	42.97	46.22		0.132	0.512	0.396	0.247			692	723
8	46.45	49.70		0.610	0.461	0.432	0.114			684	715
1				0.363	0.347	0.529	0.491			698	762
2				0.482	0.428	0.492	0.476			702	734
3				0.437	0.405	0.513	0.416			717	716
4	Same			0.427	0.383	0.423	0.423			721	718
5	as			0.336	0.334	0.457	0.369			712	716
6	above			0.336	0.293	0.434	0.340			715	715
7				0.355	0.384	0.448	0.329			710	711
8				0.326	0.310	0.425	0.338			710	711

ZHE
12/15/20



Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	29.106	→	→	→	"Hg
Static Pressure	-1.257	-1.264	-1.929	-1.140	"H_2O
Dry Bulb Temp.	684	680	710	715	°F
Wet Bulb Temp.	M4	M4	M4	M4	°F
Moisture Content	~20	M4	M4	M4	%v/v
320 P Oxygen	10.0	9.0	9.0	9.0	%v/v
Time of Meas.	845	1030	1200	1400	(24 Hour)

12/15

Pace Analytical® Field Services Division

EPA Method 4 Field Data Sheet

Constant Rate Moisture Sampling

Project Grese
Sample Location Cupola B/H Inlet
Date 12/15/20 Test/Run T, R1
Operators/Techs ZHE/AJR

Module ID CM-1
Meter Coef. γ 0.9959
Orifice Coef. ΔH@ 1.821

Bar. Pres. 29.106 In. Hg
Static Pres. -1.251 In. H_2O
Est. Moist. 20 %v/v

TC Sensor ID TC-~~8~~17
Barometer ID PB-06
Scale ID DS-42

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Orifice Meter ΔH Inches H_2O	Incre-mental Vm	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v	
	(905)	179.41											
1	5	182.12	1.00	NA	3.0	684	NA	NA	268	29	27	10.2	
	10	184.45			3.0					32	27	8.8	
	15	187.50			8.0 ~~10.0~~	672				33	29	9.0	
	20	190.30			5.0	683				33	31	9.8	
	25	193.04			2.0	687				37	32	9.1	
	30	195.71			2.0	674				40	33	8.9	
	35	198.43			2.0	675				42	34	8.6	
	40	201.16			2.0	685				45	38	9.0	
	45												
	50					ZHE							
	55					12/15/20							
	60												
	(955)												
							ZHE						
							12/15/20						
Tot/Avg	θ= 40	V_m=21.75	ΔH=1.00			t_s=680					t_m=31.2	O_2=9.18	Tot/Avg

end run @ 40 minutes to line up with Analyzer runs and started to clog moisture line

Sampling Train Leak Checks:
Pretest 0.00 @ 6.0 "Hg
Posttest 0.015 @ 9.0 "Hg

Comments:
pause run do to clogged line from stack particulate
back up @ ~~926~~ ~~924~~ 937

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	132.6	101.6	0.7			1180.0	
Initial Volume	100	100	0			1177.0	
Difference	32.6	1.6	0.7			3.0	37.9

Revised 11/13/2020

Pace Analytical®
Field Services Division

EPA Method 4 Field Data Sheet
Constant Rate Moisture Sampling

Project Greze
Sample Location Cupola BH Inlet
Date 12/15/20 Test/Run T, R2
Operators/Techs ZHE/AJR

Module ID CM-1
Meter Coef. γ 0.9959
Orifice Coef. ΔH@ 1.824

Bar. Pres. 29.106 In. Hg
Static Pres. -1.264 In. H_2O
Est. Moist. 18 %v/v

TC Sensor ID TC-347
Barometer ID DB-60
Scale ID DS-42

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Orifice Meter ΔH Inches H_2O	Incremental Vm	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v	
	(1047)	201.82											
1	5	204.54	1.00	N/A	1.5	687	NA	NA	<68	44	41	9.9	
	10	207.25			2.0	679				44	40	8.8	
	15	209.97			2.1	672				46	41	8.6	
	20	212.66			3.1	677				48	41	8.5	
	25	215.48			3.5	661				48	43	8.5	
	30	218.24			4.5	667				49	43	9.4	
	35	220.97			5.1	690				50	44	8.9	
	40	223.74			8.5	667				51	45	7.8	
	45	226.57			9.5	696				51	45	7.5	
	50	229.36			11.0	713				51	46	8.1	
	55	232.11			9.5	685				51	46	8.6	
	60				11.0	666				52	47	9.0	
	(1157)	ZHE 12/15/20											
Tot/Avg	θ= 56	V_m= 30.29	ΔH= 1.00			t_s= 680					t_m=47.08	O_2= 8.63	Tot/Avg

end run with Analyzers Moisture train plugging up

Sampling Train Leak Checks:
Pretest 0.015 @ 7.00 "Hg
Posttest 0.010 @ 13.00 "Hg

Comments:
Pause @ 1105
to unplug probe

back up @ 1110

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	236.9	118.9	2.6			1189.3	
Initial Volume	100	100	0			1180.0	
Difference	136.9	18.9	2.6			9.3	167.7

Revised 11/13/2020

Pace Analytical® Field Services Division

EPA Method 4 Field Data Sheet

Constant Rate Moisture Sampling

Project Grede
Sample Location Cupola BH Inlet
Date 12/15/20 Test/Run T, R 3
Operators/Techs ZHE/AJR

Module ID CM-1
Meter Coef. γ 0.9959
Orifice Coef. ΔH@ 1.821

Bar. Pres. 29.16 In. Hg
Static Pres. -1.264 In. H_2O
Est. Moist. 18 %v/v

TC Sensor ID TC-47
Barometer ID DB-60
Scale ID 05-42

1317 ZHE 12/15/20

233.72

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Orifice Meter ΔH Inches H_2O	Incre-mental Vm	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v	
	(~~1245~~)	~~232.80~~											
1	5 ~~1245~~	236.46	1.00	NA	3.1	684	NA	NA	268	50	46	9.5	
	10	239.20			3.5	685				50	46	8.5	
	15	241.88			4.0	692				51	46	8.7	
	20	244.89			4.6	678				52	46	9.3	
	25	247.68			5.0	687				51	47	9.9	
	30	250.45			5.0	685				53	47	8.6	
	35	253.35			7.0	707				54	48	7.3	
	40	256.02			4.5	724				55	48	8.1	
	45	258.93			5.6	720				55	49	8.6	
	50												
	55												
	60												
	(1400)												
Tot/Avg	θ= 45	V_m=25.21	ΔH= 1.00			t_s=695.77					t_m=97.0	O_2=8.72	Tot/Avg

ZHE 12/15/20

End run @ 45 min. to line up with analyzers and started to pull up.

Sampling Train Leak Checks:
Pretest 0.00 @ 11.0 "Hg
Posttest 2.00 @ 10.0 "Hg

Comments:
Pause do to site down @ 1245
back up @ 1315

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	350.0		6.8		1320.0	~~1309.0~~	
Initial Volume	100	100	0		1309.0	~~1320.0~~	
Difference	150.0		6.8			11.0	167.8

1340-1342

Revised 11/13/2020

Pace Analytical® Field Services Division

EPA Method 2 Field Data Sheet

Volumetric Airflow Determinations

Project Grede
Test Location Cupola BH Inlet
Date 12/16/20 Test/Run
Duct Dimensions 48-48 Inches
Port Length 3.25 Inches
Pitot Leak Check - Pos ✓ Neg ✓

Manometer Type and ID DM-46
Barometer Type and ID DB-60
Thermocouple Sensor ID TC-47
Pitot Tube No. 6-10 Cp 0.84
Technicians ZHE

Traverse Point IDs			Cyclonic	Velocity Head - Inches H_2O				Stack Temperature - °F			
Point No.	Inches From		Flow	Run 1	Run 2	Run 3	Run 4	Run 1	Run 2	Run 3	Run 4
	Wall	Port	°Yaw	ΔP	ΔP	ΔP	ΔP	°F	°F	°F	°F
1	1.55	4.80	0	0.329	0.483	0.397		767	627	691	
2	5.03	828	0	0.338	0.483	0.278		783	645	692	
3	9.30	12.55	0	0.429	0.442	0.359		762	649	696	
4	15.51	18.76	0	0.472	0.405	0.427		758	651	702	
5	32.49	35.74	5	0.453	0.378	0.356		717	645	703	
6	3870	41.95	5	0.484	0.355	0.390		711	680	706	
7	42.97	46.22	0	0.453	0.347	0.266		712	682	707	
8	46.45	49.70	0	0.403	0.308	0.216		704	685	698	
1	Same as above		0	0.416	0.327	0.248		762	721	692	
2			0	0.384	0.424	0.347		758	723	690	
3			0	0.452	0.348	0.383		764	735	685	
4			0	0.470	0.373	0.411		723	684	681	
5			0	0.391	0.390	0.436		717	692	700	
6			0	0.383	0.469	0.400		715	717	675	
7			0	0.383	0.400	0.440		711	712	690	
8			0	0.393	0.398	0.366		705	705	695	
							Avg	735	684	694	

ZHE ~~12~~ 1/5/21

12/16 12/17

Schematic of Duct Cross-Section

	Run 1	Run 2	Run 3	Run 4	
Bar. Pressure	28.862	→	28.914	→	"Hg
Static Pressure	-1.619	-1.337	-1.262		"H_2O
Dry Bulb Temp.	725	684	600		°F
Wet Bulb Temp.	M4	M4	M4		°F
Moisture Content	M4	M4	M4		%v/v
320 P Oxygen	9.0	—	—		%v/v
Time of Meas.	730	1200	730		(24 Hour)

684 694

Pace Analytical® Field Services Division

EPA Method 4 Field Data Sheet

Constant Rate Moisture Sampling

Project Grede
Sample Location Cupola aH Inlet
Date 12/16/20 Test/Run T, R1
Operators/Techs ZHE

Module ID CM-1
Meter Coef. γ 0.9954
Orifice Coef. ΔH@ 1.821

Bar. Pres. 28.862 In. Hg
Static Pres. -1.337 In. H_2O
Est. Moist. 20 %v/v

TC Sensor ID TC-47
Barometer ID DB-60
Scale ID DS-42

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Orifice Meter ΔH Inches H_2O	Incre-mental Vm	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v	
	(845)	259.11											
1	5	261.86	1.00	NA	4.0	703	NA	NA	<68	47	46	From 945	
	10	264.35			4.2	685				47	46		
	15	267.63			10.0	677				48	46		
	20	270.33			11.0	697				49	47		
	25	273.11			4.5	681				50	47		
	30	275.96			7.0	688				51	47		
	35	278.84			5.0	685				53	48		
	40	281.58			4.0	691				53	48		
	45	284.38			7.5	676				54	49		
	50												
	55												
	60												
	(955)												
Tot/Avg	θ= 45	V_m= 25.27	ΔH= 1.00			t_s= 687					t_m=47.11	O_2=	Tot/Avg

ZHE 12/16/20

End @ 45 min. train continually plugging up

Sampling Train Leak Checks:
Pretest 0.00 @ 10.0 "Hg
Posttest 0.035 @ 13.0 "Hg

Comments:
Pause @ 855
do to plug up.
start back up @ 910
pause @ 920 for plug up
back up @ 930

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	264.5		6.2			1334.5	
Initial Volume	200		0			1317.0	
Difference	64.5		6.2			17.5	88.2

Revised 11/13/2020

Pace Analytical®
Field Services Division

EPA Method 4 Field Data Sheet

Constant Rate Moisture Sampling

Project Grede
Sample Location Cupola BH Inlet
Date 12/16/20 Test/Run T, R2
Operators/Techs ZHE

Module ID CM-1
Meter Coef. γ 0.9959
Orifice Coef. ΔH@ 1.821

Bar. Pres. 28.862 In. Hg
Static Pres. - 1.337 In. H2O
Est. Moist. 20 %v/v

TC Sensor ID TC-97
Barometer ID DB-60
Scale ID PS-42

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Orifice Meter ΔH Inches H_2O	Incre-mental Vm	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v	
	(1240)	284.65											
1	5	287.47	1.00	NA	4.1	707	NA	NA	<68	50	48	MF	
	10	290.22			4.8	680				49	48		
	15	293.04			5.6	700				50	48		
	20	295.74			6.3	642				52	49		
	25	298.54			2.2	670				51	50		
	30	301.26			2.5	700				52	50		
	35	304.25			2.6	705				54	50		
	40	306.97			2.7	678				55	51		
	45	309.77			3.2	703				56	52		
	(1336)												
Tot/Avg	θ= 46	V_m=25.12	ΔH=1.00			t_s=692.77				t_m=49.55		O_2=MF	Tot/Avg

ZHE 12/16/20

End run early due to clog of moisture train

Sampling Train Leak Checks:
Pretest 0.00 @ 12.0 "Hg
Posttest 0.00 @ 12.0 "Hg

Comments:
Pause @ 1300
for plugged line
Back up @ 1310

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	270.5		6.5			1345.8	
Initial Volume	200		0			1334.5	
Difference	70.5		6.5			11.3	~~87.7~~ 88.3

ZHE 1/5/21
RE

Revised 11/13/2020

Pace Analytical® Field Services Division

EPA Method 4 Field Data Sheet

Constant Rate Moisture Sampling

Project Grese
Sample Location Cupola B H Inlet
Date 12/18/20 Test/Run I, R3
Operators/Techs ZHE

Module ID CM-1
Meter Coef. γ 0.9959
Orifice Coef. ΔH@ 1.8821

Bar. Pres. 28.82 In. Hg
Static Pres. -1.2 In. H_2O
Est. Moist. 20 %v/v

TC Sensor ID TC-47
Barometer ID DB-60
Scale ID DS-42

800

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Orifice Meter ΔH Inches H_2O	Incre-mental Vm	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v	
	(754)	310.22											
1	5	313.08	1.00	NA	2.0	680	NA	NA	<68	56	54	ms	
	10	315.92			2.0	687				54	54		
	15	318.75			2.5	672				56	54		
	20	321.58			3.0	698				58	54		
	25	324.43			3.9	675				59	55		
	30	327.23			4.9	667				60	56		
	35	329.88			8.6	666				61	57		
	40	332.83			3.0	679				60	58		
	45	355.64			3.5	684				60	58		
	50	338.39			4.0	674				62	58		
	55	341.17			5.0	676				63	59		
	60	344.17			6.0	689				64	59		
	(910)												
Tot/Avg	θ= 60	V_m= 33.95	ΔH=1.00			t_s=678.92					t_m=56.41	O_2=ms	Tot/Avg

ZHE
12/17/20

Sampling Train Leak Checks:
Pretest 0.00 @ 14.0 "Hg
Posttest 0.00 @ 14.0 "Hg

Comments:
Pause @ 835
plugged line
back up @ 845

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	285.4		7.3			1359.8	
Initial Volume	200		0			1345.8	
Difference	85.4		7.3			14	106.7

Revised 11/13/2020

Field Data Sheets - Cupola Exhaust

Pace Analytical®
Field Services Division

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede Iron MNT.
Sample Location Cupola Exhaust
Date 12/16/20 Test/Run T1R1
Operators/Techs AJR, TJB

Module ID CM-3
Meter Coef. γ 0.9922
Orifice Coef. ΔH@ 1.862
Nozzle No. 55 D_n .100

Pitot No. / C_p 0.84
Bar. Pres. 28.92 In. Hg
Static Pres. 0.001 In. H_2O
Est. Moist. 5 %v/v

Manometer ID ~~DS-9~~ CM-3 AJR
TC Sensor ID TC-33
Barometer ID DB-72
Scale ID DS-45

Trav. Point No.	Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incremental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(830)	169.20													
A 1	5	173.47	0.00270	2.29	173.50	4.30	6.0	184	240	253	53	53	76	77	18.3
2	10	177.92	0.00285	2.44	177.95	4.44	6.2	176	245	251	60	54	76	77	18.0
B 1	15	182.40	0.00288	2.46	182.41	4.46	6.7	178	243	251	63	55	75	77	17.8
2	20	186.69	0.00273	2.27	186.69	4.28	7.0	195	244	249	66	54	75	77	17.9
C 1	25	191.04	0.00273	2.31	191.01	4.32	6.9	183	240	255	68	50	76	77	18.4
2	30	195.39	0.00275	2.34	195.37	4.35	7.0	180	241	280	68	54	76	77	18.5
D 1	35	199.66	0.00271	2.27	199.65	4.29	6.9	190	231	264	68	54	77	77	17.9
2	40	203.96	0.00270	2.28	203.95	4.30	6.9	186	225	268	69	55	77	77	17.8
E 1	45	208.20	0.00267	2.23	208.20	4.25	6.9	193	224	265	68	56	77	77	17.7
2	50	212.36	0.00260	2.14	212.36	4.16	6.8	204	220	264	69	55	77	77	17.8
F 1	55	216.58	0.00263	2.24	216.62	4.26	6.8	179	221	277	60	58	77	78	17.8
2	60	220.85	0.00263	2.22	220.87	4.24	6.7	186	220	277	62	60	77	78	18.3
G 1	65	225.07	0.00266	2.28	225.17	4.30	7.0	176	226	275	58	58	78	79	18.6
2	70	229.48	0.00268	2.30	229.50	4.33	7.1	176	227	276	59	59	78	79	18.9
H 1	75	233.94	0.00274	2.42	233.93	4.43	7.1	160	234	278	61	61	79	80	17.3
2	80	238.43	0.00280	2.47	238.43	4.51	7.3	155	235	271	67	67	79	86	17.2
I 1	85	242.90	0.00283	2.46	242.91	4.48	7.4	170	239	264	65	65	79	80	18.3
2	90	247.59	0.00290	2.61	247.52	4.61	7.7	148	240	263	58	66	80	81	18.6
J 1	95	252.13	0.00294	2.61	252.13	4.61	7.9	158	242	266	57	66	81	82	18.0
2	100	256.82	0.00300	2.72	256.85	4.72	7.9	146	242	264	56	58	81	82	17.7
K 1	105	261.55	0.00304	2.70	261.55	4.70	8.0	158	238	263	61	63	82	82	18.7
2	110	266.30	0.00309	2.79	266.33	4.78	8.1	149	236	266	63	63	82	83	19.0
L 1	115	271.04	0.00312	2.78	271.09	4.77	8.2	159	233	265	64	63	83	83	18.3
2	120	275.90	0.00316	2.86	275.93	4.84	8.5	150	232	268	72	68	83	84	17.3
	(1030)	.	.	.			.								
	120	.	.	.			.								
Tot/Avg	θ=~~1056~~ 120	V_m=106.70	$\sqrt{\Delta P}$=0.0530	ΔH=2.44				t_s=172.5						t_m=78.8	O_2=

Samples Recovered: Filter 0-1143 ; ☒ Probe Wash; ☐ Wet Catch; ☒ M-202; ☐ Other

Sampling Train Leak Checks:
Pretest 0.00 @ 10 "Hg
Posttest 0.00 @ 15 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:
purge start 1135
End 1237

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	6.8	22.4	117.8	NA		1504	
Initial Volume	0	0	100			1476	
Difference	6.8	22.4	17.8			28	75

very light marks on frit holes on filter

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Pace Analytical®
Field Services Division

EPA Method 5 Field Data Sheet
Isokinetic Particulate Sampling

Project	Grede Iron Mnt	Module ID	CM-3	Pitot No.	— C$_p$ 0.84	Manometer ID	CM-3
Sample Location	cupola Exhaust	Meter Coef. γ	0.9922	Bar. Pres.	28.92 In. Hg	TC Sensor ID	TC-37
Date 12/16/20	Test/Run TR2	Orifice Coef. ΔH@	1.862	Static Pres.	0.001 In. H$_2$O	Barometer ID	OB-72
Operators/Techs	AJR, TJB	Nozzle No. 53	D$_n$ 1	Est. Moist.	4 %v/v	Scale ID	05-45

Trav. Point No.	Time ΔT	Meter Vol. V$_m$ Cubic Feet	Velocity Head ΔP Inches H$_2$O	Orifice Meter ΔH Inches H$_2$O	Desired ΔV$_m$ Cubic Feet	Incremental V$_m$	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
	(1230)	278.15													
A 1		284.87	0.00492	4.57	28429	6.14	11.9	147	250	269	83	67	85	87	18.6
2	10	290.06	0.00453	4.15	290.13	5.84	13.1	156	251	262	72	71	84	87	19.0
B 1		295.88	0.00469	4.36	296.12	5.99	12.9	146	256	252	70	66	84	87	17.7
2	20	301.74	0.00442	4.00	301.86	5.74	13.2	163	251	255	68	66	84	87	18.3
C 1		307.45	0.00452	3.93	307.54	5.69	12.4	159	256	255	66	66	85	87	18.6
2	30	312.95	0.00421	3.81	313.15	5.60	13.4	163	255	255	67	65	85	87	19.0
D 1		318.22	0.00378	3.22	318.30	5.15	13.6	201	256	255	72	64	85	87	18.1
2	40	323.45	0.00369	3.28	323.50	5.20	13.2	174	254	256	75	72	86	87	17.5
E 1		328.70	0.00369	3.34	328.75	5.25	12.1	163	254	256	72	68	86	87	17.4
2	50	333.88	0.00359	3.16	333.86	5.11	11.0	181	253	253	71	63	86	88	17.1
F 1		338.92	0.00354	3.15	338.96	5.10	10.9	174	256	252	69	63	86	88	19.4
2	60	343.98	0.00345	3.02	343.95	4.99	10.7	185	256	251	69	64	87	89	17.3
G 1		348.80	0.00331	2.83	348.78	4.83	8.8	203	255	257	72	60	87	89	19.0
2	70	353.61	0.00324	2.82	353.61	4.83	8.9	190	249	252	69	56	87	89	18.9
H 1		359.55	0.00323	2.88	358.50	4.88	8.9	174	255	255	69	55	88	89	17.8
2	80	363.42	0.00324	2.92	363.41	4.92	9.0	168	260	254	70	54	88	89	18.8
I 1		368.14	0.00318	2.76	368.20	4.78	8.9	192	250	251	73	61	89	90	18.8
2	90	372.90	0.00313	2.72	372.94	4.73	8.9	193	252	254	70	60	89	90	18.6
J 1		377.54	0.00307	2.64	377.63	4.68	9.0	192	257	256	72	56	90	90	18.3
2	100	382.29	0.00307	2.75	382.40	4.77	9.5	175	255	255	72	64	90	90	17.9
K 1		387.20	0.00309	2.80	387.22	4.82	9.5	166	254	255	75	74	89	90	18.1
2	110	391.82	0.00305	2.68	391.90	4.68	9.5	195	256	258	77	74	88	90	18.1
L 1		396.60	0.00303	2.67	396.61	4.70	9.6	183	257	253	76	73	88	90	18.2
2	120	401.27	0.00301	2.65	401.29	4.68	9.7	185	254	254	72	71	88	90	18.0
	(1456)	.	.	.			.								
	1456	.	.	.			.								
Tot/Avg	θ=120	V$_m$=123.14	√ΔP=0.0596	ΔH=3.21				t$_s$=176.5						t$_m$=87.7	O$_2$=

Samples Recovered: Filter ________; ☒ Probe Wash; ☐ Wet Catch; ☒ M-202; ☐ Other ____________

Sampling Train Leak Checks:
Pretest 10 @0.00 "Hg
Posttest 18 @0.00 "Hg
Pitot - Pos. X Neg. X

Comments:
purge 1515

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	16.1	19.7	89	AIR		1361.0	
Initial Volume	0	0	100			1315.0	
Difference	16.1	19.7	-11			46.0	70.8

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Pace Analytical® Field Services Division

EPA Method 5 Field Data Sheet

Isokinetic Particulate Sampling

Project Grede Iron mnt
Sample Location cupola Exhaust
Date ~~12/16/20~~ AJR 12/17/20 Test/Run T1 R3
Operators/Techs AJR, TJB

Module ID CM-3
Meter Coef. γ 0.9922
Orifice Coef. ΔH@ 1.862
Nozzle No. 55 D_n 1

Pitot No. X C_p 0.84
Bar. Pres. 28.87 In. Hg
Static Pres. ~~-1.57~~ In. H_2O
Est. Moist. 3 %v/v 0.001 AJR

Manometer ID CM-3
TC Sensor ID TC-33
Barometer ID 00-72
Scale ID 05-45

Trav. Point No.		Time ΔT	Meter Vol. V_m Cubic Feet	Velocity Head ΔP Inches H_2O	Orifice Meter ΔH Inches H_2O	Desired ΔV_m Cubic Feet	Incre-mental V_m	Train Vacuum Inches Hg	Stack Temp. °F	Filter Temp. °F	Probe Temp. °F	Sample Temp. °F	Impinger Temp. °F	Meter In Temp. °F	Mtr Out Temp. °F	320P Oxygen %v/v
		(753)	401.80													
A	1		405.86	0.00227	1.99	405.83	4.03	5.1	183	259	254	69	59	78	80	16.8
	2	10	409.74	0.00215	1.86	409.73	3.90	4.9	191	255	261	70	65	76	80	17.0
B	1		413.70	0.00222	1.92	413.69	3.96	5.0	190	255	253	74	65	75	80	17.7
	2	20	417.81	0.00234	2.08	417.81	4.12	5.0	173	251	252	77	60	76	80	17.1
C	1		421.78	0.00224	1.91	421.76	3.95	5.0	200	258	255	76	61	79	80	18.2
	2	30	425.79	0.00225	1.97	425.77	4.01	5.0	184	252	256	72	61	78	80	18.0
D	1		429.71	0.00219	1.87	429.68	3.91	5.0	201	254	251	70	62	79	80	18.1
	2	40	433.64	0.00219	1.91	433.63	3.95	5.0	189	252	257	74	66	80	81	18.6
E	1		437.55	0.00218	1.89	437.56	3.93	4.8	193	253	255	75	65	80	81	17.9
	2	50	441.50	0.00217	1.89	441.49	3.93	4.9	191	250	257	75	64	80	81	17.5
F	1		445.43	0.00216	1.87	445.41	3.92	5.0	193	254	254	76	61	81	81	17.7
	2	60	449.34	0.00216	1.88	449.33	3.92	5.0	192	251	254	75	60	82	81	18.1
G	1		453.42	0.00222	2.02	453.41	4.07	5.2	163	254	256	75	61	82	82	18.2
	2	70	457.48	0.00224	1.99	457.55	4.07	5.1	186	252	256	71	62	81	82	18.2
H	1		461.57	0.00227	2.04	461.54	4.10	5.1	170	251	254	74	60	82	82	17.7
	2	80	465.67	0.00230	2.06	465.65	4.11	5.1	175	253	253	74	60	83	82	17.9
I	1		469.87	0.00234	2.14	469.85	4.20	5.0	160	252	256	75	61	84	82	17.9
	2	90	474.18	0.00241	2.24	474.15	4.30	5.3	151	253	256	72	60	84	83	18.6
J	1		478.41	0.00244	2.23	478.44	4.29	5.4	162	253	254	71	60	84	83	17.6
	2	100	482.79	0.00250	2.33	482.82	4.38	5.8	151	252	255	70	60	85	84	18.6
K	1		487.11	0.00254	2.35	487.22	4.41	5.9	156	253	251	70	~~72~~ 64	94	84	18.3
	2	110	491.70	0.00260	2.46	491.72	4.50	6.1	143	254	258	73	62	85	84	18.8
L	1		496.26	0.00264	2.47	496.24	4.51	6.2	150	252	256	74	63	85	84	17.9
	2	120	500.78	0.00268	2.50	500.77	4.54	6.2	152	251	256	74	63	85	85	18.7
	AJR	~~(120)~~	.	.	.			.								
		(1017)	.	.	.			.								
Tot/Avg		θ=120	V_m=98.98	√ΔP=0.048	ΔH=2.08				t_s=174.7						t_m=81.4	O_2=

Samples Recovered: Filter ________; ☒ Probe Wash; ☐ Wet Catch; ☒ M-202; ☐ Other ____________

Sampling Train Leak Checks:
Pretest 15 @ 0.0 "Hg
Posttest 11 @ 0.0 "Hg
Pitot - Pos. ✓ Neg. ✓

Comments:
purge 1038
End

Impinger No.	1	2	3	4	5	Desiccant	Total
Final Volume	18.4	13.0	113.2	AJR		1376.5	
Initial Volume	0	0	100			1361.0	
Difference	18.4	13.0	13.2			15.5	60.1

Revised 11/13/2020

Pace Analytical®
Field Services Division

Field Calculation Summary

Computer Initialization and Run Summary

The data on this form is preliminary and includes estimates.
It is not intended to reflect final results.

Project Grede Iron MNT. Site Dog house Date 12/18/20
Sample Location Cupola Exhaust Tech. AJA

12/17/20

Initialization Parameters						
Parameter	**Initial**	**Run_1**	**Run_2**	**Run_3**	**Run_4**	**Run_5**
Meter Coefficient - Υ	0.9922					
Orifice Coefficient - ΔH@	1.862					
Pitot Coefficient - C_p	0.84					
Nozzle Diameter - D_n	1.00			28.87		
Barometric Pressure - P_b	28.92	28.92	28.92	AJA ~~28.92~~		
Static Pressure - P_g	0.001	0.001	0.001	0.001		
Oxygen Estimate - %O_2	18	18	18	18		
Moisture Estimate - %MC	5	5	4	3		
No. of Traverse Points	24					
Point Duration - ΔT	5					
Meter Start Temp, °F - t_m	77	77	86	78		
Initial Meter Volume - V_i	169.05	169.20	278.15	401.80		
Duct Shape (Rnd/Rect)	Rect					
Duct Width, Inches	533					
Duct Depth, Inches	239					
Final Volume - V_f		275.90	401.29	500.78		
Total Run Time - θ		120	120	120		
Condensate Volume, ml (g)		75	70.8	60.1		
End of Run Summary						
Average Sq. Rt. of the ΔP	$\sqrt{\Delta P}$	0.0530	0.0598	0.0481		
Average Orifice Meter	ΔH	2.48	3.21	2.08		
Average Stack Temperature	t_s	172.5	176.5	178.7		
Average Meter Temperature	t_m	78.8	82.6	81.4		
Sample Volume, Actual	V_m	106.70	123.14	98.98		
Sample Volume, Dry Standar	V_{std}	100.90	114.78	92.90		
Moisture Content	MC	3.38	2.82	2.96		
Estimated Mole. Wt., dry	M_d					
Estimated Mole. Wt., wet	M_w					
Average Gas Velocity	V_s	3.32	3.76	3.03		
Isokinetic Variation	%I	99.3	99.9	100.8		
Volumetric Airflow, Actual	ACFM	176250	199320	160580		
Volumetric Airflow, Standard	SCFM	142220	159830	128480		
Volumetric Airflow, Dry Std.	DSCFM	137410	155320	124680		

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Pace Analytical®
Field Services Division

Equipment & Method Summary

Isokinetic and Associated Testing

Group 1 QI TJB Group 4 QI TJB

Project Name: Greve Iron max.
Sampling Location: cupola Exhaust
Test Date: 12/13/20
Recorded By: AJR

Airflow Determination EPA Method: ☐ 2 ☐ 2C ☐ Other ______ Initials ↓

Pitot Tube No.: ______ Coef.: 0.84 Next Ver. Date: ______ Pre-Use Insp.: AJR
Pitot Tube No.: ______ Coef.: ______ Next Ver. Date: ______ Pre-Use Insp.: ______
Manometer ID: cm-3 ☒ Oil ☐ Digital Next Ver. Date: 3/4/21 Pre-Use Insp.: AJR
Manometer ID: ______ ☐ Oil ☐ Digital Next Ver. Date: ______ Pre-Use Insp.: ______
Barometer ID: DB-32 ☐ Aneroid ☒ Digital Next Ver. Date: 2/10/21 Pre-Use Insp.: AJR
Barometer ID: ______ ☐ Aneroid ☐ Digital Next Ver. Date: ______ Pre-Use Insp.: ______
T/C Readout TC-33 ☐ Single ☒ Dual Next Ver. Date: 03/08/21 Pre-Use Insp.: AJR
T/C Readout ______ ☐ Single ☐ Dual Next Ver. Date: ______ Pre-Use Insp.: ______

Gas Composition EPA Method: ☐ 3 ☐ 3/3A ☐ 3B ☐ 3C ☐ Ambient ☐ ______ Initials ↓

Container Type: ☐ Tedlar ☒ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ______
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☒ Instrumental: Instrument ID: 6 Cal Range 21
Ambient Provision Oxygen Verification: Portable O2 ID OX-13 Ambient Cal Reading: 20.9

Note: Portable O2 results are not reported as test data.

Moisture Content EPA Method: ☐ 4, back-half of iso train ☐ Other ___ Explain in Options/ Deviations Section Initials ↓

Wt. Scale ID: OS-45 ☒ Digital ☐ Beam Next Ver. Date: 7/7/2021 Pre-Use Insp.: AJR
Std. Weight ID: 412161 Std. Weight (g): 500.0 Scale Reading: 500.0 ☒ Pass ☐ Fail

Isokinetic EPA Method: ☐ 5 __ ☐ 8 ☐ 17 ☐ 23 ☐ 26A ☐ 29 ☐ Other ___ Initials ↓

Nozzle ID: ______ Type: ☒ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ______

Nozzle Cal.:	1	2	3	4	5	Avg	Pre-Use Insp.: TJB
	1.00	1.00	1.00				

Nozzle ID: ______ Type: ☐ Stainless Steel ☐ Glass ☐ Quartz ☐ Other ______

Nozzle Cal.:	1	2	3	4	5	Avg	Pre-Use Insp.: ______

Probe Length: 12 ft. Liner: ☐ SS ☒ Glass ☐ Quartz ☐ Teflon ☐ Other ______
Pitot Tube No.: ______ Coef.: 0.84 Next Ver. Date: ______ Pre-Use Insp.: AJR
Probe Length: ______ ft. Liner: ☐ SS ☐ Glass ☐ Quartz ☐ Teflon ☐ Other ______
Pitot Tube No.: ______ Coef.: ______ Next Ver. Date: ______ Pre-Use Insp.: ______
Control Mod ID: CM-3 Υ: 0.9922 ΔH@: 1.862 Next Ver. Date: 3/4/21 Pre-Use Insp.: AJR
Control Mod ID: ______ Υ: ______ ΔH@: ______ Next Ver. Date: ______ Pre-Use Insp.: ______
Filter Type: ☐ 2½" Round ☒ 4" Round ☐ Thimble ☐ Other ______
Filter Media: ☒ Glass Fiber ☐ Quartz Fiber ☐ Paper ☐ Teflon ☐ SS ☐ Other ______
Wet Catch: ☒ EPA 202 ☐ EPA 8 ☐ EPA 23 ☐ EPA 26A ☐ EPA 29 ☐ Other ___
WC Options/Deviations: ______

Pace Analytical®
Field Services Division

Equipment & Method Summary

Instrumental and Associated Testing
Group 3 QI TJB

Project Name: Grede Iron Mnt.
Sampling Location: Capola Exhaust
Test Date: 12/16/20
Recorded By: AJA

☐ Airflow Determination EPA Method: ☐ 2 ☐ 2C ☐ Other ____ Initials ↓

Pitot Tube No.: — Coef.: 0.84 Next Ver. Date: ~~12/16/20~~ AJA Pre-Use Insp.: AJA
Pitot Tube No.: ____ Coef.: ____ Next Ver. Date: ____ Pre-Use Insp.: ____
Manometer ID: CM-3 ☒ Oil ☐ Digital Next Ver. Date: 3/4/21 Pre-Use Insp.: AJR
Manometer ID: ____ ☐ Oil ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
Barometer ID: DB-72 ☐ Aneroid ☒ Digital Next Ver. Date: 2/10/21 Pre-Use Insp.: AJR
Barometer ID: ____ ☐ Aneroid ☐ Digital Next Ver. Date: ____ Pre-Use Insp.: ____
T/C Readout TC-33 ☐ Single ☒ Dual Next Ver. Date: 03/08/21 Pre-Use Insp.: AJA
T/C Readout ____ ☐ Single ☐ Dual Next Ver. Date: ____ Pre-Use Insp.: ____

☐ Gas Composition EPA Method: ☐ 3 ☒ 3/3A ☐ 3B ☐ 3C ☐ Ambient ☐ ____ Initials ↓

Container Type: ☐ Tedlar ☒ Teflon ☐ 7-Layer Inert ☐ Other Leak Checks: ____
Sampling Proc.: ☐ Single Point ☐ Multipoint ☐ With Iso Train | ☐ Grab ☐ Integrated
Gas Analysis: ☐ Orsat ☐ Fyrite ☒ Instrumental: Instrument ID: 6 Cal Range 21
Ambient Provision Oxygen Verification: Portable O2 ID OX-13 Ambient Cal Reading: 20.9
Note: Portable O2 results are not reported as test data.

☐ Moisture Content EPA Method: ☐ 4 ☐ Wet/Dry Bulb ☐ Rel. Test ☐ Other ____ Initials ↓

Wt. Scale ID: DS-45 ☒ Digital ☐ Beam Next Ver. Date: 7/8/2021 Pre-Use Insp.: AJA
Std. Weight ID: 412161 Std. Weight (g): 500.0 Scale Reading: 500.0 ☒ Pass ☐ Fail

Gas Monitoring	☐ EPA 3A	☐ EPA 6C	☐ EPA 7E	☐ EPA 10	☐ EPA 25A
Instrument ID:	O_2-CO_2-6				
Cal. Range:	0-21				
Interface:	☒ Extractive ☐ Dilution	☐ Extractive ☐ Dilution	☐ Extractive ☐ Dilution	☐ Extractive ☐ Dilution	☐ Extractive ☐ Dilution
Pre-Use Insp: (initials)	AJR				

Sample Line ID: ____ Length: ____ ft. ☐ Heated ☐ Unheated Pre-Use Insp.: ____
Gas Conditioner ID: ____ ☐ Temp. Set Pt. ____ ☐ Dilution ____ Pre-Use Insp.: ____
Options/Deviations/Provisions: ____

Pace Analytical® Field Services Division

Visible Emissions Observation Form

Method Used (circle one)
[✓ Method 9] 203A 203B Other ______

Test	Run 1	Page 1	of 2
Observation Date 12/16/20		Start Time 1010	End Time 1110

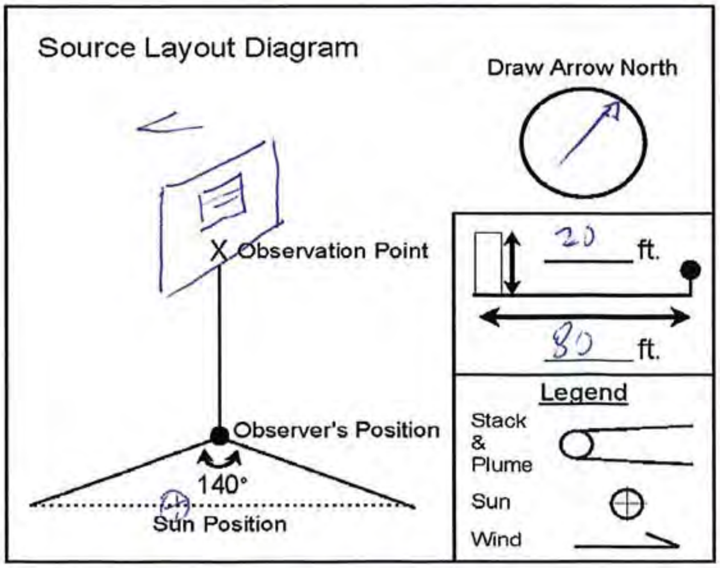
Company Name: Grede
Facility Name: Iron Mountain
Street Address: 801 S. Carpenter
City: Kingsford State: MI Zip Cd:

Process: Cupola BH ~~Exhst~~ Unit No.: Operating Mode: > 90%
Control Equipment: Operating Mode:

Emission Point Description: Cupola ~~Bst hous~~ East side
Cupola Building

Height of Emission Point Start 20 End 20
Height of Emis. Pt Relative to Observer Start 10 End 10
Distance to Emission Point Start 80 End 80
Direction of Emission Point (Degrees) Start 345 End 345
Vertical Angle to Observation Point Start 5 End 5
Did Observation Point Change Yes [✓ No]

Plume Background Description Start Gray Building End Grey Building
Emission Color Start None End Light Grey
Sky Conditions Start Clear End Clear
Wind Speed Start 5-10 End 5-10
Wind Direction Start SW End SW
Ambient Temperature (°F) Start 17 End 13
Wet Bulb Temp. %rH



Observer Name: Zachary Eckstrom
Affiliation: Pace Analytical
Certified by (Org/Date): Aerosmet 11/4/20

Min \ Sec	0	15	30	45	Comments
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1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	5	0	
6	0	0	0	0	
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11	0	0	0	0	
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28	0	0	0	0	
29	0	0	0	0	

Observer Signature: Zachary Eckstrom Date: 12/16/20

Revised 11/13/2020

Pace Analytical® Field Services Division

Visible Emissions Observation Form

Method Used (circle one)
[✓ Method 9] 203A 203B Other ______

Test 1 Run 1	Page 2 of 2

Observation Date	Start Time	End Time
12/16/20	1010	1110

Company Name: Grede
Facility Name: Iron Mountain
Street Address: 801 S. Carpenter
City: Kingsford State: MI Zip Cd

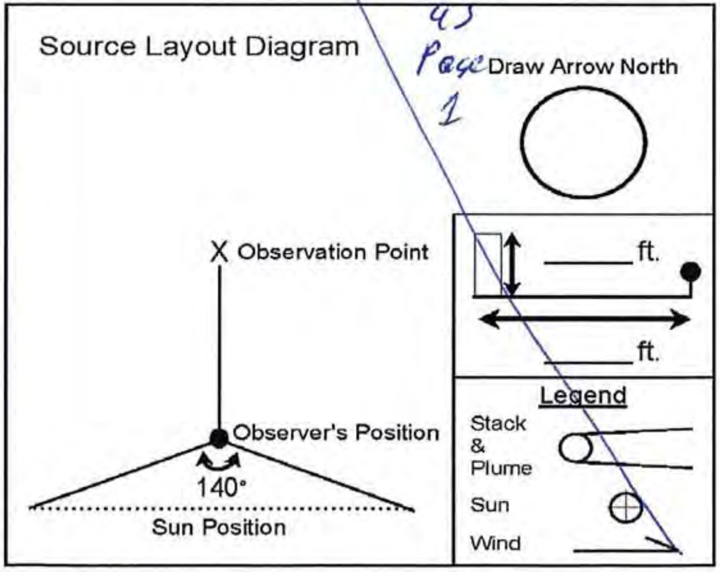
Process	Unit No.	Operating Mode
Control Equipment		Operating Mode

Emission Point Description: East side

Height of Emission Point Start End	Height of Emis. Pt Relative to Observer Start End
Distance to Emission Point Start End	Direction of Emission Point (Degrees) Start End
Vertical Angle to Observation Point Start End	Did Observation Point Change Yes No

Plume Background Description Start	End
Emission Color Start End	Sky Conditions Start End
Wind Speed Start End	Wind Direction Start End
Ambient Temperature (°F) Start End	Wet Bulb Temp. Same	%rH

as Page 1



Observer Name: Zachary Eckstrom
Affiliation: Pace Analytical
Certified by (Org/Date): Aerament 11/4/20

Min \ Sec	0	15	30	45	Comments
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55	0	0	0	0	
56	0	0	0	0	
57	0	0	0	0	
58	0	0	0	0	
59	0	0	0	0	

Observer Signature: Zachary Eckstrom
Date: 12/16/20

Pace Analytical® Field Services Division

Visible Emissions Observation Form

Method Used (circle one)

[✓ Method 9] 203A 203B Other

Test 1	Run 2	Page 1	of 2
Observation Date 12/16/20		Start Time 1010	End Time 1110

Company Name Gred-

Facility Name Iron Mountain

Street Address 801 S. Carpenter

City Kingsford | State MI | Zip Cd

Process Cupola BH Inlet | Unit No. | Operating Mode

Control Equipment | Operating Mode

Emission Point Description Cupola ~~#~~ South Side Cupola Building

Height of Emission Point Start 20 End 20 | Height of Emis. Pt Relative to Observer Start 10 End 10

Distance to Emission Point Start 80 End 80 | Direction of Emission Point (Degrees) Start 345 End 345

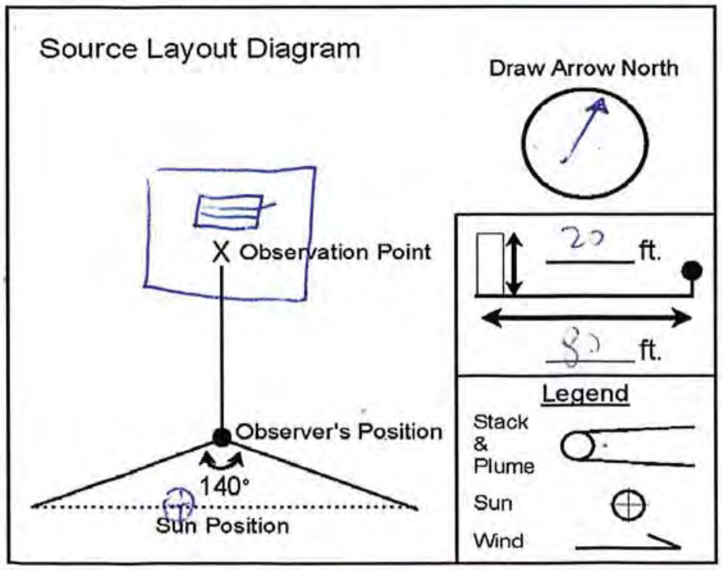
Vertical Angle to Observation Point Start 5 End 5 | Did Observation Point Change Yes [✓ No]

Plume Background Description Start Gray Building | End Gray Building

Emission Color Start None End None | Sky Conditions Start Clear End Clear

Wind Speed Start 5-10 End 5-10 | Wind Direction Start SW End SW

Ambient Temperature (°F) Start 17 End 13 | Wet Bulb Temp. | %rH



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28	0	0	0	0	
29	0	0	0	0	

Observer Name Zachary Eckstrom

Affiliation Pace Analytical

Certified by (Org/Date) Aeromet 11/4/20

Observer Signature Zachary Eckstrom | Date 12/16/20

Revised 11/13/2020

Pace Analytical®
Field Services Division

Visible Emissions Observation Form

Method Used (circle one)
[✓ Method 9] 203A 203B Other

Test 1	Run 2	Page 2	of 2
Observation Date 12/16/20		Start Time 1010	End Time 1110

Company Name Grede
Facility Name Iron Mountain
Street Address 801 S. Carpenter
City Kingsford
State MI
Zip Cd

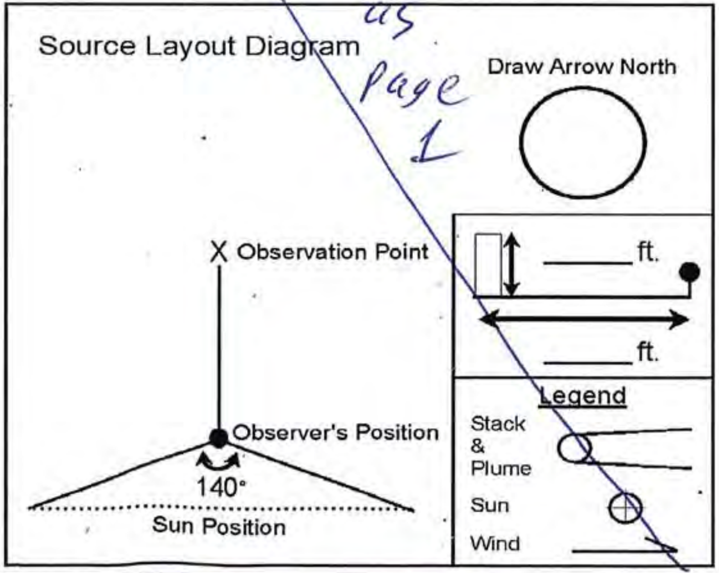
Process	Unit No.	Operating Mode
Control Equipment		Operating Mode

Emission Point Description Southside

Height of Emission Point Start End	Height of Emis. Pt Relative to Observer Start End
Distance to Emission Point Start End	Direction of Emission Point (Degrees) Start End
Vertical Angle to Observation Point Start End	Did Observation Point Change Yes No

Plume Background Description Start	End	
Emission Color Start End	Sky Conditions Start End	
Wind Speed Start End	Wind Direction Start End	
Ambient Temperature (°F) Start End	Wet Bulb Temp.	%rH

Same as Page 1



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58	0	0	0	0	
59	0	0	0	0	

Observer Name Zachary Eckstrom
Affiliation Pace Analytical
Certified by (Org/Date) Aeromet 11/4/20

Observer Signature Zachary Eckstrom
Date 12/16/20

Pace Analytical® Field Services Division

Visible Emissions Observation Form

Method Used (circle one)
[✓ Method 9] 203A 203B Other ______

Test 1 Run 3 Page 1 of 2

Observation Date 12/16/20
Start Time 1355
End Time 1455

Company Name Grede
Facility Name Iron Mountain
Street Address 801 S. Carpenter
City Kingsford State MI Zip Cd

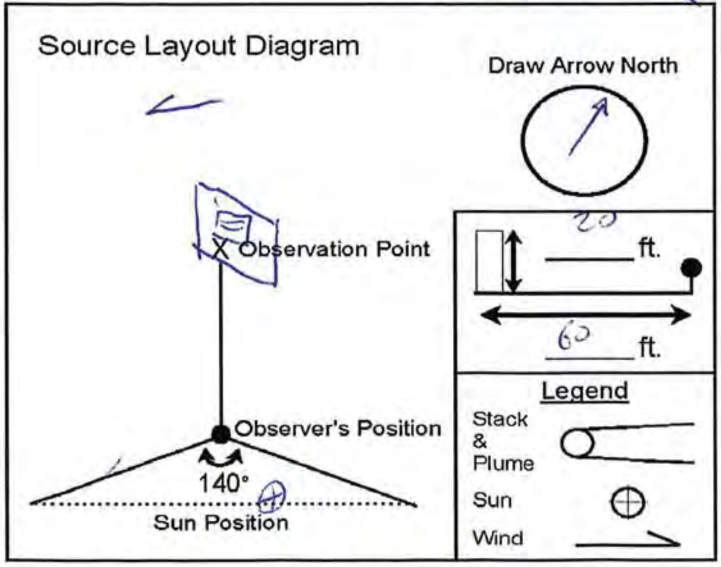
Process Cupola ~~[illegible]~~ Unit No. Operating Mode > 90%
Control Equipment Operating Mode

Emission Point Description West Side of Building Cupola Building

Height of Emission Point Start 20 End 20
Height of Emis. Pt Relative to Observer Start 10 End 10
Distance to Emission Point Start 60 End 60
Direction of Emission Point (Degrees) Start 325 End 325
Vertical Angle to Observation Point Start 5 End 5
Did Observation Point Change Yes [✓ No]

Plume Background Description Start Rusty Buildings End Rusty Building
Emission Color Start Light Grey End Light Gray
Sky Conditions Start Clear End Clear
Wind Speed Start 5-10 End 5-10
Wind Direction Start SW End SW
Ambient Temperature (°F) Start 13 End 12
Wet Bulb Temp. %RH

Source Layout Diagram



Observer Name Zachary Eckstrom
Affiliation Pace Analytical
Certified by (Org/Date) Aeromet 11/4/20

Min \ Sec	0	15	30	45	Comments
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Observer Signature Zachary Eckstrom Date 12/16/20

Revised 11/13/2020

Pace Analytical® Field Services Division

Visible Emissions Observation Form

Method Used (circle one)
[✓ Method 9] 203A 203B Other

Test 1 Run 3 Page 2 of 2
Observation Date 12/16/20
Start Time 1355
End Time 1455

Company Name Grede
Facility Name Iron Mountain
Street Address 801 S. Carpenter
City Kingsford State MI Zip Cd

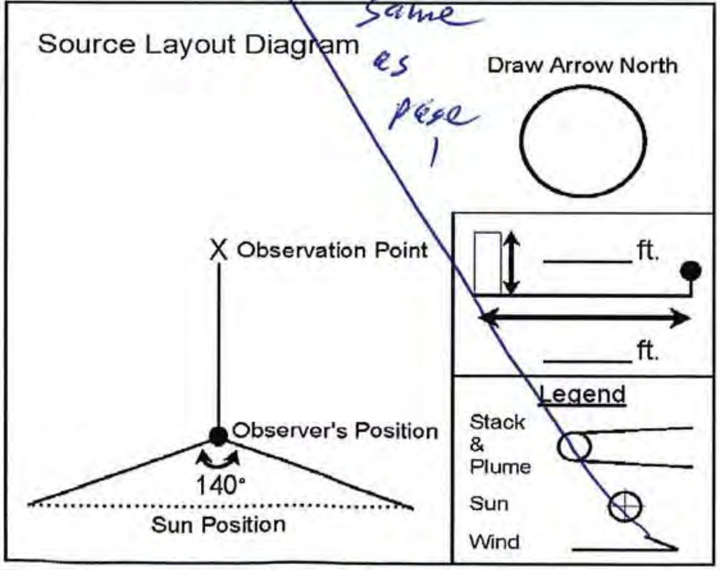
Process Cupola BH
Unit No.
Operating Mode
Control Equipment
Operating Mode

Emission Point Description west side

Height of Emission Point Start End
Height of Emis. Pt Relative to Observer Start End
Distance to Emission Point Start End
Direction of Emission Point (Degrees) Start End
Vertical Angle to Observation Point Start End
Did Observation Point Change Yes No

Plume Background Description Start End
Emission Color Start End
Sky Conditions Start End
Wind Speed Start End
Wind Direction Start End
Ambient Temperature (°F) Start End
Wet Bulb Temp. %rH

Same as page 1



Observer Name Zachary Eckstrom
Affiliation Pace Analytical
Certified by (Org/Date) Aeromet 11/4/20

Min \ Sec	0	15	30	45	Comments
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56	0	0	0	0	
57	0	0	0	0	
58	0	0	0	0	
59	5	0	0	0	

Observer Signature Zachary Eckstrom
Date 12/16/20

Appendix B

Quantitation and Laboratory Reports

EPA Method 3/3A Field Data Sheets

EPA Method 3/3A Field Data Sheet

Instrumental Analysis of Collected Samples

Project: Grede, LLC - Iron Mountain

Test Location: Cupola BH Inlet

Sampling Date: 12/16-17/2020

Fuel Type:

Analyst: A. Radabaugh

Analysis Date: 12/16-17/2020

Instrument ID:

Sample Type: Time Integrated

Certs: Zero: ____ Low: ____ Mid: cc95749 High: DT0033087

Instrument Calibration												
Cylinder Value			Pretest Reading		Calibration Error		Posttest Reading		Pre-Post Test Drift		Calibration Status	
Level	CO_2	O_2	CO_2	O_2	CO_2	O_2	CO_2	O_2	CO_2	O_2	CE	Drift
Zero	0		0	0	0.0%	0.0%	0.1	0.1	0.5%	0.5%	Pass	Pass
Low												
Mid	9.93	10.9	9.8	10.9	-0.6%	0.0%	9.9	11	0.5%	0.5%	Pass	Pass
High	20	21	20	21	0.0%	0.0%	20.1	21.1	0.5%	0.5%	Pass	Pass

Sample Analysis Results								
Sample ID		O_2 Hold		Instrument Results		QC Criteria		QC Check Status
Test	Run	Field	Lab	$\%CO_2$	$\%O_2$	HoldΔ	F_o	Result Acceptance
1	1			11.5	9.0	??	1.03	O2 Hold Missing
Calibration Bias Adjusted				11.60	8.95			
1	2			11.0	9.6	??	1.023	O2 Hold Missing
Calibration Bias Adjusted				11.10	9.55			
1	3			10.7	9.8	??	1.033	O2 Hold Missing
				10.79	9.75			
Calibration Bias Adjusted								
Calibration Bias Adjusted								
Calibration Bias Adjusted								
Calibration Bias Adjusted								
Calibration Bias Adjusted								
Calibration Bias Adjusted								

O_2 Hold Acceptance Field O_2 - Lab O_2 = Hold Range ≤ 0.3% O_2 Fo is a guideline, not criterion.

EPA Method 3/3A Field Data Sheet

Instrumental Analysis of Collected Samples

Project Grede, LLC - Iron Mountain
Test Location Cupola BH Exhaust
Sampling Date 12/16-17/2020
Fuel Type

Analyst A. Radabaugh
Analysis Date 12/16-17/2020
Instrument ID
Sample Type Time Integrated

Certs: Zero: ____ Low: ____ Mid: cc95749 High: DT0033087

Instrument Calibration

Cylinder Value			Pretest Reading		Calibration Error		Posttest Reading		Pre-Post Test Drift		Calibration Status	
Level	CO_2	O_2	CO_2	O_2	CO_2	O_2	CO_2	O_2	CO_2	O_2	CE	Drift
Zero	0		0	0	0.0%	0.0%	0.1	0.1	0.5%	0.5%	Pass	Pass
Low												
Mid	9.93	10.9	9.8	10.9	-0.6%	0.0%	9.9	11	0.5%	0.5%	Pass	Pass
High	20	21	20	21	0.0%	0.0%	20.1	21.1	0.5%	0.5%	Pass	Pass

Sample Analysis Results

Sample ID		O_2 Hold		Instrument Results		QC Criteria		QC Check Status
Test	Run	Field	Lab	$\%CO_2$	$\%O_2$	HoldΔ	F_o	Result Acceptance
1	1	18.1	17.9	3.1	17.9	0.2	0.987	Criteria Met
Calibration Bias Adjusted				3.09	17.85			
1	2	18.6	18.5	2.4	18.5	0.1	1.029	Criteria Met
Calibration Bias Adjusted				2.38	18.45			
1	3	18.5	18.3	2.7	18.3	0.2	0.987	Criteria Met
				2.69	18.25			
Calibration Bias Adjusted								
Calibration Bias Adjusted								
Calibration Bias Adjusted								
Calibration Bias Adjusted								
Calibration Bias Adjusted								
Calibration Bias Adjusted								

O_2 Hold Acceptance Field O_2 - Lab O_2 = Hold Range ≤ 0.3% O_2

Fo is a guideline, not criterion.

Bias Adjustment Summary

Appendix B

Bias Adjustment Summary
Cupola Baghouse Inlet
Test 1

Oxygen (O2), %v/v, Dry	Interval 1	Interval 2	Interval 3
Date of Run	12/15/2020	12/15/2020	12/15/2020
Time of Run	0855-0955	1045-1145	1230-1401
Span Cylinder Concentration	10.9	10.9	10.9
Pre-Run Zero Reading	0.0946	0.0306	0.00460
Post-Run Zero Reading	0.0306	0.00460	-0.0205
Pre-Run Span Reading	10.9	10.9	10.8
Post-Run Span Reading	10.9	10.8	10.8
Run Period Analyzer Average	9.16	8.91	8.31
Bias Adjusted Run Result	**9.16**	**8.95**	**8.40**

Carbon Dioxide, %v/v, Dry	Interval 1	Interval 2	Interval 3
Date of Run	12/15/2020	12/15/2020	12/15/2020
Time of Run	0855-0955	1045-1145	1230-1401
Span Cylinder Concentration	9.93	9.93	9.93
Pre-Run Zero Reading	-0.0267	-0.0297	-0.0371
Post-Run Zero Reading	-0.0297	-0.0371	-0.0466
Pre-Run Span Reading	9.82	9.87	9.95
Post-Run Span Reading	9.87	9.95	9.88
Run Period Analyzer Average	11.3	11.8	12.3
Bias Adjusted Run Result	**11.4**	**11.8**	**12.3**

Total Hydrocarbons, PPM, Wet	Interval 1	Interval 2	Interval 3
Date of Run	12/15/2020	12/15/2020	12/15/2020
Time of Run	0855-0955	1045-1145	1230-1401
Span Cylinder Concentration	15.0	15.0	15.0
Pre-Run Zero Reading	0.0466	0.263	0.240
Post-Run Zero Reading	0.263	0.240	0.0683
Pre-Run Span Reading	15.2	15.4	15.3
Post-Run Span Reading	15.4	15.3	15.2
Run Period Analyzer Average	0.173	0.120	0.0808
Bias Adjusted Run Result	**0.0184**	**-0.130**	**-0.0729**
Result Adjusted to Method MDL	**0.1**	**0.1**	**0.1**

Appendix B

Bias Adjustment Summary
Cupola Baghouse Inlet
Test 1

Carbon Monoxide, PPM, Dry	Interval 1	Interval 2	Interval 3
Date of Run	12/15/2020	12/15/2020	12/15/2020
Time of Run	0855-0955	1045-1145	1230-1401
Span Cylinder Concentration	49.6	49.6	49.6
Pre-Run Zero Reading	0.636	0.963	1.28
Post-Run Zero Reading	0.963	1.28	1.19
Pre-Run Span Reading	48.8	48.5	48.1
Post-Run Span Reading	48.5	48.1	51.0
Run Period Analyzer Average	14.2	10.8	14.0
Bias Adjusted Run Result	**13.9**	**10.2**	**13.1**

Sulfur Dioxide, PPM, Dry	Interval 1	Interval 2	Interval 3
Date of Run	12/15/2020	12/15/2020	12/15/2020
Time of Run	0855-0955	1045-1145	1230-1401
Span Cylinder Concentration	49.0	49.0	49.0
Pre-Run Zero Reading	0.688	1.08	1.80
Post-Run Zero Reading	1.08	1.80	1.91
Pre-Run Span Reading	47.4	47.4	46.9
Post-Run Span Reading	47.4	46.9	46.6
Run Period Analyzer Average	13.5	11.1	10.4
Bias Adjusted Run Result	**13.3**	**10.4**	**9.37**

Gas Monitoring Log

Grede, LLC - Iron Mountain

Kingsford, MI
Pace Project No. 20-04074

Appendix B

RM Data Acquisition Log
Cupola Baghouse Inlet
Test 1

	DAQ Channels						Comments
	Ch - 1	**Ch - 2**	**Ch - 3**	**Ch - 4**	**Ch - 5**	**Ch - 6**	
	O2	**CO2**	**THC**	**CO**	**SO2**		
Date/Time	**%v/v, Dry**	**%v/v, Dry**	**PPM, Wet**	**PPM, Dry**	**PPM, Dry**		
12/15/2020 7:37	20.86	0.07	1.3	3.4	0.0		System Response Time
12/15/2020 7:38	20.87	0.06	1.4	4.0	0.0		To Zero 1
12/15/2020 7:39	20.85	0.08	1.4	4.9	0.1		Up-scale 1
12/15/2020 7:40	20.84	0.09	1.4	4.7	0.1		Minutes
12/15/2020 7:41	20.82	0.09	1.4	4.5	0.1		
12/15/2020 7:42	20.85	4.21	1.4	4.3	0.1		
12/15/2020 7:43	20.91	19.51	1.4	1.5	0.1		
12/15/2020 7:44	20.90	19.59	1.4	-0.1	0.1		
12/15/2020 7:45	20.95	19.80	1.4	0.1	0.1		
12/15/2020 7:46	21.05	20.07	1.4	0.1	0.1		21/20
12/15/2020 7:47	21.00	17.51	1.4	0.2	0.1		
12/15/2020 7:48	12.06	9.83	1.4	1.5	0.1		
12/15/2020 7:49	11.06	9.89	1.4	1.5	0.2		
12/15/2020 7:50	11.05	9.89	1.4	1.5	0.2		10.9/9.93
12/15/2020 7:51	11.04	9.88	1.4	1.6	0.2		
12/15/2020 7:52	16.98	3.44	1.4	2.5	0.2		
12/15/2020 7:53	18.68	0.43	1.4	16.5	12.6		
12/15/2020 7:54	0.32	0.01	1.4	127.7	104.6		
12/15/2020 7:55	0.14	-0.01	1.4	110.0	113.8		
12/15/2020 7:56	0.09	-0.01	1.4	109.7	111.6		
12/15/2020 7:57	0.08	-0.02	1.4	109.8	112.0		
12/15/2020 7:58	0.07	-0.02	1.4	110.0	110.9		
12/15/2020 7:59	0.06	-0.02	1.4	110.0	111.1		110/110
12/15/2020 8:00	0.16	-0.02	1.4	108.9	105.6		
12/15/2020 8:01	1.27	0.04	1.4	58.3	52.4		
12/15/2020 8:02	0.05	-0.03	1.4	48.6	50.4		
12/15/2020 8:03	0.04	-0.03	1.4	48.4	50.1		
12/15/2020 8:04	0.04	-0.03	1.4	48.5	50.0		49.6/49
12/15/2020 8:05	2.81	0.01	1.4	56.7	57.8		
12/15/2020 8:06	0.25	-0.03	1.4	208.2	208.1		
12/15/2020 8:07	0.05	-0.04	1.4	247.2	210.5		
12/15/2020 8:08	0.04	-0.04	1.4	247.8	210.5		246
12/15/2020 8:09	2.31	-0.01	1.4	207.7	176.9		
12/15/2020 8:10	19.11	0.09	1.4	35.1	30.1		
12/15/2020 8:11	20.67	0.10	1.4	4.7	8.5		
12/15/2020 8:12	20.81	0.08	1.4	3.5	2.9		
12/15/2020 8:13	13.22	8.32	1.4	9.4	7.2		
12/15/2020 8:14	9.20	11.18	1.4	10.8	14.5		
12/15/2020 8:15	8.59	11.75	1.4	12.2	14.3		

	DAQ Channels						Comments
	Ch - 1	**Ch - 2**	**Ch - 3**	**Ch - 4**	**Ch - 5**	**Ch - 6**	
	O2	**CO2**	**THC**	**CO**	**SO2**		
Date/Time	**%v/v, Dry**	**%v/v, Dry**	**PPM, Wet**	**PPM, Dry**	**PPM, Dry**		
12/15/2020 8:16	9.91	10.09	1.4	13.8	13.3		system
12/15/2020 8:17	10.89	9.80	1.4	5.4	3.0		
12/15/2020 8:18	10.89	9.81	1.4	0.8	1.1		
12/15/2020 8:19	10.89	9.81	1.4	0.7	0.9		
12/15/2020 8:20	10.89	9.82	1.4	0.7	0.8		
12/15/2020 8:21	10.89	9.82	1.4	0.6	0.7		10.9/9.93/0/0
12/15/2020 8:22	16.39	3.71	1.4	0.9	0.7		
12/15/2020 8:23	9.35	0.62	1.4	23.2	19.2		
12/15/2020 8:24	0.16	0.01	1.4	47.9	42.3		
12/15/2020 8:25	0.13	-0.01	1.4	48.3	45.0		
12/15/2020 8:26	0.11	-0.02	1.4	48.5	46.5		
12/15/2020 8:27	0.10	-0.02	1.4	49.0	47.3		
12/15/2020 8:28	0.09	-0.03	1.4	48.8	47.4		0/0/49.6/49
12/15/2020 8:29	0.09	-0.03	1.4	48.8	47.5		
12/15/2020 8:30	11.59	0.04	1.4	27.4	20.4		
12/15/2020 8:31	20.85	-0.03	19.6	2.1	1.8		
12/15/2020 8:32	20.90	-0.04	1.4	1.3	1.2		
12/15/2020 8:33	20.80	0.03	7.7	1.6	0.9		
12/15/2020 8:34	20.74	0.06	37.9	2.2	0.8		
12/15/2020 8:35	20.53	0.04	10.1	2.6	1.7		
12/15/2020 8:36	20.90	-0.03	1.1	2.1	1.1		
12/15/2020 8:37	20.97	-0.04	0.0	1.3	0.8		0
12/15/2020 8:38	20.98	-0.04	0.2	1.2	0.7		
12/15/2020 8:39	20.93	-0.03	50.7	1.4	0.7		
12/15/2020 8:40	20.97	-0.04	40.2	1.5	0.6		
12/15/2020 8:41	20.97	-0.04	39.9	1.4	0.6		39.9
12/15/2020 8:42	20.93	-0.04	28.9	1.5	0.6		
12/15/2020 8:43	20.87	-0.04	25.2	1.4	0.6		
12/15/2020 8:44	20.87	-0.05	25.1	1.4	0.6		25.9
12/15/2020 8:45	20.84	-0.04	20.5	1.4	0.6		
12/15/2020 8:46	20.63	-0.03	15.2	1.7	0.7		
12/15/2020 8:47	20.65	-0.05	15.2	1.5	0.6		15
12/15/2020 8:48	20.65	-0.05	10.5	1.5	0.6		
12/15/2020 8:49	17.02	4.40	0.5	2.8	4.9		
12/15/2020 8:50	9.14	11.45	0.3	10.3	21.7		In Stack
12/15/2020 8:51	8.51	12.04	0.3	10.6	19.4		
12/15/2020 8:52	8.39	12.00	0.3	6.9	19.2		
12/15/2020 8:53	9.28	11.01	0.3	8.7	19.5		
12/15/2020 8:54	8.46	11.98	0.3	13.9	16.9		
12/15/2020 8:55	8.28	12.13	0.3	8.3	16.2		Run 1
12/15/2020 8:56	8.58	11.83	0.3	6.7	17.9		

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RM Data Acquisition Log
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Test 1

DAQ Channels　Comments

	Ch - 1	Ch - 2	Ch - 3	Ch - 4	Ch - 5	Ch - 6
	O2	CO2	THC	CO	SO2	
Date/Time	**%v/v, Dry**	**%v/v, Dry**	**PPM, Wet**	**PPM, Dry**	**PPM, Dry**	
12/15/2020 8:57	9.54	10.81	0.3	7.6	17.5	
12/15/2020 8:58	9.48	10.88	0.3	10.3	17.8	
12/15/2020 8:59	9.07	11.35	0.3	17.2	20.5	
12/15/2020 9:00	8.11	12.35	0.3	11.0	18.1	
12/15/2020 9:01	8.91	11.44	0.3	8.1	18.1	
12/15/2020 9:02	9.17	11.12	0.3	8.0	18.7	
12/15/2020 9:03	9.48	10.94	0.3	13.1	15.4	
12/15/2020 9:04	7.95	12.51	0.3	11.4	16.8	
12/15/2020 9:05	8.04	12.31	0.3	6.9	18.9	
12/15/2020 9:06	9.67	10.65	0.3	7.7	15.8	
12/15/2020 9:07	9.69	10.72	0.2	9.5	14.3	
12/15/2020 9:08	9.87	10.46	0.2	11.6	15.7	
12/15/2020 9:09	9.13	11.27	0.2	15.9	13.2	
12/15/2020 9:10	8.70	11.59	0.2	9.5	14.4	
12/15/2020 9:11	9.00	11.26	0.2	7.8	16.0	
12/15/2020 9:12	9.38	10.98	0.2	8.1	16.1	
12/15/2020 9:13	9.32	11.12	0.2	11.1	15.4	
12/15/2020 9:14	8.99	11.50	0.2	15.5	13.5	
12/15/2020 9:15	8.33	12.09	0.2	7.7	14.5	
12/15/2020 9:16	9.41	10.95	0.2	7.1	14.6	
12/15/2020 9:17	9.84	10.55	0.2	10.4	13.8	
12/15/2020 9:18	9.03	11.45	0.1	15.4	13.3	
12/15/2020 9:19	8.97	11.46	0.1	10.3	13.2	
12/15/2020 9:20	9.19	11.23	0.1	9.2	14.5	
12/15/2020 9:21	9.88	10.47	0.1	8.5	13.6	
12/15/2020 9:22	9.92	10.62	0.1	12.3	13.4	
12/15/2020 9:23	9.12	11.42	0.1	14.5	14.1	
12/15/2020 9:24	8.64	11.90	0.1	8.2	14.2	
12/15/2020 9:25	9.68	10.78	0.1	7.7	13.8	
12/15/2020 9:26	9.73	10.71	0.1	12.1	12.0	
12/15/2020 9:27	8.80	11.70	0.1	16.4	7.8	
12/15/2020 9:28	8.80	11.67	0.1	8.9	9.9	
12/15/2020 9:29	9.33	11.11	0.1	7.6	11.0	
12/15/2020 9:30	9.83	10.64	0.1	8.4	10.8	
12/15/2020 9:31	9.60	10.91	0.1	11.7	11.0	
12/15/2020 9:32	9.34	11.06	0.1	12.3	10.1	
12/15/2020 9:33	9.17	11.41	0.1	8.7	9.7	
12/15/2020 9:34	9.28	11.21	0.1	7.5	11.0	
12/15/2020 9:35	9.82	10.67	0.1	9.3	11.9	
12/15/2020 9:36	10.09	10.38	0.1	16.8	10.6	
12/15/2020 9:37	8.55	11.95	0.2	12.9	10.6	

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	DAQ Channels						Comments
Date/Time	**Ch - 1 O2 %v/v, Dry**	**Ch - 2 CO2 %v/v, Dry**	**Ch - 3 THC PPM, Wet**	**Ch - 4 CO PPM, Dry**	**Ch - 5 SO2 PPM, Dry**	**Ch - 6**	
12/15/2020 9:38	9.03	11.31	0.1	7.0	13.8		
12/15/2020 9:39	9.65	10.84	0.3	9.1	11.9		
12/15/2020 9:40	9.55	11.05	0.2	240.9	10.6		
12/15/2020 9:41	7.60	13.02	0.1	13.1	12.8		
12/15/2020 9:42	8.73	11.73	0.1	6.5	12.2		
12/15/2020 9:43	9.31	11.12	0.1	8.2	10.7		
12/15/2020 9:44	8.56	12.06	0.1	12.3	11.4		
12/15/2020 9:45	8.90	11.48	0.1	9.5	12.5		
12/15/2020 9:46	9.41	11.21	0.1	11.3	11.8		
12/15/2020 9:47	9.14	11.31	0.1	9.1	10.9		
12/15/2020 9:48	9.16	11.26	0.1	11.8	11.3		
12/15/2020 9:49	8.92	11.54	0.1	12.9	11.3		
12/15/2020 9:50	8.76	11.62	0.1	8.2	11.8		
12/15/2020 9:51	9.51	10.85	0.1	8.6	13.1		
12/15/2020 9:52	9.86	10.54	0.1	11.3	11.0		
12/15/2020 9:53	9.68	10.75	0.1	14.2	10.6		
12/15/2020 9:54	8.87	11.61	0.1	10.3	10.8		
12/15/2020 9:55	9.77	10.70	0.1	8.5	10.8		End R1
12/15/2020 9:56	9.37	11.20	0.1	11.3	10.9		
12/15/2020 9:57	7.94	12.64	0.1	11.0	11.9		
12/15/2020 9:58	12.09	7.64	1.3	6.4	12.8		
12/15/2020 9:59	20.73	0.09	0.8	3.3	3.4		
12/15/2020 10:00	20.89	0.02	0.6	1.5	1.8		
12/15/2020 10:01	20.91	0.01	0.4	1.5	1.4		
12/15/2020 10:02	20.92	0.00	0.3	1.5	1.3		
12/15/2020 10:03	20.93	-0.01	0.3	1.5	1.2		0
12/15/2020 10:04	20.90	0.00	5.5	1.5	1.1		
12/15/2020 10:05	20.58	-0.02	15.0	1.9	1.2		
12/15/2020 10:06	20.59	-0.02	15.3	1.7	1.1		
12/15/2020 10:07	20.59	-0.02	15.4	1.6	1.0		15
12/15/2020 10:08	20.60	0.02	9.2	1.7	1.1		
12/15/2020 10:09	12.08	9.25	0.1	1.7	1.1		
12/15/2020 10:10	10.89	9.85	0.0	1.0	1.1		
12/15/2020 10:11	10.88	9.87	0.0	1.0	1.1		10.9/9.93
12/15/2020 10:12	10.87	9.89	0.0	0.9	1.1		
12/15/2020 10:13	11.40	8.87	0.3	1.0	1.1		
12/15/2020 10:14	3.55	0.63	-0.1	33.7	29.8		
12/15/2020 10:15	0.10	0.02	-0.1	48.2	45.7		
12/15/2020 10:16	0.08	0.00	-0.1	48.3	46.5		
12/15/2020 10:17	0.06	-0.01	-0.1	48.1	46.7		
12/15/2020 10:18	0.05	-0.02	-0.1	48.2	46.7		

	DAQ Channels						Comments
Date/Time	**Ch - 1 O2 %v/v, Dry**	**Ch - 2 CO2 %v/v, Dry**	**Ch - 3 THC PPM, Wet**	**Ch - 4 CO PPM, Dry**	**Ch - 5 SO2 PPM, Dry**	**Ch - 6**	
12/15/2020 10:19	0.05	-0.02	-0.1	48.3	47.0		
12/15/2020 10:20	0.04	-0.02	-0.1	48.5	47.2		
12/15/2020 10:21	0.04	-0.03	-0.1	48.3	47.3		
12/15/2020 10:22	0.03	-0.03	-0.1	48.3	47.4		
12/15/2020 10:23	0.03	-0.03	-0.1	48.5	47.4		49.6-49
12/15/2020 10:24	0.03	-0.03	-0.1	48.2	47.4		
12/15/2020 10:25	3.99	-0.01	0.3	42.1	37.7		
12/15/2020 10:26	20.54	0.02	0.7	5.1	4.0		
12/15/2020 10:27	20.66	0.02	1.0	3.2	2.2		
12/15/2020 10:28	20.68	0.02	1.0	3.9	1.8		
12/15/2020 10:29	20.70	0.02	0.8	3.4	1.6		
12/15/2020 10:30	20.71	0.02	0.7	2.7	1.5		
12/15/2020 10:31	20.72	0.02	0.8	3.2	1.4		
12/15/2020 10:32	20.73	0.02	1.0	2.9	1.4		
12/15/2020 10:33	20.73	0.01	0.5	3.0	1.3		
12/15/2020 10:34	20.73	0.01	0.5	2.1	1.3		
12/15/2020 10:35	20.74	0.01	0.5	2.1	1.3		
12/15/2020 10:36	20.74	0.01	0.9	2.5	1.3		
12/15/2020 10:37	20.74	0.01	0.8	3.7	1.3		
12/15/2020 10:38	20.74	0.03	0.8	3.3	1.3		In Stack
12/15/2020 10:39	10.60	10.84	0.3	8.0	3.2		
12/15/2020 10:40	9.22	11.66	0.1	15.5	11.6		
12/15/2020 10:41	8.39	12.33	0.1	7.7	15.3		
12/15/2020 10:42	9.36	11.31	0.1	7.8	13.4		
12/15/2020 10:43	9.75	10.87	0.1	9.6	11.4		
12/15/2020 10:44	8.88	11.81	0.1	13.1	10.9		
12/15/2020 10:45	8.50	12.13	0.1	12.6	9.9		Start R2
12/15/2020 10:46	8.96	11.63	0.1	9.5	9.8		
12/15/2020 10:47	9.24	11.30	0.2	8.7	11.0		
12/15/2020 10:48	9.26	11.30	0.1	13.8	11.0		
12/15/2020 10:49	8.76	11.85	0.1	12.5	9.9		
12/15/2020 10:50	9.04	11.44	0.2	8.4	11.3		
12/15/2020 10:51	9.57	11.03	0.1	11.0	10.2		
12/15/2020 10:52	8.70	11.85	0.1	10.3	11.9		
12/15/2020 10:53	9.03	11.69	0.1	14.8	10.0		
12/15/2020 10:54	8.30	12.28	0.1	7.9	10.7		
12/15/2020 10:55	9.23	11.31	0.1	8.2	11.4		
12/15/2020 10:56	9.22	11.30	0.2	11.2	11.9		
12/15/2020 10:57	8.43	12.25	0.2	13.6	10.9		
12/15/2020 10:58	8.52	12.03	0.2	8.1	11.7		
12/15/2020 10:59	8.97	11.57	0.2	7.6	12.5		

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Test 1

DAQ Channels — Comments

	Ch - 1	Ch - 2	Ch - 3	Ch - 4	Ch - 5	Ch - 6
	O2	CO2	THC	CO	SO2	
Date/Time	**%v/v, Dry**	**%v/v, Dry**	**PPM, Wet**	**PPM, Dry**	**PPM, Dry**	
12/15/2020 11:00	9.38	11.07	0.1	9.7	13.3	
12/15/2020 11:01	8.67	11.90	0.1	14.9	11.7	
12/15/2020 11:02	8.66	11.79	0.2	9.0	12.3	
12/15/2020 11:03	9.11	11.33	0.1	7.1	13.1	
12/15/2020 11:04	9.70	10.85	0.1	9.9	12.9	
12/15/2020 11:05	8.99	11.65	0.1	13.9	11.9	
12/15/2020 11:06	8.65	11.96	0.1	12.2	11.1	
12/15/2020 11:07	8.76	11.75	0.1	7.3	13.1	
12/15/2020 11:08	9.69	11.02	0.1	9.5	12.1	
12/15/2020 11:09	9.37	11.33	0.1	15.3	13.0	
12/15/2020 11:10	8.38	12.56	0.1	12.7	10.4	
12/15/2020 11:11	8.66	12.14	0.1	6.6	11.9	
12/15/2020 11:12	9.84	10.92	0.1	8.2	11.8	
12/15/2020 11:13	10.07	10.73	0.1	13.5	11.2	
12/15/2020 11:14	8.86	12.02	0.1	12.9	11.0	
12/15/2020 11:15	9.29	11.45	0.1	9.1	12.9	
12/15/2020 11:16	9.76	10.98	0.1	9.4	12.7	
12/15/2020 11:17	9.84	11.10	0.1	18.9	11.3	
12/15/2020 11:18	8.03	13.02	0.1	12.6	10.4	
12/15/2020 11:19	9.13	11.60	0.1	7.1	11.3	
12/15/2020 11:20	9.27	11.46	0.1	7.6	11.4	
12/15/2020 11:21	9.55	11.27	0.2	12.6	10.5	
12/15/2020 11:22	8.47	12.34	0.2	11.9	10.0	
12/15/2020 11:23	8.23	12.59	0.1	7.5	10.9	
12/15/2020 11:24	9.37	11.20	0.1	8.9	11.9	
12/15/2020 11:25	9.03	11.80	0.1	16.2	10.7	
12/15/2020 11:26	8.14	12.60	0.2	11.8	12.2	
12/15/2020 11:27	8.22	12.42	0.1	9.2	11.7	
12/15/2020 11:28	8.79	11.72	0.1	9.0	12.0	
12/15/2020 11:29	8.57	12.00	0.1	11.4	11.4	
12/15/2020 11:30	8.34	12.33	0.1	13.6	10.3	
12/15/2020 11:31	7.89	12.67	0.1	8.4	12.1	
12/15/2020 11:32	9.32	11.27	0.1	9.8	10.0	
12/15/2020 11:33	8.86	11.78	0.1	10.0	11.1	
12/15/2020 11:34	8.91	11.96	0.1	20.2	8.5	
12/15/2020 11:35	7.46	13.28	0.1	6.4	10.6	
12/15/2020 11:36	8.76	11.92	0.1	7.1	11.4	
12/15/2020 11:37	9.54	11.07	0.1	10.0	10.1	
12/15/2020 11:38	9.12	11.76	0.1	19.3	9.3	
12/15/2020 11:39	8.05	12.69	0.1	10.8	9.7	
12/15/2020 11:40	8.71	11.98	0.1	8.0	10.3	

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Cupola Baghouse Inlet
Test 1

	DAQ Channels						Comments
	Ch - 1	**Ch - 2**	**Ch - 3**	**Ch - 4**	**Ch - 5**	**Ch - 6**	
	O2	**CO2**	**THC**	**CO**	**SO2**		
Date/Time	**%v/v, Dry**	**%v/v, Dry**	**PPM, Wet**	**PPM, Dry**	**PPM, Dry**		
12/15/2020 11:41	9.04	11.59	0.1	8.7	10.0		
12/15/2020 11:42	8.77	11.88	0.2	10.9	11.3		
12/15/2020 11:43	9.31	11.42	0.1	13.9	8.0		
12/15/2020 11:44	8.23	12.45	0.1	8.6	9.7		
12/15/2020 11:45	9.73	10.85	0.1	9.4	10.0		End R2
12/15/2020 11:46	9.15	11.54	0.1	12.0	9.5		
12/15/2020 11:47	8.72	11.99	0.1	17.2	8.6		
12/15/2020 11:48	7.71	12.93	0.1	8.9	10.6		
12/15/2020 11:49	15.33	4.52	0.7	6.9	8.3		
12/15/2020 11:50	19.95	0.14	0.3	5.1	3.6		
12/15/2020 11:51	20.82	0.01	0.2	2.1	2.1		
12/15/2020 11:52	20.84	0.00	0.2	1.7	1.8		
12/15/2020 11:53	20.85	-0.01	0.2	1.6	1.7		0
12/15/2020 11:54	20.78	0.01	5.1	1.6	1.7		
12/15/2020 11:55	20.45	-0.01	15.2	2.3	1.8		
12/15/2020 11:56	20.51	-0.03	15.4	1.9	1.7		
12/15/2020 11:57	20.51	-0.03	15.6	1.9	1.7		
12/15/2020 11:58	20.51	-0.03	15.4	1.8	1.6		
12/15/2020 11:59	20.51	-0.03	15.3	1.9	1.7		15
12/15/2020 12:00	20.51	-0.03	12.7	1.9	1.6		
12/15/2020 12:01	20.45	0.55	1.2	2.1	1.7		
12/15/2020 12:02	11.25	9.75	0.0	2.0	1.8		
12/15/2020 12:03	10.83	9.94	0.0	1.2	1.7		
12/15/2020 12:04	10.82	9.95	0.0	1.3	1.8		10.9/9.93
12/15/2020 12:05	10.83	9.81	0.4	1.3	1.8		
12/15/2020 12:06	5.50	0.98	0.0	27.8	26.6		
12/15/2020 12:07	0.07	0.01	-0.1	48.4	45.8		
12/15/2020 12:08	0.04	-0.01	-0.1	48.2	46.6		
12/15/2020 12:09	0.03	-0.02	-0.1	48.1	46.7		
12/15/2020 12:10	0.02	-0.03	-0.1	48.3	46.8		
12/15/2020 12:11	0.01	-0.03	-0.1	48.1	47.0		
12/15/2020 12:12	0.01	-0.03	-0.1	47.9	46.9		
12/15/2020 12:13	0.00	-0.04	-0.1	48.1	46.9		49.6/49
12/15/2020 12:14	5.04	-0.01	0.5	40.4	35.5		
12/15/2020 12:15	20.52	0.01	0.6	4.3	4.6		
12/15/2020 12:16	20.60	0.01	0.9	3.3	2.7		
12/15/2020 12:17	20.62	0.01	0.8	3.6	2.3		
12/15/2020 12:18	20.64	0.00	0.7	3.3	2.1		
12/15/2020 12:19	20.65	0.01	1.2	3.2	2.0		
12/15/2020 12:20	20.66	0.00	1.0	4.1	1.9		
12/15/2020 12:21	20.66	0.01	0.6	3.8	1.8		

Grede, LLC - Iron Mountain

Kingsford, MI
Pace Project No. 20-04074

Appendix B

RM Data Acquisition Log
Cupola Baghouse Inlet
Test 1

	DAQ Channels						Comments
	Ch - 1	Ch - 2	Ch - 3	Ch - 4	Ch - 5	Ch - 6	
	O2	CO2	THC	CO	SO2		
Date/Time	%v/v, Dry	%v/v, Dry	PPM, Wet	PPM, Dry	PPM, Dry		
12/15/2020 12:22	20.66	0.01	0.9	3.2	1.8		
12/15/2020 12:23	20.67	0.00	0.5	3.5	1.8		
12/15/2020 12:24	18.53	2.89	0.4	2.6	1.8		
12/15/2020 12:25	8.33	12.23	0.2	5.5	5.1		
12/15/2020 12:26	8.88	11.52	0.2	7.5	13.9		
12/15/2020 12:27	8.78	11.66	0.1	12.5	13.6		
12/15/2020 12:28	8.20	12.25	0.1	13.9	11.2		
12/15/2020 12:29	8.04	12.30	0.1	7.8	11.6		
12/15/2020 12:30	9.23	11.10	0.1	9.4	10.6		Run 3
12/15/2020 12:31	8.84	11.50	0.1	10.1	11.3		
12/15/2020 12:32	9.22	11.14	0.1	10.0	9.7		
12/15/2020 12:33	8.94	11.41	0.1	11.2	9.3		
12/15/2020 12:34	8.37	12.19	0.1	10.2	9.6		
12/15/2020 12:35	8.85	11.66	0.1	11.0	8.8		
12/15/2020 12:36	8.22	12.41	0.1	12.7	7.6		
12/15/2020 12:37	8.66	11.76	0.1	7.9	8.7		
12/15/2020 12:38	8.64	11.87	0.2	9.3	9.1		
12/15/2020 12:39	9.17	11.25	0.1	11.8	9.0		
12/15/2020 12:40	8.28	12.22	0.1	14.8	8.3		
12/15/2020 12:41	8.20	12.20	0.1	9.0	9.2		
12/15/2020 12:42	8.50	11.75	0.1	7.6	10.4		
12/15/2020 12:43	9.49	10.75	0.1	19.8	9.9		
12/15/2020 12:44	8.31	12.15	0.1	22.8	7.2		
12/15/2020 12:45	7.83	12.65	0.0	10.4	9.3		
12/15/2020 12:46	13.94	5.99	1.5	369.7	8.5		Cupola off Blast
12/15/2020 12:47	18.17	2.57	0.3	143.6	3.5		Cupola off Blast
12/15/2020 12:48	17.47	2.83	0.1	76.0	3.0		Cupola off Blast
12/15/2020 12:49	15.77	4.29	0.2	20.2	3.1		Cupola off Blast
12/15/2020 12:50	14.12	5.50	0.2	6.2	4.1		Cupola off Blast
12/15/2020 12:51	15.74	4.19	0.3	5.8	3.1		Cupola off Blast
12/15/2020 12:52	20.33	0.13	0.9	4.7	2.2		Cupola off Blast
12/15/2020 12:53	20.60	0.03	0.5	3.8	2.0		Cupola off Blast
12/15/2020 12:54	20.61	0.03	0.6	2.6	1.9		Cupola off Blast
12/15/2020 12:55	20.62	0.02	0.8	2.5	1.8		Cupola off Blast
12/15/2020 12:56	20.63	0.02	0.8	2.8	1.8		Cupola off Blast
12/15/2020 12:57	20.63	0.01	0.6	2.9	1.7		Cupola off Blast
12/15/2020 12:58	20.64	0.01	0.6	2.6	1.7		Cupola off Blast
12/15/2020 12:59	20.65	0.01	0.8	2.7	1.7		Cupola off Blast
12/15/2020 13:00	20.65	0.01	0.7	2.9	1.7		Cupola off Blast
12/15/2020 13:01	20.66	0.01	0.6	2.9	1.7		Cupola off Blast
12/15/2020 13:02	20.66	0.01	0.4	2.2	1.7		Cupola off Blast

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Appendix B

RM Data Acquisition Log
Cupola Baghouse Inlet
Test 1

	DAQ Channels						Comments
	Ch - 1	Ch - 2	Ch - 3	Ch - 4	Ch - 5	Ch - 6	
	O2	CO2	THC	CO	SO2		
Date/Time	%v/v, Dry	%v/v, Dry	PPM, Wet	PPM, Dry	PPM, Dry		
12/15/2020 13:03	20.65	0.00	0.4	1.8	1.8		Cupola off Blast
12/15/2020 13:04	20.65	0.00	0.5	2.1	1.8		Cupola off Blast
12/15/2020 13:05	20.66	0.00	0.7	2.3	1.7		Cupola off Blast
12/15/2020 13:06	20.66	0.00	0.5	3.1	1.7		Cupola off Blast
12/15/2020 13:07	20.67	0.00	0.8	2.8	1.7		Cupola off Blast
12/15/2020 13:08	20.67	0.00	0.6	3.6	1.7		Cupola off Blast
12/15/2020 13:09	20.66	0.00	0.8	3.0	1.7		Cupola off Blast
12/15/2020 13:10	12.69	8.39	0.3	341.4	2.3		Cupola off Blast
12/15/2020 13:11	9.35	11.06	0.2	42.7	9.2		
12/15/2020 13:12	7.19	13.31	6.2	339.2	14.3		start up mode
12/15/2020 13:13	6.18	14.42	0.8	525.0	24.2		start up mode
12/15/2020 13:14	6.61	14.28	0.1	374.2	23.0		start up mode
12/15/2020 13:15	7.16	14.18	0.1	21.7	13.8		start up mode
12/15/2020 13:16	6.87	14.28	0.1	12.5	12.7		
12/15/2020 13:17	6.50	14.96	0.1	60.0	17.6		Resume R3
12/15/2020 13:18	8.17	12.86	0.1	21.2	13.5		
12/15/2020 13:19	8.42	12.70	0.1	23.8	15.1		
12/15/2020 13:20	8.24	12.92	0.1	20.4	9.0		
12/15/2020 13:21	7.58	13.52	0.2	12.1	11.2		
12/15/2020 13:22	8.41	12.60	0.2	11.9	12.7		
12/15/2020 13:23	9.69	11.12	0.1	16.9	11.1		
12/15/2020 13:24	8.66	12.49	0.2	18.8	9.6		
12/15/2020 13:25	7.79	13.39	0.1	11.5	10.1		
12/15/2020 13:26	8.22	12.92	0.1	10.1	10.6		
12/15/2020 13:27	8.58	12.25	0.1	10.6	11.5		
12/15/2020 13:28	8.76	12.32	0.1	14.0	10.6		
12/15/2020 13:29	8.56	12.43	0.1	11.5	9.2		
12/15/2020 13:30	8.46	12.70	0.1	11.7	9.4		
12/15/2020 13:31	9.11	11.27	0.1	11.9	10.3		
12/15/2020 13:32	8.25	12.38	0.1	17.8	8.6		
12/15/2020 13:33	7.23	13.35	0.1	10.6	9.8		
12/15/2020 13:34	7.74	12.74	0.1	8.6	10.3		
12/15/2020 13:35	8.82	11.52	0.1	11.2	10.0		
12/15/2020 13:36	8.03	12.48	0.1	14.2	10.1		
12/15/2020 13:37	8.33	12.10	0.1	14.5	9.4		
12/15/2020 13:38	7.73	12.73	0.0	12.5	10.1		
12/15/2020 13:39	7.92	12.51	0.1	10.4	11.0		
12/15/2020 13:40	8.23	12.12	0.0	13.3	10.4		
12/15/2020 13:41	8.31	12.17	0.1	16.8	8.0		
12/15/2020 13:42	8.00	12.38	0.0	9.7	10.7		
12/15/2020 13:43	8.85	11.71	0.0	13.3	10.0		

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Grede, LLC - Iron Mountain

Kingsford, MI
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Appendix B

RM Data Acquisition Log
Cupola Baghouse Inlet
Test 1

	DAQ Channels						Comments
Date/Time	**Ch - 1 O2 %v/v, Dry**	**Ch - 2 CO2 %v/v, Dry**	**Ch - 3 THC PPM, Wet**	**Ch - 4 CO PPM, Dry**	**Ch - 5 SO2 PPM, Dry**	**Ch - 6**	
12/15/2020 13:44	7.95	12.67	0.0	13.0	10.1		
12/15/2020 13:45	7.50	13.24	0.0	12.0	9.5		
12/15/2020 13:46	7.64	12.97	0.1	9.2	11.1		
12/15/2020 13:47	8.11	12.46	0.0	9.1	10.5		
12/15/2020 13:48	8.82	11.68	0.0	15.1	10.2		
12/15/2020 13:49	7.43	13.26	0.0	18.1	8.6		
12/15/2020 13:50	7.29	13.09	0.0	13.5	12.4		
12/15/2020 13:51	8.50	11.79	0.0	10.8	11.4		
12/15/2020 13:52	8.62	11.71	0.1	14.2	9.7		
12/15/2020 13:53	7.41	12.95	0.1	14.7	9.2		
12/15/2020 13:54	7.51	12.92	0.0	14.5	16.6		
12/15/2020 13:55	8.24	12.05	0.0	15.2	12.7		
12/15/2020 13:56	8.58	11.89	0.0	18.8	14.7		
12/15/2020 13:57	8.61	11.77	0.0	17.9	10.8		
12/15/2020 13:58	8.65	11.80	0.0	16.5	9.0		
12/15/2020 13:59	8.05	12.41	0.0	8.7	10.5		
12/15/2020 14:00	8.53	11.88	0.0	9.0	12.0		
12/15/2020 14:01	9.36	11.00	0.1	16.2	10.1		
12/15/2020 14:02	8.04	12.20	0.2	15.3	9.3		
12/15/2020 14:03	19.01	0.46	0.4	6.2	7.6		
12/15/2020 14:04	20.74	0.02	0.2	2.3	2.9		
12/15/2020 14:05	20.76	0.00	0.2	1.6	2.3		
12/15/2020 14:06	20.78	-0.01	0.2	1.6	2.0		
12/15/2020 14:07	20.78	-0.02	0.1	1.6	1.9		
12/15/2020 14:08	20.79	-0.02	0.1	1.6	1.9		0
12/15/2020 14:09	20.79	-0.03	0.1	1.6	1.9		
12/15/2020 14:10	20.59	-0.02	12.1	1.7	1.9		
12/15/2020 14:11	20.45	-0.03	15.7	2.0	1.9		
12/15/2020 14:12	20.45	-0.04	15.9	1.9	1.9		
12/15/2020 14:13	20.45	-0.04	16.0	1.8	1.9		
12/15/2020 14:14	20.45	-0.04	16.0	2.0	2.0		adjusted backpressure
12/15/2020 14:15	20.45	-0.04	15.2	1.9	2.0		15
12/15/2020 14:16	20.45	-0.01	9.9	1.8	2.0		
12/15/2020 14:17	11.94	9.20	0.0	2.1	2.1		
12/15/2020 14:18	10.79	9.85	0.0	1.5	2.0		
12/15/2020 14:19	10.78	9.87	0.0	1.3	1.9		
12/15/2020 14:20	10.77	9.88	0.0	1.2	1.9		10.9/9.93
12/15/2020 14:21	10.76	9.88	0.0	1.2	1.9		
12/15/2020 14:22	6.66	4.18	0.0	18.0	16.8		
12/15/2020 14:23	0.05	0.02	-0.1	50.3	43.8		
12/15/2020 14:24	0.02	-0.01	-0.1	50.8	45.4		

	DAQ Channels						Comments
	Ch - 1	**Ch - 2**	**Ch - 3**	**Ch - 4**	**Ch - 5**	**Ch - 6**	
	O2	**CO2**	**THC**	**CO**	**SO2**		
Date/Time	**%v/v, Dry**	**%v/v, Dry**	**PPM, Wet**	**PPM, Dry**	**PPM, Dry**		
12/15/2020 14:25	0.01	-0.02	-0.1	51.1	45.8		
12/15/2020 14:26	0.00	-0.03	-0.1	51.1	45.9		
12/15/2020 14:27	-0.01	-0.04	-0.1	51.1	46.1		
12/15/2020 14:28	-0.01	-0.04	-0.1	51.1	46.2		
12/15/2020 14:29	-0.01	-0.04	-0.1	51.1	46.4		
12/15/2020 14:30	-0.02	-0.04	-0.1	51.1	46.5		
12/15/2020 14:31	-0.02	-0.05	-0.1	51.1	46.5		
12/15/2020 14:32	-0.02	-0.05	-0.1	51.0	46.6		49.6/49
12/15/2020 14:33	2.49	-0.02	0.4	46.8	40.5		
12/15/2020 14:34	20.29	0.00	0.9	7.8	7.2		
12/15/2020 14:35	20.53	0.00	0.8	3.5	3.5		
12/15/2020 14:36	20.56	0.00	0.6	4.0	2.7		
12/15/2020 14:37	20.57	0.01	0.6	2.8	2.4		
12/15/2020 14:38	20.57	0.03	0.7	2.7	2.1		
12/15/2020 14:39							
12/15/2020 14:40							
12/15/2020 14:41							
12/15/2020 14:42							
12/15/2020 14:43							
12/15/2020 14:44							

Electronic Data Log Attestation

	Row	Date/Time
Start:	13	12/15/2020 7:37
End:	434	12/15/2020 14:38

I certify this to be a complete and unaltered record of instrument output as logged. Clarifying annotations were made by me.

Terry Borgerding

Subcontract Laboratory Report

EMSL Analytical, Inc.
3410 Winnetka Avenue North
New Hope, MN 55427
(763) 449-4922

Terry Borgerding
Pace Analytical – MN Field Services
1700 Elm Street SE Suite 200
Minneapolis, MN 55414

December 30, 2020

EMSL Order #: 352011173

RE: Grede – 20-04074

Dear Terry Borgerding:

EMSL Analytical, Inc. received samples for the project identified above on December 11, 2020. The sample(s) were analyzed in the EMSL Analytical, Inc. laboratory unless otherwise noted. Analytical results are summarized in the following report.

Analytical results are reported on an "as received" basis unless otherwise noted. Where possible, the samples will be retained by the laboratory for 60 days following issuance of the initial final report. The samples will be disposed of or returned at that time. Arrangements can be made for extended storage by contacting me at this time.

We appreciate your decision to use EMSL Analytical, Inc. for this project. We are committed to being your vendor of choice to meet your analytical needs.

If you have any questions please contact me at the above phone number.

Sincerely,

Mark D. Erickson

Mark Erickson

Laboratory Manager

Pace Analytical Services – MN Field Department

352011173

M5 analysis

26 samples, 25 runs and 1 blank

20-04074 - Grede

Custody	The samples were received on 12/11/2020 by Amanda Lindahl. The samples were delivered at ambient temperature in good condition. No leaks or sample loss was evident.
Analysis	The samples were analyzed for particulate matter using the analytical procedures in EPA Method 5, Determination of Particulate Matter Emissions from Stationary Sources (40 CFR Part 60, Appendix A).
QC Notes	For M5 analysis, all weights were performed on Balance IH-35-05 (Ohaus Explorer EX125) which is calibrated by NBS Calibrations through 09/2021. No reagent correction factors were applied to the reported fractions. The reagent blank was calculated but not applied to the runs.
Reporting Notes	Gravimetric analyses are considered accurate to +/- 0.5 mg. Negative weights between 0 and -0.5 mg are set to 0 in the calculation and not investigated. Negative weights greater than -0.5 mg are investigated. For M5 analysis, no reported weights were greater than -0.5 mg. For M5 analysis, probe was fraction for sample Disa Exh (324678) run 3 (352011173-0013) glass fragments were removed from the beaker prior to performing the final weights.

M5 Weights

LIMS ID	352011173-0001	352011173-0002	352011173-0003
Sample ID	No. 5 HMP (324848) Run 1	No. 5 HMP (324848) Run 2	No. 5 HMP (324848) Run 3

Filter ID	0-0648	Date/Time	0-0691	Date/Time	0-0668	Date/Time
Final Weight 1 (g)	0.50863	12/28/20 2P	0.50822	12/28/20 2P	0.50519	12/28/20 2P
Final Weight 2 (g)	0.50866	12/29/20 9A	0.50816	12/29/20 9A	0.50510	12/29/20 9A
Tare Weight (g)	0.50654	6/30/2020	0.50563	6/30/2020	0.50267	6/30/2020
Net Filter Catch (mg)	2.12		2.53		2.43	

Tin ID	0-1395	Date/Time	0-1396	Date/Time	0-1397	Date/Time
Weight 1 (g)	3.35602	12/28/20 2P	3.54805	12/28/20 2P	3.44769	12/28/20 2P
Weight 2 (g)	3.35585	12/29/20 9A	3.54768	12/29/20 9A	3.44736	12/29/20 9A
Tare Weight (g)	3.33742	12/7/2020	3.53266	11/17/2020	3.43267	11/17/2020
Net Acetone Residue (mg)	18.43		15.02		14.69	
Acetone Volume (mL)	126		80		70	
Total Particulate (mg)	20.55		17.55		17.12	

LIMS ID	352011173-0004	352011173-0005	352011173-0006
Sample ID	Disa CC (324682) Run 1	Disa CC (324682) Run 2	Disa CC (324682) Run 3

Filter ID	0-0624	Date/Time	0-0692	Date/Time	0-1180	Date/Time
Final Weight 1 (g)	0.50817	12/28/20 2P	0.50255	12/28/20 2P	0.50738	12/28/20 2P
Final Weight 2 (g)	0.50830	12/29/20 9A	0.50249	12/29/20 9A	0.50737	12/29/20 9A
Tare Weight (g)	0.50656	6/30/2020	0.50116	6/30/2020	0.50613	11/4/2020
Net Filter Catch (mg)	1.74		1.33		1.24	

Tin ID	0-1398	Date/Time	0-1399	Date/Time	0-1400	Date/Time
Weight 1 (g)	3.32476	12/28/20 2P	3.40311	12/28/20 2P	3.48283	12/28/20 2P
Weight 2 (g)	3.32438	12/29/20 9A	3.40264	12/29/20 9A	3.48250	12/29/20 9A
Tare Weight (g)	3.32153	11/17/2020	3.39841	11/17/2020	3.47815	11/17/2020
Net Acetone Residue (mg)	2.85		4.23		4.35	
Acetone Volume (mL)	76		58		88	
Total Particulate (mg)	4.59		5.56		5.59	

Reagent Blank	Acetone

Tin ID	0-1393	
Initial Volume (ml)	200	Date/Time
Weight 1 (g)	3.31503	12/28/20 2P
Weight 2 (g)	3.31505	12/29/20 9A
Tare Weight (g)	3.31476	11/17/2020
Residue (mg)	0.29	
Max Residue (mg)	0.00145	

M5 Weights

LIMS ID	352011173-0007	352011173-0008	352011173-0009
Sample ID	Disa CC (324682) Run 4	No. 7 HMP (324662) Run 1	No. 7 HMP (324662) Run 2

Filter ID	0-1178	Date/Time	0-1147	Date/Time	9-1040	Date/Time
Final Weight 1 (g)	0.51092	12/28/20 2P	0.51255	12/28/20 2P	0.50907	12/28/20 2P
Final Weight 2 (g)	0.51088	12/29/20 9A	0.51256	12/29/20 9A	0.50891	12/29/20 9A
Tare Weight (g)	0.50965	11/4/2020	0.50564	11/4/2020	0.50387	12/10/2019
Net Filter Catch (mg)	1.23		6.92		5.04	

Tin ID	0-1401	Date/Time	0-1402	Date/Time	0-1403	Date/Time
Weight 1 (g)	3.33489	12/28/20 2P	3.34849	12/28/20 2P	3.26554	12/28/20 2P
Weight 2 (g)	3.33474	12/29/20 9A	3.34834	12/29/20 9A	3.26521	12/29/20 9A
Tare Weight (g)	3.32965	12/21/2020	3.31549	12/21/2020	3.23690	12/21/2020
Net Acetone Residue (mg)	5.09		32.85		28.31	
Acetone Volume (mL)	96		90		110	
Total Particulate (mg)	6.32		39.77		33.35	

LIMS ID	352011173-0010	352011173-0011	352011173-0012
Sample ID	No. 7 HMP (324662) Run 3	Disa Exh (324678) Run 1	Disa Exh (324678) Run 2

Filter ID	0-1141	Date/Time	0-1142	Date/Time	0-1145	Date/Time
Final Weight 1 (g)	0.51038	12/28/20 2P	0.50628	12/28/20 2P	0.50270	12/28/20 2P
Final Weight 2 (g)	0.51045	12/29/20 9A	0.50635	12/29/20 9A	0.50278	12/29/20 9A
Tare Weight (g)	0.50609	11/4/220	0.50329	11/4/2020	0.49984	11/4/2020
Net Filter Catch (mg)	4.36		3.06		2.94	

Tin ID	0-1404	Date/Time	0-1405	Date/Time	0-1406	Date/Time
Weight 1 (g)	3.31053	12/28/20 2P	3.33428	12/28/20 2P	3.31713	12/28/20 2P
Weight 2 (g)	3.31021	12/29/20 9A	3.33426	12/29/20 9A	3.31700	12/29/20 9A
Tare Weight (g)	3.28852	12/21/2020	3.31781	12/21/2020	3.30407	12/21/2020
Net Acetone Residue (mg)	21.69		16.45		12.93	
Acetone Volume (mL)	86		92		90	
Total Particulate (mg)	26.05		19.51		15.87	

Reagent Blank	Acetone

Tin ID	0-1393	
Initial Volume (ml)	200	Date/Time
Weight 1 (g)	3.31503	12/28/20 2P
Weight 2 (g)	3.31505	12/29/20 9A
Tare Weight (g)	3.31476	11/17/2020
Residue (mg)	0.29	
Max Residue (mg)	0.00145	

M5 Weights

LIMS ID	352011173-0013	352011173-0014	352011173-0015
Sample ID	Disa Exh (324678) Run 3	Disa Pouring (324484) Run 1	Disa Pouring (324484) Run 2

Filter ID	0-1146	Date/Time	0-1177	Date/Time	0-1179	Date/Time
Final Weight 1 (g)	0.50692	12/28/20 2P	0.50783	12/28/20 2P	0.51599	12/28/20 2P
Final Weight 2 (g)	0.50698	12/29/20 9A	0.50766	12/29/20 9A	0.51608	12/29/20 9A
Tare Weight (g)	0.50377	11/4/2020	0.50525	11/4/2020	0.51269	11/4/2020
Net Filter Catch (mg)	3.21		2.41		3.39	

Tin ID	0-1407	Date/Time	0-1408	Date/Time	0-1409	Date/Time
Weight 1 (g)	3.28806	12/28/20 2P	3.30848	12/28/20 2P	3.33880	12/28/20 2P
Weight 2 (g)	3.28810	12/29/20 9A	3.30814	12/29/20 9A	3.33869	12/29/20 9A
Tare Weight (g)	3.26964	12/21/2020	3.30037	12/21/2020	3.32971	12/21/2020
Net Acetone Residue (mg)	18.46		7.77		8.98	
Acetone Volume (mL)	94		82		100	
Total Particulate (mg)	21.67		10.18		12.37	

LIMS ID	352011173-0016	352011173-0017	352011173-0018
Sample ID	Disa Pouring (324484) Run 3	Mod PLT Exh (334176) Run 1	Mod PLT Exh (334176) Run 2

Filter ID	0-1176	Date/Time	0-0667	Date/Time	0-0611	Date/Time
Final Weight 1 (g)	0.51471	12/28/20 2P	0.51065	12/28/20 2P	0.50790	12/28/20 2P
Final Weight 2 (g)	0.51483	12/29/20 9A	0.51077	12/29/20 9A	0.50777	12/29/20 9A
Tare Weight (g)	0.51196	11/4/2020	0.50799	6/30/2020	0.50616	6/30/2020
Net Filter Catch (mg)	2.87		2.78		1.61	

Tin ID	0-1410	Date/Time	0-1411	Date/Time	0-1412	Date/Time
Weight 1 (g)	3.27743	12/28/20 2P	3.45457	12/28/20 2P	3.51085	12/28/20 2P
Weight 2 (g)	3.27738	12/29/20 9A	3.45419	12/29/20 9A	3.51070	12/29/20 9A
Tare Weight (g)	3.26533	12/21/2020	3.44042	12/21/2020	3.50014	12/21/2020
Net Acetone Residue (mg)	12.05		13.77		10.56	
Acetone Volume (mL)	84		116		110	
Total Particulate (mg)	14.92		16.55		12.17	

Reagent Blank	Acetone

Tin ID	0-1393	
Initial Volume (ml)	200	Date/Time
Weight 1 (g)	3.31503	12/28/20 2P
Weight 2 (g)	3.31505	12/29/20 9A
Tare Weight (g)	3.31476	11/17/2020
Residue (mg)	0.29	
Max Residue (mg)	0.00145	

M5 Weights

LIMS ID	352011173-0019	352011173-0020	352011173-0021
Sample ID	Mod PLT Exh (334176) Run 3	Mod PLT Exh (334116) Run 1	Mod PLT Exh (334116) Run 2

Filter ID	0-0614	Date/Time	0-0643	Date/Time	0-0641	Date/Time
Final Weight 1 (g)	0.50193	12/28/20 2P	0.50626	12/28/20 2P	0.50846	12/28/20 2P
Final Weight 2 (g)	0.50220	12/29/20 9A	0.50625	12/29/20 9A	0.50803	12/29/20 9A
Tare Weight (g)	0.49992	6/30/2020	0.50170	6/30/2020	0.50197	6/30/2020
Net Filter Catch (mg)	2.28		4.55		6.06	

Tin ID	0-1413	Date/Time	0-1414	Date/Time	0-1415	Date/Time
Weight 1 (g)	3.34507	12/28/20 2P	3.45474	12/28/20 2P	3.43760	12/28/20 2P
Weight 2 (g)	3.34470	12/29/20 9A	3.45441	12/29/20 9A	3.43725	12/29/20 9A
Tare Weight (g)	3.33427	12/21/2020	3.44083	12/21/2020	3.42279	12/21/2020
Net Acetone Residue (mg)	10.43		13.58		14.46	
Acetone Volume (mL)	78		98		120	
Total Particulate (mg)	12.71		18.13		20.52	

LIMS ID	352011173-0022	352011173-0023	352011173-0024
Sample ID	Mod PLT Exh (334116) Run 3	No. 6 HMP (324632) Run 1	No. 6 HMP (324632) Run 2

Filter ID	0-0642	Date/Time	0-1175	Date/Time	0-1144	Date/Time
Final Weight 1 (g)	0.50467	12/28/20 2P	0.50458	12/28/20 2P	0.50391	12/28/20 2P
Final Weight 2 (g)	0.50476	12/29/20 9A	0.50461	12/29/20 9A	0.50402	12/29/20 9A
Tare Weight (g)	0.50204	6/30/2020	0.50307	11/4/2020	0.50152	11/4/2020
Net Filter Catch (mg)	2.72		1.54		2.50	

Tin ID	0-1416	Date/Time	0-1417	Date/Time	0-1418	Date/Time
Weight 1 (g)	3.29732	12/28/20 2P	3.28968	12/28/20 2P	3.34768	12/28/20 2P
Weight 2 (g)	3.29717	12/29/20 9A	3.28947	12/29/20 9A	3.34759	12/29/20 9A
Tare Weight (g)	3.28709	12/21/2020	3.27899	12/21/2020	3.33719	12/21/2020
Net Acetone Residue (mg)	10.08		10.48		10.40	
Acetone Volume (mL)	136		98		90	
Total Particulate (mg)	12.80		12.02		12.90	

Reagent Blank	Acetone

Tin ID	0-1393	
Initial Volume (ml)	200	Date/Time
Weight 1 (g)	3.31503	12/28/20 2P
Weight 2 (g)	3.31505	12/29/20 9A
Tare Weight (g)	3.31476	11/17/2020
Residue (mg)	0.29	
Max Residue (mg)	0.00145	

M5 Weights

LIMS ID	352011173-0025	352011173-0026	
Sample ID	No. 6 HMP (324632) Run 3	Acetone Blank	

Filter ID	0-1148	Date/Time	NA			
Final Weight 1 (g)	0.51206	12/28/20 2P				
Final Weight 2 (g)	0.51199	12/29/20 9A				
Tare Weight (g)	0.50946	11/4/2020				
Net Filter Catch (mg)	2.53					

Tin ID	0-1419	Date/Time	0-1420	Date/Time		
Weight 1 (g)	3.25495	12/28/20 2P	3.27306	12/28/20 2P		
Weight 2 (g)	3.25480	12/29/20 9A	3.27279	12/29/20 9A		
Tare Weight (g)	3.24037	12/21/2020	3.26932	12/21/2020		
Net Acetone Residue (mg)	14.43		3.47			
Acetone Volume (mL)	100		210			
Total Particulate (mg)	16.96		3.47			

LIMS ID			
Sample ID			

Filter ID						
Final Weight 1 (g)						
Final Weight 2 (g)						
Tare Weight (g)						
Net Filter Catch (mg)						

Tin ID						
Weight 1 (g)						
Weight 2 (g)						
Tare Weight (g)						
Net Acetone Residue (mg)						
Acetone Volume (mL)						
Total Particulate (mg)						

Reagent Blank	Acetone

Tin ID	0-1393	
Initial Volume (ml)	200	Date/Time
Weight 1 (g)	3.31503	12/28/20 2P
Weight 2 (g)	3.31505	12/29/20 9A
Tare Weight (g)	3.31476	11/17/2020
Residue (mg)	0.29	
Max Residue (mg)	0.00145	

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CHAIN-OF-CUSTODY Analytical Request Document

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LAB USE ONLY- Affix Workorder/Login Label Here or List Pace Workorder Number or MTJL Log-in Number Here

35201173

ALL SHADED AREAS are for LAB USE ONLY

Company: Pace MN-Field

Address: 1700 Elm St.

Report To: T. Borgerding

Copy To: Beth Kelm

Customer Project Name/Number: Grede / 20-04074

Phone/Email: Terry.Borgerding@pacelabs.com

Collected By (print): Terry Borgerding

Collected By (signature): TB

Sample Disposal:
[ ] Dispose as appropriate [ ] Return
[ ] Archive: ______________
[ ] Hold: ______________

Billing Information:

Email To:

Site Collection Info/Address:

State: / County/City: Time Zone Collected: [ ] PT [ ] MT [ ] CT [ ] ET

Site/Facility ID #:

Compliance Monitoring? [ ] Yes [ ] No

Purchase Order #:
Quote #:

DW PWS ID #:
DW Location Code:

Turnaround Date Required: Std

Immediately Packed on Ice: [ ] Yes [ ] No

Rush:
[ ] Same Day [ ] Next Day
[ ] 2 Day [ ] 3 Day [ ] 4 Day [ ] 5 Day
(Expedite Charges Apply)

Field Filtered (if applicable): [ ] Yes [ ] No
Analysis: ______________

Container Preservative Type **

Lab Project Manager:

** Preservative Types: (1) nitric acid, (2) sulfuric acid, (3) hydrochloric acid, (4) sodium hydroxide, (5) zinc acetate, (6) methanol, (7) sodium bisulfate, (8) sodium thiosulfate, (9) hexane, (A) ascorbic acid, (B) ammonium sulfate, (C) ammonium hydroxide, (D) TSP, (U) Unpreserved, (O) Other ______________

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Wastewater (WW), Product (P), Soil/Solid (SL), Oil (OL), Wipe (WP), Air (AR), Tissue (TS), Bioassay (B), Vapor (V), Other (OT)

Customer Sample ID	Matrix *	Comp / Grab	Collected (or Composite Start)		Composite End		Res Cl	# of Ctns	Analyses: MS - PW, AF
			Date	Time	Date	Time			
No.5 HMP (324848) Run1	AR	C	12-8-20	0750				2	✓
" " Run2				0935				2	✓
" " Run3				1206				2	✓
Disa CC (324682) Run1				0743				2	✓
" " Run 2				0935				2	✓
" " Run3				1215				2	✓
No.7 HMP (324662) Run1				0748				2	✓
" " Run2				0959				2	✓
" " Run3				1225				2	✓
Disa Exh (324678) Run1			12-9-20	1052				2	✓

Lab Profile/Line:

```
Lab Sample Receipt Checklist:

Custody Seals Present/Intact  Y N NA
Custody Signatures Present    Y N NA
Collector Signature Present   Y N NA
Bottles Intact                Y N NA
Correct Bottles               Y N NA
Sufficient Volume             Y N NA
Samples Received on Ice       Y N NA
VOA - Headspace Acceptable    Y N NA
USDA Regulated Soils          Y N NA
Samples in Holding Time       Y N NA
Residual Chlorine Present     Y N NA
Cl Strips: ______________
Sample pH Acceptable          Y N NA
pH Strips: ______________
Sulfide Present               Y N NA
Lead Acetate Strips: __________

LAB USE ONLY:
Lab Sample # / Comments:
```

Customer Remarks / Special Conditions / Possible Hazards:
ship to EMSL
pg 1 of 3

Type of Ice Used: Wet Blue Dry None

Packing Material Used:

Radchem sample(s) screened (<500 cpm): Y N NA

SHORT HOLDS PRESENT (<72 hours): Y N N/A

Lab Tracking #: 2362519

Samples received via: FEDEX UPS Client Courier Pace Courier

Lab Sample Temperature Info:
Temp Blank Received: Y N NA
Therm ID#: ______________
Cooler 1 Temp Upon Receipt: _____oC
Cooler 1 Therm Corr. Factor: _____oC
Cooler 1 Corrected Temp: _____oC
Comments:

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:
TB / Pace	12/11/20 / 910	CMS / Pace	12/11/20 9:19
CMS / Pace	12/11/20 9:19		
		EMSL	12-11-2020 1:05

MTJL LAB USE ONLY
Table #:
Acctnum:
Template:
Prelogin:
PM:
PB:

Trip Blank Received: Y N NA
HCL MeOH TSP Other

Non Conformance(s): YES / NO

Page: ______
of: ______

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OrderID: 35201173

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3S2011173

ALL SHADED AREAS are for LAB USE ONLY

Company: Pace MN - Field
Address: 1700 Elm St.
Report To: T. Borgerding
Copy To: Beth Kelm
Customer Project Name/Number: Grede / 20-04074
Phone:
Email: terry.borgerding@pacelabs.com
Collected By (print): Terry Borgerding
Collected By (signature):
Sample Disposal:
☐ Dispose as appropriate ☐ Return
☐ Archive: ______
☐ Hold: ______

Billing Information:
Email To:
Site Collection Info/Address:
State: / County/City: Time Zone Collected: ☐ PT ☐ MT ☐ CT ☐ ET
Site/Facility ID #:
Compliance Monitoring? ☐ Yes ☐ No
Purchase Order #:
Quote #:
DW PWS ID #:
DW Location Code:
Turnaround Date Required: Std
Immediately Packed on Ice: ☐ Yes ☐ No
Rush: ☐ Same Day ☐ Next Day ☐ 2 Day ☐ 3 Day ☐ 4 Day ☐ 5 Day (Expedite Charges Apply)
Field Filtered (if applicable): ☐ Yes ☐ No
Analysis: ______

Container Preservative Type **
Lab Project Manager:

** Preservative Types: (1) nitric acid, (2) sulfuric acid, (3) hydrochloric acid, (4) sodium hydroxide, (5) zinc acetate, (6) methanol, (7) sodium bisulfate, (8) sodium thiosulfate, (9) hexane, (A) ascorbic acid, (B) ammonium sulfate, (C) ammonium hydroxide, (D) TSP, (U) Unpreserved, (O) Other ______

Analyses
Lab Profile/Line:

```
Lab Sample Receipt Checklist:

Custody Seals Present/Intact Y N NA
Custody Signatures Present   Y N NA
Collector Signature Present  Y N NA
Bottles Intact               Y N NA
Correct Bottles              Y N NA
Sufficient Volume            Y N NA
Samples Received on Ice      Y N NA
VOA - Headspace Acceptable   Y N NA
USDA Regulated Soils         Y N NA
Samples in Holding Time      Y N NA
Residual Chlorine Present    Y N NA
Cl Strips: ______________
Sample pH Acceptable         Y N NA
pH Strips: ______________
Sulfide Present              Y N NA
Lead Acetate Strips: ________

LAB USE ONLY:
Lab Sample # / Comments:
```

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Wastewater (WW), Product (P), Soil/Solid (SL), Oil (OL), Wipe (WP), Air (AR), Tissue (TS), Bioassay (B), Vapor (V), Other (OT)

Customer Sample ID	Matrix *	Comp / Grab	Collected (or Composite Start)		Composite End		Res Cl	# of Ctns	Method 5 - PW/AF
			Date	Time	Date	Time			
Disa Exh (324678) Run 2	AR	C	12-9-20	1251				2	✓
" " Run 3				1435				2	✓
Disa Pouring (324484) Run 1				0826				2	✓
" " Run 2				1015				2	✓
" " Run 3				1205				2	✓
Mod Alt Exh. (334176) Run 1				0815				2	✓
" " Run 2				1035				2	✓
" " Run 3	↓	↓	↓	1228				2	✓
Mod Alt Exh (334116) Run 1			12-10-20	0750				2	✓
" " Run 2	↓	↓	↓	0940				2	✓

Customer Remarks / Special Conditions / Possible Hazards:

Ship to EMSL

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Type of Ice Used: Wet Blue Dry None
Packing Material Used:
Radchem sample(s) screened (<500 cpm): Y N NA
SHORT HOLDS PRESENT (<72 hours): Y N N/A
Lab Tracking #: 2362520
Samples received via: FEDEX UPS Client Courier Pace Courier

Lab Sample Temperature Info:
Temp Blank Received: Y N NA
Therm ID#: ______
Cooler 1 Temp Upon Receipt: ____oC
Cooler 1 Therm Corr. Factor: ____oC
Cooler 1 Corrected Temp: ____oC
Comments:

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:
/ Pace	12/11/20 / 910	/ Pace	12/11/20 9:19
/ Pace	12/11/20 9:19		

MTJL LAB USE ONLY
Table #:
Acctnum:
Template:
Prelogin:
PM:
PB:

Trip Blank Received: Y N NA
HCL MeOH TSP Other

Non Conformance(s): YES / NO
Page: ______
of: ______

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OrderID: 352011173

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35201173

ALL SHADED AREAS are for LAB USE ONLY

Company: Pace MN - Field
Address: 1700 Elm st.
Report To: T. Borgerding
Copy To: Beth Kelm
Customer Project Name/Number: Grede / 20-04074
Phone:
Email: terry.borgerding@pacelabs.com
Collected By (print): Terry Borgerding
Collected By (signature):

Billing Information:
Email To:
Site Collection Info/Address:
State: County/City: /
Time Zone Collected: [ ] PT [ ] MT [ ] CT [ ] ET
Site/Facility ID #:
Compliance Monitoring? [ ] Yes [ ] No
Purchase Order #:
Quote #:
DW PWS ID #:
DW Location Code:
Turnaround Date Required: Std
Immediately Packed on Ice: [ ] Yes [ ] No

Sample Disposal:
[ ] Dispose as appropriate [ ] Return
[ ] Archive: ____________
[ ] Hold: ____________

Rush:
[ ] Same Day [ ] Next Day
[ ] 2 Day [ ] 3 Day [ ] 4 Day [ ] 5 Day
(Expedite Charges Apply)

Field Filtered (if applicable): [ ] Yes [ ] No
Analysis: ____________

Container Preservative Type **

Lab Project Manager:

** Preservative Types: (1) nitric acid, (2) sulfuric acid, (3) hydrochloric acid, (4) sodium hydroxide, (5) zinc acetate, (6) methanol, (7) sodium bisulfate, (8) sodium thiosulfate, (9) hexane, (A) ascorbic acid, (B) ammonium sulfate, (C) ammonium hydroxide, (D) TSP, (U) Unpreserved, (O) Other ____________

Analyses

Lab Profile/Line:

```
Lab Sample Receipt Checklist:

Custody Seals Present/Intact Y N NA
Custody Signatures Present   Y N NA
Collector Signature Present  Y N NA
Bottles Intact               Y N NA
Correct Bottles              Y N NA
Sufficient Volume            Y N NA
Samples Received on Ice      Y N NA
VOA - Headspace Acceptable   Y N NA
USDA Regulated Soils         Y N NA
Samples in Holding Time      Y N NA
Residual Chlorine Present    Y N NA
Cl Strips: ____________
Sample pH Acceptable         Y N NA
pH Strips: ____________
Sulfide Present              Y N NA
Lead Acetate Strips: __________

LAB USE ONLY:
Lab Sample # / Comments:
```

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Wastewater (WW), Product (P), Soil/Solid (SL), Oil (OL), Wipe (WP), Air (AR), Tissue (TS), Bioassay (B), Vapor (V), Other (OT)

Customer Sample ID	Matrix *	Comp / Grab	Collected (or Composite Start)		Composite End		Res Cl	# of Ctns	Method 5 - PW/AF
			Date	Time	Date	Time			
Med Plt. Exh (334116) Run 3	AR	C	121020	1226				2	✓
No 6 HMP (324632) Run 1	↓	↓	↓	0720				2	✓
" " Run 2				0925				2	✓
" " Run 3		↓		1210				2	✓
Acetone Blank	↓	G	↓	1330				1	✓

Page 3 of 3

Customer Remarks / Special Conditions / Possible Hazards:
pg. 3 of 3
Ship to EMSL

Type of Ice Used: Wet Blue Dry None
Packing Material Used:
Radchem sample(s) screened (<500 cpm): Y N NA

SHORT HOLDS PRESENT (<72 hours): Y N N/A
Lab Tracking #: 2362541
Samples received via: FEDEX UPS Client Courier Pace Courier

Lab Sample Temperature Info:
Temp Blank Received: Y N NA
Therm ID#: ____________
Cooler 1 Temp Upon Receipt: _____oC
Cooler 1 Therm Corr. Factor: _____oC
Cooler 1 Corrected Temp: _____oC
Comments:

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:
TB / Pace	12/10/20 / 910	/ Pace	12/11/20 9:19
/ Pace	12/11/20 9:19		

MTJL LAB USE ONLY
Table #:
Acctnum:
Template:
Prelogin:
PM:
PB:

Trip Blank Received: Y N NA
HCL MeOH TSP Other

Non Conformance(s): YES / NO
Page: ______
of: ______

OrderID: 352011173

EMSL Analytical, Inc.
3410 Winnetka Avenue North
New Hope, MN 55427
(763) 449-4922

Terry Borgerding
Pace Analytical – MN Field Services
1700 Elm Street SE Suite 200
Minneapolis, MN 55414

January 05, 2021

EMSL Order #: 352011456

RE: Iron Mountain Grede 20-04074

Dear Terry Borgerding:

EMSL Analytical, Inc. received samples for the project identified above on December 18, 2020. The sample(s) were analyzed in the EMSL Analytical, Inc. laboratory unless otherwise noted. Analytical results are summarized in the following report.

Analytical results are reported on an "as received" basis unless otherwise noted. Where possible, the samples will be retained by the laboratory for 60 days following issuance of the initial final report. The samples will be disposed of or returned at that time. Arrangements can be made for extended storage by contacting me at this time.

We appreciate your decision to use EMSL Analytical, Inc. for this project. We are committed to being your vendor of choice to meet your analytical needs.

If you have any questions please contact me at the above phone number.

Sincerely,

Mark Erickson

Laboratory Manager

Pace Analytical Services – MN Field Department

352011456

M5 analysis

4 samples, 3 runs and 1 blank

20-04074 – Iron Mountain Grede

Custody	The samples were received on 12/18/2020 by Mark Erickson. The samples were delivered at ambient temperature in good condition. No leaks or sample loss was evident.
Analysis	The samples were analyzed for particulate matter using the analytical procedures in EPA Method 5, Determination of Particulate Matter Emissions from Stationary Sources (40 CFR Part 60, Appendix A).
QC Notes	For M5 analysis, all weights were performed on Balance IH-35-05 (Ohaus Explorer EX125) which is calibrated by NBS Calibrations through 09/2021. No reagent correction factors were applied to the reported fractions. The reagent blank was calculated but not applied to the runs.
Reporting Notes	Gravimetric analyses are considered accurate to +/- 0.5 mg. Negative weights between 0 and -0.5 mg are set to 0 in the calculation and not investigated. Negative weights greater than -0.5 mg are investigated. For M5 analysis, no reported weights were greater than -0.5 mg.

M5 Weights

LIMS ID	352011456-0001	352011456-0002	352011456-0003
Sample ID	Cupola Exhaust T1R1	Cupola Exhaust T1R2	Cupola Exhaust T1R3

Filter ID	0-1143	Date/Time	0-0606	Date/Time	0-0674	Date/Time
Final Weight 1 (g)	0.50624	1/4/21 10A	0.50636	1/4/21 10A	0.50876	1/4/21 10A
Final Weight 2 (g)	0.50617	1/5/21 9A	0.50647	1/5/21 9A	0.50874	1/5/21 9A
Tare Weight (g)	0.50494	11/4/2020	0.50517	6/30/2020	0.50759	6/30/2020
Net Filter Catch (mg)	1.23		1.30		1.15	

Tin ID	0-1421	Date/Time	0-1422	Date/Time	0-1423	Date/Time
Weight 1 (g)	3.27718	1/4/21 10A	3.37942	1/4/21 10A	3.36830	1/4/21 10A
Weight 2 (g)	3.27722	1/5/21 9A	3.37902	1/5/21 9A	3.36797	1/5/21 9A
Tare Weight (g)	3.26055	12/29/2020	3.37467	12/29/2020	3.36126	12/29/2020
Net Acetone Residue (mg)	16.67		4.35		6.71	
Acetone Volume (mL)	164		122		154	
Total Particulate (mg)	17.90		5.65		7.86	

LIMS ID	352011456-0004		
Sample ID	Cupola Blank T1R0		

Filter ID	0-1174	Date/Time				
Final Weight 1 (g)	0.50452	1/4/21 10A				
Final Weight 2 (g)	0.50449	1/5/21 9A				
Tare Weight (g)	0.50407	11/4/2020				
Net Filter Catch (mg)	0.42					

Tin ID	0-1424	Date/Time				
Weight 1 (g)	3.34790	1/4/21 10A				
Weight 2 (g)	3.34796	1/5/21 9A				
Tare Weight (g)	3.34670	12/29/2020				
Net Acetone Residue (mg)	1.26					
Acetone Volume (mL)	114					
Total Particulate (mg)	1.68					

Reagent Blank	Acetone

Tin ID	0-1429	
Initial Volume (ml)	200	Date/Time
Weight 1 (g)	3.33613	1/4/21 10A
Weight 2 (g)	3.33607	1/5/21 9A
Tare Weight (g)	3.33592	12/29/2020
Residue (mg)	0.15	
Max Residue (mg)	0.00075	

Pace Analytical Services – MN Field Department

352011456

M202 analysis

4 samples, 3 runs and 1 blank

20-04074 – Iron Mountain Grede

Custody	The samples were received on 12/18/2020 by Mark Erickson. The samples were delivered at ambient temperature in good condition. No leaks or sample loss was evident.
Analysis	The samples were analyzed for particulate matter using the analytical procedures in Appendix M to Part 51 (202 eCFR) Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources.
QC Notes	For M202 analysis, all weights were performed on Balance IH-35-05 (Ohaus Explorer EX125) which is calibrated by NBS Calibrations through 09/2021. No reagent correction factors were applied to the reported fractions. The train blank was calculated but not applied to the runs.
Reporting Notes	Gravimetric analyses are considered accurate to +/- 0.5 mg. Negative weights between 0 and -0.5 mg are set to 0 in the calculation and not investigated. Negative weights greater than -0.5 mg are investigated. For M202 analysis, no reported weights were greater than -0.5 mg.

M202 Weights

LIMS ID	352011456-0001	352011456-0002	352011456-0003	352011456-0004
Sample ID	Cupola Exhaust T1R1	Cupola Exhaust T1R2	Cupola Exhaust T1R3	Cupola Blank T1R0

Organic Catch

Beaker ID	0-1425		0-1426		0-1427		0-1428	
Initial Solvent Vol. (ml)	132	Date/Time	108	Date/Time	140	Date/Time	106	Date/Time
Organic FW 1 (g)	3.39009	1/4/21 10A	3.55383	1/4/21 10A	3.34344	1/4/21 10A	3.27442	1/4/21 10A
Organic FW 2 (g)	3.38995	1/5/21 9A	3.55372	1/5/21 9A	3.34359	1/5/21 9A	3.27462	1/5/21 9A
Tare Weight (g)	3.38847	12/29/2020	3.55182	12/29/2020	3.34142	12/29/2020	3.27427	12/29/2020
Organic Catch (mg)	1.48		1.90		2.17		0.35	

Inorganic Catch

Vessel ID	A0713325		A0713326		A0713327		A0713328	
Sample Vol. (mL)	128		90		128		50	
DI Added (mL)	75	Date/Time	75	Date/Time	75	Date/Time	75	Date/Time
Weight 1 (g)	3.90665	1/4/21 10A	3.89286	1/4/21 10A	3.83609	1/4/21 10A	3.91114	1/4/21 10A
Weight 2 (g)	3.90654	1/5/21 9A	3.89278	1/5/21 9A	3.83592	1/5/21 9A	3.91098	1/5/21 9A
Tare Weight (g)	3.90328	12/16/2020	3.88789	12/16/2020	3.83336	12/16/2020	3.91027	12/16/2020
Net Inorg Catch (mg)	3.26		4.89		2.56		0.71	
Resp. DI added (mL)	0		0		0		0	
Volume Titrated (mL)	0		0		0		0	
NH3 Correction (mg)	0.00		0.00		0.00		0.00	
Corrected Inorg Catch (mg)	3.26		4.89		2.56		0.71	
CPM (mg)	4.74		6.79		4.73		1.06	

Reagent Blanks	Acetone		Hexane		DI Water	
Beaker ID	0-1429		0-1430		A0713329	
Initial Volume (ml)	200	Date/Time	200	Date/Time	200	Date/Time
Weight 1 (g)	3.33613	1/4/21 10A	3.36508	1/4/21 10A	3.88292	1/4/21 10A
Weight 2 (g)	3.33607	1/5/21 9A	3.36497	1/5/21 9A	3.88305	1/5/21 9A
Tare Weight (g)	3.33592	12/29/2020	3.36475	12/29/2020	3.88319	12/16/2020
Residue (mg)	0.15		0.22		-0.14	
Max Residue (mg)	0.00075		0.00110		-0.00070	

Pace Analytical®

CHAIN-OF-CUSTODY Analytical Request Document

Chain-of-Custody is a LEGAL DOCUMENT - Complete all relevent fields

LAB USE ONLY- Affix Workorder/Login Label Here or List Pace Workorder Number or MTJL Log-in Number Here

352011456

ALL SHADED AREAS are for LAB USE ONLY

Company: Pace Analytical
Billing Information: Pace Air FSD
Address: 1800 Elm St.
Report To: Terry Borgerding
Email To: Ciara Ruikke
Copy To: Beth Kelm
Site Collection Info/Address:
Customer Project Name/Number: Iron mountain Grede 20-04074
State: MI County/City: Kingsford Time Zone Collected: [ ] PT [ ] MT [ ] CT [ ] ET
Phone:
Email: 612-723-0181
Site/Facility ID #:
Compliance Monitoring? [ ] Yes [ ] No
Collected By (print): Andrew Rodabaugh
Purchase Order #:
Quote #:
DW PWS ID #:
DW Location Code:
Collected By (signature): andrew Rodabaugh
Turnaround Date Required:
Immediately Packed on Ice: [ ] Yes [ ] No
Sample Disposal: [ ] Dispose as appropriate [ ] Return [ ] Archive: ______ [ ] Hold: ______
Rush: [ ] Same Day [ ] Next Day [ ] 2 Day [ ] 3 Day [ ] 4 Day [ ] 5 Day (Expedite Charges Apply)
Field Filtered (if applicable): [ ] Yes [ ] No
Analysis: ______

Container Preservative Type **

Lab Project Manager:

** Preservative Types: (1) nitric acid, (2) sulfuric acid, (3) hydrochloric acid, (4) sodium hydroxide, (5) zinc acetate, (6) methanol, (7) sodium bisulfate, (8) sodium thiosulfate, (9) hexane, (A) ascorbic acid, (B) ammonium sulfate, (C) ammonium hydroxide, (D) TSP, (U) Unpreserved, (O) Other ______

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Wastewater (WW), Product (P), Soil/Solid (SL), Oil (OL), Wipe (WP), Air (AR), Tissue (TS), Bioassay (B), Vapor (V), Other (OT)

Customer Sample ID	Matrix *	Comp / Grab	Collected (or Composite Start)		Composite End		Res Cl	# of Ctns	Analyses: M202 PW	M202 WC	M202 SR	M202 CPM	M202 AF	Lab Sample # / Comments
			Date	Time	Date	Time								
Cupola Exhaust T,R1	AR	comp	12/16	830	12/16	1056		5	1	1	1	1	1	
Cupola Exhaust T,R2	AR	comp	12/16	1230	12/16	1456		5	1	1	1	1	1	
cupola Exhaust T,R3	AR	comp	12/17	753	12/17	1017		5	1	1	1	1	1	
Cupola Blank T,0	AR	Grab	12/16	1600	12/16	1600		5	1	1	1	1	1	

Lab Profile/Line:

```
Lab Sample Receipt Checklist:

Custody Seals Present/Intact  Y N NA
Custody Signatures Present    Y N NA
Collector Signature Present   Y N NA
Bottles Intact                Y N NA
Correct Bottles               Y N NA
Sufficient Volume             Y N NA
Samples Received on Ice       Y N NA
VOA - Headspace Acceptable    Y N NA
USDA Regulated Soils          Y N NA
Samples in Holding Time       Y N NA
Residual Chlorine Present     Y N NA
Cl Strips: ____________
Sample pH Acceptable          Y N NA
pH Strips: ____________
Sulfide Present               Y N NA
Lead Acetate Strips: ________

LAB USE ONLY:
Lab Sample # / Comments:
```

Customer Remarks / Special Conditions / Possible Hazards:

Type of Ice Used: Wet Blue Dry None
SHORT HOLDS PRESENT (<72 hours): Y N N/A
Packing Material Used:
Lab Tracking #: 2362540
Radchem sample(s) screened (<500 cpm): Y N NA
Samples received via: FEDEX UPS Client Courier Pace Courier

Lab Sample Temperature Info:
Temp Blank Received: Y N NA
Therm ID#: ______
Cooler 1 Temp Upon Receipt: ____oC
Cooler 1 Therm Corr. Factor: ____oC
Cooler 1 Corrected Temp: ____oC
Comments:

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:
andrew Rodabaugh Pace	12/18/20 1000	/Pace	12/18/20 11:00
/Pace	12/18/20 11:00	MDIE (EMSL-MN) via WI	12/18/2020 13:30

MTJL LAB USE ONLY
Table #:
Acctnum:
Template:
Prelogin:
PM:
PB:

Trip Blank Received: Y N NA
HCL MeOH TSP Other

Non Conformance(s): YES / NO
Page: ______
of: ______

Page 1 Of 1

OrderID: 352011456

Appendix C

Calculation Equations and Report Nomenclature

Intermediate Calculation Summaries

Appendix C

Intermediate Data Summary

Main Plant Pouring & Cooling Disa Pouring - 324484

Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	84	84	84
Barometric Pressure, inches Hg	28.431	28.431	28.431
Static Pressure Of Duct, Inches H_2O	-1.5	-1.5	-1.5
Absolute Pressure Of Duct, Inches Hg	28.32	28.32	28.32
Meter Coefficient	0.9916	0.9916	0.9916
Pitot Tube Coefficient	0.840	0.840	0.840
Nozzle Diameter, Inches	0.250	0.250	0.250
Area Of Nozzle Opening, Square Feet	0.000341	0.000341	0.000341
Average Sq. Root of ΔPs, Inches H_2O	0.7482	0.7609	0.7613
Average ΔH, Inches H_2O	2.50	2.65	2.66
Average Stack Temperature, °F	90.08	89.17	91.38
Average Stack Temperature, °R	549.75	548.84	551.05
Average Meter Temperature, °F	52.27	64.83	68.21
Average Meter Temperature, °R	511.94	524.50	527.88
Meter Volume, Cubic Feet	70.38	73.54	73.85
Dry Standard Sample Volume, Cubic Feet	68.84	70.23	70.08
Collected Condensate Volume, ml	25.0	34.8	26.2
Moisture Content Of Flue Gas, % v/v	1.68	2.28	1.73
Dry Molecular Wt of Flue Gas, LB/LB-mole	28.96	28.96	28.96
Wet Molecular Wt of Flue Gas, LB/LB-mole	28.78	28.71	28.77
Source Gas Velocity, Feet Per Second	44.13	44.89	44.96
Actual Gas Volume Flow, ACFM	8,318	8,462	8,474
Standard Gas Volume Flow, SCFM	7,562	7,706	7,686
Dry Standard Gas Volume Flow, DSCFM	7,435	7,530	7,553
Isokinetic Variation, %	101.6	102.4	101.9

Appendix C

Intermediate Data Summary
Main Plant Pouring & Cooling No. 6 HMP - 324632
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	84	84	84
Barometric Pressure, inches Hg	28.66	28.66	28.66
Static Pressure Of Duct, Inches H_2O	-0.35	-0.35	-0.35
Absolute Pressure Of Duct, Inches Hg	28.63	28.63	28.63
Meter Coefficient	0.9916	0.9916	0.9916
Pitot Tube Coefficient	0.840	0.840	0.840
Nozzle Diameter, Inches	0.371	0.371	0.371
Area Of Nozzle Opening, Square Feet	0.000751	0.000751	0.000751
Average Sq. Root of ΔPs, Inches H_2O	0.3982	0.4119	0.4050
Average ΔH, Inches H_2O	3.46	3.63	3.57
Average Stack Temperature, °F	83.67	89.46	94.13
Average Stack Temperature, °R	543.34	549.13	553.80
Average Meter Temperature, °F	54.31	55.60	66.73
Average Meter Temperature, °R	513.98	515.27	526.40
Meter Volume, Cubic Feet	82.92	84.98	85.33
Dry Standard Sample Volume, Cubic Feet	81.63	83.48	82.04
Collected Condensate Volume, ml	15.7	15.8	7.0
Moisture Content Of Flue Gas, % v/v	0.90	0.88	0.40
Dry Molecular Wt of Flue Gas, LB/LB-mole	28.96	28.96	28.96
Wet Molecular Wt of Flue Gas, LB/LB-mole	28.86	28.86	28.92
Source Gas Velocity, Feet Per Second	23.19	24.11	23.78
Actual Gas Volume Flow, ACFM	4,371	4,545	4,483
Standard Gas Volume Flow, SCFM	4,065	4,182	4,091
Dry Standard Gas Volume Flow, DSCFM	4,028	4,145	4,074
Isokinetic Variation, %	101.0	100.4	100.4

Grede, LLC - Iron Mountain

Appendix C

Kingsford, MI
Pace Project No. 20-04074

Intermediate Data Summary
Main Plant Pouring & Cooling No. 7 HMP - 324662
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	96	72	72
Barometric Pressure, inches Hg	28.65	28.65	28.65
Static Pressure Of Duct, Inches H_2O	-0.5	-0.5	-0.5
Absolute Pressure Of Duct, Inches Hg	28.61	28.61	28.61
Meter Coefficient	0.996	0.996	0.996
Pitot Tube Coefficient	0.840	0.840	0.840
Nozzle Diameter, Inches	0.260	0.260	0.260
Area Of Nozzle Opening, Square Feet	0.000369	0.000369	0.000369
Average Sq. Root of ΔPs, Inches H_2O	0.721	0.734	0.726
Average ΔH, Inches H_2O	2.45	2.54	2.51
Average Stack Temperature, °F	90.67	94.54	95.75
Average Stack Temperature, °R	550.34	554.21	555.42
Average Meter Temperature, °F	67.40	72.63	80.06
Average Meter Temperature, °R	527.07	532.30	539.73
Meter Volume, Cubic Feet	86.19	66.30	66.20
Dry Standard Sample Volume, Cubic Feet	82.86	63.12	62.16
Collected Condensate Volume, ml	13.6	10.8	11.6
Moisture Content Of Flue Gas, % v/v	0.77	0.80	0.87
Dry Molecular Wt of Flue Gas, LB/LB-mole	28.96	28.96	28.96
Wet Molecular Wt of Flue Gas, LB/LB-mole	28.88	28.87	28.86
Source Gas Velocity, Feet Per Second	42.27	43.17	42.75
Actual Gas Volume Flow, ACFM	8,645	8,830	8,744
Standard Gas Volume Flow, SCFM	7,932	8,045	7,950
Dry Standard Gas Volume Flow, DSCFM	7,871	7,980	7,880
Isokinetic Variation, %	101.4	101.6	101.3

Appendix C

Intermediate Data Summary

Main Plant Pouring & Cooling Disa Pouring - 324678

Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	72	72	72
Barometric Pressure, inches Hg	28.45	28.45	28.45
Static Pressure Of Duct, Inches H_2O	-0.25	-0.25	-0.25
Absolute Pressure Of Duct, Inches Hg	28.43	28.43	28.43
Meter Coefficient	0.9959	0.9959	0.9959
Pitot Tube Coefficient	0.840	0.840	0.840
Nozzle Diameter, Inches	0.310	0.310	0.310
Area Of Nozzle Opening, Square Feet	0.000524	0.000524	0.000524
Average Sq. Root of ΔPs, Inches H_2O	0.531	0.526	0.530
Average ΔH, Inches H_2O	2.85	2.90	2.92
Average Stack Temperature, °F	70.58	61.13	65.63
Average Stack Temperature, °R	530.25	520.80	525.30
Average Meter Temperature, °F	79.29	86.08	85.67
Average Meter Temperature, °R	538.96	545.75	545.34
Meter Volume, Cubic Feet	70.50	70.98	71.23
Dry Standard Sample Volume, Cubic Feet	65.89	65.52	65.80
Collected Condensate Volume, ml	5.5	0.7	1.0
Moisture Content Of Flue Gas, % v/v	0.39	0.05	0.07
Dry Molecular Wt of Flue Gas, LB/LB-mole	28.96	28.96	28.96
Wet Molecular Wt of Flue Gas, LB/LB-mole	28.92	28.95	28.95
Source Gas Velocity, Feet Per Second	30.60	30.06	30.38
Actual Gas Volume Flow, ACFM	17,666	17,353	17,539
Standard Gas Volume Flow, SCFM	16,716	16,718	16,753
Dry Standard Gas Volume Flow, DSCFM	16,650	16,709	16,741
Isokinetic Variation, %	100.9	100.0	100.3

Appendix C

Intermediate Data Summary

Main Plant Pouring & Cooling Disa Pouring - 324682

Test 1

Parameter	**Run 2**	**Run 3**	**Run 4**
Sample Duration, Minutes	84	84	84
Barometric Pressure, inches Hg	28.634	28.634	28.634
Static Pressure Of Duct, Inches H_2O	-0.45	-0.45	-0.45
Absolute Pressure Of Duct, Inches Hg	28.60	28.60	28.60
Meter Coefficient	0.9916	0.9916	0.9916
Pitot Tube Coefficient	0.840	0.840	0.840
Nozzle Diameter, Inches	0.310	0.310	0.310
Area Of Nozzle Opening, Square Feet	0.000524	0.000524	0.000524
Average Sq. Root of ΔPs, Inches H_2O	0.4489	0.4451	0.4501
Average ΔH, Inches H_2O	2.23	2.20	2.24
Average Stack Temperature, °F	63.46	66.04	66.63
Average Stack Temperature, °R	523.13	525.71	526.30
Average Meter Temperature, °F	52.31	56.50	54.85
Average Meter Temperature, °R	511.98	516.17	514.52
Meter Volume, Cubic Feet	66.45	66.05	66.63
Dry Standard Sample Volume, Cubic Feet	65.40	64.48	65.26
Collected Condensate Volume, ml	8.2	9.7	15.1
Moisture Content Of Flue Gas, % v/v	0.59	0.70	1.08
Dry Molecular Wt of Flue Gas, LB/LB-mole	28.96	28.96	28.96
Wet Molecular Wt of Flue Gas, LB/LB-mole	28.90	28.88	28.84
Source Gas Velocity, Feet Per Second	25.65	25.50	25.82
Actual Gas Volume Flow, ACFM	14,807	14,720	14,902
Standard Gas Volume Flow, SCFM	14,286	14,133	14,291
Dry Standard Gas Volume Flow, DSCFM	14,202	14,033	14,137
Isokinetic Variation, %	100.7	100.5	100.9

Appendix C

Intermediate Data Summary
Main Plant Pouring & Cooling No. 5 HMP - 324848
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	84	84	84
Barometric Pressure, inches Hg	28.64	28.64	28.64
Static Pressure Of Duct, Inches H_2O	-2	-2	-2
Absolute Pressure Of Duct, Inches Hg	28.49	28.49	28.49
Meter Coefficient	0.9958	0.9958	0.9958
Pitot Tube Coefficient	0.840	0.840	0.840
Nozzle Diameter, Inches	0.210	0.210	0.210
Area Of Nozzle Opening, Square Feet	0.000241	0.000241	0.000241
Average Sq. Root of ΔPs, Inches H_2O	0.9915	1.0047	1.0035
Average ΔH, Inches H_2O	2.27	2.34	2.36
Average Stack Temperature, °F	77.42	78.79	80.38
Average Stack Temperature, °R	537.09	538.46	540.05
Average Meter Temperature, °F	52.42	56.38	60.48
Average Meter Temperature, °R	512.09	516.05	520.15
Meter Volume, Cubic Feet	66.14	67.42	67.75
Dry Standard Sample Volume, Cubic Feet	65.38	66.15	65.95
Collected Condensate Volume, ml	5.8	8.8	7.8
Moisture Content Of Flue Gas, % v/v	0.42	0.62	0.55
Dry Molecular Wt of Flue Gas, LB/LB-mole	28.96	28.96	28.96
Wet Molecular Wt of Flue Gas, LB/LB-mole	28.91	28.89	28.90
Source Gas Velocity, Feet Per Second	57.49	58.35	58.36
Actual Gas Volume Flow, ACFM	10,836	10,999	11,001
Standard Gas Volume Flow, SCFM	10,145	10,271	10,242
Dry Standard Gas Volume Flow, DSCFM	10,103	10,207	10,186
Isokinetic Variation, %	100.7	100.8	100.7

Appendix C

Intermediate Data Summary
Module Pouring & Cooling Exhaust - 334116
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	84	84	84
Barometric Pressure, inches Hg	28.69	28.69	28.69
Static Pressure Of Duct, Inches H_2O	-0.07	-0.07	-0.07
Absolute Pressure Of Duct, Inches Hg	28.68	28.68	28.68
Meter Coefficient	0.9958	0.9958	0.9958
Pitot Tube Coefficient	0.840	0.840	0.840
Nozzle Diameter, Inches	0.346	0.346	0.346
Area Of Nozzle Opening, Square Feet	0.000653	0.000653	0.000653
Average Sq. Root of ΔPs, Inches H_2O	0.4419	0.4314	0.4308
Average ΔH, Inches H_2O	3.26	3.11	3.11
Average Stack Temperature, °F	85.75	92.08	97.33
Average Stack Temperature, °R	545.42	551.75	557.00
Average Meter Temperature, °F	55.06	61.94	68.44
Average Meter Temperature, °R	514.73	521.61	528.11
Meter Volume, Cubic Feet	79.59	78.35	78.90
Dry Standard Sample Volume, Cubic Feet	78.61	76.33	75.92
Collected Condensate Volume, ml	15.3	2.9	12.5
Moisture Content Of Flue Gas, % v/v	0.91	0.18	0.77
Dry Molecular Wt of Flue Gas, LB/LB-mole	28.96	28.96	28.96
Wet Molecular Wt of Flue Gas, LB/LB-mole	28.86	28.94	28.88
Source Gas Velocity, Feet Per Second	25.76	25.26	25.37
Actual Gas Volume Flow, ACFM	7,587	7,439	7,472
Standard Gas Volume Flow, SCFM	7,041	6,825	6,790
Dry Standard Gas Volume Flow, DSCFM	6,977	6,813	6,738
Isokinetic Variation, %	100.9	100.3	100.9

Appendix C

Intermediate Data Summary
Module Pouring & Cooling Exhaust - 334176
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	84	84	84
Barometric Pressure, inches Hg	28.47	28.47	28.47
Static Pressure Of Duct, Inches H_2O	-0.14	-0.14	-0.14
Absolute Pressure Of Duct, Inches Hg	28.46	28.46	28.46
Meter Coefficient	0.9958	0.9958	0.9958
Pitot Tube Coefficient	0.840	0.840	0.840
Nozzle Diameter, Inches	0.425	0.425	0.425
Area Of Nozzle Opening, Square Feet	0.000985	0.000985	0.000985
Average Sq. Root of ΔPs, Inches H_2O	0.2287	0.2373	0.2383
Average ΔH, Inches H_2O	2.07	2.23	2.27
Average Stack Temperature, °F	80.13	82.25	85.04
Average Stack Temperature, °R	539.80	541.92	544.71
Average Meter Temperature, °F	59.71	64.10	68.13
Average Meter Temperature, °R	519.38	523.77	527.80
Meter Volume, Cubic Feet	63.41	66.27	66.85
Dry Standard Sample Volume, Cubic Feet	61.41	63.66	63.74
Collected Condensate Volume, ml	6.1	14.2	5.7
Moisture Content Of Flue Gas, % v/v	0.47	1.04	0.42
Dry Molecular Wt of Flue Gas, LB/LB-mole	28.96	28.96	28.96
Wet Molecular Wt of Flue Gas, LB/LB-mole	28.91	28.85	28.91
Source Gas Velocity, Feet Per Second	13.30	13.85	13.92
Actual Gas Volume Flow, ACFM	3,918	4,078	4,101
Standard Gas Volume Flow, SCFM	3,645	3,779	3,781
Dry Standard Gas Volume Flow, DSCFM	3,628	3,740	3,765
Isokinetic Variation, %	100.5	101.0	100.5

Grede, LLC - Iron Mountain

Kingsford, MI
Pace Project No. 20-04074

Appendix C

Intermediate Data Summary
Cupola Baghouse Inlet
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	40	56	45
Barometric Pressure, In. Hg	29.106	29.106	29.106
Static Pressure Of Duct, In. H_2O	-1.251	-1.251	-1.251
Absolute Pressure Of Duct, In. Hg	29.01	29.01	29.01
Meter Coefficient	0.9959	0.9959	0.9959
Average ΔH, Inches H_2O	1.0	1.0	1.0
Average Stack Temperature, °F	680.0	680.0	695.8
Average Stack Temperature, °R	1139.7	1139.7	1155.4
Average Meter Temperature, °F	33.8	46.1	49.7
Average Meter Temperature, °R	493.4	505.8	509.3
Meter Volume, CF	21.75	30.29	25.21
Dry Standard Sample Volume, DSCF	22.61	30.71	25.38
Collected Condensate Volume, ml	37.9	167.7	167.8
Condensate Moisture Content, % v/v	7.31	20.45	23.73
100% rH Moisture Content, % v/v	NA (>BP)	NA (>BP)	NA (>BP)
Dry Molecular Wt of Flue Gas, LB/LB-m	30.19	30.24	30.30
Wet Molecular Wt of Flue Gas, LB/LB-m	29.29	27.74	27.38

Appendix C

Intermediate Data Summary
Cupola Baghouse Inlet
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	45	46	60
Barometric Pressure, In. Hg	28.862	28.862	28.82
Static Pressure Of Duct, In. H_2O	-1.337	-1.337	-1.200
Absolute Pressure Of Duct, In. Hg	28.76	28.76	28.73
Meter Coefficient	0.9959	0.9959	0.9959
Average ΔH, Inches H_2O	1.0	1.0	1.0
Average Stack Temperature, °F	687.0	692.8	678.9
Average Stack Temperature, °R	1146.7	1152.4	1138.6
Average Meter Temperature, °F	48.7	50.8	57.9
Average Meter Temperature, °R	508.3	510.5	517.6
Meter Volume, CF	25.27	25.12	33.95
Dry Standard Sample Volume, DSCF	25.28	25.02	33.31
Collected Condensate Volume, ml	88.2	88.3	106.7
Condensate Moisture Content, % v/v	14.11	14.24	13.10
100% rH Moisture Content, % v/v	NA (>BP)	NA (>BP)	NA (>BP)
Dry Molecular Wt of Flue Gas, LB/LB-m	30.21	30.16	30.12
Wet Molecular Wt of Flue Gas, LB/LB-m	28.49	28.43	28.53

Appendix C

Intermediate Data Summary
Cupola Baghouse Exhaust
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Sample Duration, Minutes	120	120	120
Barometric Pressure, inches Hg	28.92	28.92	28.87
Static Pressure Of Duct, Inches H_2O	0.001	0.001	0.001
Absolute Pressure Of Duct, Inches Hg	28.92	28.92	28.87
Meter Coefficient	0.9922	0.9922	0.9922
Pitot Tube Coefficient	0.840	0.840	0.840
Nozzle Diameter, Inches	1.000	1.000	1.000
Area Of Nozzle Opening, Square Feet	0.005454	0.005454	0.005454
Average Sq. Root of ΔPs, Inches H_2O	0.0530	0.0598	0.0481
Average ΔH, Inches H_2O	2.44	3.21	2.08
Average Stack Temperature, °F	172.46	176.46	174.71
Average Stack Temperature, °R	632.13	636.13	634.38
Average Meter Temperature, °F	78.79	87.67	81.52
Average Meter Temperature, °R	538.46	547.34	541.19
Meter Volume, Cubic Feet	106.70	123.14	98.98
Dry Standard Sample Volume, Cubic Feet	100.96	114.85	92.94
Collected Condensate Volume, ml	75.0	70.8	60.1
Moisture Content Of Flue Gas, % v/v	3.38	2.82	2.95
Dry Molecular Wt of Flue Gas, LB/LB-mole	29.21	29.12	29.16
Wet Molecular Wt of Flue Gas, LB/LB-mole	28.83	28.81	28.83
Source Gas Velocity, Feet Per Second	3.53	3.36	3.22
Actual Gas Volume Flow, ACFM	187,622	178,387	170,789
Standard Gas Volume Flow, SCFM	151,478	143,116	137,161
Dry Standard Gas Volume Flow, DSCFM	146,360	139,081	133,109
Isokinetic Variation, %	93.3	111.7	94.4

Calculation Equations

Flue Gas Linear Velocity:

324484

$$V_s = 85.49 \times C_p \times \sqrt{\overline{\Delta P}} \times \sqrt{\frac{\overline{T_s}}{P_s \times M_s}}$$

$$44.89 = 85.49 \times 0.84 \times 0.7609 \times \sqrt{\frac{549}{28.32 \times 28.71}}$$

Volumetric Flow Rates - ACFM, SCFM, DSCFM:

$$Q = 60 \times v_s \times A$$

$$8{,}462 = 60 \times 44.89 \times 3.14$$

$$Q_s = Q \times \left(\frac{528}{T_s}\right) \times \left(\frac{P_s}{29.92}\right)$$

$$7{,}706 = 8{,}462 \times \frac{528}{549} \times \frac{28.32}{29.92}$$

$$Q_{sd} = Q_s \times (1 - B_{ws})$$

$$7{,}530 = 7{,}706 \times (1 - 0.023)$$

Mass Flow Rate Wet Flue Gas

$$m_g = \frac{4.995 \times Q_{sd} \times G_d}{1 - B_{ws}}$$

$$35{,}093 = \frac{4.995 \times 7{,}530 \times 0.91176}{(1 - 0.023)}$$

Actual Gas Density

$$\rho = \frac{0.04585 \times P_s \times M_s}{\overline{T_s}}$$

$$0.0679 \quad \frac{0.0459 \times 28.32 \times 28.71}{549}$$

Where:
A = Cross-sectional area of duct at sample point (sq. ft.).
B_{ws} = Water vapor in gas stream (proportion by volume).
C_p = Pitot tube calibration coefficient.
G_d = Flue gas specific gravity relative to air, dimensionless.
m_g = Mass flow rate of wet flue gas (LB/HR).
M_s = Molecular weight of wet flue gas (LB/LB-mole).
P_s = Absolute gas pressure of duct (Inches Hg).
ΔP = Velocity pressure measured by pitot tube (Inches WC).
Q = Actual flue gas volumetric flow rate (ACFM).
Q_s = Volumetric gas flow at standard conditions (SCFM).
Q_{sd} = Dry standard volumetric gas flow rate (DSCFM).
T_s = Flue gas temperature (°R).
V_s = Flue gas linear velocity (feet per second).
ρ = Actual flue gas density (LB/CF).

Appendix C - Calculation Equations

EPA Method 3 Calculations

Main Plant Pouring & Cooling Disa Pouring - 324484

Test 1, Run 2

As reported on Table 11

Dry Molecular Weight of Flue Gas

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

28.84 = (0.44 x 0.04) + (0.32 x 20.95) +
(0.28 x 79.01) + (0.28 x 0.000)

Md = 28.96 by default for non-combustion sources (includes Argon).

Wet Molecular Weight of Flue Gas

$$M_s = M_d \times (1 - B_{ws}) + (18 \times B_{ws})$$

28.71 = 28.96 x (1 - 0.023) + (18 x 0.023)

Percent Excess Air

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

$$\text{Not Applicable} = 100 \times \frac{20.95 - (0.50 \times 0.000)}{(0.264 \times 79.01) - (21.0 - (0.5 \times 0.000))}$$

(No Combustion)

Fuel F-factor (for comparison)

$$F_o = \frac{20.9 - \%O_2}{\%CO_2}$$

$$\text{NA} = \frac{20.9 - 21.0}{0.04}$$

Where:

Bws = Water vapor in gas stream (proportion by volume).
%CO = Carbon monoxide in gas stream (percent).
$\%CO_2$ = Carbon dioxide in gas stream (percent).
%EA = Excess air for combustion (percent).
F_o = Fuel F-factor for results comparison.
M_d = Molecular weight of dry flue gas (LB/LB-mole).
M_s = Molecular weight of wet flue gas (LB/LB-mole).
$\%N_2$ = Nitrogen in gas stream (percent).
$\%O_2$ = Oxygen in gas stream (percent).

Main Plant Pouring & Cooling Disa Pouring - 324484
Test 1, Run 2
As reported on Table 11

Sample Volume, Standard Conditions

$$V_{std} = 17.647 \times V_m \times Y \times \left(\frac{P_b + \frac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right)$$

$$70.23 = 17.647 \times 73.54 \times 0.9916 \times \frac{28.43 + \frac{2.65}{13.6}}{525}$$

Volume of Water Vapor Sampled

$$V_w = 0.047070 \times V_{lc}$$

$$1.64 = 0.0471 \times 34.8$$

Proportion of Water Vapor in Sampled Gas

$$B_{ws} = \frac{V_w}{V_w + V_{std}}$$

$$0.0228 = \frac{1.64}{1.64 + 70.23}$$

x 100 %MC= 2.28

Where:

B_{ws} = Water vapor in gas stream (proportion by volume).
ΔH = Orifice meter differential pressure (Inches WC).
P_b = Barometric pressure (Inches Hg).
T_m = Sampling train meter temperature (°R).
V_{lc} = Total volume of liquid collected in sampling train (mls
V_m = Volume of gas sample measured by gas meter (CF).
V_{std} = Gas volume corrected to standard conditions (DSCF)
V_w = Volume of water vapor in gas sample (SCF).
Y = Dry gas meter calibration coefficient.

Appendix C - Calculation Equations

EPA Method 5 Calculations

Main Plant Pouring & Cooling Disa Pouring - 324484

Test 1, Run 2

As reported on Table 22

Sample Volume, Standard Conditions

$$V_{std} = 17.647 \times V_m \times Y \times \left(\frac{P_b + \frac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right)$$

$$70.23 = 17.647 \text{ x } 73.54 \text{ x } 0.9916 \text{ x } \frac{28.43 + \frac{2.65}{13.6}}{525}$$

Isokinetic Variation

$$I = \left(\frac{0.09450 \times \overline{T_s} \times V_{std}}{P_s \times V_s \times A_n \times \theta \times (1 - B_{ws})} \right)$$

$$102.4 = \frac{0.0945 \text{ x } 549 \text{ x } 70.23}{28.32 \text{ x } 44.9 \text{ x } 0.0003 \text{ x } 84 \text{ x } 0.98}$$

Particulate Concentration

$$C_s = 15.432 \times \left(\frac{m_n}{V_{std}} \right)$$

$$0.00254 = 15.432 \text{ x } \frac{0.01158}{70.23}$$

Dry Catch PM Only

Particulate Mass Rate

$$m_p = 0.008571 \times C_s \times Q_{sd}$$

$$0.1642 = 0.008571 \text{ x } 0.00254 \text{ x } 7{,}530$$

Dry Catch PM Only

Where:
A_n = Cross-sectional area of nozzle opening (square feet).
B_{ws} = Water vapor in gas stream (proportion by volume).
C_s = Particulate concentration of gas stream (GR/DSCF).
ΔH = Orifice meter differential pressure (Inches WC).
I = Isokinetic variation of sampling rate (percent).
m_n = Total particulate collected in sampling train (grams).
m_p = Particulate mass flow rate (LB/HR).
P_b = Barometric pressure (Inches Hg).
P_s = Absolute gas pressure of duct (Inches Hg).
Q_{sd} = Dry standard volumetric gas flow rate (DSCFM).
T_m = Sampling train meter temperature (°R).
T_s = Flue gas temperature (°R).
V_m = Volume of gas sample measured by gas meter (CF).
V_{std} = Gas volume corrected to standard conditions (DSCF)
V_s = Flue gas linear velocity (feet per second).
Y = Dry gas meter calibration coefficient.
θ = Total sampling time of run (minutes).

Grede, LLC - Iron Mountain

Kingsford, MI
Pace Project No. 20-04074

Appendix C - Calculation Equations

EPA Method 2 Calculations

Cupola Baghouse Exhaust

Test 1, Run 3

As reported on Table 30

Flue Gas Linear Velocity:

$$V_s = 85.49 \times C_p \times \sqrt{\overline{\Delta P}} \times \sqrt{\frac{\overline{T_s}}{P_s \times M_s}}$$

From dilution calculation.

$$3.22 = 85.49 \times 0.84 \times 0.0481 \times \frac{634}{28.78 \times 28.83}$$

Volumetric Flow Rates - ACFM, SCFM, DSCFM:

$$Q = 60 \times v_s \times A$$

$$170{,}789 = 60 \times 3.22 \times 884.63$$

$$Q_s = Q \times \left(\frac{528}{T_s}\right) \times \left(\frac{P_s}{29.92}\right)$$

$$136{,}721 = 170{,}789 \times \frac{528}{634} \times \frac{28.78}{29.92}$$

$$Q_{sd} = Q_s \times (1 - B_{ws})$$

$$132{,}683 = 136{,}721 \times (1 - 0.030)$$

Mass Flow Rate Wet Flue Gas

$$m_g = \frac{4.995 \times Q_{sd} \times G_d}{1 - B_{ws}}$$

$$549{,}688 = \frac{4.995 \times 132{,}683 \times 0.80491}{(1 - 0.030)}$$

Actual Gas Density

$$\rho = \frac{0.04585 \times P_s \times M_s}{\overline{T_s}}$$

$$0.0600 \quad \frac{0.0459 \times 28.78 \times 28.83}{634}$$

Where: A = Cross-sectional area of duct at sample point (sq. ft.).
B_{ws} = Water vapor in gas stream (proportion by volume).
C_p = Pitot tube calibration coefficient.
G_d = Flue gas specific gravity relative to air, dimensionless.
m_g = Mass flow rate of wet flue gas (LB/HR).
M_s = Molecular weight of wet flue gas (LB/LB-mole).
P_s = Absolute gas pressure of duct (Inches Hg).
ΔP = Velocity pressure measured by pitot tube (Inches WC).
Q = Actual flue gas volumetric flow rate (ACFM).
Q_s = Volumetric gas flow at standard conditions (SCFM).
Q_{sd} = Dry standard volumetric gas flow rate (DSCFM).
T_s = Flue gas temperature (°R).
V_s = Flue gas linear velocity (feet per second).
ρ = Actual flue gas density (LB/CF).

Cupola Baghouse Exhaust

Test 1, Run 3

As reported on Table 19

Dry Molecular Weight of Flue Gas

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

29.16 = (0.44 x 2.69) + (0.32 x 18.25) +
(0.28 x 79.06) + (0.28 x 0.000)

Wet Molecular Weight of Flue Gas

$$M_s = M_d \times (1 - B_{ws}) + (18 \times B_{ws})$$

28.83 = 29.16 x (1 - 0.030) + (18 x 0.030)

Percent Excess Air

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

$$696\% = 100 \times \frac{18.25 - (0.50 \times 0.000)}{(0.264 \times 79.06) - (18.3 - (0.5 \times 0.000))}$$

Fuel F-factor (for comparison)

$$F_o = \frac{20.9 - \%O_2}{\%CO_2}$$

$$0.985 = \frac{20.9 - 18.3}{2.69}$$

Where:

Bws = Water vapor in gas stream (proportion by volume).
%CO = Carbon monoxide in gas stream (percent).
$\%CO_2$ = Carbon dioxide in gas stream (percent).
%EA = Excess air for combustion (percent).
F_o = Fuel F-factor for results comparison.
M_d = Molecular weight of dry flue gas (LB/LB-mole).
M_s = Molecular weight of wet flue gas (LB/LB-mole).
$\%N_2$ = Nitrogen in gas stream (percent).
$\%O_2$ = Oxygen in gas stream (percent).

Appendix C - Calculation Equations

EPA Method 4 Calculations

Cupola Baghouse Exhaust

Test 1, Run 3

As reported on Table 19

Sample Volume, Standard Conditions

$$V_{std} = 17.647 \times V_m \times Y \times \left(\frac{P_b + \frac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right)$$

$$92.94 = 17.647 \times 98.98 \times 0.9922 \times \frac{28.87 + \frac{2.08}{13.6}}{541}$$

Volume of Water Vapor Sampled

$$V_w = 0.047070 \times V_{lc}$$

$$2.83 = 0.0471 \times 60.1$$

Proportion of Water Vapor in Sampled Gas

$$B_{ws} = \frac{V_w}{V_w + V_{std}}$$

$$0.0295 = \frac{2.83}{2.83 + 92.94}$$

x 100 %MC= 2.95

Where:

B_{ws} = Water vapor in gas stream (proportion by volume).
ΔH = Orifice meter differential pressure (Inches WC).
P_b = Barometric pressure (Inches Hg).
T_m = Sampling train meter temperature (°R).
V_{lc} = Total volume of liquid collected in sampling train (mls
V_m = Volume of gas sample measured by gas meter (CF).
V_{std} = Gas volume corrected to standard conditions (DSCF)
V_w = Volume of water vapor in gas sample (SCF).
Y = Dry gas meter calibration coefficient.

Appendix C - Calculation Equations

EPA Method 5 Calculations

Cupola Baghouse Exhaust

Test 1, Run 3

As reported on Table 30

Sample Volume, Standard Conditions

$$V_{std} = 17.647 \times V_m \times Y \times \left(\frac{P_b + \frac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right)$$

$$92.94 = 17.647 \times 98.98 \times 0.9922 \times \frac{28.87 + \frac{2.08}{13.6}}{541}$$

Isokinetic Variation

$$I = \left(\frac{0.09450 \times \overline{T_s} \times V_{std}}{P_s \times V_s \times A_n \times \theta \times (1 - B_{ws})} \right)$$

$$94.7 = \frac{0.0945 \times 634 \times 92.94}{28.78 \times 3.2 \times 0.0055 \times 120 \times 0.97}$$

Particulate Concentration

$$C_s = 15.432 \times \left(\frac{m_n}{V_{std}} \right)$$

$$0.00110 = 15.432 \times \frac{0.00664}{92.94}$$

Dry Catch PM Only

Particulate Mass Rate

$$m_p = 0.008571 \times C_s \times Q_{sd}$$

$$1.2539 = 0.008571 \times 0.00110 \times 132,683$$

Dry Catch PM Only

Where:
A_n = Cross-sectional area of nozzle opening (square feet).
B_{ws} = Water vapor in gas stream (proportion by volume).
C_s = Particulate concentration of gas stream (GR/DSCF).
ΔH = Orifice meter differential pressure (Inches WC).
I = Isokinetic variation of sampling rate (percent).
m_n = Total particulate collected in sampling train (grams).
m_p = Particulate mass flow rate (LB/HR).
P_b = Barometric pressure (Inches Hg).
P_s = Absolute gas pressure of duct (Inches Hg).
Q_{sd} = Dry standard volumetric gas flow rate (DSCFM).
T_m = Sampling train meter temperature (°R).
T_s = Flue gas temperature (°R).
V_m = Volume of gas sample measured by gas meter (CF).
V_{std} = Gas volume corrected to standard conditions (DSCF)
V_s = Flue gas linear velocity (feet per second).
Y = Dry gas meter calibration coefficient.
θ = Total sampling time of run (minutes).

Analyzer Calibration Error:

$$A_E = \frac{C_{AR} - C_{Cyl}}{S_{FS}} \times 100$$

$$0.01\% = \frac{110.0 - 110.0}{110.0} \times 100$$

(high gas)
CO PPM

System Calibration Bias:

$$B_{Sys} = \frac{C_{SR} - C_{AR}}{S_{FS}} \times 100$$

$$0.01\% = \frac{48.52 - 48.50}{110} \times 100$$

(upscale)
CO PPM

System Drift:

$$D_{Sys} = \frac{C_{SR_F} - C_{SR_I}}{S_{FS}} \times 100$$

(absolute)

$$0.40\% = \frac{48.08 - 48.52}{110} \times 100$$

(upscale)
CO PPM

Gas Concentration Corrected for System Bias:

$$C_{Gas} = \left(\overline{C} - C_{0_{SR}}\right) \frac{C_{Cyl}}{\left(\frac{C_{SR_I} + C_{SR_F}}{2}\right) - C_{0_{SR}}}$$

CO PPM, Dry

PPM, Dry

$$10.21 = (10.8 - 1.12) \times \frac{49.60}{\frac{(48.5 + 48.1)}{2} - 1.12}$$

Conversion to Weight/Volume Basis:

$$C_{mg/dscm} = C_{Gas} \times \frac{M_{Gas}}{24.04}$$

$$11.893 = 10.2134 \times \frac{28.01}{24.055}$$

CO mg/dscm

Emission Rate:

$$E_R = 6.243 \times 10^{-8} \times C_{mg/dscm} \times DSCFM \times 60$$

CO LB/HR

0.673 = 6.24E-08 x 11.8926 x 15,106 x 60

See equation nomenclature on following page.

Where:

A_E = Analyzer calibration error, percent of span.
B_{Sys} = System calibration bias, percent of span.
D_{Sys} = System calibration drift, percent of span.
$\overline{C}$ = Average gas concentration response from analyzer, PPM (or %).
C_{0SR} = Average of initial and final system calibration bias check responses for the zero gas, PPM (or %).
C_{AR} = Analyzer direct calibration response, PPM (or %).
C_{Cyl} = Actual concentration of calibration gas, PPM (or %).
C_{SR} = System calibration response, PPM (or %).
C_{SRF} = Final system calibration response, PPM (or %).
C_{SRI} = Initial system calibration response, PPM (or %).
C_{gas} = Concentration adjusted for system bias, PPM (or %).
$C_{mg/dscm}$ = Constituent concentration converted to mg/dscm.
M_{Gas} = Molecular weight of target constituent, lb/lb-mole.
E_R = Emission rate of constituent, LB/HR.
S_{FS} = System measurement span, full scale.
DSCFM = Dry standard cubic feet per minute.
6.243×10^{-8} = Conversion factor, mg/cm to LB/CF.
60 = Conversion factor, minutes to hours.

Appendix C - Calculation Equations

Gas Concentration and Emission Rate

Cupola Baghouse Inlet

Test 1, Run 2

As reported on Table 10

Mass Analysis to Weight/Volume Concentration:

NA - Analyzed as gas

$$C_{mg/dscm} = \frac{m}{V_{std}}$$

NA = $\frac{NA}{NA}$ (Carbon Monoxide)

Volume/Volume Concentration to Weight/Volume Concentration:

$$C_{mg/dscm} = C_{PPM-d} \times \frac{MW}{24.055}$$

11.9 = 10.2 x $\frac{28.01}{24.055}$ (Carbon Monoxide)

µg/dscm	11,893	=	11.9	x	1000	Conversion Factor
GR/DSCF	0.00520	=	11.9	x	0.0004370	Conversion Factor
LB/DSCF	7.4E-07	=	11.9	x	6.24E-08	Conversion Factor

Weight/Volume Concentration to Volume/Volume Concentration:

$$C_{PPM-d} = C_{mg/dscm} \times \frac{24.055}{MW}$$

10.2 = 11.9 x $\frac{24.055}{28.01}$ (Carbon Monoxide)

Constituent Emission Rate:

$$E_{Gas} = (6.243 \times 10^{-8}) \times 60 \times C_{mg/dscm} x DSCFM$$

0.673 6.243E-08 x 60 x 11.9 x 15,106 Carbon Monoxide)

Where:

$C_{mg/dscm}$	=	Constituent Concentration, mg/cubic meter.
C_{PPM-d}	=	Constituent Concentration, PPM v/v, dry basis.
DSCFM	=	Volumetric Airflow, dry standard cubic feet per minute.
E_{gas}	=	Constituent Emission Rate, LB/HR.
m	=	Mass of Constituent Collected, µg.
MW	=	Molecular Weight of Constituent.
V_{std}	=	Standard Volume of Air Sample, dry standard cubic meters.
24.055	=	Ideal gas molar volume at 293 °K and 760 mm Hg, liters/g-mole.
$6.243x10^{-8}$	=	Conversion From mg/dscm To LB/CF.
60	=	Conversion From Minutes to Hours.

Note: Calculations on this page are shown for dry basis concentrations.

Wet to Dry Concentration Correction:

$$C_{dry} = \frac{C_{wet}}{\left(1 - \frac{MC_{source}}{100}\right)} \qquad 10.2 = \frac{8.12}{\left|1 - \frac{20.45}{100}\right|}$$

(Carbon Monoxide)

Dry to Wet Concentration Correction:

$$C_{wet} = C_{dry} \times \left(1 - \frac{MC_{source}}{100}\right) \qquad 8.12 = 10.2 \times \left|1 - \frac{20.45}{100}\right|$$

(Carbon Monoxide)

Wet Analytical Basis to Wet Stack Basis

$$C_{wet-s} = \frac{C_{wet-a}}{\left(1 - \frac{MC_{analyses}}{100}\right)} \times \left(1 - \frac{MC_{source}}{100}\right)$$

Not applicable to this data set.

Where:

C_{dry} = Constituent Concentration, PPM v/v, dry basis.
C_{wet} = Constituent Concentration, PPM v/v, wet basis.
C_{wet-a} = Constituent Analyzed Concentration, PPM v/v, wet basis.
C_{wet-s} = Constituent Stack Concentration, PPM v/v, wet basis.
$MC_{analyses}$ = Gas Moisture Content at Analyses, %v/v.
MC_{source} = Gas Moisture Content of Source Gas, %v/v.

Report Nomenclature

Abbreviations, Symbols, and Nomenclature

“Hg	Inches of Mercury (pressure)
“WC	Inches Water Column (pressure)
°C	Degrees Centigrade or Celsius
°F	Degrees Fahrenheit
°K	Degrees Kelvin (absolute)
°R	Degrees Rankin (absolute)
% v/v	Percent by volume
% w/w	Percent by weight
ACFM	Actual Cubic Feet per Minute
AP-42	Compilation of Air Pollutant Emission Factors, Volume I, Stationary Point and Area Sources.
BACT	Best Available Control Technology
BH	Baghouse
BHP	Brake Horsepower
BTU	British Thermal Unit
c	Centimeter
c^3	Cubic Centimeter
cc	Cubic Centimeter
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CE	Control Equipment (in Reg. ID Nos.)
CE	Control Efficiency
CEM	Continuous Emissions Monitor
CEMS	Continuous Emissions Monitoring System
CF	Cubic Feet
CFR	Code of Federal Regulations
C_1	Carbon (as carbon)
CH_4	Methane
C_3H_8	Propane
cm	Cubic Meter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DGS	Distiller’s Grains with Solubles
DDGS	Dry Distiller’s Grains with Solubles
DRE	Destruction/Reduction Efficiency
DSCF	Dry Standard Cubic Feet
DSCFM	Dry Standard Cubic Feet per Minute
dscm	Dry Standard Cubic Meter
dscmm	Dry Standard Cubic Meter per Minute
dsl	Dry Standard Liter
EPA	Environmental Protection Agency
EP	Emission Point
ESP	Electrostatic Precipitator
EU	Emission Unit
FID	Flame Ionization Detector
FGR	Flue Gas Recirculation
FPD	Flame Photometric Detector
FPM	Feet Per Minute
FPS	Feet Per Second
FR	Federal Register
FT or ft	Foot or Feet
FT^3	Cubic Feet
FTIR	Fourier Transform Infrared
g	Gram
GC	Gas Chromatograph(y)
GPD	Gallons Per Day
GPH	Gallons Per Hour
GR	Grains
H_2O	Water
H_2S	Hydrogen Sulfide
HAP	Hazardous Air Pollutant
HAPs	Hazardous Air Pollutants
Hg	Mercury
HP	Horsepower
HR	Hour
In.	Inch or Inches
KLB	Thousand Pounds
kW	Kilowatt
kWH	Kilowatt Hour
l	liter
LB	Pound or Pounds
LDAR	Leak Detection and Repair
m	Meter
m^3	Cubic Meter
MACT	Maximum Achievable Control Technology
MC	Moisture Content
µg	Microgram
µl	Microliter
µm	Micrometer (micron)
mg	Milligram
MGAL	Thousand Gallons
Min.	Minute or Minutes
ml	Milliliter
mm	Millimeter
MMBTU	Million British Thermal Units
MMSCF	Million Standard Cubic Feet
MS	Mass Spectrometry
MSDS	Material Safety Data Sheet
mW	Megawatt
MW	Molecular Weight
N_2	Nitrogen
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides (quantified as NO_2)
NSPS	New Source Performance Standard
O_2	Oxygen
PEMS	Parametric (or Predictive) Emissions Monitoring System
PID	Photo Ionization Detector
PM	Particulate Matter

Abbreviations, Symbols, and Nomenclature

PM_{10}	Particulate Matter with an aerodynamic diameter equal to or less than 10 microns
PM-10	PM_{10}
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter equal to or less than 2.5 microns
PM-2.5	$PM_{2.5}$
PPB	Parts Per Billion (see variation below)
PPM	Parts Per Million
PPMv	Part Per Million by volume
PPMv-dry	Parts Per Million by volume, dry basis
PPMv-wet	Parts Per Million by volume, wet basis
PPMw	Parts Per Million by Weight (mg/l)
PSIA	Pounds per Square Inch, Absolute
PSIG	Pounds per Square Inch, Gauge
PTE	Permanent Total Enclosure
RA	Relative Accuracy
RATA	Relative Accuracy Test Audit
rH	Relative Humidity
RTO	Regenerative Thermal Oxidizer or Recuperative Thermal Oxidizer
SCF	Standard Cubic Feet
SCFM	Standard Cubic Feet per Minute
scm	Standard Cubic Meter
scmm	Standard Cubic Meter per Minute
Scr.	Scrubber
SIC	Standard Industrial Classification
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
Sq. Ft.	Square Feet
TCD	Thermal Conductivity Detector
TO	Thermal Oxidizer
TPD	Tons Per Day
TPH	Tons Per Hour
TPY	Tons per year
TRS	Total Reduced Sulfur
TSP	Total Suspended Particulate Matter
TTE	Temporary Total Enclosure
USEPA	United States Environmental Protection Agency
VHAP	Volatile Hazardous Air Pollutant
VOC	Volatile Organic Compound
VOCs	Volatile Organic Compounds
WC	Water Column
WDGS	Wet Distiller’s Grains with Solubles

State Environmental Agency Acronyms

ADEM	Alabama Department of Environmental Management
ADEC	Alaska Department of Environmental Conservation
ADEQ	Arizona Department of Environmental Quality
ADEQ	Arkansas Department of Environmental Quality
CARB	California Air Resources Board
CDPHE	Colorado Department of Public Health & Environment
CDEP	Connecticut Department of Environmental Protection
DNREC	Delaware Natural Resources & Environmental Control
FDEP	Florida Department of Environmental Protection
GEPD	Georgia Environmental Protection Division
IDEQ	Idaho Department of Environmental Quality
IEPA	Illinois Environmental Protection Agency
IDNR	Iowa Department of Natural Resources
KDHE	Kansas Department of Health & Environment
KDEP	Kentucky Department for Environmental Protection
LDEQ	Louisiana Department of Environmental Quality
MDEP	Maine Department of Environmental Protection
MDE	Maryland Department of the Environment
MDEP	Massachusetts Department of Environmental Protection
EGLE	Michigan Department of Environment, Great Lakes, and Energy
MPCA	Minnesota Pollution Control Agency
MDEQ	Mississippi Department of Environmental Quality
MDNR	Missouri Department of Natural Resources
MDEQ	Montana Department of Environmental Quality
NDEE	Nebraska Department of Environment and Energy
NDEP	Nevada Division of Environmental Protection
NHDES	New Hampshire Department of Environmental Services
NJDEP	New Jersey Department of Environmental Protection
NMED	New Mexico Environment Department
NYSDEC	New York State Department of Environmental Conservation
NCDENR	North Carolina Department of Environment & Natural Resources
NDDEQ	North Dakota Department of Environmental Quality
OEPA	Ohio Environmental Protection Agency
ODEQ	Oklahoma Department of Environmental Quality
ODEQ	Oregon Department of Environmental Quality
PDEP	Pennsylvania Department of Environmental Protection
RIDEM	Rhode Island Department of Environmental Management
SCDHEC	South Carolina Department of Health & Environmental Control
SDDENR	South Dakota Department of Environment & Natural Resources
TDEC	Tennessee Department of Environment & Conservation
TCEQ	Texas Commission on Environmental Quality
UDEQ	Utah Department of Environmental Quality
VANR	Vermont Agency of Natural Resources
VDEQ	Virginia Department of Environmental Quality
WSDNR	Washington State Department of Natural Resources
WVDEP	West Virginia Division of Environmental Protection
WDNR	Wisconsin Department of Natural Resources

Appendix D

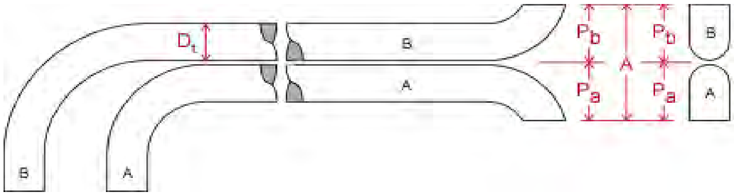
Quality Assurance Information

Sampling Train Calibration Data

Grede, LLC - Iron Mountain
Kingsford, MI
Pace Project No. 20-04074

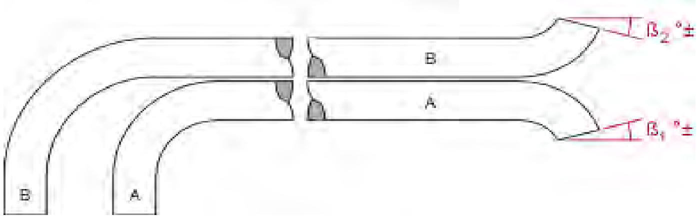
Appendix D
S-Type Pitot Verification Certificate
Pitot Tube No.: 3_01
Verification Date: 1/2/2020

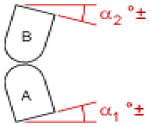
S-Type Pitot Contruction and Mechanical Integrity Verification



Tube Obstruction Check	**Pass**	Tubing Diameter - D_t ($^3/_{16}$" to $^3/_8$")	**5/16"**	**Pass**
Check for Tip Damage	**Pass**	Distance Between Face Planes - A	**0.930"**	**Pass**
Face Planes Parallel	**Pass**	Base to Face Plane A Distance - P_a	**0.450"**	**Pass**
Part of an Assemby?	**Yes**	Base to Face Plane B Distance - P_b	**0.480"**	**Pass**
Nozzle Clearance	**Pass**	**Criterion:1.05Dt ≤ P ≤ 1.5Dt, P_a=P_b (± 2% of A)**		
Thermocouple Clearance	**Pass**			

Face Plane Alignment Verification





Longitudinal Deflection

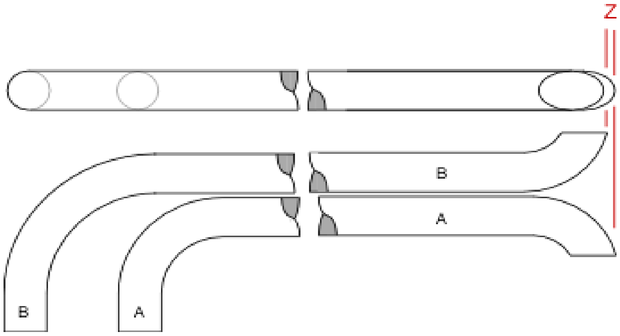
Plane A	**2°**	**Pass**
Plane B	**4°**	**Pass**

Criterion: $ß_1$ and $ß_2$ ≤ ±5°

Transverse Deflection

Plane A	**2°**	**Pass**
Plane B	**2°**	**Pass**

Criterion: α_1 and α_2 ≤ ±10°



Transverse Alignment - W **0.004"** **Pass**

Criterion: W ≤ 0.03125"

Verification performed pursuant to Pace
Standard Operating Procedure: S-FSD-E-006

Longitudinal Alignment - Z **0.010"** **Pass**

Criterion: Z ≤ 0.125"

Verification specifications are: **Met**
Assigned baseline coefficient: **0.840**

Caliper ID **CL-4**
Protractor ID **AG-1**

Verified/Certified¹ By: Z. Eckstrom 1/2/2020

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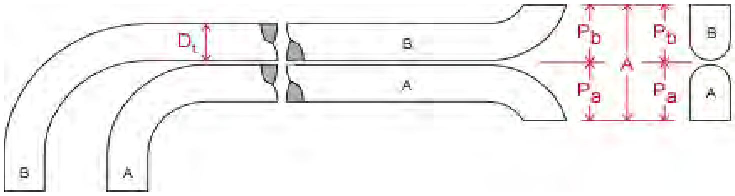
[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP S-FSD-Q-004.

S-Type Pitot Verification Certificate
Pitot Tube No.: **3_41**
Verification Date: **1/2/2020**

S-Type Pitot Contruction and Mechanical Integrity Verification

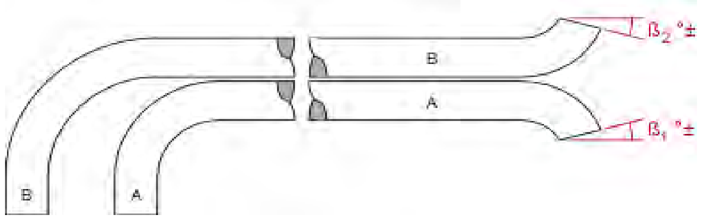


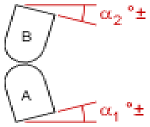
Tube Obstruction Check	**Pass**
Check for Tip Damage	**Pass**
Face Planes Parallel	**Pass**
Part of an Assemby?	**Yes**
Nozzle Clearance	**Pass**
Thermocouple Clearance	**Pass**

Tubing Diameter - D_t ($^3/_{16}$" to $^3/_8$")	**5/16"**	**Pass**
Distance Between Face Planes - A	**0.940"**	**Pass**
Base to Face Plane A Distance - P_a	**0.470"**	**Pass**
Base to Face Plane B Distance - P_b	**0.470"**	**Pass**

Criterion:1.05Dt ≤ P ≤ 1.5Dt, P_a=$P_{b\ (\pm\ 2\%\ of\ A)}$

Face Plane Alignment Verification





Longitudinal Deflection

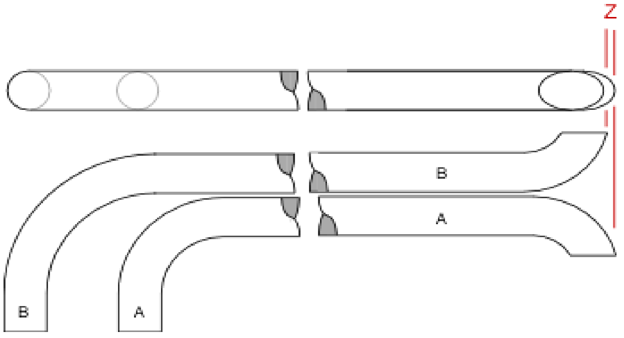
Plane A	**1°**	**Pass**
Plane B	**3°**	**Pass**

Criterion: $ß_1$ and $ß_2$ ≤ ±5°

Transverse Deflection

Plane A	**2°**	**Pass**
Plane B	**2°**	**Pass**

Criterion: α_1 and α_2 ≤ ±10°



Transverse Alignment - W **0.000"** **Pass**
Criterion: W ≤ 0.03125"

Verification performed pursuant to Pace Standard Operating Procedure: S-FSD-E-006

Longitudinal Alignment - Z **0.005"** **Pass**
Criterion: Z ≤ 0.125"

Verification specifications are: **Met**
Assigned baseline coefficient: **0.840**

Caliper ID **CL-4**
Protractor ID **AG-1**

Verified/Certified[1] By: Z. Eckstrom 1/2/2020

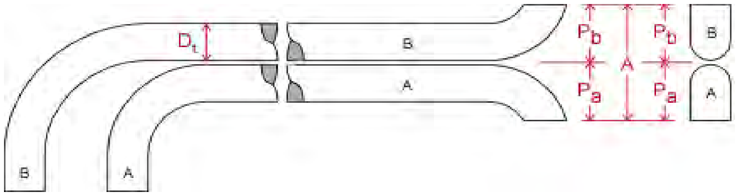
[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP S-FSD-Q-004.

Appendix D

S-Type Pitot Verification Certificate

Pitot Tube No.: **4_02**
Verification Date: **1/3/2020**

S-Type Pitot Contruction and Mechanical Integrity Verification

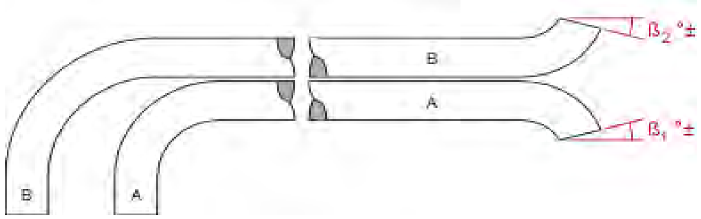


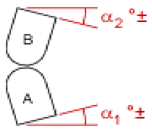
Tube Obstruction Check	**Pass**
Check for Tip Damage	**Pass**
Face Planes Parallel	**Pass**
Part of an Assemby?	**Yes**
Nozzle Clearance	**Pass**
Thermocouple Clearance	**Pass**

Tubing Diameter - D_t ($^3/_{16}$" to $^3/_8$")	**5/16"**	**Pass**
Distance Between Face Planes - A	**0.935"**	**Pass**
Base to Face Plane A Distance - P_a	**0.460"**	**Pass**
Base to Face Plane B Distance - P_b	**0.475"**	**Pass**

Criterion:1.05Dt ≤ P ≤ 1.5Dt, P_a=P_b (± 2% of A)

Face Plane Alignment Verification





Longitudinal Deflection

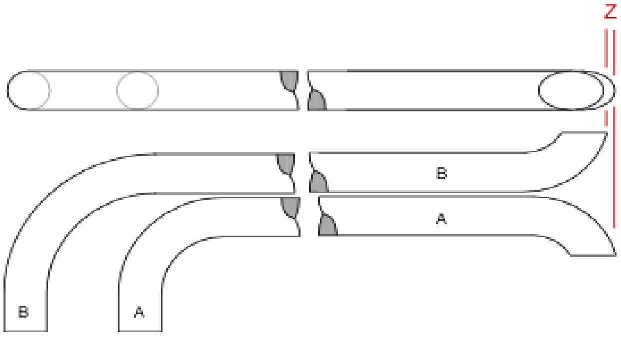
Plane A	**4°**	**Pass**
Plane B	**0°**	**Pass**

Criterion: $ß_1$ and $ß_2$ ≤ ±5°

Transverse Deflection

Plane A	**5°**	**Pass**
Plane B	**0°**	**Pass**

Criterion: α_1 and α_2 ≤ ±10°



Transverse Alignment - W **0.004"** **Pass**

Criterion: W ≤ 0.03125"

Longitudinal Alignment - Z **0.000"** **Pass**

Criterion: Z ≤ 0.125"

Verification performed pursuant to Pace Standard Operating Procedure: S-FSD-E-006

Verification specifications are: **Met**
Assigned baseline coefficient: **0.840**

Caliper ID	**CL-4**
Protractor ID	**AG-1**

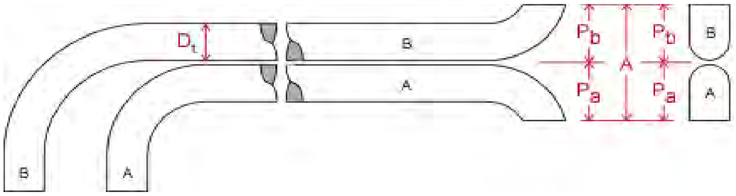
Verified/Certified[1] By: Z. Eckstrom 1/3/2020

[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP S-FSD-Q-004.

S-Type Pitot Verification Certificate

Pitot Tube No.: **4_06**
Verification Date: **1/3/2020**

S-Type Pitot Contruction and Mechanical Integrity Verification

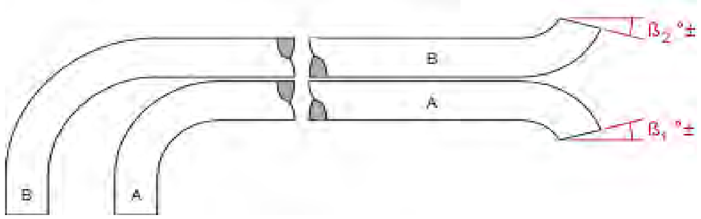


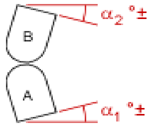
Tube Obstruction Check	**Pass**
Check for Tip Damage	**Pass**
Face Planes Parallel	**Pass**
Part of an Assemby?	**Yes**
Nozzle Clearance	**Pass**
Thermocouple Clearance	**Pass**

Tubing Diameter - D_t ($^3/_{16}$" to $^3/_8$")	**5/16"**	**Pass**
Distance Between Face Planes - A	**0.932"**	**Pass**
Base to Face Plane A Distance - P_a	**0.482"**	**Pass**
Base to Face Plane B Distance - P_b	**0.450"**	**Pass**

Criterion:1.05Dt ≤ P ≤ 1.5Dt, P_a=P_b (± 2% of A)

Face Plane Alignment Verification





Longitudinal Deflection

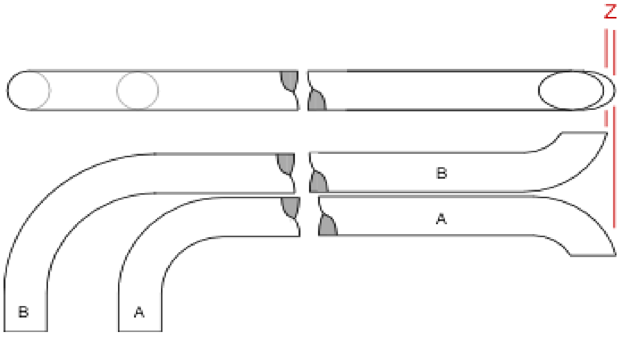
Plane A	**2°**	**Pass**
Plane B	**0°**	**Pass**

Criterion: $ß_1$ and $ß_2$ ≤ ±5°

Transverse Deflection

Plane A	**4°**	**Pass**
Plane B	**2°**	**Pass**

Criterion: α_1 and α_2 ≤ ±10°



Transverse Alignment - W **0.004"** **Pass**

Criterion: W ≤ 0.03125"

Verification performed pursuant to Pace Standard Operating Procedure: S-FSD-E-006

Longitudinal Alignment - Z **0.021"** **Pass**

Criterion: Z ≤ 0.125"

Verification specifications are: **Met**
Assigned baseline coefficient: **0.840**

Caliper ID **CL-4**
Protractor ID **AG-1**

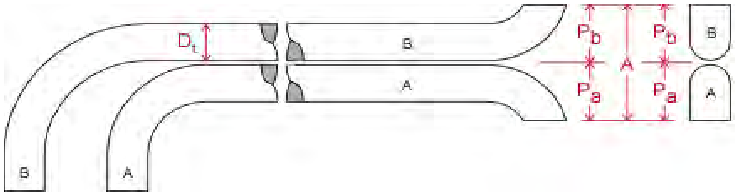
Verified/Certified[1] By: Z. Eckstrom 1/3/2020

[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP S-FSD-Q-004.

Appendix D

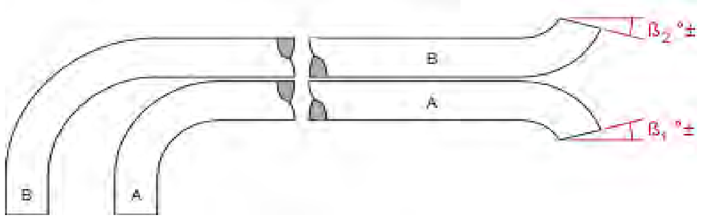
S-Type Pitot Verification Certificate
Pitot Tube No.: **6_10**
Verification Date: **12/26/2019**

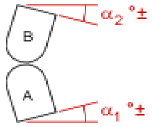
S-Type Pitot Contruction and Mechanical Integrity Verification



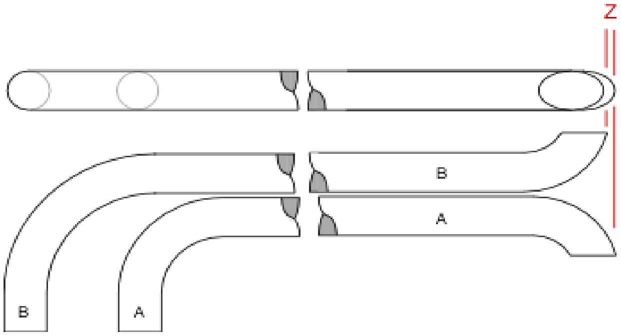
Tube Obstruction Check	**Pass**	Tubing Diameter - D_t ($^3/_{16}$" to $^3/_8$")	**3/8 "**	**Pass**
Check for Tip Damage	**Pass**	Distance Between Face Planes - A	**1.098"**	**Pass**
Face Planes Parallel	**Pass**	Base to Face Plane A Distance - P_a	**0.555"**	**Pass**
Part of an Assemby?	**No**	Base to Face Plane B Distance - P_b	**0.543"**	**Pass**
Nozzle Clearance	**NA**	**Criterion:1.05Dt ≤ P ≤ 1.5Dt, P_a=P_b (± 2% of A)**		
Thermocouple Clearance	**NA**			

Face Plane Alignment Verification





Longitudinal Deflection			Transverse Deflection		
Plane A	**4°**	**Pass**	Plane A	**1°**	**Pass**
Plane B	**3°**	**Pass**	Plane B	**1°**	**Pass**
Criterion: $ß_1$ and $ß_2$ ≤ ±5°			**Criterion: α_1 and α_2 ≤ ±10°**		



Transverse Alignment - W **0.010"** **Pass**
Criterion: W ≤ 0.03125"

Verification performed pursuant to Pace
Standard Operating Procedure: S-FSD-E-006

Longitudinal Alignment - Z **0.006"** **Pass**
Criterion: Z ≤ 0.125"

Verification specifications are: **Met**
Assigned baseline coefficient: **0.840**

Caliper ID **CL-4**
Protractor ID **AG-1**

Verified/Certified[1] By: J. Kokkinen 12/26/2019

[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP S-FSD-Q-004.

Calibration/Verification Certificate
Isokinetic Control Module No. CM_1
DTM Serial No. 33227

Verification of Mounted Thermocouple Displays (°F)

Temperature Reference Standard No. Omega CL23A

Acceptance Crtierion: % Difference ≤ 1.5% (°R - absolute)

Stack Display

Target	Results	% Diff.
1800	1798	0.09%
1500	1499	0.05%
1000	999	0.07%
500	498	0.21%
200	201	0.15%
100	100	0.00%
0	3	0.65%
Verification Status:		**Pass**

EPA M-2 & 5 criterion is 1.5% °R.

Meter Inlet Display

Target	Results	% Diff.
200	198	0.30%
150	146	0.66%
100	96	0.71%
75	71	0.75%
50	46	0.78%
25	21	0.82%
0	-2	0.43%
Verification Status:		**Pass**

EPA M-5 criterion of 5.4°F for highlighted range is met.

Meter Outlet Display

Target	Results	% Diff.
200	201	0.15%
150	148	0.33%
100	96	0.71%
75	71	0.75%
50	46	0.78%
25	21	0.82%
0	-2	0.43%
Verification Status:		**Pass**

EPA M-5 criterion of 5.4°F for highlighted range is met.

Impinger Outlet Display

Target	Results	% Diff.
200	194	0.91%
150	144	0.98%
100	94	1.07%
75	69	1.12%
50	46	0.78%
25	21	0.82%
0	-1	0.22%
Verification Status:		**Pass**

EPA M-2 & 202 criterion is 1.5% °R.

Oven Display

Target	Results	% Diff.
350	340	1.23%
300	292	1.05%
250	242	1.13%
200	192	1.21%
150	141	1.48%
100	92	1.43%
50	43	1.37%
Verification Status:		**Pass**

EPA M-5 criterion of 5.4°F for highlighted range is not met.

Probe Display

Target	Results	% Diff.
350	348	0.25%
300	298	0.26%
250	248	0.28%
200	198	0.30%
150	147	0.49%
100	97	0.54%
50	51	0.20%
Verification Status:		**Pass**

EPA M-5 criterion of 5.4°F for highlighted range is met.

Verified/Certified¹ : K. Althoff 10/15/2020

Dry Test Meter and Orifice Periodic Calibration

Volume Reference Standard WTM No. WTM-2

Orifice Diff. Press., ΔH Inches WC	Dry Test Meter Vol. Cubic Ft.	Wet Test Meter Vol. Cubic Ft.	Dry Test Meter Temperature, °F Inlet	Dry Test Meter Temperature, °F Outlet	Wet Test Meter Temp., °F	Elapsed Time Minutes	Gas Meter Coefficient α	Orifice Coefficient ΔH@
0.5	5.412	5.3	77.0	76.0	67.4	13.294	0.9944	1.780
1	6.100	6.0	77.0	75.0	67.1	10.754	0.9982	1.815
1.75	6.745	6.7	75.0	72.5	66.6	9.137	1.0039	1.840
2.5	10.871	10.6	79.5	75.5	67.1	12.055	0.9875	1.829
3.5	20.470	20.1	80.0	77.0	67.3	19.439	0.9954	1.840

Preferential Range 0.99 - 1.01	**Met**	Average Coefficients	**0.9959**	**1.821**
Meter Range Spec. ± 0.02 of Avg	**Pass**	Max. Δ from Average	**0.0084**	
Orifice Range Spec. ± 0.2 of Avg	**Pass**	Max. Δ from Average		**0.041**

Verified/Certified¹ : K. Althoff 10/15/2020

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¹ Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP S-FSD-Q-004.

Calibration/Verification Certificate
Isokinetic Control Module No. CM_3
DTM Serial No. 661003

Verification of Mounted Thermocouple Displays (°F)

Temperature Reference Standard No. Omega CL23A

Acceptance Crtierion: % Difference ≤ 1.5% (°R - absolute)

Stack Display			Meter Inlet Display			Meter Outlet Display		
Target	**Results**	**% Diff.**	**Target**	**Results**	**% Diff.**	**Target**	**Results**	**% Diff.**
1800	1799	0.04%	200	198	0.30%	200	199	0.15%
1500	1499	0.05%	150	147	0.49%	150	148	0.33%
1000	998	0.14%	100	96	0.71%	100	98	0.36%
500	498	0.21%	75	71	0.75%	75	73	0.37%
200	201	0.15%	50	46	0.78%	50	48	0.39%
100	100	0.00%	25	22	0.62%	25	24	0.21%
0	2	0.43%	0	-1	0.22%	0	0	0.00%
Verification Status:		**Pass**	Verification Status:		**Pass**	Verification Status:		**Pass**
EPA M-2 & 5 criterion is 1.5% °R.			EPA M-5 criterion of 5.4°F for highlighted range is met.			EPA M-5 criterion of 5.4°F for highlighted range is met.		

Impinger Outlet Display			Oven Display			Probe Display		
Target	**Results**	**% Diff.**	**Target**	**Results**	**% Diff.**	**Target**	**Results**	**% Diff.**
200	196	0.61%	350	357	0.86%	350	354	0.49%
150	146	0.66%	300	307	0.92%	300	304	0.53%
100	96	0.71%	250	257	0.99%	250	254	0.56%
75	71	0.75%	200	207	1.06%	200	204	0.61%
50	48	0.39%	150	156	0.98%	150	153	0.49%
25	23	0.41%	100	106	1.07%	100	104	0.71%
0	0	0.00%	50	57	1.37%	50	55	0.98%
Verification Status:		**Pass**	Verification Status:		**Pass**	Verification Status:		**Pass**
EPA M-2 & 202 criterion is 1.5% °R.			EPA M-5 criterion of 5.4°F for highlighted range is not met.			EPA M-5 criterion of 5.4°F for highlighted range is met.		

Verified/Certified¹ : K. Althoff 12/4/2020

Dry Test Meter and Orifice Periodic Calibration

Volume Reference Standard WTM No. WTM-2

Orifice Diff. Press., ΔH Inches WC	**Dry Test Meter Vol. Cubic Ft.**	**Wet Test Meter Vol. Cubic Ft.**	**Dry Test Meter Temperature, °F Inlet**	**Dry Test Meter Temperature, °F Outlet**	**Wet Test Meter Temp., °F**	**Elapsed Time Minutes**	**Gas Meter Coefficient α**	**Orifice Coefficient ΔH@**
0.5	5.784	5.7	84.5	81.0	72.5	14.277	0.9944	1.828
1	5.429	5.3	85.5	81.0	72.7	9.473	0.9925	1.833
1.75	6.128	6.0	81.5	80.0	72.8	8.251	0.9898	1.899
2.5	11.165	10.9	85.0	80.5	72.4	12.482	0.9933	1.862
3.5	13.351	13.1	87.0	82.0	73.0	12.684	0.9910	1.889

Preferential Range 0.99 - 1.01	**Met**	Average Coefficients	**0.9922**	**1.862**
Meter Range Spec. ± 0.02 of Avg	**Pass**	Max. Δ from Average	**0.0024**	
Orifice Range Spec. ± 0.2 of Avg	**Pass**	Max. Δ from Average		**0.037**

Verified/Certified¹ : K. Althoff 12/4/2020

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¹ Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP S-FSD-Q-004.

Appendix D

Calibration/Verification Certificate
Isokinetic Control Module No. CM_5
DTM Serial No. 351158

Verification of Mounted Thermocouple Displays (°F)

Temperature Reference Standard No. Omega CL23A

Acceptance Crtierion: % Difference ≤ 1.5% (°R - absolute)

Stack Display			Meter Inlet Display			Meter Outlet Display		
Target	**Results**	**% Diff.**	**Target**	**Results**	**% Diff.**	**Target**	**Results**	**% Diff.**
1800	1800	0.00%	200	198	0.30%	200	205	0.76%
1500	1499	0.05%	150	146	0.66%	150	154	0.66%
1000	999	0.07%	100	95	0.89%	100	101	0.18%
500	497	0.31%	75	70	0.93%	75	76	0.19%
200	198	0.30%	50	45	0.98%	50	51	0.20%
100	96	0.71%	25	21	0.82%	25	27	0.41%
0	-1	0.22%	0	-2	0.43%	0	3	0.65%
Verification Status:		**Pass**	Verification Status:		**Pass**	Verification Status:		**Pass**
EPA M-2 & 5 criterion is 1.5% °R.			EPA M-5 criterion of 5.4°F for highlighted range is met.			EPA M-5 criterion of 5.4°F for highlighted range is met.		

Impinger Outlet Display			Oven Display			Probe Display		
Target	**Results**	**% Diff.**	**Target**	**Results**	**% Diff.**	**Target**	**Results**	**% Diff.**
200	199	0.15%	350	349	0.12%	350	354	0.49%
150	147	0.49%	300	299	0.13%	300	305	0.66%
100	96	0.71%	250	249	0.14%	250	242	1.13%
75	71	0.75%	200	199	0.15%	200	204	0.61%
50	46	0.78%	150	149	0.16%	150	154	0.66%
25	22	0.62%	100	98	0.36%	100	104	0.71%
0	-2	0.43%	50	50	0.00%	50	55	0.98%
Verification Status:		**Pass**	Verification Status:		**Pass**	Verification Status:		**Pass**
EPA M-2 & 202 criterion is 1.5% °R.			EPA M-5 criterion of 5.4°F for highlighted range is met.			EPA M-5 criterion of 5.4°F for highlighted range is not met.		

Verified/Certified¹ : K. Althoff 11/13/2020

Dry Test Meter and Orifice Periodic Calibration

Volume Reference Standard WTM No. WTM-2

Orifice Diff. Press., ΔH Inches WC	**Dry Test Meter Vol. Cubic Ft.**	**Wet Test Meter Vol. Cubic Ft.**	**Dry Test Meter Temperature, °F Inlet**	**Dry Test Meter Temperature, °F Outlet**	**Wet Test Meter Temp., °F**	**Elapsed Time Minutes**	**Gas Meter Coefficient α**	**Orifice Coefficient ΔH@**
0.5	5.728	5.7	76.5	78.0	70.2	15.143	0.9982	2.032
1	5.399	5.3	77.0	77.0	70.1	10.083	0.9914	2.053
1.75	5.376	5.3	74.0	76.5	70.2	7.701	0.9903	2.098
2.5	12.567	12.4	77.0	77.0	70.2	14.958	0.9899	2.076
3.5	13.308	13.1	79.5	79.0	71.2	13.468	0.9880	2.108

Preferential Range 0.99 - 1.01	**Met**	Average Coefficients	**0.9916**	**2.074**
Meter Range Spec. ± 0.02 of Avg	**Pass**	Max. Δ from Average	**0.0067**	
Orifice Range Spec. ± 0.2 of Avg	**Pass**	Max. Δ from Average		**0.041**

Verified/Certified¹ : K. Althoff 11/13/2020

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¹ Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP S-FSD-Q-004.

Calibration/Verification Certificate
Isokinetic Control Module No. CM_11
DTM Serial No. 352457

Verification of Mounted Thermocouple Displays (°F)

Temperature Reference Standard No. Omega CL23A

Acceptance Crtierion: % Difference ≤ 1.5% (°R - absolute)

Stack Display

Target	**Results**	**% Diff.**
1800	1804	0.18%
1500	1505	0.26%
1000	1004	0.27%
500	500	0.00%
200	202	0.30%
100	100	0.00%
0	2	0.43%
Verification Status:		**Pass**

EPA M-2 & 5 criterion is 1.5% °R.

Meter Inlet Display

Target	**Results**	**% Diff.**
200	204	0.61%
150	153	0.49%
100	103	0.54%
75	78	0.56%
50	53	0.59%
25	28	0.62%
0	4	0.87%
Verification Status:		**Pass**

EPA M-5 criterion of 5.4°F for highlighted range is met.

Meter Outlet Display

Target	**Results**	**% Diff.**
200	206	0.91%
150	154	0.66%
100	103	0.54%
75	78	0.56%
50	54	0.78%
25	29	0.82%
0	5	1.09%
Verification Status:		**Pass**

EPA M-5 criterion of 5.4°F for highlighted range is met.

Impinger Outlet Display

Target	**Results**	**% Diff.**
200	202	0.30%
150	152	0.33%
100	102	0.36%
75	77	0.37%
50	53	0.59%
25	29	0.82%
0	6	1.30%
Verification Status:		**Pass**

EPA M-2 & 202 criterion is 1.5% °R.

Oven Display

Target	**Results**	**% Diff.**
350	351	0.12%
300	301	0.13%
250	251	0.14%
200	200	0.00%
150	150	0.00%
100	100	0.00%
50	51	0.20%
Verification Status:		**Pass**

EPA M-5 criterion of 5.4°F for highlighted range is met.

Probe Display

Target	**Results**	**% Diff.**
350	352	0.25%
300	301	0.13%
250	251	0.14%
200	201	0.15%
150	151	0.16%
100	101	0.18%
50	52	0.39%
Verification Status:		**Pass**

EPA M-5 criterion of 5.4°F for highlighted range is met.

Verified/Certified¹ : K. Althoff 11/10/2020

Dry Test Meter and Orifice Periodic Calibration

Volume Reference Standard WTM No. WTM-2

Orifice Diff. Press., ΔH Inches WC	**Dry Test Meter Vol. Cubic Ft.**	**Wet Test Meter Vol. Cubic Ft.**	**Dry Test Meter Temperature, °F**		**Wet Test Meter Temp., °F**	**Elapsed Time Minutes**	**Gas Meter Coefficient α**	**Orifice Coefficient ΔH@**
			Inlet	**Outlet**				
0.5	6.152	6.0	89.0	84.0	73.4	15.755	0.9985	1.974
1	7.955	7.8	86.5	84.0	73.6	14.729	0.9954	2.061
1.75	5.759	5.7	82.5	82.0	73.8	8.157	0.9922	2.102
2.5	13.291	13.1	86.0	82.5	73.8	15.862	0.9960	2.121
3.5	22.279	21.9	87.5	84.5	73.4	22.603	0.9971	2.136

Preferential Range 0.99 - 1.01	**Met**	Average Coefficients	**0.9958**	**2.079**
Meter Range Spec. ± 0.02 of Avg	**Pass**	Max. Δ from Average	**0.0036**	
Orifice Range Spec. ± 0.2 of Avg	**Pass**	Max. Δ from Average		**0.105**

Verified/Certified¹ : K. Althoff 11/10/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP S-FSD-Q-004.

Appendix D

Atmospheric Barometer Certificate
Barometer No.: DB_35
Calibration Date: 9/22/2020

Make and Model:	Motorola Razr	Pace SOP No.:	ENV-SOP-FIELD-0030
Serial Number:	TA4310EWR9	Reference Standard:	DB-33
Barometer Range:	11-31 Inches Hg	Acceptance Criterion:	0.10 Inches Hg

Reference Barometric Pressure Inches Hg	**As Found**		**As Left**	
	Barometer Rdg Inches Hg	**Difference Inches Hg**	**Barometer Rdg Inches Hg**	**Difference Inches Hg**
29.58	29.61	0.03	29.61	0.03
	Acceptance Criterion	0.10		0.10
	Acceptance Status	**Pass**		**Pass**

Reference Barometric Pressure is determined from the raw mercury in glass absolute pressure reading of 29.58 and applying the appropriate temperature correction factor of 0 for 67°F at the time and place of calibration/verification.

Verified/Certified[1] By: Stanley Broome 9/22/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to SOP S-FSD-Q-004.

Atmospheric Barometer Certificate

Barometer No.: **DB_60**
Calibration Date: **8/6/2020**

Make and Model:	iPhone 6	Pace SOP No.:	ENV-SOP-FIELD-0030
Serial Number:	FK1VJWZUHFLR	Reference Standard:	Princo-2
Barometer Range:	11628 Inches Hg	Acceptance Criterion:	0.10 Inches Hg

Reference Barometric Pressure Inches Hg	**As Found**		**As Left**	
	Barometer Rdg Inches Hg	**Difference Inches Hg**	**Barometer Rdg Inches Hg**	**Difference Inches Hg**
29.14	29.10	0.05	29.10	0.05
	Acceptance Criterion	0.10		0.10
	Acceptance Status	**Pass**		**Pass**

Reference Barometric Pressure is determined from the raw mercury in glass absolute pressure reading of 29.25 and applying the appropriate temperature correction factor of -0.109 for 70°F at the time and place of calibration/verification.

Verified/Certified[1] By: K. Althoff 8/6/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to SOP S-FSD-Q-004.

Atmospheric Barometer Certificate

Barometer No.: **DB_72**
Calibration Date: **8/6/2020**

Make and Model:	Apple iPhone 7	Pace SOP No.:	ENV-SOP-FIELD-0030	
Serial Number:	DX3XCJXMHG6W	Reference Standard:	Princo-2	
Barometer Range:	Inches Hg	Acceptance Criterion:	0.10	Inches Hg

Reference	**As Found**		**As Left**	
Barometric Pressure Inches Hg	**Barometer Rdg Inches Hg**	**Difference Inches Hg**	**Barometer Rdg Inches Hg**	**Difference Inches Hg**
29.14	29.16	0.02	29.16	0.02
	Acceptance Criterion	0.10		0.10
	Acceptance Status	**Pass**		**Pass**

Reference Barometric Pressure is determined from the raw mercury in glass absolute pressure reading of 29.25 and applying the appropriate temperature correction factor of -0.109 for 70°F at the time and place of calibration/verification.

Verified/Certified[1] By: K. Althoff 8/6/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to SOP S-FSD-Q-004.

Digital Manometer Calibration Certificate

Digital Manometer No.: DM_46
Calibration Date: 7/15/2020

Make and Model:	Fluke 922	Pace SOP No.:	ENV-SOP-FIELD-0033
Serial Number:	44280430	Reference Standard:	Manometer #1 and #2
Pressure Range:	16.5 Inches of Water	Acceptance Criterion:	1.00% Of Scale

Reference Pressure In. H_2O	**As Found**		**As Left**	
	EDM Rdg In. H_2O	**Difference % of Scale**	**EDM Rdg In. H_2O**	**Difference % of Scale**
-14.90	-14.86	0.27%	-14.86	0.27%
-8.30	-8.31	0.04%	-8.31	0.04%
-0.80	-0.80	0.02%	-0.80	0.02%
0.00	0.00	0.00%	0.00	0.00%
0.80	0.80	0.01%	0.80	0.01%
8.30	8.30	0.01%	8.30	0.01%
14.90	14.86	0.24%	14.86	0.24%

Average % Difference	0.08%	Average % Difference	0.08%
Maximum % Difference	0.27%	Maximum % Difference	0.27%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Leak Check	**Pass**

Verified/Certified[1] By: T. Rehling 7/15/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to SOP S-FSD-Q-004.

Digital Manometer Calibration Certificate

Digital Manometer No.: DM_48
Calibration Date: 10/1/2020

Make and Model:	Fluke 922	Pace SOP No.:	ENV-SOP-FIELD-0033
Serial Number:	49810028	Reference Standard:	Manometer #1 & #2
Pressure Range:	16.5 Inches of Water	Acceptance Criterion:	1.00% Of Scale

Reference Pressure In. H_2O	As Found EDM Rdg In. H_2O	As Found Difference % of Scale	As Left EDM Rdg In. H_2O	As Left Difference % of Scale
-14.90	-14.91	0.07%	-14.91	0.07%
-8.30	-8.33	0.19%	-8.33	0.19%
-0.80	-0.82	0.10%	-0.82	0.10%
0.00	0.00	0.00%	0.00	0.00%
0.80	0.82	0.09%	0.82	0.09%
8.30	8.35	0.33%	8.35	0.33%
14.90	14.94	0.22%	14.94	0.22%

Average % Difference	0.14%	Average % Difference	0.14%
Maximum % Difference	0.33%	Maximum % Difference	0.33%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Leak Check	**Pass**

Verified/Certified[1] By: K. Althoff 10/1/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to SOP S-FSD-Q-004.

Scale/Balance Calibration Certificate
Electronic Digital Scale No.: DS_38
Calibration Date: 7/8/2020

Make and Model:	Smart Weigh Pro Pocket	Pace SOP No.:	ENV-SOP-FIELD-0029
Serial Number:	A17-286	Reference Standard:	HWS-001 & 602981
Weight Range:	2000 Grams	Acceptance Criterion:	0.50% Of Weight

Reference Weight Grams	**As Found**		**As Left**	
	Scale Rdg Grams	**Difference % of Ref. Wt.**	**Scale Rdg Grams**	**Difference % of Ref. Wt.**
200	200	0.15%	200	0.15%
300	300	0.13%	300	0.13%
500	501	0.12%	501	0.12%
1000	1001	0.12%	1001	0.12%
1500	1502	0.13%	1502	0.13%

Average % Difference	0.13%	Average % Difference	0.13%
Maximum % Difference	0.15%	Maximum % Difference	0.15%
Acceptance Status	**Pass**	Acceptance Status	**Pass**

Verified/Certified[1] By: K. Althoff 7/8/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to SOP S-FSD-Q-004.

Scale/Balance Calibration Certificate
Electronic Digital Scale No.: DS_42
Calibration Date: 4/7/2020

Make and Model: Smart Weigh Pro Pocket
Serial Number: A18-242
Weight Range: 2000 Grams
Pace SOP No.: ENV-SOP-FIELD-0029
Reference Standard: HWS-001 & 602981
Acceptance Criterion: 0.50% Of Weight

Reference Weight Grams	**As Found**		**As Left**	
	Scale Rdg Grams	**Difference % of Ref. Wt.**	**Scale Rdg Grams**	**Difference % of Ref. Wt.**
200	200	0.00%	200	0.00%
300	300	0.03%	300	0.03%
500	500	0.02%	500	0.02%
1000	1000	0.02%	1000	0.02%
1500	1500	0.03%	1500	0.03%

Average % Difference	0.02%	Average % Difference	0.02%
Maximum % Difference	0.03%	Maximum % Difference	0.03%
Acceptance Status	**Pass**	Acceptance Status	**Pass**

Verified/Certified[1] By: T. Rehling 4/7/2020

[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to SOP S-FSD-Q-004.

Appendix D

Scale/Balance Calibration Certificate
Electronic Digital Scale No.: DS_45
Calibration Date: 7/8/2020

Make and Model:	Smart Weigh Pro Pocket	Pace SOP No.:	ENV-SOP-FIELD-0029
Serial Number:	A18-242	Reference Standard:	HWS-001 & 602981
Weight Range:	2000 Grams	Acceptance Criterion:	0.50% Of Weight

Reference Weight Grams	**As Found**		**As Left**	
	Scale Rdg Grams	**Difference % of Ref. Wt.**	**Scale Rdg Grams**	**Difference % of Ref. Wt.**
200	200	0.00%	200	0.00%
300	300	0.03%	300	0.03%
500	500	0.02%	500	0.02%
1000	1000	0.03%	1000	0.03%
1500	1501	0.03%	1501	0.03%
Average % Difference		0.02%		0.02%
Maximum % Difference		0.03%		0.03%
Acceptance Status		**Pass**		**Pass**

Verified/Certified[1] By: K. Althoff 7/8/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to SOP S-FSD-Q-004.

Appendix D

Thermocouple Display Calibration Certificate

Thermocouple Display No.: **TC_33**
Calibration Date: **3/9/2020**

Make and Model:	Omega HH12B	Pace SOP No.:	ENV-SOP-FIELD-0031
Serial Number:	111305	Reference Standard:	Omega CL23A
Temperature Range:	2000 Fahrenheit - °F	Acceptance Criterion:	1.50% °R (°F+460)

Reference Temperature °F	**As Found**		**As Left**	
	Display Rdg °F	**Difference % of Rdg**	**Display Rdg °F**	**Difference % of Rdg**
1800	1800	0.00%	1800	0.00%
1500	1500	0.00%	1500	0.00%
1000	1000	0.00%	1000	0.00%
500	500	0.00%	500	0.00%
200	200	0.06%	200	0.06%
100	100	0.07%	100	0.07%
0	0	0.04%	0	0.04%

Average % Difference	0.03%	Average % Difference	0.03%
Maximum % Difference	0.07%	Maximum % Difference	0.07%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Channel 2 Verification	**Pass**

Verified/Certified[1] By: T. Rehling 3/9/2020

---

[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP ENV-SOP-FIELD-0004.

Thermocouple Display Calibration Certificate

Thermocouple Display No.: TC_38
Calibration Date: 3/9/2020

Make and Model:	Omega HH12B	Pace SOP No.:	ENV-SOP-FIELD-0031
Serial Number:	130634	Reference Standard:	Omega CL23A
Temperature Range:	2000 Fahrenheit - °F	Acceptance Criterion:	1.50% °R (°F+460)

Reference Temperature °F	**As Found**		**As Left**	
	Display Rdg °F	**Difference % of Rdg**	**Display Rdg °F**	**Difference % of Rdg**
1800	1800	0.00%	1800	0.00%
1500	1500	0.00%	1500	0.00%
1000	1000	0.00%	1000	0.00%
500	500	0.00%	500	0.00%
200	201	0.15%	201	0.15%
100	100	0.04%	100	0.04%
0	0	0.02%	0	0.02%

Average % Difference	0.03%	Average % Difference	0.03%
Maximum % Difference	0.15%	Maximum % Difference	0.15%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Channel 2 Verification	**Pass**

Verified/Certified[1] By: T. Rehling 3/9/2020

---

[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP ENV-SOP-FIELD-0004.

Appendix D

Thermocouple Display Calibration Certificate

Thermocouple Display No.: **TC_41.1**
Calibration Date: **2/12/2020**

Make and Model:	Omega HHC201	Pace SOP No.:	ENV-SOP-FIELD-0031
Serial Number:	180082	Reference Standard:	Omega CL23A
Temperature Range:	2000 Fahrenheit - °F	Acceptance Criterion:	1.50% °R (°F+460)

Reference Temperature °F	**As Found**		**As Left**	
	Display Rdg °F	**Difference % of Rdg**	**Display Rdg °F**	**Difference % of Rdg**
1800	1799	0.03%	1799	0.03%
1500	1499	0.03%	1499	0.03%
1000	1000	0.01%	1000	0.01%
500	500	0.01%	500	0.01%
200	200	0.03%	200	0.03%
100	100	0.02%	100	0.02%
0	0	0.00%	0	0.00%

Average % Difference	0.02%	Average % Difference	0.02%
Maximum % Difference	0.03%	Maximum % Difference	0.03%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Channel 2 Verification	**Pass**

Verified/Certified[1] By: T. Rehling 2/12/2020

---

[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP ENV-SOP-FIELD-0004.

Thermocouple Display Calibration Certificate
Thermocouple Display No.: TC_41.2
Calibration Date: 2/12/2020

Make and Model:	Omega HHC201	Pace SOP No.:	ENV-SOP-FIELD-0031
Serial Number:	180082	Reference Standard:	Omega CL23A
Temperature Range:	2000 Fahrenheit - °F	Acceptance Criterion:	1.50% °R (°F+460)

Reference Temperature °F	**As Found**		**As Left**	
	Display Rdg °F	**Difference % of Rdg**	**Display Rdg °F**	**Difference % of Rdg**
1800	1799	0.03%	1799	0.03%
1500	1499	0.04%	1499	0.04%
1000	1000	0.03%	1000	0.03%
500	500	0.02%	500	0.02%
200	200	0.03%	200	0.03%
100	100	0.05%	100	0.05%
0	0	0.00%	0	0.00%

Average % Difference	0.03%	Average % Difference	0.03%
Maximum % Difference	0.05%	Maximum % Difference	0.05%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Channel 2 Verification	**Pass**

Verified/Certified[1] By: T. Rehling 2/12/2020

[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP ENV-SOP-FIELD-0004.

Thermocouple Display Calibration Certificate

Thermocouple Display No.: TC_44.1
Calibration Date: 10/31/2020

Make and Model:	Omega HHC201	Pace SOP No.:	ENV-SOP-FIELD-0031
Serial Number:	180097	Reference Standard:	Omega CL23A
Temperature Range:	2000 Fahrenheit - °F	Acceptance Criterion:	1.50% °R (°F+460)

Reference Temperature °F	**As Found**		**As Left**	
	Display Rdg °F	**Difference % of Rdg**	**Display Rdg °F**	**Difference % of Rdg**
1800	1799	0.03%	1799	0.03%
1500	1500	0.03%	1500	0.03%
1000	999	0.06%	999	0.06%
500	500	0.03%	500	0.03%
200	200	0.06%	200	0.06%
100	100	0.07%	100	0.07%
0	0	0.07%	0	0.07%

Average % Difference	0.05%	Average % Difference	0.05%
Maximum % Difference	0.07%	Maximum % Difference	0.07%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Channel 2 Verification	**NA**

Verified/Certified[1] By: K. Althoff 10/31/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP ENV-SOP-FIELD-0004.

Appendix D

Thermocouple Display Calibration Certificate
Thermocouple Display No.: TC_44.2
Calibration Date: 10/31/2020

Make and Model:	Omega HHC201	Pace SOP No.:	ENV-SOP-FIELD-0031
Serial Number:	180097	Reference Standard:	Omega CL23A
Temperature Range:	2000 Fahrenheit - °F	Acceptance Criterion:	1.50% °R (°F+460)

Reference Temperature °F	**As Found**		**As Left**	
	Display Rdg °F	**Difference % of Rdg**	**Display Rdg °F**	**Difference % of Rdg**
1800	1799	0.03%	1799	0.03%
1500	1499	0.03%	1499	0.03%
1000	1000	0.03%	1000	0.03%
500	500	0.03%	500	0.03%
200	199	0.09%	199	0.09%
100	99	0.11%	99	0.11%
0	0	0.09%	0	0.09%

Average % Difference	0.06%	Average % Difference	0.06%
Maximum % Difference	0.11%	Maximum % Difference	0.11%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Channel 2 Verification	**NA**

Verified/Certified[1] By: K. Althoff 10/31/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP ENV-SOP-FIELD-0004.

Thermocouple Display Calibration Certificate

Thermocouple Display No.: TC_47.1
Calibration Date: 4/10/2020

Make and Model:	Omega HCC201	Pace SOP No.:	ENV-SOP-FIELD-0031
Serial Number:	190033	Reference Standard:	Omega CL23A
Temperature Range:	2000 Fahrenheit - °F	Acceptance Criterion:	1.50% °R (°F+460)

Reference Temperature °F	**As Found**		**As Left**	
	Display Rdg °F	**Difference % of Rdg**	**Display Rdg °F**	**Difference % of Rdg**
1800	1799	0.04%	1799	0.04%
1500	1499	0.03%	1499	0.03%
1000	999	0.04%	999	0.04%
500	500	0.04%	500	0.04%
200	200	0.06%	200	0.06%
100	100	0.04%	100	0.04%
0	0	0.04%	0	0.04%

Average % Difference	0.04%	Average % Difference	0.04%
Maximum % Difference	0.06%	Maximum % Difference	0.06%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Channel 2 Verification	**NA**

Verified/Certified[1] By: T. Rehling 4/10/2020

---

[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP ENV-SOP-FIELD-0004.

Thermocouple Display Calibration Certificate
Thermocouple Display No.: TC_47.2
Calibration Date: 4/10/2020

Make and Model:	Omega HCC201	Pace SOP No.:	ENV-SOP-FIELD-0031
Serial Number:	190033	Reference Standard:	Omega CL23A
Temperature Range:	2000 Fahrenheit - °F	Acceptance Criterion:	1.50% °R (°F+460)

Reference Temperature °F	**As Found**		**As Left**	
	Display Rdg °F	**Difference % of Rdg**	**Display Rdg °F**	**Difference % of Rdg**
1800	1800	0.02%	1800	0.02%
1500	1500	0.02%	1500	0.02%
1000	1000	0.00%	1000	0.00%
500	500	0.04%	500	0.04%
200	200	0.03%	200	0.03%
100	100	0.05%	100	0.05%
0	1	0.13%	1	0.13%

Average % Difference	0.04%	Average % Difference	0.04%
Maximum % Difference	0.13%	Maximum % Difference	0.13%
Acceptance Status	**Pass**	Acceptance Status	**Pass**
		Channel 2 Verification	**NA**

Verified/Certified[1] By: T. Rehling 4/10/2020

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[1] Certifying personnel identity validated by computer login and data entry tracking pursuant to Pace FSD SOP ENV-SOP-FIELD-0004.

Calibration Gas Certifications

Making our planet more productive

DocNumber: 225596

Praxair Distribution, Inc.
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Toledo OH 43611
Tel: +1 (419) 729-7732
Fax: +1 (419) 729-2411
PGVP ID: F12018

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PRAXAIR PKG ROSEVILLE MN P
2455 ROSEGATE
ROSEVILLE MN 55113-2717

Customer Reference: NO2=1.1ppm

Certificate Issuance Date: 10/08/2018
Praxair Order Number: 70730454
Part Number: NI CO245NS1ZEAS

Fill Date: 09/21/2018
Lot Number: 700018264GB
Cylinder Style & Outlet: AS CGA 660
Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

ProSpec EZ Cert

Expiration Date:	**10/02/2026**	NIST Traceable
Cylinder Number:	**CC93519**	Expanded Uncertainty
246 ppm	**Carbon monoxide**	**± 0.4 %**
247 ppm	**Nitric oxide**	**± 0.3 %**
247 ppm	**Sulfur dioxide**	**± 0.6 %**
Balance	**Nitrogen**	

Certification Information:

Certification Date: 10/02/2018 *Term:* 96 Months *Expiration Date:* 10/02/2026

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1.

Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. ***Component:*** **Carbon monoxide**

Requested Concentration: 245 ppm
Certified Concentration: 246 ppm
Instrument Used: Horiba VIA 510
Analytical Method: NDIR
Last Multipoint Calibration: 10/04/2018

Reference Standard: Type / Cylinder #: GMIS / EB0005134
Concentration / Uncertainty: 250.6 ppm ±0.3%
Expiration Date: 03/16/2026
Traceable to: SRM # / Sample # / Cylinder #: 2636a / 57-F-15 / FF30792
SRM Concentration / Uncertainty: 247.1 PPM / ±0.5 PPM
SRM Expiration Date: 03/26/2018

First Analysis Data:						**Date**	09/25/2018
Z:	0	**R:**	250.8	**C:**	246	**Conc:**	246
R:	250.8	**Z:**	0	**C:**	246	**Conc:**	246
Z:	0	**C:**	246	**R:**	250.8	**Conc:**	246
UOM:	ppm			**Mean Test Assay:**		246	ppm

Second Analysis Data:						**Date**	
Z:	0	**R:**	0	**C:**	0	**Conc:**	0
R:	0	**Z:**	0	**C:**	0	**Conc:**	0
Z:	0	**C:**	0	**R:**	0	**Conc:**	0
UOM:	ppm			**Mean Test Assay:**			ppm

2. ***Component:*** **Nitric oxide**

Requested Concentration: 245 ppm
Certified Concentration: 247 ppm
Instrument Used: Thermo-42i LS
Analytical Method: Chemiluminescence
Last Multipoint Calibration: 09/17/2018

Reference Standard: Type / Cylinder #: GMIS / CC192721
Concentration / Uncertainty: 255 ppm ±0.3%
Expiration Date: 02/24/2026
Traceable to: SRM # / Sample # / Cylinder #: 1687b / 41-L-12 / FF10415
SRM Concentration / Uncertainty: 985.3 PPM / ±2.1 PPM
SRM Expiration Date: 05/01/2020

First Analysis Data:						**Date**	09/25/2018
Z:	0	**R:**	255	**C:**	247	**Conc:**	247
R:	255	**Z:**	0	**C:**	247	**Conc:**	247
Z:	0	**C:**	247	**R:**	255	**Conc:**	247
UOM:	ppm			**Mean Test Assay:**		247	ppm

Second Analysis Data:						**Date**	10/02/2018
Z:	0	**R:**	255	**C:**	247	**Conc:**	247
R:	255	**Z:**	0	**C:**	247	**Conc:**	247
Z:	0	**C:**	248	**R:**	255	**Conc:**	248
UOM:	ppm			**Mean Test Assay:**		247	ppm

3. ***Component:*** **Sulfur dioxide**

Requested Concentration: 245 ppm
Certified Concentration: 247 ppm
Instrument Used: AMETEK 921
Analytical Method: UV Spectrometry
Last Multipoint Calibration: 09/17/2018

Reference Standard: Type / Cylinder #: GMIS / EB0015349
Concentration / Uncertainty: 506 ppm ±0.573%
Expiration Date: 01/04/2026
Traceable to: SRM # / Sample # / Cylinder #: 1661a / 94-I-14 / FF28055
SRM Concentration / Uncertainty: 494.6 PPM / .00794
SRM Expiration Date: 09/14/2018

First Analysis Data:						**Date**	09/25/2018
Z:	0	**R:**	506	**C:**	248	**Conc:**	248
R:	506	**Z:**	0	**C:**	247	**Conc:**	247
Z:	0	**C:**	248	**R:**	506	**Conc:**	248
UOM:	ppm			**Mean Test Assay:**		248	ppm

Second Analysis Data:						**Date**	10/02/2018
Z:	0	**R:**	506	**C:**	247	**Conc:**	247
R:	506	**Z:**	0	**C:**	247	**Conc:**	247
Z:	0	**C:**	248	**R:**	506	**Conc:**	248
UOM:	ppm			**Mean Test Assay:**		247	ppm

Marcus Huguley

Analyzed By **Marcus Huguley**

Certified By **Jack Fu**

PRAXAIR
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DocNumber: 308798

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Fax: +1 (419) 729-2411
PGVP ID: F12020

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PRAXAIR PKG ROSEVILLE MN P
2455 ROSEGATE
ROSEVILLE MN 55113-2717

Certificate Issuance Date: 06/24/2020
Praxair Order Number: 71360746
Part Number: NI CD10O28E-AS
Customer PO Number: 79351935

Fill Date: 06/04/2020
Lot Number: 700010156F3
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

ProSpec EZ Cert

Expiration Date:	**06/24/2028**	NIST Traceable
Cylinder Number:	**CC95749**	Expanded Uncertainty
9.93 %	**Carbon dioxide**	**± 1.2 %**
10.9 %	**Oxygen**	**± 0.4 %**
Balance	**Nitrogen**	

Certification Information:

Certification Date: 06/24/2020 *Term:* 96 Months *Expiration Date:* 06/24/2028

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1.

Do Not Use this Standard if Pressure is less than 100 PSIG.

O2 responses have been corrected for CO2 interference.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. *Component:* **Carbon dioxide**

Requested Concentration: 10.0 %
Certified Concentration: 9.93 %
Instrument Used: MKS 2030
Analytical Method: FTIR
Last Multipoint Calibration: 06/01/2020

Reference Standard: Type / Cylinder #: GMIS / EB0054692
Concentration / Uncertainty: 15.05 % ±0.27%
Expiration Date: 08/02/2026
Traceable to: SRM # / Sample # / Cylinder #: 2745 / 9-C-03 / CAL016000
SRM Concentration / Uncertainty: 15.633% / ±0.037%
SRM Expiration Date: 02/07/2025

First Analysis Data: **Date** 06/24/2020

Z:	0	**R:**	15.3	**C:**	10.1	**Conc:**	9.93
R:	15.3	**Z:**	0	**C:**	10.1	**Conc:**	9.93
Z:	0	**C:**	10.1	**R:**	15.3	**Conc:**	9.93

UOM: % **Mean Test Assay:** 9.93 %

Second Analysis Data: **Date**

Z:	0	**R:**	0	**C:**	0	**Conc:**	0
R:	0	**Z:**	0	**C:**	0	**Conc:**	0
Z:	0	**C:**	0	**R:**	0	**Conc:**	0

UOM: % **Mean Test Assay:** %

2. *Component:* **Oxygen**

Requested Concentration: 11.0 %
Certified Concentration: 10.9 %
Instrument Used: Servomex 575
Analytical Method: Paramagnetic
Last Multipoint Calibration: 06/22/2020

Reference Standard: Type / Cylinder #: GMIS / SGAL2224
Concentration / Uncertainty: 22.49 % ±0.3%
Expiration Date: 12/02/2027
Traceable to: SRM # / Sample # / Cylinder #: 2659a / 71-D-04 / CAL015785
SRM Concentration / Uncertainty: 20.72 / ±0.043
SRM Expiration Date: 08/23/2021

First Analysis Data: **Date** 06/24/2020

Z:	0	**R:**	22.49	**C:**	10.9	**Conc:**	10.9
R:	22.5	**Z:**	0	**C:**	10.9	**Conc:**	10.9
Z:	0	**C:**	10.9	**R:**	22.5	**Conc:**	10.9

UOM: % **Mean Test Assay:** 10.9 %

Second Analysis Data: **Date**

Z:	0	**R:**	0	**C:**	0	**Conc:**	0
R:	0	**Z:**	0	**C:**	0	**Conc:**	0
Z:	0	**C:**	0	**R:**	0	**Conc:**	0

UOM: % **Mean Test Assay:** %

Analyzed By **Mike Monnette**

Certified By **Edward E Zucal**

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DocNumber: 301615

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Fax: +1 (419) 729-2411
PGVP ID: F12020

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PRAXAIR PKG ROSEVILLE MN P
2455 ROSEGATE
ROSEVILLE MN 55113-2717

Certificate Issuance Date: 03/17/2020
Praxair Order Number: 71274090
Part Number: NI CO112NS1ZEAS
Customer PO Number: 79263469

Fill Date: 03/04/2020
Lot Number: 700010064WE
Cylinder Style & Outlet: AS CGA 660
Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

ProSpec EZ Cert

Expiration Date:	**03/17/2028**	NIST Traceable
Cylinder Number:	**CC128093**	Expanded Uncertainty
116 ppm	**Nitric oxide**	**± 0.4 %**
110 ppm	**Sulfur dioxide**	**± 0.8 %**
110 ppm	**Carbon monoxide**	**± 0.6 %**
Balance	**Nitrogen**	

For Reference Only: *NO2 0.8 ppm*

Certification Information: *Certification Date:* 03/17/2020 *Term:* 96 Months *Expiration Date:* 03/17/2028

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1.

Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. ***Component:*** **Nitric oxide**

Requested Concentration: 112 ppm
Certified Concentration: 116 ppm
Instrument Used: Thermo-42i LS
Analytical Method: Chemiluminescence
Last Multipoint Calibration: 03/03/2020

Reference Standard: Type / Cylinder #: GMIS / DT0006335
Concentration / Uncertainty: 254.55 ppm ±0.214%
Expiration Date: 04/28/2026
Traceable to: SRM # / Sample # / Cylinder #: 1687b / 41-L-32 / FF10415
SRM Concentration / Uncertainty: 985 / .00213
SRM Expiration Date: 05/01/2020

First Analysis Data:						**Date**	03/10/2020
Z:	0	**R:**	255	**C:**	115	**Conc:**	115
R:	255	**Z:**	0	**C:**	115	**Conc:**	115
Z:	0	**C:**	115	**R:**	255	**Conc:**	115
UOM:	ppm			**Mean Test Assay:**		115	ppm

Second Analysis Data:						**Date**	03/17/2020
Z:	0	**R:**	255	**C:**	117	**Conc:**	117
R:	255	**Z:**	0	**C:**	117	**Conc:**	117
Z:	0	**C:**	117	**R:**	255	**Conc:**	117
UOM:	ppm			**Mean Test Assay:**		117	ppm

2. ***Component:*** **Sulfur dioxide**

Requested Concentration: 112 ppm
Certified Concentration: 110 ppm
Instrument Used: AMETEK 921
Analytical Method: UV Spectrometry
Last Multipoint Calibration: 03/04/2020

Reference Standard: Type / Cylinder #: GMIS / DT0029404
Concentration / Uncertainty: 509 ppm ±0.387%
Expiration Date: 12/14/2027
Traceable to: SRM # / Sample # / Cylinder #: 1661a / 94-I-XX / FF22309
SRM Concentration / Uncertainty: 495 / 0.38
SRM Expiration Date: 08/30/2021

First Analysis Data:						**Date**	03/10/2020
Z:	0	**R:**	509	**C:**	111	**Conc:**	111
R:	509	**Z:**	0	**C:**	111	**Conc:**	111
Z:	0	**C:**	111	**R:**	509	**Conc:**	111
UOM:	ppm			**Mean Test Assay:**		111	ppm

Second Analysis Data:						**Date**	03/17/2020
Z:	0	**R:**	509	**C:**	110	**Conc:**	110
R:	509	**Z:**	0	**C:**	110	**Conc:**	110
Z:	0	**C:**	110	**R:**	509	**Conc:**	110
UOM:	ppm			**Mean Test Assay:**		110	ppm

3. ***Component:*** **Carbon monoxide**

Requested Concentration: 112 ppm
Certified Concentration: 110 ppm
Instrument Used: Horiba VIA 510
Analytical Method: NDIR
Last Multipoint Calibration: 02/20/2020

Reference Standard: Type / Cylinder #: GMIS / CC179337
Concentration / Uncertainty: 249.9 ppm ±0.27%
Expiration Date: 03/16/2026
Traceable to: SRM # / Sample # / Cylinder #: 2636a / 57-F-15 / FF30792
SRM Concentration / Uncertainty: 247.1 / ±0.5 PPM
SRM Expiration Date: 03/26/2018

First Analysis Data:						**Date**	03/10/2020
Z:	0	**R:**	250	**C:**	110.4	**Conc:**	110
R:	250	**Z:**	0	**C:**	110.2	**Conc:**	110
Z:	0	**C:**	110.3	**R:**	250	**Conc:**	110
UOM:	ppm			**Mean Test Assay:**		110	ppm

Second Analysis Data:						**Date**	
Z:	0	**R:**	0	**C:**	0	**Conc:**	0
R:	0	**Z:**	0	**C:**	0	**Conc:**	0
Z:	0	**C:**	0	**R:**	0	**Conc:**	0
UOM:	ppm			**Mean Test Assay:**			ppm

Analyzed By **Gregory Brodbeck**

Certified By **Edward E Zucal**

Praxair Distribution. Inc.
10210 North Freeway
Houston, TX 77037
Tel: 1-281-880-4445
Fax: 1-281-880-4449

Customer & Order Information:

Certificate Issuance Date: **4/12/2019**

PACE ANALYTICAL SERVICES INC
1700 ELM ST SE, DEPT 1251 FIELD SERVICES AIR GARAGE
MINNEAPOLIS, MN 55414

Praxair Order Number: **73931383**
Customer PO Number: **BETH KELM EMAIL**

Certification Date: **4/12/2019**
Lot Number: **70017910101**
Part Number: **AI HX40MC-AS**

DocNumber: **67205**
Expiration Date: **4/11/2024**

CERTIFICATE OF ANALYSIS

Certified Standard

Component	Requested Concentration (Molar)	Certified Concentration (Molar)	Analytical Reference	Analytical Uncertainty
n-Hexane	**40.0 ppm**	**39.9 ppm**	**1**	**± 5 %**
Air	**Balance**	**Balance**		

Cylinder Style: **AS**
Cylinder Pressure @ 70 F: **2000 psig**
Cylinder Volume: **142.8 ft3**
Valve Outlet Connection: **CGA 590**
Cylinder Number(s): **CC158131**

Fill Date: **4/11/2019**
Analysis Date: **4/12/2019**

Filling Method: **Gravimetric**

Brian Courts

Certifier: **Brian Courts**

Approved Signer: **Abel Navarrete**

Key to Analytical Techniques:

Reference	Analytical Instrument - Analytical Principle
1	Varian 450-GC - Gas Chromatography with FID

The gas calibration cylinder standard prepared by Praxair Distribution, Inc. is considered a certified standard. It is prepared by gravimetric, volumetric, or partial pressure techniques. The calibration standard provided is certified against Praxair Distribution, Inc. Reference Materials which are either prepared by weights traceable to the National Institute of Standards and Technology (NIST), Measurement Canada, or by using NIST Standard Reference Materials where available.

Note: All expressions for concentration (e.g., % or ppm) are for gas phase, by volume (e.g., ppmv) unless otherwise noted. Analytical uncertainty is expressed as a Relative % unless otherwise noted.

Making our planet more productive

Praxair Distribution. Inc.
10210 North Freeway
Houston, TX 77037
Tel: 1-281-880-4445
Fax: 1-281-880-4449

Customer & Order Information:

PACE ANALYTICAL SERVICES INC
1700 ELM ST SE, DEPT 1251 FIELD SERVICES AIR
GARAGE
MINNEAPOLIS, MN 55414

Praxair Order Number: **73931383**
Customer PO Number: **BETH KELM EMAIL**

Certificate Issuance Date: **4/12/2019**

Certification Date: **4/12/2019**
Lot Number: **70017910101**
Part Number: **AI HX25MC-AS**

DocNumber: **67206**
Expiration Date: **4/11/2024**

CERTIFICATE OF ANALYSIS

Certified Standard

Component	Requested Concentration (Molar)	Certified Concentration (Molar)	Analytical Reference	Analytical Uncertainty
n-Hexane	**25.0 ppm**	**25.9 ppm**	**1**	**± 5 %**
Air	**Balance**	**Balance**		

Cylinder Style: **AS**
Cylinder Pressure @ 70 F: **2000 psig**
Cylinder Volume: **142.8 ft3**
Valve Outlet Connection: **CGA 590**
Cylinder Number(s): **CC171522**

Fill Date: **4/11/2019**
Analysis Date: **4/12/2019**

Filling Method: **Gravimetric**

Brian Courts

Certifier: **Brian Courts**

Approved Signer: **Abel Navarrete**

Key to Analytical Techniques:

Reference	Analytical Instrument - Analytical Principle
1	Varian CP-4900 Micro GC - Gas Chromatography with TCD

The gas calibration cylinder standard prepared by Praxair Distribution, Inc. is considered a certified standard. It is prepared by gravimetric, volumetric, or partial pressure techniques. The calibration standard provided is certified against Praxair Distribution, Inc. Reference Materials which are either prepared by weights traceable to the National Institute of Standards and Technology (NIST), Measurement Canada, or by using NIST Standard Reference Materials where available.

Note: All expressions for concentration (e.g., % or ppm) are for gas phase, by volume (e.g., ppmv) unless otherwise noted. Analytical uncertainty is expressed as a Relative % unless otherwise noted.

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DocNumber: 298366

Praxair Distribution, Inc.
6055 Brent Drive
Toledo OH 43611
Tel: +1 (419) 729-7732
Fax: +1 (419) 729-2411
PGVP ID: F12020

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PRAXAIR PKG ROSEVILLE MN P
2455 ROSEGATE
ROSEVILLE MN 55113-2717

Certificate Issuance Date: 02/05/2020
Praxair Order Number: 71228421
Part Number: NI CO50MNS3ZEAS
Customer PO Number: 79216841

Fill Date: 01/22/2020
Lot Number: 700010022WH
Cylinder Style & Outlet: AS CGA 660
Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

ProSpec EZ Cert

Expiration Date:	**02/03/2028**	NIST Traceable
Cylinder Number:	**CC350671**	Expanded Uncertainty
51.0 ppm	**Nitric oxide**	**± 0.5 %**
49.0 ppm	**Sulfur dioxide**	**± 0.8 %**
49.6 ppm	**Carbon monoxide**	**± 0.2 %**
Balance	**Nitrogen**	

For Reference Only: *NO2 0.3 ppm*

Certification Information: *Certification Date:* 02/03/2020 *Term:* 96 Months *Expiration Date:* 02/03/2028

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1.

Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. ***Component:*** **Nitric oxide**

Requested Concentration: 50 ppm
Certified Concentration: 51.0 ppm
Instrument Used: Thermo-42i LS
Analytical Method: Chemiluminescence
Last Multipoint Calibration: 01/10/2020

Reference Standard: Type / Cylinder #: GMIS / DT0027997
Concentration / Uncertainty: 103.3 ppm ±0.3%
Expiration Date: 05/15/2027
Traceable to: SRM # / Sample # / Cylinder #: C1303210.03 / N/A / APEX1223951
SRM Concentration / Uncertainty: 100.1 / .2997
SRM Expiration Date: 07/27/2020

First Analysis Data:						**Date**	01/27/2020
Z:	0	**R:**	103.3	**C:**	50.8	**Conc:**	50.8
R:	103.3	**Z:**	0	**C:**	50.9	**Conc:**	50.9
Z:	0	**C:**	50.7	**R:**	103.4	**Conc:**	50.7
UOM:	ppm			**Mean Test Assay:**		50.8	ppm

Second Analysis Data:						**Date**	02/03/2020
Z:	0	**R:**	103.3	**C:**	51.3	**Conc:**	51.3
R:	103.2	**Z:**	0	**C:**	51.2	**Conc:**	51.2
Z:	0	**C:**	51.3	**R:**	103.2	**Conc:**	51.3
UOM:	ppm			**Mean Test Assay:**		51.3	ppm

2. ***Component:*** **Sulfur dioxide**

Requested Concentration: 50 ppm
Certified Concentration: 49.0 ppm
Instrument Used: AMETEK 921
Analytical Method: UV Spectrometry
Last Multipoint Calibration: 01/10/2020

Reference Standard: Type / Cylinder #: GMIS / DT0006731
Concentration / Uncertainty: 97.2 ppm ±0.818%
Expiration Date: 01/12/2024
Traceable to: SRM # / Sample # / Cylinder #: 1694a / 95-J-88 / CAL016706
SRM Concentration / Uncertainty: 98.07 / .00795
SRM Expiration Date: 12/11/2015

First Analysis Data:						**Date**	01/27/2020
Z:	0	**R:**	97.2	**C:**	49.5	**Conc:**	49.5
R:	97.1	**Z:**	0	**C:**	49.4	**Conc:**	49.4
Z:	0	**C:**	49.4	**R:**	97.3	**Conc:**	49.4
UOM:	ppm			**Mean Test Assay:**		49.4	ppm

Second Analysis Data:						**Date**	02/03/2020
Z:	0	**R:**	97.2	**C:**	48.6	**Conc:**	48.6
R:	97.2	**Z:**	0	**C:**	48.7	**Conc:**	48.7
Z:	0	**C:**	48.6	**R:**	97.3	**Conc:**	48.6
UOM:	ppm			**Mean Test Assay:**		48.6	ppm

3. ***Component:*** **Carbon monoxide**

Requested Concentration: 50 ppm
Certified Concentration: 49.6 ppm
Instrument Used: Horiba VIA 510
Analytical Method: NDIR
Last Multipoint Calibration: 01/13/2020

Reference Standard: Type / Cylinder #: GMIS / DT0012181
Concentration / Uncertainty: 50.2 ppm ±0.144%
Expiration Date: 07/03/2026
Traceable to: SRM # / Sample # / Cylinder #: 1678c / 4-L-26 / FF18339
SRM Concentration / Uncertainty: 49.136 ppm / ±0.065 PPM
SRM Expiration Date: 02/04/2021

First Analysis Data:						**Date**	01/27/2020
Z:	0	**R:**	50.2	**C:**	49.7	**Conc:**	49.7
R:	50.2	**Z:**	0	**C:**	49.6	**Conc:**	49.6
Z:	0	**C:**	49.6	**R:**	50.2	**Conc:**	49.6
UOM:	ppm			**Mean Test Assay:**		49.6	ppm

Second Analysis Data:						**Date**	02/03/2020
Z:	0	**R:**	0	**C:**	0	**Conc:**	0
R:	0	**Z:**	0	**C:**	0	**Conc:**	0
Z:	0	**C:**	0	**R:**	0	**Conc:**	0
UOM:	ppm			**Mean Test Assay:**			ppm

Analyzed By **Gregory Brodbeck**

Certified By **Edward E Zucal**

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DocNumber: 310025

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Tel: +1 (419) 729-7732
Fax: +1 (419) 729-2411
PGVP ID: F12020

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PRAXAIR PKG ROSEVILLE MN P
2455 ROSEGATE
ROSEVILLE MN 55113-2717

Certificate Issuance Date: 07/16/2020
Praxair Order Number: 71382017
Part Number: NI CD20O3E-AS
Customer PO Number: 79373728

Fill Date: 06/25/2020
Lot Number: 700010177F2
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

ProSpec EZ Cert

Expiration Date:	**07/16/2028**	NIST Traceable
Cylinder Number:	**DT0033087**	Expanded Uncertainty
20.0 %	**Carbon dioxide**	**± 0.6 %**
21.0 %	**Oxygen**	**± 0.4 %**
Balance	**Nitrogen**	

Certification Information:

Certification Date: 07/16/2020 *Term:* 96 Months *Expiration Date:* 07/16/2028

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1.

Do Not Use this Standard if Pressure is less than 100 PSIG.

O2 responses have been corrected for CO2 interference.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. ***Component:*** **Carbon dioxide**

Requested Concentration: 20.0 %
Certified Concentration: 20.0 %
Instrument Used: MKS 2030
Analytical Method: FTIR
Last Multipoint Calibration: 07/01/2020

Reference Standard: Type / Cylinder #: GMIS / CC110516
Concentration / Uncertainty: 20.23 % ±0.235%
Expiration Date: 01/13/2026
Traceable to: SRM # / Sample # / Cylinder #: PRM# 3222577.01 / n/a / FF27613
SRM Concentration / Uncertainty: 20.008% / ±0.028%
SRM Expiration Date: 04/01/2020

First Analysis Data:						**Date**	07/16/2020
Z:	0	**R:**	17.1	**C:**	16.8	**Conc:**	20
R:	17.1	**Z:**	0	**C:**	16.9	**Conc:**	20.1
Z:	0	**C:**	16.8	**R:**	16.9	**Conc:**	20
UOM:	%			**Mean Test Assay:**		20	%

Second Analysis Data:						**Date**	
Z:	0	**R:**	0	**C:**	0	**Conc:**	0
R:	0	**Z:**	0	**C:**	0	**Conc:**	0
Z:	0	**C:**	0	**R:**	0	**Conc:**	0
UOM:	%			**Mean Test Assay:**			%

2. ***Component:*** **Oxygen**

Requested Concentration: 21.0 %
Certified Concentration: 21.0 %
Instrument Used: Servomex 575
Analytical Method: Paramagnetic
Last Multipoint Calibration: 06/22/2020

Reference Standard: Type / Cylinder #: GMIS / SGAL2224
Concentration / Uncertainty: 22.49 % ±0.3%
Expiration Date: 12/02/2027
Traceable to: SRM # / Sample # / Cylinder #: 2659a / 71-D-04 / CAL015785
SRM Concentration / Uncertainty: 20.72 / ±0.043
SRM Expiration Date: 08/23/2021

First Analysis Data:						**Date**	07/16/2020
Z:	0	**R:**	22.5	**C:**	21	**Conc:**	21
R:	22.5	**Z:**	0	**C:**	21	**Conc:**	21
Z:	0	**C:**	21	**R:**	22.5	**Conc:**	21
UOM:	%			**Mean Test Assay:**		21	%

Second Analysis Data:						**Date**	
Z:	0	**R:**	0	**C:**	0	**Conc:**	0
R:	0	**Z:**	0	**C:**	0	**Conc:**	0
Z:	0	**C:**	0	**R:**	0	**Conc:**	0
UOM:	%			**Mean Test Assay:**			%

Analyzed By **Mike Monnette**

Certified By **Edward E Zucal**

Praxair Distribution. Inc.
10210 North Freeway
Houston, TX 77037
Tel: 1-281-880-4445
Fax: 1-281-880-4449

Customer & Order Information:

Certificate Issuance Date: **4/12/2019**

PACE ANALYTICAL SERVICES INC
1700 ELM ST SE, DEPT 1251 FIELD SERVICES AIR GARAGE
MINNEAPOLIS, MN 55414

Praxair Order Number: **C73931383**
Customer PO Number: **BETH KELM EMAIL**

Certification Date: **4/12/2019**
Lot Number: **70017910101**
Part Number: **AI HX15MC-AS**

DocNumber: **67210**
Expiration Date: **4/11/2024**

CERTIFICATE OF ANALYSIS

Certified Standard

Component	Requested Concentration (Molar)	Certified Concentration (Molar)	Analytical Reference	Analytical Uncertainty
n-Hexane	**15.0 ppm**	**15.0 ppm**	**1**	**± 5 %**
Air	**Balance**	**Balance**		

Cylinder Style: **AS**
Cylinder Pressure @ 70 F: **2000 psig**
Cylinder Volume: **142.8 ft3**
Valve Outlet Connection: **CGA 590**
Cylinder Number(s): **LCCO-SA3511**

Fill Date: **4/11/2019**
Analysis Date: **4/12/2019**

Filling Method: **Gravimetric**

Brian Courts

Certifier: **Brian Courts**

Approved Signer: **Abel Navarrete**

Key to Analytical Techniques:

Reference	Analytical Instrument - Analytical Principle
1	Varian CP-4900 Micro GC - Gas Chromatography with TCD

The gas calibration cylinder standard prepared by Praxair Distribution, Inc. is considered a certified standard. It is prepared by gravimetric, volumetric, or partial pressure techniques. The calibration standard provided is certified against Praxair Distribution, Inc. Reference Materials which are either prepared by weights traceable to the National Institute of Standards and Technology (NIST), Measurement Canada, or by using NIST Standard Reference Materials where available.

Note: All expressions for concentration (e.g., % or ppm) are for gas phase, by volume (e.g., ppmv) unless otherwise noted. Analytical uncertainty is expressed as a Relative % unless otherwise noted.

Gas Stratification Determination

Grede, LLC - Iron Mountain

Kingsford, MI
Pace Project No. 20-04074

Appendix D

Gas Stratification Determination
Cupola Baghouse Inlet
Test 1

Traverse Point	Distance From Wall	O2 %v/v, Dry	CO2 %v/v, Dry	THC PPM, Wet	CO PPM, Dry	SO2 PPM, Dry
1	8.0	8.72	11.69	0.28	9.13	17.14
2	24.0	8.81	11.57	0.28	11.05	18.83
3	40.0	8.84	11.55	0.26	8.87	16.45
Average Concentration		8.79	11.60	0.27	9.68	17.47

Difference from Mean	Conc.	%	Conc.	%	Conc.	%	Conc.	%	Conc.	%
1	-0.07	0.8%	0.09	0.8%	0.01	3.9%	-0.55	5.7%	-0.34	1.9%
2	0.02	0.3%	-0.03	0.3%	0.01	2.4%	1.37	14.2%	1.36	7.8%
3	0.05	0.6%	-0.05	0.5%	-0.02	6.3%	-0.82	8.4%	-1.02	5.9%
Max Deviation (abs)	0.07	0.8%	0.09	0.8%	0.02	6.3%	1.37	14.2%	1.36	7.8%
Stratification Status	Unstratified		Unstratified		Not Used		Not Used		Not Used	
Sampling Traverse	1 Point		1 Point							

Sample Traverse Point Specifications

Required Traverse Points 1

System Response Time:	1	Minutes
Pause between Points:	1	Readings
Dwell Time Per Point:	4	Readings

Point Locations for Round Duct
Use Most Representative Point

Stratification Specification - EPA 7E, Section 8.1.2

Unstratified:	≤ 5% or 0.5 PPM^1 max deviation
Minimal Strat:	≤ 10% or 1.0 PPM^1 max deviation
Stratified:	> 10% or 1.0 PPM^1 max deviation

Gas Monitor Calibration Summary

Grede, LLC - Iron Mountain

Kingsford, MI
Pace Project No. 20-04074

Appendix D

Gas Monitor Calibration Summary
Cupola Baghouse Inlet
Test 1

	Oxygen (O2), %v/v	**Cal Set 1**	**Cal Set 2**	**Cal Set 3**
Calibration Error:	Zero Gas Value	0.00		
	Low Gas Value			
	Mid Gas Value	10.90		
	High Gas Value	21.00		
	Cal Date	12/15/2020		
	Cal Time	7:46		
	Zero Reading	0.06		
	Low Reading			
	Mid Reading	11.05		
	High Reading	21.05		
	Zero Gas Error, %	0.29%		
	Low Gas Error, %			
	Mid Gas Error, %	0.70%		
	High Gas Error, %	0.26%		
System Bias:	Cal Date	12/15/2020	12/15/2020	12/15/2020
	Pre Bias Start	8:21	10:11	12:04
	Post Bias End	10:23	12:13	14:32
	CE Rdg for Span	11.05	11.05	11.05
	Pre Zero Reading	0.09	0.03	0.00
	Post Zero Reading	0.03	0.00	-0.02
	Pre Span Reading	10.89	10.88	10.82
	Post Span Reading	10.88	10.82	10.77
	Pre Zero Bias, %	0.16%	-0.14%	-0.27%
	Post Zero Bias, %	-0.14%	-0.27%	-0.39%
	Pre Span Bias, %	-0.75%	-0.80%	-1.08%
	Post Span Bias, %	-0.80%	-1.08%	-1.32%
	Zero Drift, %	0.30%	0.12%	0.12%
	Upscale Drift, %	0.06%	0.28%	0.24%

	Carbon Dioxide, %v/v	**Cal Set 1**	**Cal Set 2**	**Cal Set 3**
Calibration Error:	Zero Gas Value	0.00		
	Low Gas Value			
	Mid Gas Value	9.93		
	High Gas Value	20.00		
	Cal Date	12/15/2020		
	Cal Time	7:46		
	Zero Reading	-0.02		
	Low Reading			
	Mid Reading	9.89		
	High Reading	20.07		
	Zero Gas Error, %	-0.11%		
	Low Gas Error, %			
	Mid Gas Error, %	-0.22%		
	High Gas Error, %	0.35%		
System Bias:	Cal Date	12/15/2020	12/15/2020	12/15/2020
	Pre Bias Start	8:21	10:11	12:04
	Post Bias End	10:23	12:13	14:32
	CE Rdg for Span	9.89	9.89	9.89
	Pre Zero Reading	-0.03	-0.03	-0.04
	Post Zero Reading	-0.03	-0.04	-0.05
	Pre Span Reading	9.82	9.87	9.95
	Post Span Reading	9.87	9.95	9.88
	Pre Zero Bias, %	-0.02%	-0.03%	-0.07%
	Post Zero Bias, %	-0.03%	-0.07%	-0.12%
	Pre Span Bias, %	-0.32%	-0.06%	0.32%
	Post Span Bias, %	-0.06%	0.32%	-0.04%
	Zero Drift, %	0.02%	0.04%	0.05%
	Upscale Drift, %	0.26%	0.39%	0.36%

Grede, LLC - Iron Mountain

Kingsford, MI
Pace Project No. 20-04074

Appendix D

Gas Monitor Calibration Summary
Cupola Baghouse Inlet
Test 1

Total Hydrocarbons (C3H8), PPM		Cal Set 1	Cal Set 2	Cal Set 3
Calibration Error:	Zero Gas Value	0.00		
	Low Gas Value	15.00		
	Mid Gas Value	25.90		
	High Gas Value	39.90		
	Cal Date	12/15/2020		
	Cal Time	8:37		
	Zero Reading	0.05		
	Low Reading	15.21		
	Mid Reading	25.11		
	High Reading	39.87		
	Zero Gas Error, %	0.12%		
	Low Gas Error, %	0.53%		
	Mid Gas Error, %	-1.97%		
	High Gas Error, %	-0.08%		
System Bias:	Cal Date	12/15/2020	12/15/2020	12/15/2020
	Pre Bias Start	8:37	10:03	11:53
	Post Bias End	10:07	11:59	14:15
	CE Rdg for Span	15.21	15.21	15.21
	Pre Zero Reading	0.05	0.26	0.24
	Post Zero Reading	0.26	0.24	0.07
	Pre Span Reading	15.21	15.44	15.34
	Post Span Reading	15.44	15.34	15.22
	Pre Zero Bias, %	0.00%	0.54%	0.49%
	Post Zero Bias, %	0.54%	0.49%	0.05%
	Pre Span Bias, %	0.00%	0.57%	0.31%
	Post Span Bias, %	0.57%	0.31%	0.01%
	Zero Drift, %	0.54%	0.06%	0.43%
	Upscale Drift, %	0.57%	0.26%	0.30%

Carbon Monoxide, PPM		Cal Set 1	Cal Set 2	Cal Set 3
Calibration Error:	Zero Gas Value	0.00		
	Low Gas Value			
	Mid Gas Value	49.60		
	High Gas Value	110.00		
	Cal Date	12/15/2020		
	Cal Time	7:46		
	Zero Reading	0.12		
	Low Reading			
	Mid Reading	48.50		
	High Reading	110.01		
	Zero Gas Error, %	0.11%		
	Low Gas Error, %			
	Mid Gas Error, %	-1.00%		
	High Gas Error, %	0.01%		
System Bias:	Cal Date	12/15/2020	12/15/2020	12/15/2020
	Pre Bias Start	8:21	10:11	12:04
	Post Bias End	10:23	12:13	14:32
	CE Rdg for Span	48.50	48.50	48.50
	Pre Zero Reading	0.64	0.96	1.28
	Post Zero Reading	0.96	1.28	1.19
	Pre Span Reading	48.81	48.52	48.08
	Post Span Reading	48.52	48.08	51.00
	Pre Zero Bias, %	0.47%	0.77%	1.05%
	Post Zero Bias, %	0.77%	1.05%	0.97%
	Pre Span Bias, %	0.28%	0.01%	-0.39%
	Post Span Bias, %	0.01%	-0.39%	2.27%
	Zero Drift, %	0.30%	0.28%	0.08%
	Upscale Drift, %	0.27%	0.40%	2.65%

Appendix D

Gas Monitor Calibration Summary
Cupola Baghouse Inlet
Test 1

Sulfur Dioxide, PPM		Cal Set 1	Cal Set 2	Cal Set 3
Calibration Error:	Zero Gas Value	0.00		
	Low Gas Value			
	Mid Gas Value	49.00		
	High Gas Value	110.00		
	Cal Date	12/15/2020		
	Cal Time	7:46		
	Zero Reading	0.13		
	Low Reading			
	Mid Reading	49.97		
	High Reading	111.07		
	Zero Gas Error, %	0.12%		
	Low Gas Error, %			
	Mid Gas Error, %	0.88%		
	High Gas Error, %	0.97%		
System Bias:	Cal Date	12/15/2020	12/15/2020	12/15/2020
	Pre Bias Start	8:21	10:11	12:04
	Post Bias End	10:23	12:13	14:32
	CE Rdg for Span	49.97	49.97	49.97
	Pre Zero Reading	0.69	1.08	1.80
	Post Zero Reading	1.08	1.80	1.91
	Pre Span Reading	47.39	47.35	46.88
	Post Span Reading	47.35	46.88	46.62
	Pre Zero Bias, %	0.50%	0.86%	1.51%
	Post Zero Bias, %	0.86%	1.51%	1.62%
	Pre Span Bias, %	-2.34%	-2.38%	-2.81%
	Post Span Bias, %	-2.38%	-2.81%	-3.04%
	Zero Drift, %	0.36%	0.65%	0.11%
	Upscale Drift, %	0.04%	0.43%	0.24%

Calibration Gas List
Cupola Baghouse Inlet
Test 1

Calibration Gas Parameter		High Level Calibration Gas		Mid Level Calibration Gas		Low Level Calibration Gas	
		Certified Value	Certificate No.	Certified Value	Certificate No.	Certified Value	Certificate No.
O2	Oxygen (O2)	21	DT0033087	10.9	CC95749		
CO2	Carbon Dioxide	20	DT0033087	9.93	CC95749		
THC	Propane	39.9	CC158131	25.9	CC171522	15	SA3511
CO	Carbon Monoxide	246	CC93519	110	CC128093	49.6	CC350671
SO2	Sulfur Dioxide	110	CC128093	49	CC350671		

VE Observer Certifications

AeroMet
Engineering, Inc.
Solutions for a Changing Environment

Certification of Visible Opacity Reading

Zachary Eckstrom

qualified to conduct EPA Method 9 Tests for visible opacity in accordance with the methods established for such qualification in 40 CFR Part 60 Appendix A.

Certification Date: November 04, 2020

Expiration Date: May 04, 2021

Douglas Young

AeroMet Instructor: Douglas Young

AEROMET ENGINEERING INC. CERTIFIES THAT

Zachary Eckstrom

has qualified as a CERTIFIED VISIBLE EMISSIONS READER per Title 40 Part 60 Appendix A USEPA Method 9

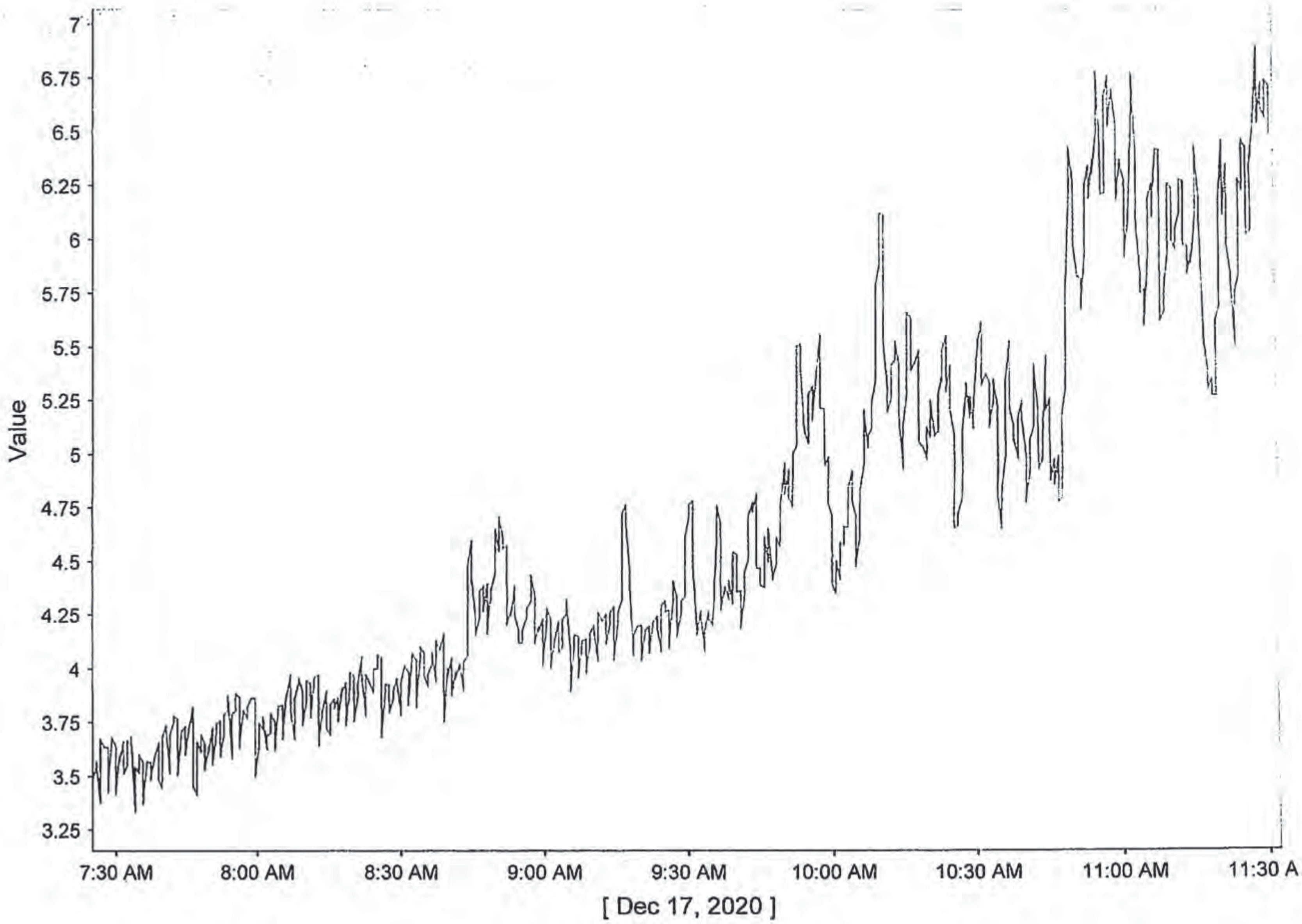
Issued: 11/04/2020 Expires: 05/04/2021

Questions? Call 573.636.6393

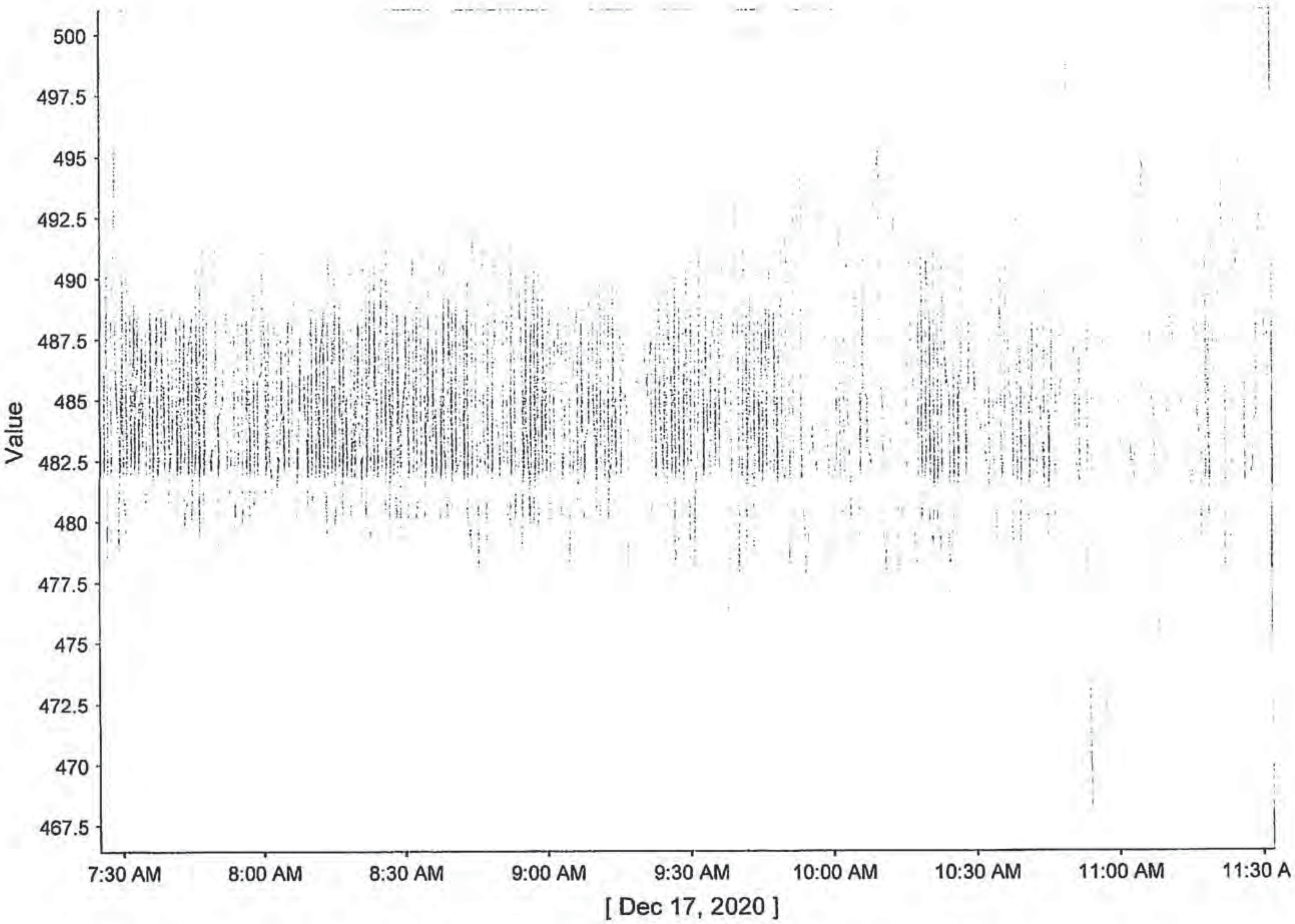
Appendix E

Source/Process/Plant Information

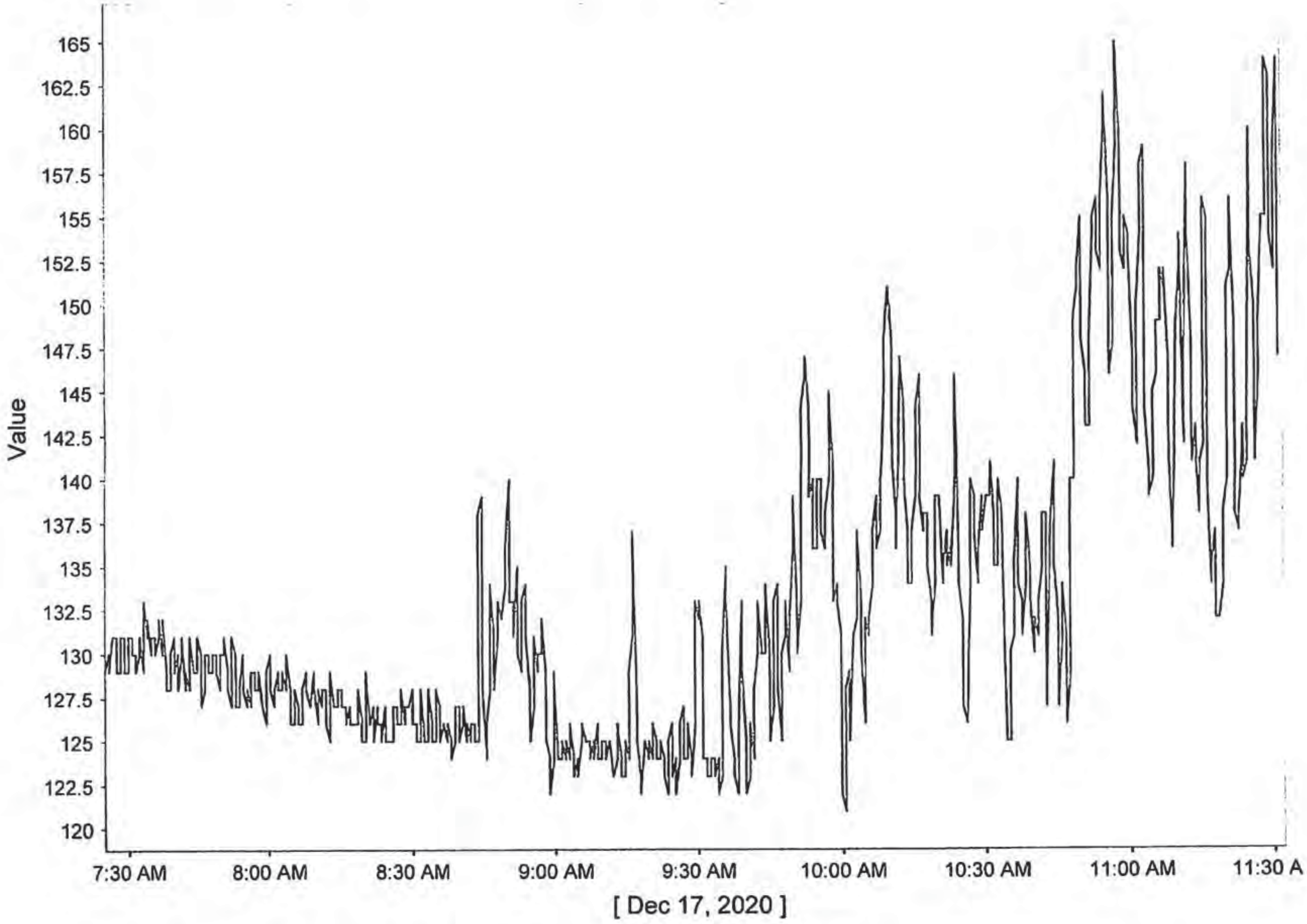
Process Operating Data



Baghouse Diff Press



Baghouse Inlet Temp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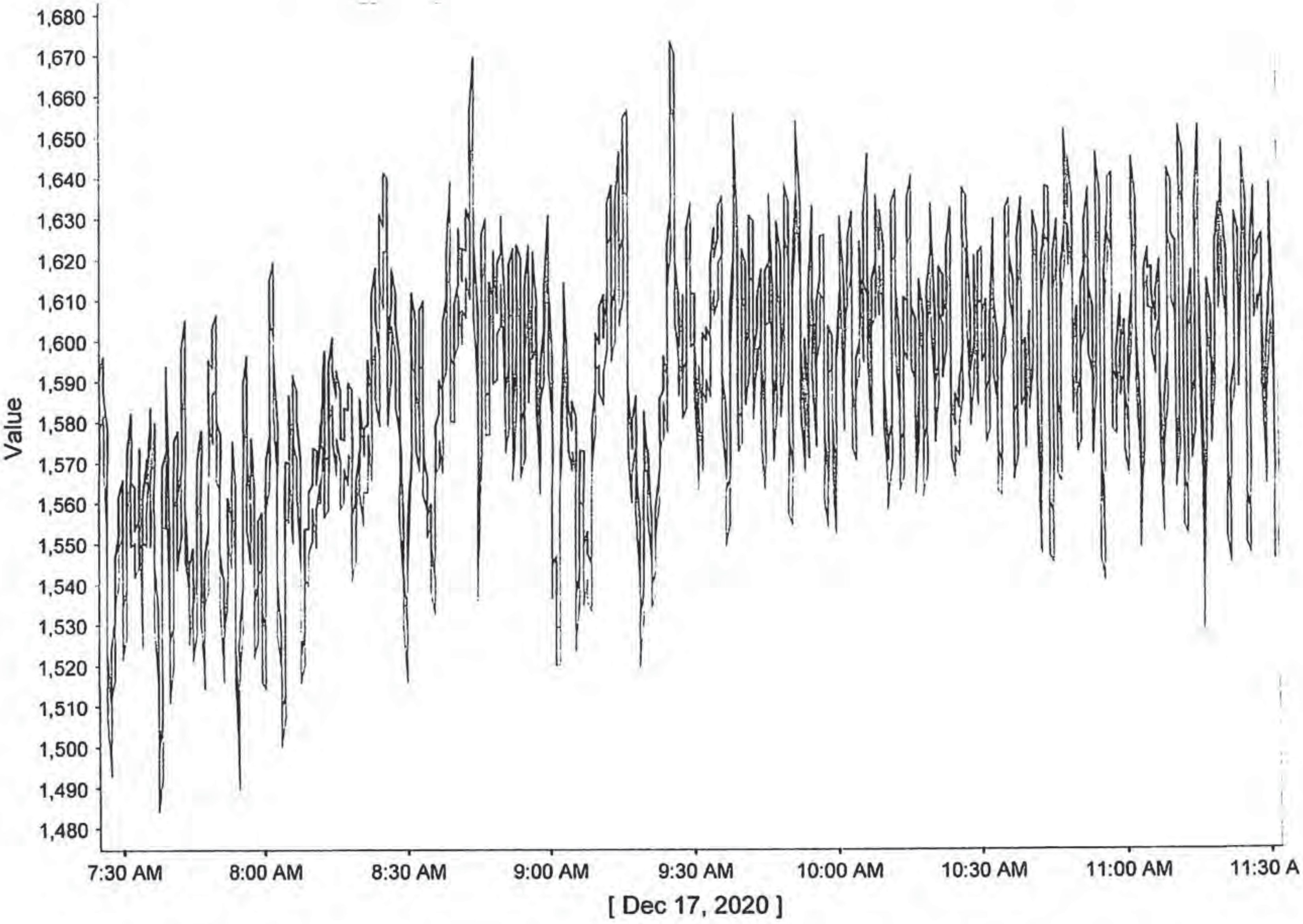
125
122.5
120
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
11:30 A
[Dec 17, 2020]

Blower Amps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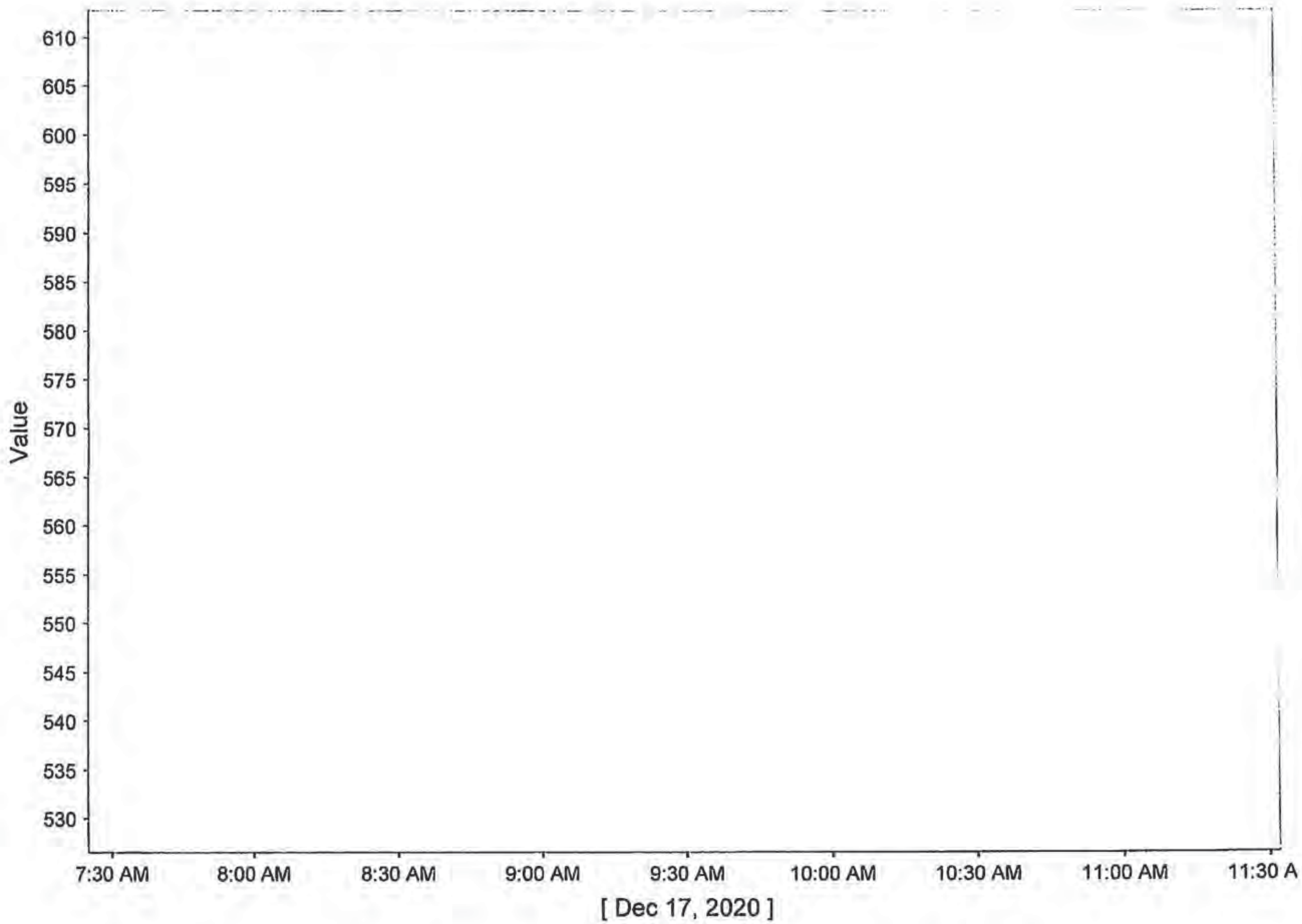
1,490
1,480
Value
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
11:30 A
[Dec 17, 2020]

stack Temp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8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
11:30 A
[Dec 17, 2020]

Blast Rate

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG

DATE: 12 / 17 / 20

WEIGHT VARIANCE CHECK

1. Record the weight on one complete charge.
2. Place clock number (Charger)
3. Notify Melt Supervisor if variation exceeds limits.

BED STONE: 200

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHA CLO
432	1	1500	1000	0	235	2/2	180	15	100	
435	2									
439	3									
442	4									
445	5				+50✓					
448	6									
451	7	1250*	1250*	0	235	2/2	120	10*	100	
454	8									
457	9				+100✓				+100✓	
518	10									
522	1									
525	2									
529	3									
542	4									
546	5									
549	6									
553	7									
559	8	1100*	1400*	0	[illegible] 235	2/2	120	10	100	
602	9									
607	20									
610	1									
614	2									

SCALE TOLERANCE CHECK

TIME CHECKED: ____:____

EMPL ID NO.: ________

CHARGE SCALE:	ZERO	STEEL	RETURNS	PIGS
WEIGHT IN:				
WEIGHT OUT:				
LUMP SCALE (ACTUAL):				

INITIALS OF SUPERVISOR NOTIFIED OF OUT OF TOLERANCE WEIGHTS: ________

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG (CONTINUED)

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHARG CLOCK
617	23									
620	24									
627	25									
630	26									
637	27									
640	28									
643	29									
646	30	1100	1400	0	235	2/2	120	0A	100	
650	1									
656	2									
659	3									
707	4									
710	5									
713	6									
717	7									
724	8									
727	9									
730	40									
737	1									
741	2									
748	3									
751	4									
45 754	5				235					
800	6	1100	1400	0	275	2/2	120	0	120	
805	7									
811	8									
814	9									
817	50									
826	1									
830	2									
834	3									

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG

DATE: 12 / 17 / 20

WEIGHT VARIANCE CHECK

1. Record the weight on one complete charge.
2. Place clock number (Charger)
3. Notify Melt Supervisor if variation exceeds limits.

48

BED STONE: ____________

	TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHA CLO
	837	54	1100	1400	0	235	2/2	120	0	120	
	841	5									
	848	6									
	854	7									
	857	8									
	900	9									
	907	60									
	914	1									
	918	2									
	923	3									
	927	4									
	933	5									
	936	6									
	940	7									
	945	8									
	949	9									
25	956	70									
	1000	1									
	1007	2									
	1010	3									
	1013	4									
	1022	5				50					

SCALE TOLERANCE CHECK

TIME CHECKED: ____:____	CHARGE SCALE:	ZERO	STEEL	RETURNS	PIGS
	WEIGHT IN:				
EMPL ID NO.: ____________	WEIGHT OUT:				
	LUMP SCALE (ACTUAL):				

INITIALS OF SUPERVISOR NOTIFIED OF OUT OF TOLERANCE WEIGHTS: ______

FORM 030036

+5 Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG (CONTINUED)

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHARGI CLOCK
1025	76	1100	1400	0	235	2/2	120	0	120	
1030	7									
1033	8									
1037	9									
1041	80									
1047	1									
1052	2									
1057	3				+100					
1 1100	4.	1500#	1000#	0	235	2/2	120	0	120	
2 1105	5.									
3 1108	6.								+200	
4. 1113	7.									
5 1119	8.	1500	1000	0	235	2/2	0#	40#	120	
4 1123	9									
1128	90								+200	
21 1131	1									
	~~2~~									
	3									
	4.									
	5.									
	6									
	7									
	8									
	9									
	100									
	1									
	2									
	3									
	4									
	5									
	6									

#1000

Cover

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG

DATE: 12 / 16 / 20

WEIGHT VARIANCE CHECK

1. Record the weight on one complete charge.
2. Place clock number (Charger)
3. Notify Melt Supervisor if variation exceeds limits.

BED STONE: 200

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHAR CLO
429	1	1500	1000	0	235	2/2½	120	15	100	
433	2									
437	3									
441	4				+25					
446	5									
450	6									
454	7	1250*	1250*	0	235	2/2½	120	10*	100	
458	8									
502	9								+100	
522	10									
526	1				+100					
531	2									
535	3									
539	4									
543	5									
547	6									
552	7									
556	8	1100*	1400*	0	235	2/2½	120	10	100	
602	9									
605	20									
608	1									
611	2									

SCALE TOLERANCE CHECK

TIME CHECKED: ____:____

EMPL ID NO.: __________

CHARGE SCALE:	ZERO	STEEL	RETURNS	PIGS
WEIGHT IN:				
WEIGHT OUT:				

LUMP SCALE (ACTUAL):

INITIALS OF SUPERVISOR NOTIFIED OF OUT OF TOLERANCE WEIGHTS: ________

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG (CONTINUED)

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHARG CLOCK
614	3	1100	1400	0	235	2/2½	120	10	100	07618
619	4									
626	5									
629	6									
632	7									
636	8									
640	9									
644	30									
651	1									
654	2	1100	1400	0	235	2/2½	120	0	100	Bffa
657	3									
705	4									
708	5									
711	6									
714	7									
718	8									
723	9									
726	40									
733	1									
736	2									
740	3									
755	4									
800	5									
804	6									
807	7									
810	8									
814	9									
820	50									
824	1									
827	2									
830	3									

25

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG

DATE: 12 / 16 / 20

WEIGHT VARIANCE CHECK

1. Record the weight on one complete charge.
2. Place clock number (Charger)
3. Notify Melt Supervisor if variation exceeds limits.

BED STONE: ____________

8

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHAI CLO
833	4	1100	1400	0	235	2/12	120	0	100	0761B
836	5									
839	6									
843	7									
850	8									
853	9									
901	60				+50 ✓				+100 ✓	
904	1									
907	2									
911	3									
914	4									
918	5									
925	6									
935	7									
938	8									
941	9									
944	70									
948	1									
951	2									
954	3									
㉙ 1000	4									
1005	5									

SCALE TOLERANCE CHECK

TIME CHECKED: ____:____

EMPL ID NO.: ____________

CHARGE SCALE:	ZERO	STEEL	RETURNS	PIGS
WEIGHT IN:				
WEIGHT OUT:				

LUMP SCALE (ACTUAL):

INITIALS OF SUPERVISOR NOTIFIED OF OUT OF TOLERANCE WEIGHTS: ________

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG (CONTINUED)

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHARG CLOCK
1008	6	1100	1400	0	235	2/12	120	0	100	07618
1013	7									
1016	8									
1022	9									
1026	80									
1029	1									
1032	2									
1037	3									
1040	4									
1044	5									
1051	6									
1054	7									
1057	8									
1104	9									
1107	90									
1110	1									
1141	2									
1145	3									
1148	4						90			
1154	5									
1158	6									
1207	7									
1210	8						90			
1215	9									
1218	100									
1223	1									
1227	2									
1232	3									
1235	4									
1240	5									
1244	6									

23

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG

DATE: 12 / 16 / 20

WEIGHT VARIANCE CHECK

1. Record the weight on one complete charge.
2. Place clock number (Charger)
3. Notify Melt Supervisor if variation exceeds limits.

BED STONE: ____________

T10

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHA CLO
1247	107	1100	1400	0	235	2/2	120	0	100	
1253	8									
1257	9									
102	110									
108.	1									
111	2									
114	3									
117.	4									
127.	5									
130	6									
138	7									
142.	8									
145.	9									
153	120									
156.	1									
159	2									
202	3									
211	4									
214	5									
218.	6									
225	7									
229	8									

26

SCALE TOLERANCE CHECK

TIME CHECKED: ____:____

EMPL ID NO.: ____________

CHARGE SCALE:	ZERO	STEEL	RETURNS	PIGS
WEIGHT IN:				
WEIGHT OUT:				
LUMP SCALE (ACTUAL):				

INITIALS OF SUPERVISOR NOTIFIED OF OUT OF TOLERANCE WEIGHTS: ________

FORM 030036

Date Revised: 05/15/10 Revision 4A

+6

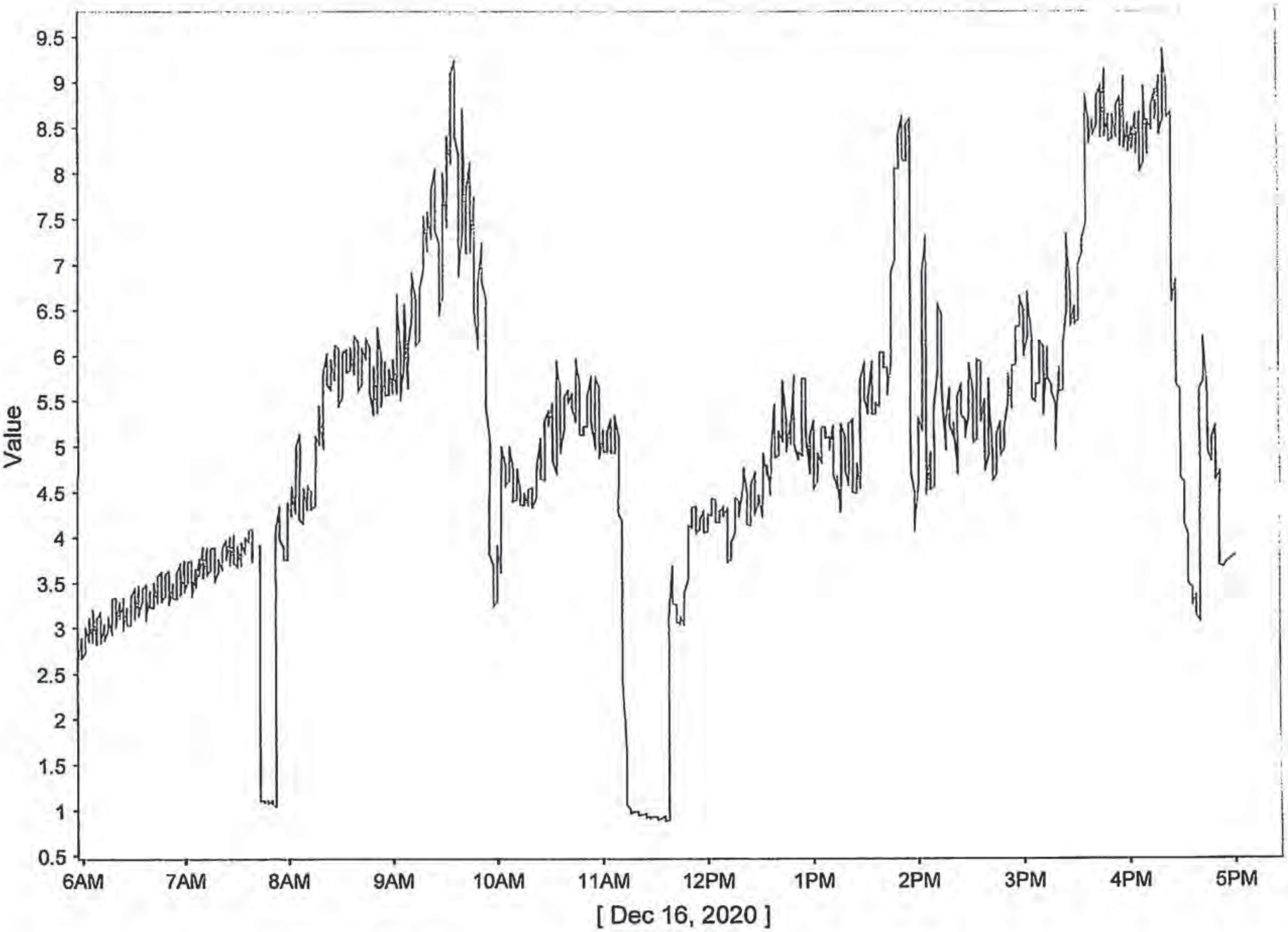
DAILY CHARGE LOG (CONTINUED)

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHARGI CLOCK
232	129	1100	1400	0	235	2/2	120	0	100	078752
2:35	130									
238	1									
241	2									
245	3				+100 ✓					
250	4	1500*	1000*	0	235	2/2	120	10*	100	
255	5									
259	6				+200 ✓					
302	7	1500	1000	0	235	2/2	0*	40*	100	
311	8								+100 ✓	
3:14	9								+100 ✓	
318	140									
3:22	1								+100 ✓	
3:23	2									
	3									
	4									
	5									
	6									
	7									
	8									
	9									
	150									

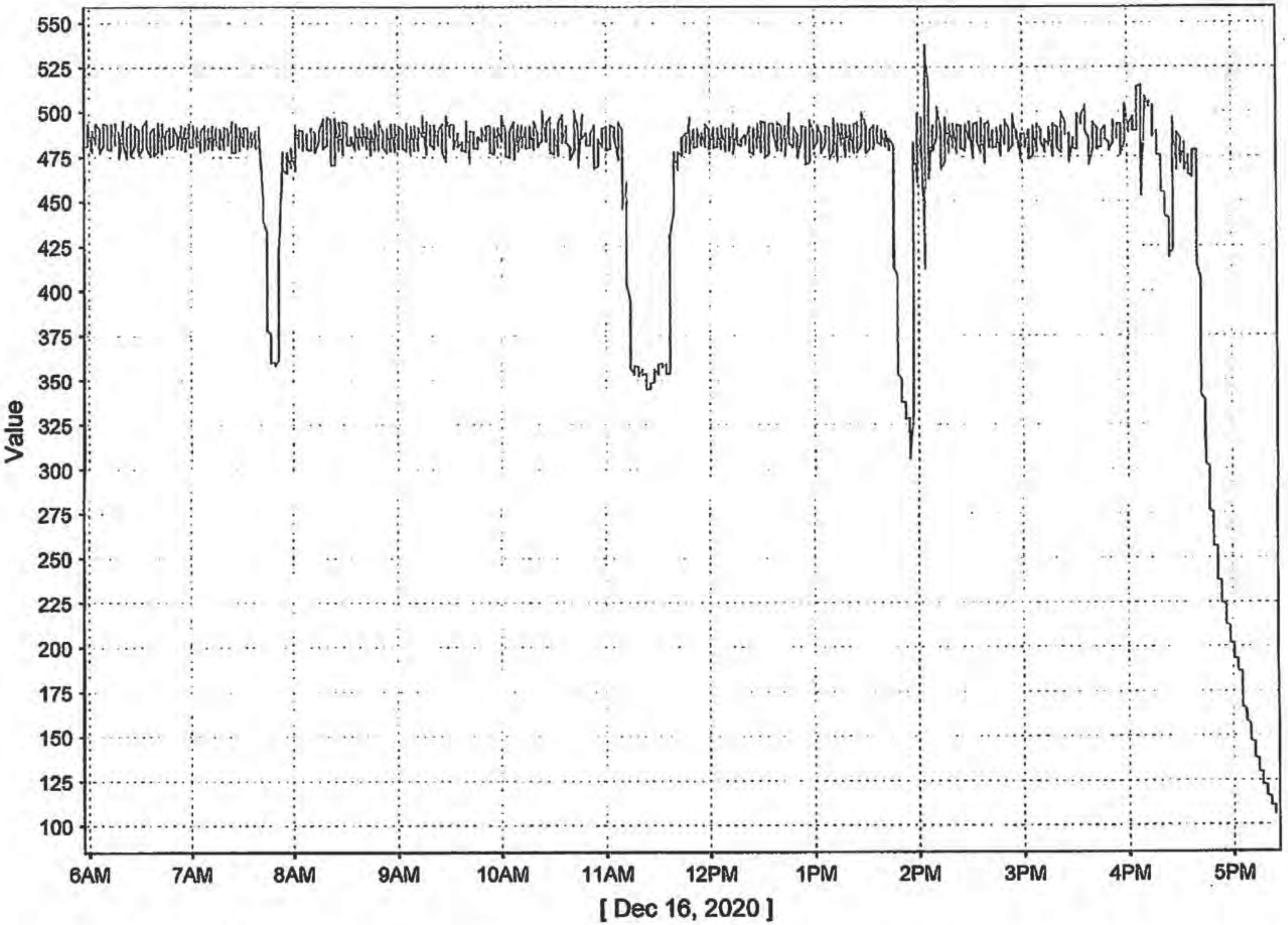
20

700 lbs !
Coke up

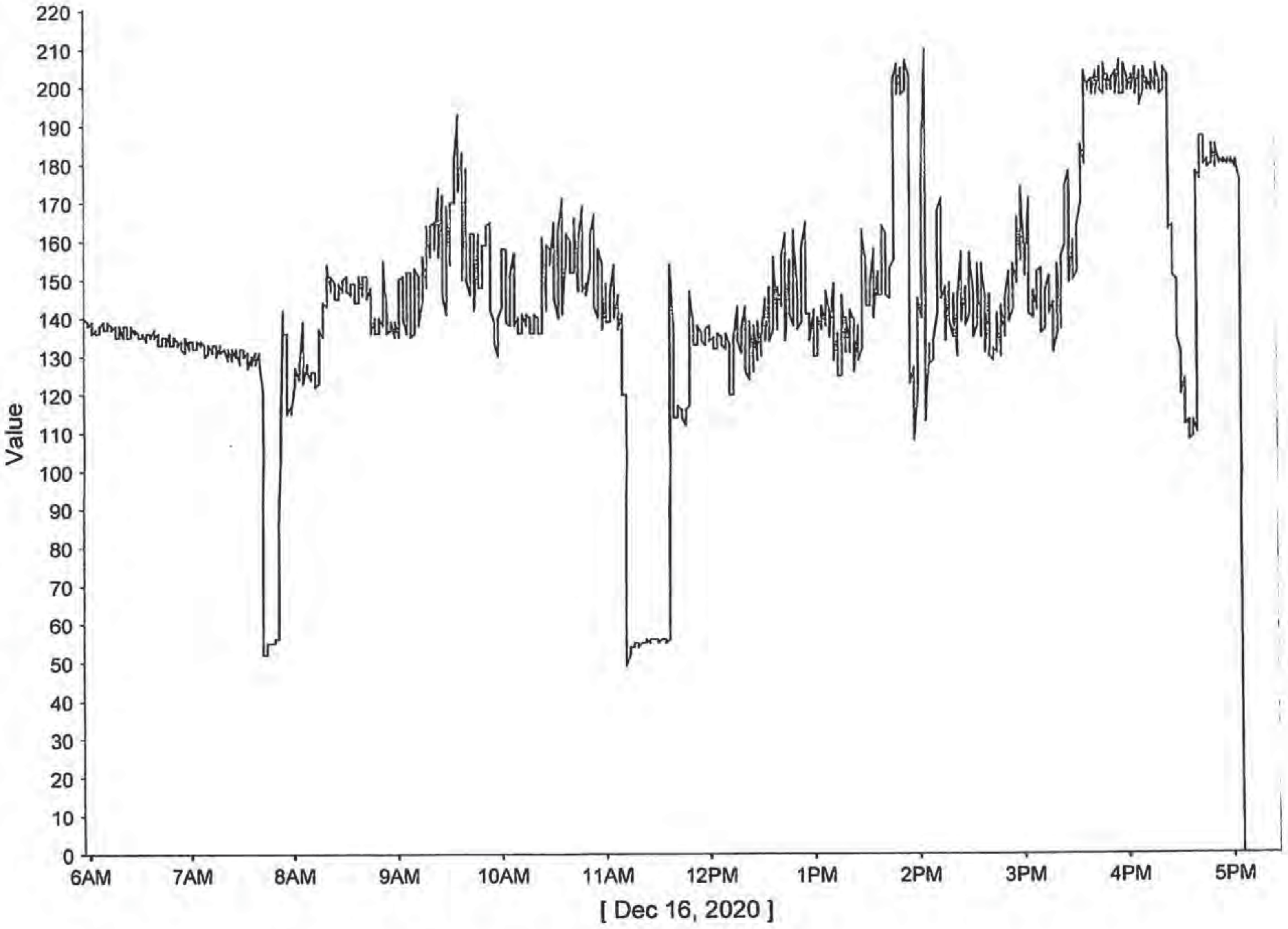
FORM 030036



Baghouse Diff. Press

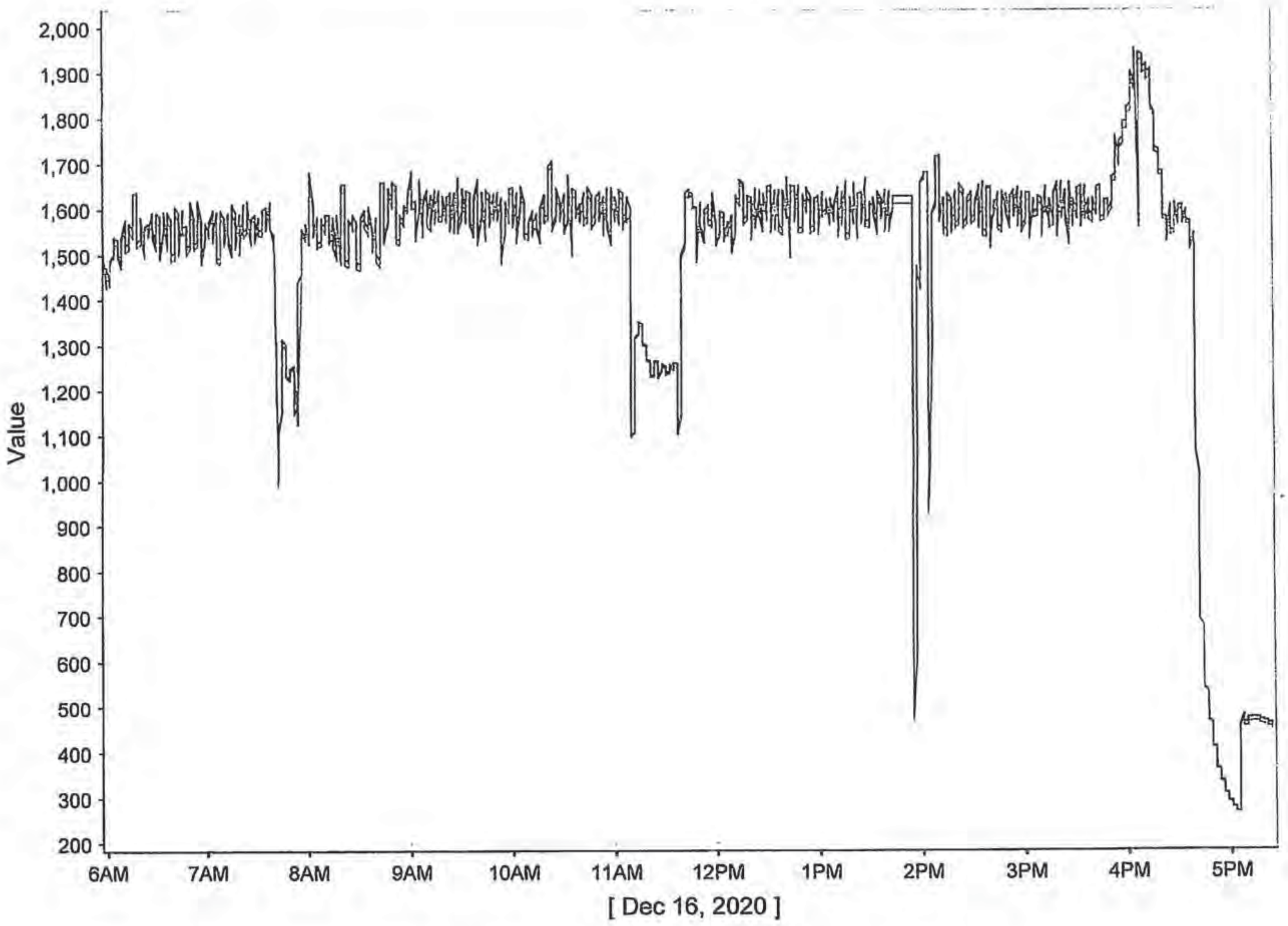


Baghouse Inlet Temp



220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Value
6AM
7AM
8AM
9AM
10AM
11AM
12PM
1PM
2PM
3PM
4PM
5PM
[Dec 16, 2020]

Blower Amps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600
500
400
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3PM
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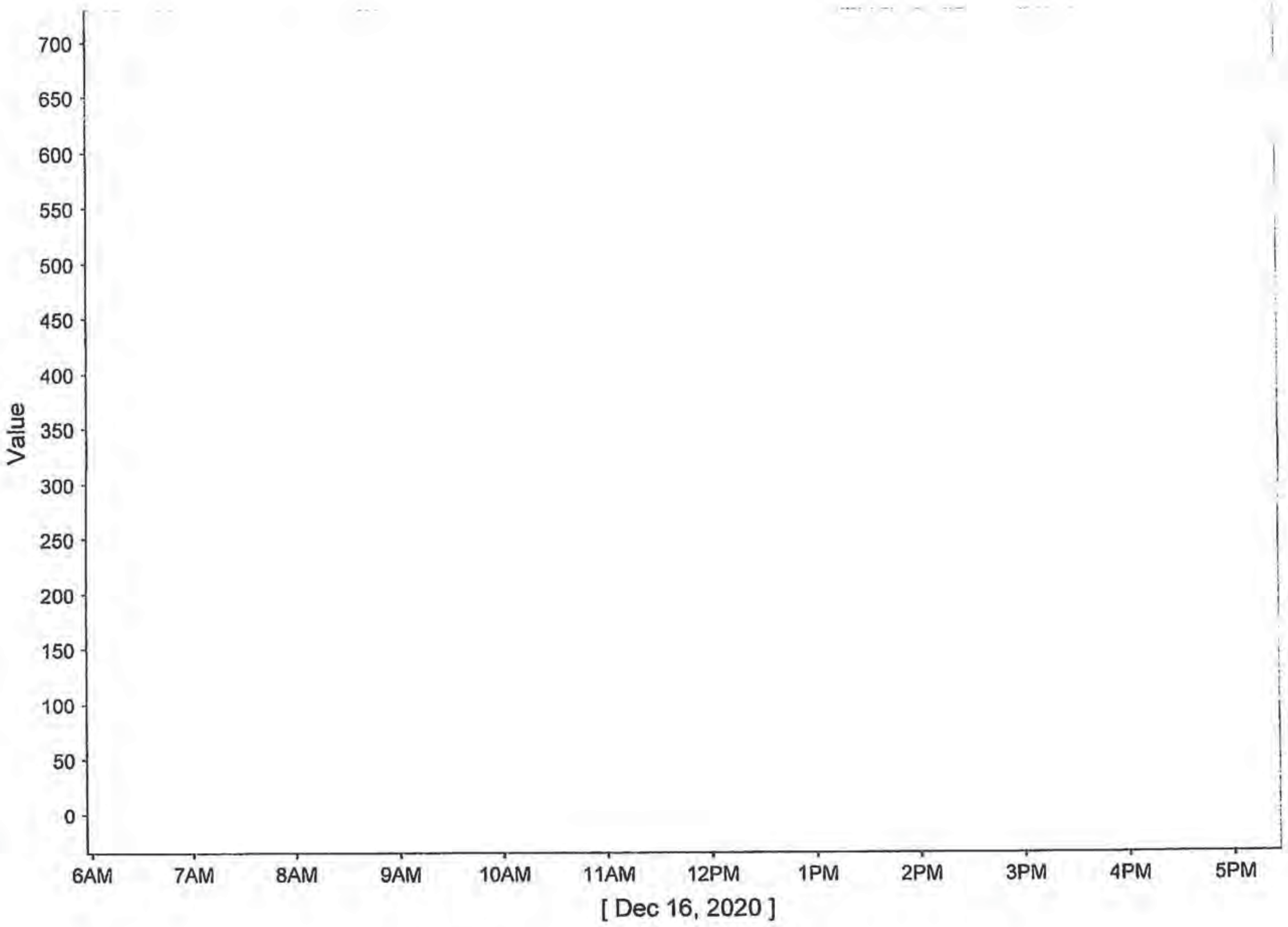
5PM
[Dec 16, 2020]

Stack Temp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100
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Value
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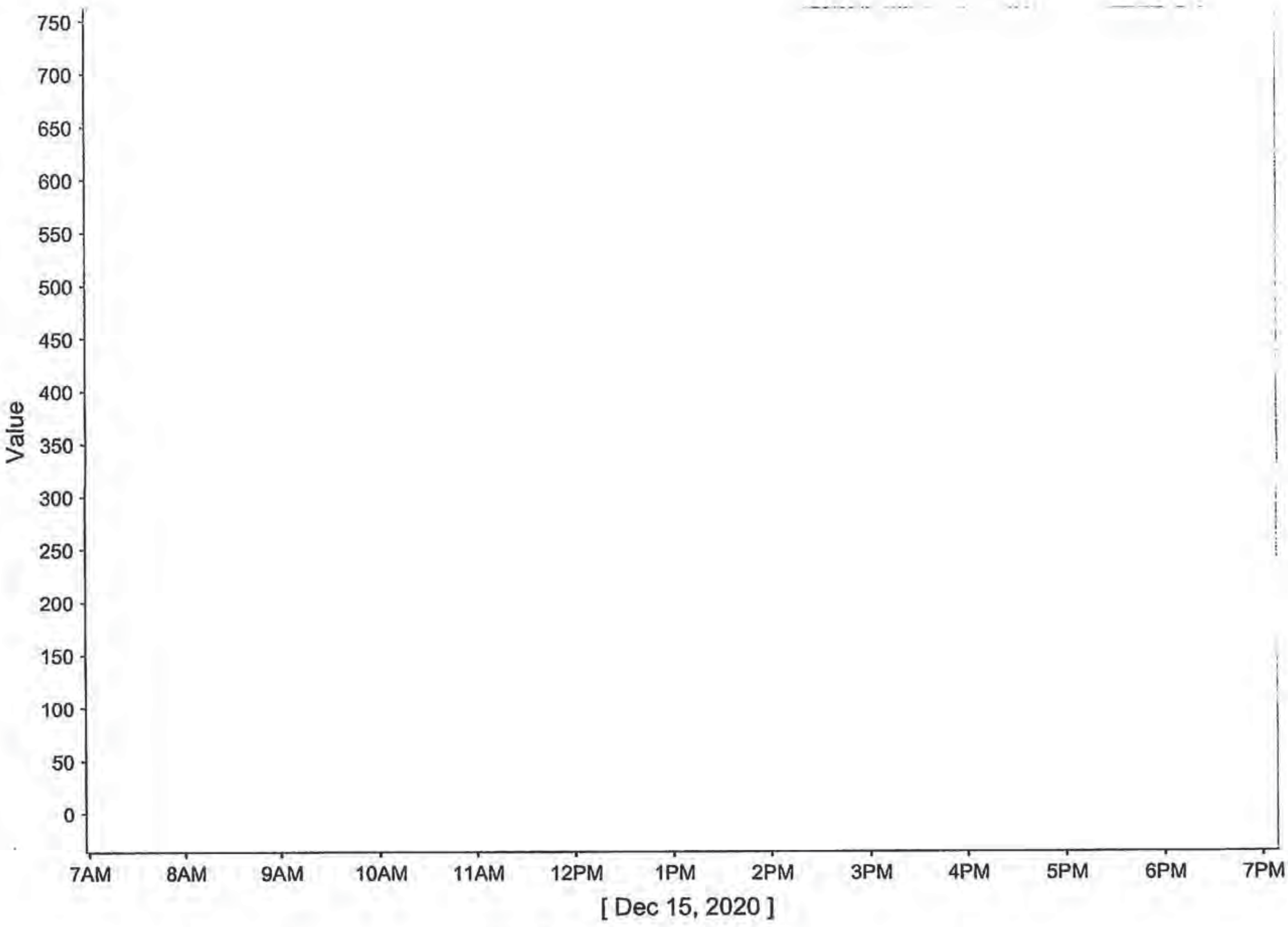
[Dec 16, 2020]

Blast Rate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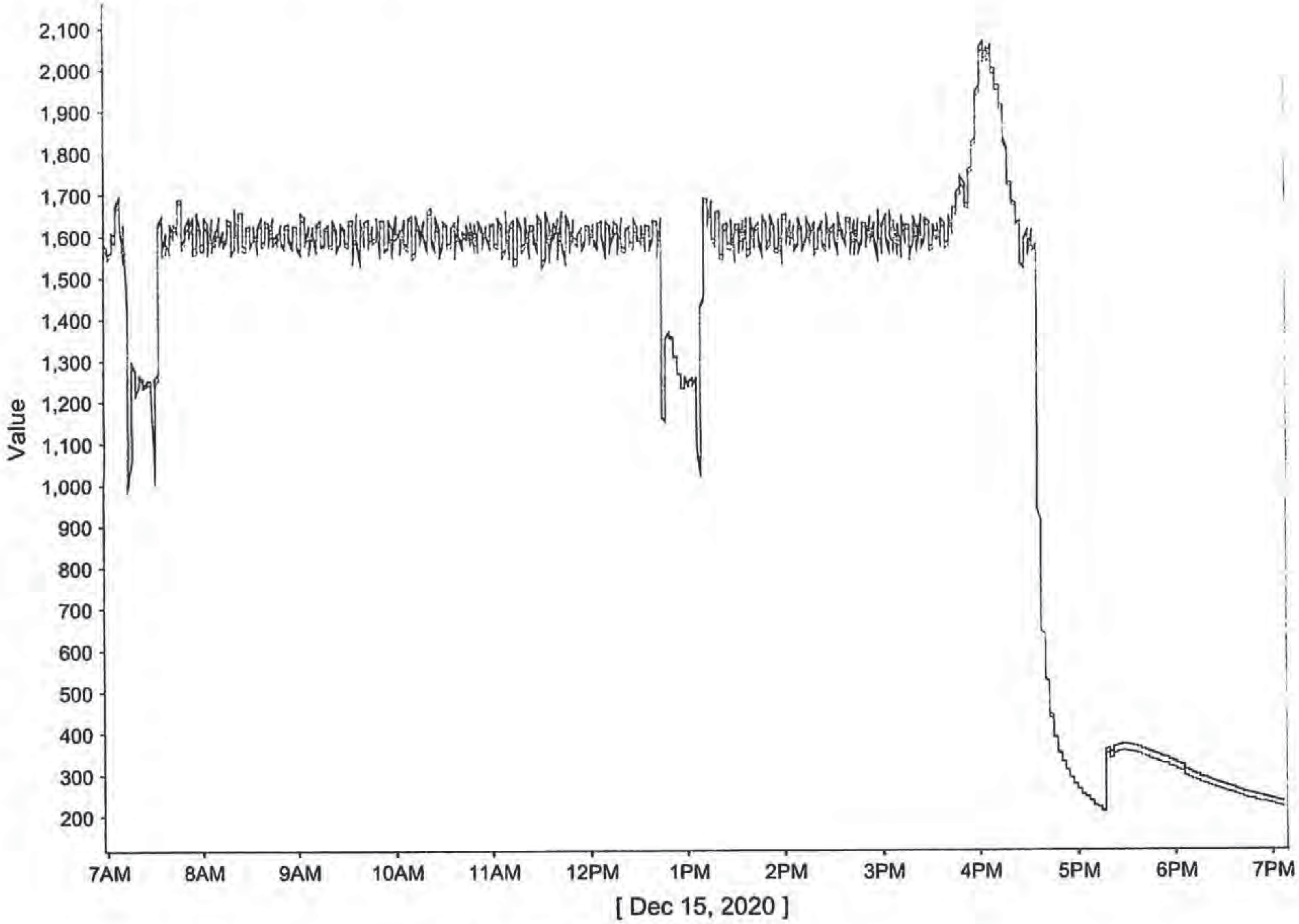
[Dec 15, 2020]

Blast Rate



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1,200
1,100
1,000
900
800
700
600
500
400
300
200
Value
7AM
8AM
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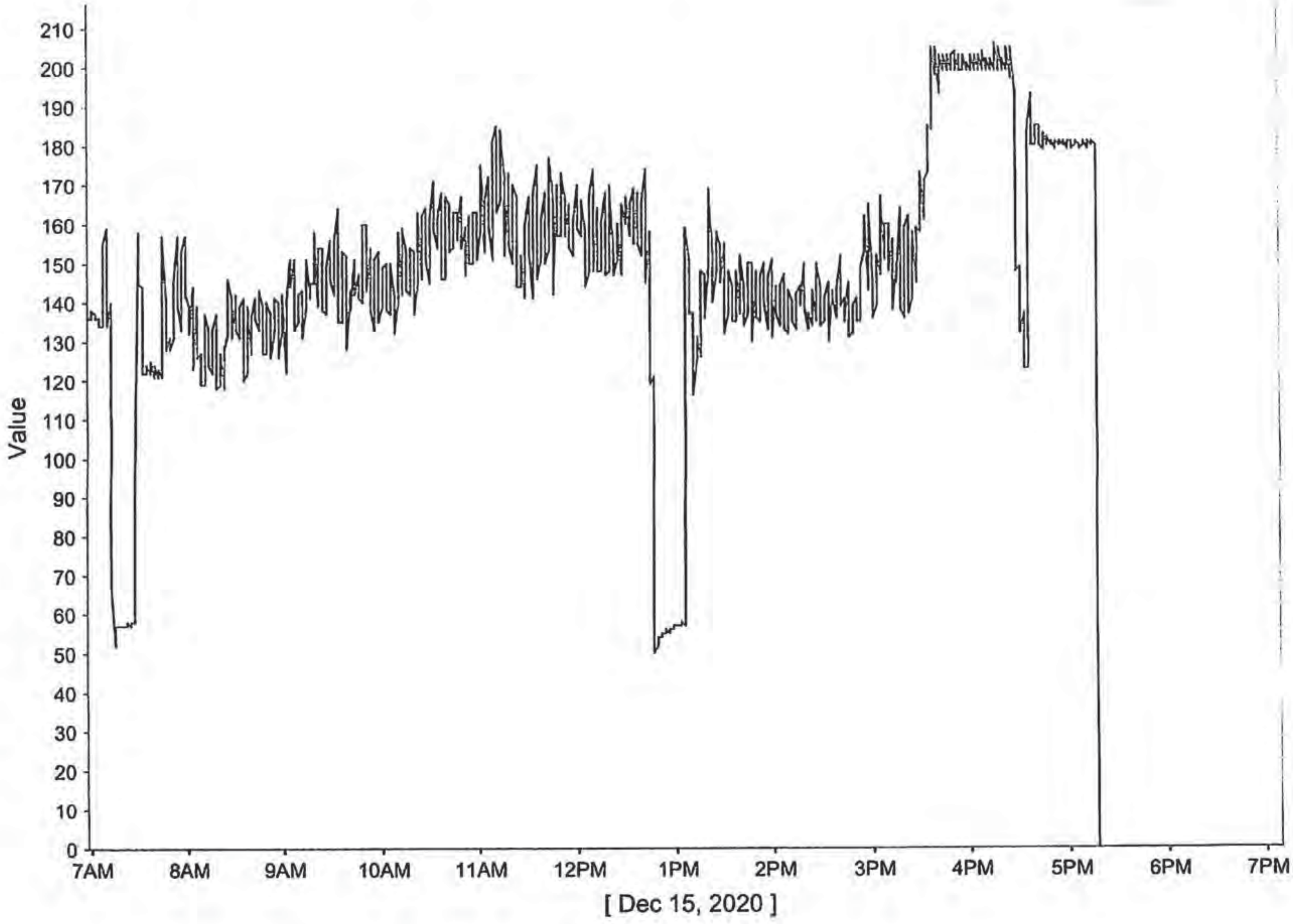
11AM
12PM
1PM
2PM
3PM
4PM
5PM
6PM
7PM
[Dec 15, 2020]

Stack Temp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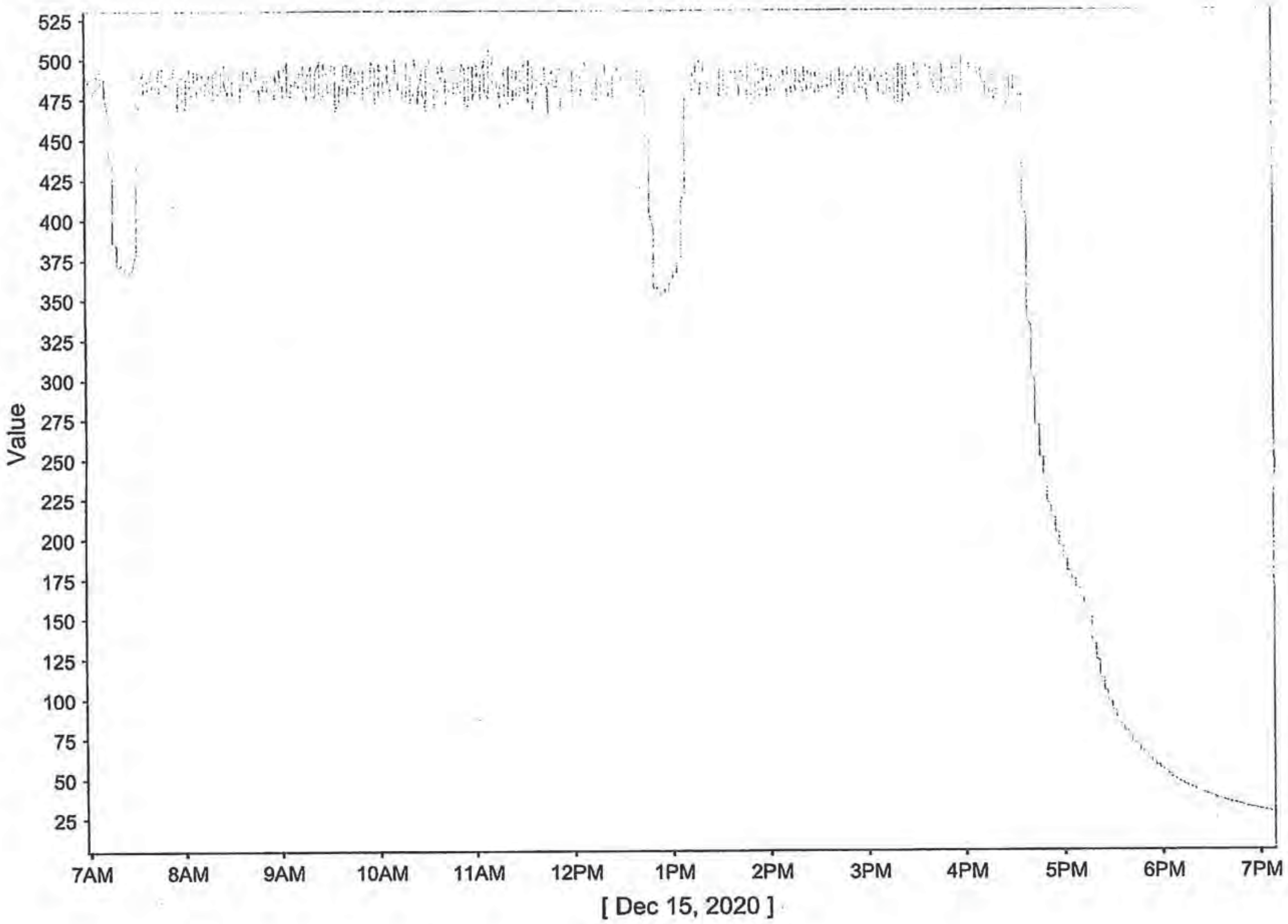
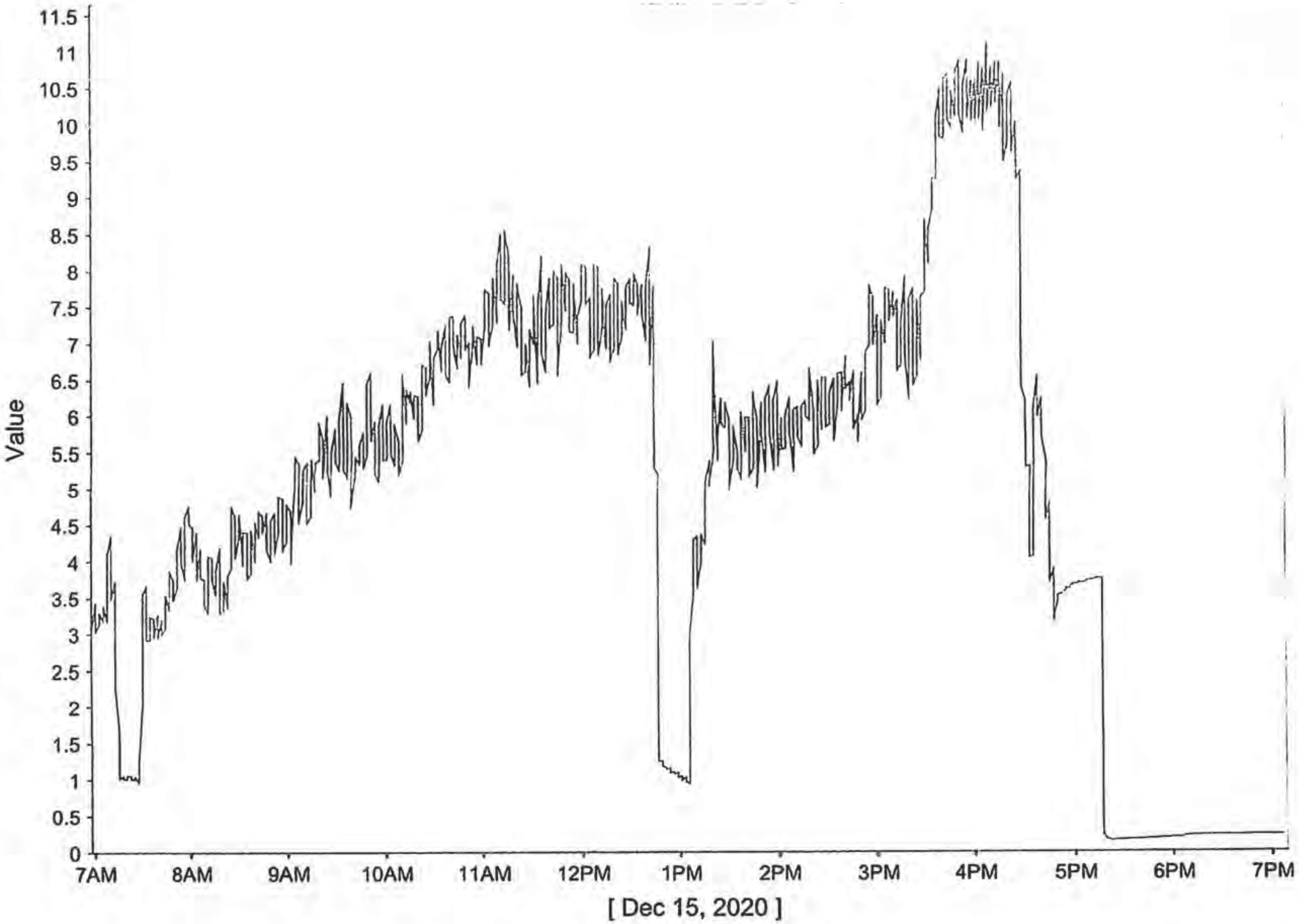
30
20
10
0
7AM
8AM
9AM
10AM
11AM
12PM
1PM
2PM
3PM
4PM
5PM
6PM
7PM
[Dec 15, 2020]

Blower Amps



Baghouse Inlet Temp



Bag house Diff. Press

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG

DATE: 12 / 15 / 20

WEIGHT VARIANCE CHECK

1. Record the weight on one complete charge.
2. Place clock number (Charger)
3. Notify Melt Supervisor if variation exceeds limits.

BED STONE: 200 ✓

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHA CLO
445	1	1500	1000	0	235	2/2½	120	15	100	
448	2									
451	3									
454	4									
457	5									
501	6									
504	7	1250*	1250*	0	235	2/2½	120	10*	100	
507	8									
510	9								+100 ✓	
545	10				+100 ✓					
548	1				[illegible]					
554	2									
600	3									
603	4									
606	5									
609	6									
612	7				+100 ✓					
617	8	1100*	1400*	0	235	2/2½	120	10	100	
622	9									
628	20									
631	1									
639	2				+250 ✓					

SCALE TOLERANCE CHECK

TIME CHECKED: ____:____

EMPL ID NO.: ____________

CHARGE SCALE:	ZERO	STEEL	RETURNS	PIGS
WEIGHT IN:				
WEIGHT OUT:				

LUMP SCALE (ACTUAL):

INITIALS OF SUPERVISOR NOTIFIED OF OUT OF TOLERANCE WEIGHTS: ________

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG (CONTINUED)

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHARGE CLOCK
642	3	1100	1400	0	235	2/2½	120	10	100	07618
645	4									
651	5									
654	6									
658	7									
701	8									
705	9									
731	30	1100	1400	0	235	2/2½	120	0	100	
736	1									
741	2									
745	3									
752	4									
757	5									
802	6									
807	7									
811	8									
816	9									
820	40									
824	1									
828	2									
833	3									
837	4				+100-✓					
841	5									
850	6									
854	7									
859	8									
904	9									
909	50									
913	1									
918	2									
922	3									

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FORM 030036

DAILY CHARGE LOG

DATE: 12 / 15 / 20

WEIGHT VARIANCE CHECK

1. Record the weight on one complete charge.
2. Place clock number (Charger)
3. Notify Melt Supervisor if variation exceeds limits.

BED STONE: ____________

18

(26)

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHAR CLOC
926	4	1100	1400	0	235	2/2½	120	0	100	076A
931	5									
936	6									
940	7									
944	8									
948	9									
952	60									
957	1									
1001	2									
1005	3									
1009	4									
1013	5									
1017	6									
1022	7									
1026	8									
1031	9									
1035	70									
1040	1									
1044	2									
1048	3									
1052	4									
1057	5									

SCALE TOLERANCE CHECK

TIME CHECKED: ____:____

EMPL ID NO.: ____________

CHARGE SCALE:	ZERO	STEEL	RETURNS	PIGS
WEIGHT IN:				
WEIGHT OUT:				

LUMP SCALE (ACTUAL): ____________

INITIALS OF SUPERVISOR NOTIFIED OF OUT OF TOLERANCE WEIGHTS: ________

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG (CONTINUED)

	TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHARG CLOCK
	1101	6	1100	1400	0	235	2/2½	120	0	100	
	1105	7									
	1109	8									
	1113	9									
	1117	80									
	1121	1									
	1125	2									
	1129	3									
	1134	4									
	1138	5									
	1142	6									
	1146	7									
	1150	8									
	1154	9									
29	1158	90									
	1202	1									
	1206	2									
	1211	3									
	1215	4									
	1219	5									
	1223	6									
	1227	7									
	1231	8									
	1235	9									
	1239	100									
	1243	1									
	1248	2									
	111	3									
	115	4									
	119	5									
	123	6									

FORM 030036

Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG

DATE: 12 / 15 / 20

WEIGHT VARIANCE CHECK

1. Record the weight on one complete charge.
2. Place clock number (Charger)
3. Notify Melt Supervisor if variation exceeds limits.

BED STONE: ____________

+16

+4

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	~~COKE~~ +50	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHAI CLO
127	107	1100	1400	0	235	2/2½	120	0	100	
132	8									
136	9									
140	110									
144	1									
148	2									
152	3									
157	4									
201	5									
205	6									
209	7									
214	8									
218	9									
222	120									
226	1									
231	2									
235	3									
239	4									
243	5									
248	6				+100					
254	7	1500*	1000*	0	235	2/2½	120	10#	100	
258	8									

SCALE TOLERANCE CHECK

TIME CHECKED: ____:____	CHARGE SCALE:	ZERO	STEEL	RETURNS	PIGS
	WEIGHT IN:				
EMPL ID NO.: ____________	WEIGHT OUT:				
	LUMP SCALE (ACTUAL):				

INITIALS OF SUPERVISOR NOTIFIED OF OUT OF TOLERANCE WEIGHTS: ________

FORM 030036

+4 Date Revised: 05/15/10 Revision 4A

DAILY CHARGE LOG (CONTINUED)

TIME	CHARGE NUMBER	FRAG. STEEL	RETURN / DUCT	PIG	COKE	ILMENITE / FEMN	SI CARBIDE	75% LUMP FESI	LIME STONE	CHARG CLOCK
302	9	1500	1000	0	235 200	2/2½	120	10	100	
307	130	1500	1000	0	235	2/2½	0#	40#	100 +100	✓
311	1									
316.	2								+100	✓
320	3									
324	4								+100	✓
	5									
	6									
	7									
	8									
	9									
	140									

0

700

Coke up.

FORM 030036

#6 Hunter

Casting Integrity

Pouring Production Entry Form

Date: 12-10-20

Operator Name: SKOGMAN

Machine Number: 371

Shift: 1st

Operator Clock: 26129

Page No: 1

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
941	3225E1695	2590 - 2620	2614	1	20	440	-	20	
		-	2600	2	20	—	—	20	
		-	2605	3	20	—	—	20	
		-	2597	4	20	—	—	20	
		-	2612	5	20	—	—	20	
		-	2593	6	20	—	—	20	
			[illegible]	7	20	—	-	20	
		-	2607	8	20	—	—	20	
		-	2603	9	20	—	—	20	
		-	2596	10	20	-	—	20	
		-	2602	11	20	—	—	20	
		-	2598	12	20	—	—	20	
		-	2604	13	20	—	—	20	
		-	2612	14	20	—	—	20	
		-	2604	15	20	—	—	20	
		-	2612	16	20	—	—	20	
		-	2602	17	20	—	—	20	
		-	2601	18	20	—	-	20	
			2619	19	20	—	-	20	
			2602	20	20	—	—	20	
			2608	21	20	-	—	20	
			2609	22	20	—	—	20	
1009	8FG783	2570 - 2600	2578	1	17	35	1	16	

FORM 030707

Page No: #1

Machine Number: 371

FORM 030832

Date Revised 09/24/18 Revision

	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Molds Poured	Stop And Notify Supervisor Corrective Action
CON	856783	2570 - 2600	2594	2	18	–	–	18	
1054	246463	2570 - 2600	2556	1	18	32	–	18	
		-	2578	2	15	–	–	18	
DSH	XG2008950	2540 - 2570	2541	1	18	54	–	18	
		-	2540	2	18	–	–	18	
		-	2556	3	18	52	-	18	
D59	0207090	2570-2600	2574	1	9	–	–	9	
		-	2582	2	9	–	–	9	
		-	2582	3	9	–	–	9	
		-	2586	4	9	–	–	9	
		-	2586	5	9	–	–	9	
		-	[illegible]	6	7	–	–	7	
005	XG2008957	2600 - 2620	2603	1	20	60	–	20	
		-	2600	2	20	–	–	20	
		-	2623	3	20			20	
322	246463	2570 - 2600	2572	1	18	54	–	18	
		-	[illegible]	2	18	–	–	18	
		-	2572	3	18	–	–	18	
		-							
		-							
		-							
		-							
		-							
		-							
		-							
		-							
		-							
		-							
		-							
		-							
		-							
		-							

FORM 030832

Date Revised 09/24/18 Revisi

Module Hunter

WE ARE IRON MOUNTAIN

Pouring Production Entry Form

Date: 12-10-20
Operator Name: K. Rose
Machine Number: Module

Shift: 1st
Operator Clock: 027646
Page No: 1

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
	29549325	2585 - +	2637	1	14	308	3	14	
		-	2625	2	14	1		13	
		-	2630	3	14			14	
		-	2633	4	14			14	
		-	2630	5	14			14	
		-	2637	6	14			14	
		-	2620	7	14			14	
		-	2646	8	14			14	
		-	2626	9	14			14	
		-	2622	10	14			14	
		-	2626	11	14			14	
		-	2642	12	14			14	
		-	2616	13	14			14	
		-	2645	14	14			14	
		-	2645	15	14			14	
		-	2666	16	14			14	
		-	2663	[illegible]	14			14	
		-	2660	18	14			14	

* If More Than Two Runouts Stop And Notify Supervisor Corrective Action Required
** All Out Of Range Temperature Readings Must Include Corrective Action Taken (Wait, Chill, Pig)

HOUR	GOAL	ACTUAL	COMMENTS	HOUR	GOAL	ACTUAL	COMMENTS
1	H65 DM90 DF110			7	H65 DM90 DF110		
2	H65 DM90 DF110			8	H65 DM90 DF110		
3	H65 DM90 DF110			9	H65 DM90 DF110		
4	H65 DM90 DF110			10	H65 DM90 DF110		
5	H65 DM90 DF110			11	H65 DM90 DF110		
6	H65 DM90 DF110			12	H65 DM90 DF110		

FORM 030832 Created 09/24/18 Revisic

Machine Number: Module

Page No: 2

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	If More Than Two Runnouts Stop And Notify Supervisor Corrective Action
	29549325	2585- +	2656	19	14			14	
		-	2648	20	14	1		13	
		-	2665	21	14			14	
		-	2661	22	14	1		13	
	29505904	2520 - 2550	2541	23	19	283		19	
		-	2536	24	19			19	
		-	2549	25	19			19	
		-	2526	26	19			19	
		-	2522	27	19			19	
		-	2546	28	19			19	
		-	2549	29	19			19	
		-	2549	30	19			19	
		-	2542	31	19			19	
		-	2544	32	19			19	
		-	2530	33	19			19	
		-	2536	34	19			19	
		-	2534	35	19			19	
		-	2541	36	19			19	
		-	2537	37	17			17	
		-		38					
		-		39					
		-		40					
		-							
		-							
		-							
		-							
		-							
		-							

[redacted]

Module

WE ARE IRON MOUNTAIN

Pouring Production Entry Form

Date: 12-9-20

Operator Name: B. Rosz

Machine Number: Module

Shift: 1

Operator Clock: 076046

Page No: 1

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
	29549325	2585 - +	2586	1	14	1		13	
		-	2603	2	14	1		13	
		-	2601	3	14			14	
		-	2605	4	14	1		13	
		-	2604	5	14	2		12	
		-	2607	6	14	6		8	
		-	2610	7	14	1		13	
		-	2617	8	14			14	
		-	0605	9	14			14	
		-	2612	10	14			14	
		-	2600	11	14			14	
		-	2606	12	14			14	
		-	2615	13	14			14	
		-	2615	14	14			14	
		-	2618	15	14			14	
	38505904	2520 - 2550	2544	16	19			19	
		-	2548	17	19			19	
		-	2550	18	19			19	

* If More Than Two Runouts Stop And Notify Supervisor Corrective Action Required

** All Out Of Range Temperature Readings Must Include Corrective Action Taken (Wait, Chill, Pig)

HOUR	GOAL	ACTUAL	COMMENTS	HOUR	GOAL	ACTUAL	COMMENTS
1	H65 DM90 DF110			7	H65 DM90 DF110		
2	H65 DM90 DF110			8	H65 DM90 DF110		
3	H65 DM90 DF110			9	H65 DM90 DF110		

Machine Number: MOQVI-2

Page No: 2

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	If More Than Two Runnouts Stop And Notify Supervisor Corrective Action
	29505904	2520-2550	2549	17	19			19	
		-	2544	20	19			19	
		-	2548	21	19			19	
		-	2537	22	19			19	
		-	2533	23	19			19	
		-	2526	24	19			19	
		-	2540	25	19			19	
		-	2547	26	19			19	
		-	2541	27	19			19	
		-	2528	28	19			19	
		-	2533	29	19			19	
		-	2528	30	12			12	
	29644325	2585-	2640	31	14			14	
		-	2647	32	14			14	
		-	2635	33	14			14	
		-	2625	34	19			14	
		-		35					
		-							
		-							
		-							
		-							
		-							
		-							
		-							

[redacted]

Casting Integrity

DISA FORMA

Pouring Production Entry Form

Date: 12-9-20
Operator Name: Phil Smith
Machine Number: FORMA

Shift: 1
Operator Clock: 76053
Page No: 1

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
6:00	K034658	2570-2615	2577	1	20	/		20	
		-	2581	2	20			20	
		-	2574	3	20			20	
		-	2586	4	21	1		20	
		-	2574	5	20			20	
		-	2594	6	20			20	
		-	2587	7	20			20	
		-	2596	8	20			20	260
		-	2587	9	21	1		20	
		-	2574	10	20			20	
		-	2589	11	20			20	
		-	2594	12	20			20	
		-	2594	13	20			20	
8:00	238629	2630 2670	2635	1	13			13	
		-	2632	2	15			15	
		-	2639	3	17			17	72
		-	2633	4	15			15	
		-	2637	5	12			12	
848	K034655	2570 2610	2577	1	20			20	
			2584	2	20			20	
			2574	3	20			20	100
			2594	4	20			20	
			2595	5	20			20	

②

	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Molds Poured	Stop And Notify Supervisor Corrective Action
935	3535400	2620 - 2650	2633	1	20			20	
		-	2627	2	20			20	
		-	2620	3	20			20	
		-	2626	4	20			20	
		-	2636	5	20			20	
		-	2638	6	20			20	338
		-	2639	7	20			20	
		-	2630	8	20			20	
		-	2636	9	20			20	
		-	2626	10	20		1	20	[illegible]
		-	2644	11	20			20	
		-	2642	12	20			20	
			2641	13	20			20	
		-	2638	14	20			20	
		-	2620	15	20			20	
	~~K034655~~	[illegible]							
[illegible]	K034655	2570 - 2660	2583	1	17			17	
		-	2583	2	20			20	
		-	2593	3	20			20	97
		-	2586	4	20			20	
		-	2595	5	20			20	
1250	29512740	2600 - 2670	2638	1	17	1		16	
		-	209	2	17			17	
		-	2633	3	17			17	0,1
		-	2639	4	17			17	
		-	2625	5	17			17	
		-	2613	6	17			17	
		-	2631	7	17			17	

[redacted]

[redacted]

Casting Integrity

Pouring Production Entry Form

Date: 12-9-20

Operator Name: PM /

Machine Number: FormA

Shift: 1

Operator Clock: 76253

Page No: 3

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
CA.	29512720	2600 -2620	2622	12	17			17	
		-	2626	13	17			17	
		-	2620	14	17			17	325
		-	2632	15	17			17	
		-	2632	16	17			17	
		-	2636	17	17			17	
		-	2638	18	17			17	
		-	2642	19	17			17	
		-	2642	20	9			9	
	R034655	2570 -2600	2577	1	20			20	
		-	2581	2	20			20	
		-	2581	3	20			20	
		-	2590	4	20			20	
		-	2579	5	20			20	
		-		6					
		-		7					
		-		8					
		-							

Casting Integrity

Pouring Production Entry Form

Date: 12-8-20
Operator Name: Pohl/pault 1
Machine Number: PoruA

Shift: 1
Operator Clock: 26063 88735
Page No: 1

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
537	KC034658 ~~[illegible]~~	2520–2600 ~~2560~~ (~~[illegible]~~)	2590	1	20			20	
		-	2582	2	21			21	
		-	2476	3	20			20	
		-	2571	4	20			20	
		-	2572	5	20	1		19	
		-	2575	6	20			20	
		-	2579	7	14			14	388
		-	2574	8	20			20	
		-	2598	9	20			20	
		-	2575	10	20			20	199
		-	2580	11	20			20	
		-	2593	12	20			20	
		-	2592	13	20			20	
		-	2587	14	20			20	
		-	2591	15	20			20	
		-	2598	16	20			20	
		-	2600	17	20			20	
		-	2594	18	20			20	
835	29812740	2600 2670	2604	1	17			17	
			2607	2	17			17	
			2620	3	17			17	
			2614	4	18		1	17	
			2621	5	17			17	

PAGE
2

	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Molds Poured	Stop And Notify Supervisor Corrective Action
Cat.	29512740	2600 - 2670	2607	6	17			17	
		-	2613	7	17			17	
		-	2624	8	12			12	
		-	2625	9	17			17	
		-	2631	10	12			12	
		-	2623	11	17			17	
		-	2622	12	12			12	
		-	2609	13	17			17	
		-	2615	14	17			17	
		-	2688	15	17			17	
		-	2609	16	17			17	
		-	2604	17	17			17	
		-	2606	18	12			12	
		-	2610	19	17			17	
		-	2609	20	17			17	385
		-	2607	21	17			12	[illegible]
		-	2607	22	18	1		17	
		-	2604	23	17			17	
		-	2611	24	12			17	
		-	2609	25	17			17	
		-	2608	26	11			11	
		-	2604	27	17			17	
		-	2601	28	17			17	
		-	2604	29	17			17	
		-	2613	30	17			17	499
		-	2607	31	13			13	
		-	2604	32	17			17	
		-	2606	33	17			17	
		-	[illegible]	[illegible]	14			14	

Casting Integrity

Pouring Production Entry Form

Date: 12-8-20
Operator Name: Bhl/ Smith
Machine Number: Pourer

Shift: 1
Operator Clock: 26053
Page No: 3

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
[illegible]	29512748	2600 - 2620	2616	38	8			8	
		-		39					
		-		40					
		-							
		-							
		-							
		-							
		-							
		-							
		-							
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Casting Integrity

Pouring Production Entry Form

Date: 12-8
Operator Name: S. Reynolds
Machine Number: 560

Shift: 1st
Operator Clock: 076227
Page No: 1

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
5:45	969887	2570-2630	2599	1	12			12	
		-	2606	2	12			12	
		-	2594	3	12			12	
		-	2587	4	12			12	
		-	2584	5	12			12	
		-	2591	6	12			12	
		-	2609	7	12			12	
		-	2588	8	12			12	
		-	2594	9	12			12	
		-	2594	10	12			12	
		-	2600	11	12			12	
		-	2611	12	12			12	
		-	2624	13	12			12	
		-	2605	14	12			12	
		-	2610	15	2			2	
7:55	3687801	2570-2600	2591	1	11			11	
	Heavy Job	-	2599	2	11			11	
	Pours at 18 sec.	-	2592	3	11			11	

* If More Than Two Runouts Stop And Notify Supervisor Corrective Action Required
** All Out Of Range Temperature Readings Must Include Corrective Action Taken (Wait, Chill, Pig)

HOUR	GOAL	ACTUAL	COMMENTS	HOUR	GOAL	ACTUAL	COMMENTS
1	H65 DM90 DF110			7	H65 DM90 DF110		
2	H65 DM90 DF110			8	H65 DM90 DF110		
3	H65 DM90 DF110			9	H65 DM90 DF110		

Machine Number: 560 **Page No:** 2

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	If More Than Two Runnouts Stop And Notify Supervisor Corrective Action
(CON)	3687801	2570-2600	2598	4	11			11	
	- Heavy Job -	-	2600	5	11			11	
	pours slow 18sec.	-	2590	6	"			"	
		-	2595	7	11			11	
		-	2600	8	5			5	; pigs
9:05	2835602	2620-2650	2631	1	14			14	
		-	2621	2	14			14	
		-	2637	3	14			14	
		-	2648	4	14			14-	
		-	2650	5	14			14	
		-	2648	6	14			14	
		-	2646	7	14			14	
		-	2633	9	14			14	
		-	2630	9	14			14	
		-	2643	10	14			14	
		-	2623	11	14			14	
		-	2640	12	14			14	
		-	2633	13	14			14	
		-	2639	14	14			14	
		-	2624	15	14			14	
		-	2629	16	14			14	
		-	2641	17	14			14	
		-	2620	18	14			14	
		-	2621	19	14			14	
		-	2626	20	14			14	

Casting Integrity

Pouring Production Entry Form

Date: 12-8
Operator Name: S. Reynolds
Machine Number: 560
Shift: 1st
Operator Clock: 076227
Page No: 3

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
(CON)	28350002	2620-2650	2629	24	14			14	
		-	2633	25	14			14	
		-	2649	26	14			14	
		-	2649	27	14			14	
		-	2626	28	14			14	
		-	2631	29	14		1	13	
		-	2630	30	14			14	
		-	2637	31	14			14	
		-	2639	32	14			14	
		-	2644	33	14	1		13	
		-	2646	34	14			14	
		-	2649	35	14			14	
		-	2640	36	14			14	
		-	2640	37	14			14	
		-	2622	38	14			14	
		-	2621	39	4			4	
3:00	CDE1350	2630-2670	2630	1	12			12	
		-	2632	2	12			12	

34

* If More Than Two Runouts Stop And Notify Supervisor Corrective Action Required
** All Out Of Range Temperature Readings Must Include Corrective Action Taken (Wait, Chill, Pig)

HOUR	GOAL	ACTUAL	COMMENTS	HOUR	GOAL	ACTUAL	COMMENTS
1	H85 DM90 DF110			7	H85 DM90 DF110		
2	H85 DM90 DF110			8	H85 DM90 DF110		
3	H85 DM90 DF110			9	H85 DM90 DF110		

Machine Number: 500

Page No: 4

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	If More Than Two Runnouts Stop And Notify Supervisor Corrective Action
con	GE750	2630-2670	2634	3	12			12	
4:00	02835602	2620-2650	2630	1	14			14	
		-	2634	2	14			14	
		-	2630	3	14			14	
		-							
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Pouring Production Entry Form

Casting Integrity

Date: 12-8-20
Operator Name: Frank Sunders
Machine Number: 7

Shift: 1st
Operator Clock: 076088
Page No: 1

Time	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Total Good Molds Poured	Corrective Action
5:50	29505904	2520 - 2550	2527	1	18	-	-	18	
		-	2529	2	18	-	-	18	
		-	2523	3	18	-	-	18	
		-	2537	4	18	-	-	18	
		-	2525	5	19	-	1	18	
		-	2537	6	18	-	-	18	
		-	2522	7	18	-	-	18	
		-	2549	8	19	-	-	19	
		-	2542	9	19	-	-	19	
		-	2520	10	19	-	-	19	
		-	2537	11	19	-	-	19	
		-	2539	12	19	-	-	19	
		-	2543	13	19	-	-	19	
		-	2548	14	19	-	-	19	
		-	2550	15	19	-	-	19	
		-	2539	16	19	-	-	19	
		-	2548	17	19	-	-	19	
		-	2535	18	19	-	-	19	
			2530	19	19	-	-	19	
			2531	20	19	-	-	19	
			2524	21	12	-	-	19	
			2522	22	19	-	-	19	
			2550	23	19	-	-	19	

	Part Number	Process Card Temp Range	Ladle Temp	Ladle Number	Molds Poured	Run Outs	Pour Short	Molds Poured	Stop And Notify Supervisor Corrective Action
	29505904	2520 - 2550	2524	24	19	—	—	19	
		-	2533	25	19	—	-	19	
		-	2528	26	19	—	-	19	
		-	2548	27	19	-	-	19	
		-	2540	28	19	-	-	19	
		-	2520	29	19	-	-	19	
		-	2536	30	19	—	—	19	
		-	2546	31	18	-	-	18	
		-	2523	32	19	—	—	19	
		-	2543	33	19	—	-	19	
		-	2543	34	19	—	-	19	
		-	2548	35	19	-	-	19	
		-	2542	36	19	-	—	19	
		-	2545	37	19	—	—	19	
		-	2550	38	19	—	-	19	
		-	2548	39	19	—	-	19	
		-	2530	40	19	—	-	19	
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Appendix F

Test Protocol and Pretest Correspondence

Test Plan Approval Letter

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
CADILLAC DISTRICT OFFICE

GRETCHEN WHITMER
GOVERNOR

EGLE

LIESL EICHLER CLARK
DIRECTOR

December 4, 2020

VIA E-MAIL ONLY

Mr. Tom White
Grede, LLC – Iron Mountain
801 South Carpenter Avenue
Kingsford, Michigan 49802

SRN: B1577, Dickinson County

Dear Mr. White:

SUBJECT: Approval of Protocol for Emissions Testing.

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division (AQD) has completed our review of the protocol for the emissions testing at Grede, LLC – Iron Mountain located in Kingsford, Dickinson County. This protocol was received by the DEQ on November 17, 2020. Testing is scheduled to begin December 8, 2020. Testing is required by Renewable Operating Permit MI-ROP-B1577-2020 and Title 40 of the Code of Federal Regulations (CFR), Part 63, Subpart EEEEE. Emissions will be determined as listed below:

Source	Method*	Parameter	Limit	Unit
EU-P009 CUPOLA	9	VE	0	%OP
	1,2,3/3A,4,10	CO	21.0	lb/hr
			250.0	mg/scm
	1,2,3/3A,4,6C	SO2	13.8	lb/hr
			170	mg/scm
	1,2,3/3A,4,5D,202	PM10	1.30	lb/hr
		PM	0.011	lb/1000lb
		PM	0.006	gr/dscf
			or	
			0.10	lb/tn
			or	
	1,2,3/3A,4,29	TMHAP	0.0005	gr/dscf
			or	
			0.008	lb/tn
	3/3A,4,25A	VOHAP	20	ppmvd @10%O2
EU-P016 MAIN PLANT POURING	1,2,3/3A,4,5,29	PM	0.010	gr/dscf
			or	
		TMHAP	0.0008	gr/dscf
EU-P036 MODULE POURING	1,2,3/3A,4,5,29	PM	0.010	gr/dscf
			or	
		TMHAP	0.0008	gr/dscf

Appendix
*EPA Method VE = visual emissions CO = carbon monoxide SO2 = sulfur dioxide PM10 = particulate matter ten microns or less in diameter PM = particulate matter TMHAP = total metal hazardous air pollutants as defined in Subpart EEEEE VOHAP = volatile organic hazardous air pollutants as defined in Subpart EEEEE %OP = percent opacity lb/hr = pounds per hour mg/scm = milligrams per standard cubic meter, corrected to 70F and 29.92”Hg lb/1000lb = pounds per thousand pounds of exhaust gases gr/dscf = grains per dry standard cubic foot lb/tn = pounds per ton of metal charged ppmvd @10%O2 = part per million as hexane by volume, dry basis @10%O2 = corrected to ten percent oxygen, dry basis

The proposed methods are acceptable given the following stipulations:

- TESTING
  - EMC GD-008 is approved in stacks having cyclonic flow in excess of 20 degrees.
  - EU-P009 CUPOLA sampling
    - Each cupola baghouse exit run will require a corresponding inlet flow run.
    - Each cupola baghouse exit run sampling will begin within one hour of the corresponding inlet flow run’s sampling end.
    - Temperature will be used as the diluent.
  - Visual emissions from each building or structure housing any iron and steel foundry emissions source will be tested to ensure discharges of fugitive emissions to the atmosphere from foundry operations will not exhibit opacity greater than 20 percent (6-minute average), except for one 6-minute average per hour that does not exceed 27 percent opacity.
  - Process conditions that need to be recorded for each test run:
    - EU-P009 CUPOLA
      - Number and weight of charges added to the cupola in tons per hour
      - Afterburner combustion zone temperature on a continuous basis in degrees Fahrenheit
      - Baghouse overall static pressure drop on a continuous basis in inches of water column
      - Baghouse inlet temperature on a continuous basis in degrees Fahrenheit
      - Amperage of the emission control system fan on a continuous basis in amperes
    - EU-P016 MAIN PLANT POURING
      - Main plant pour rate in tons per hour
    - EU-P036 MODULE POURING
      - Module plant pour rate in tons per hour

  - Testing will be performed in accordance with EGLE, AQD, Air Pollution Control Rules, Part 10, Intermittent Testing and Sampling.
  - All requirements and specifications of the above methods apply; any modifications of the test methods onsite must be approved by the AQD.
  - The stacks that need to be tested for each source:
    - EU-P009 CUPOLA
      - SV-S009-324644
    - EU-P036 MODULE POURING
      - SV-S036-334116
      - SV-S036-334176
    - EU-P016 MAIN PLANT POURING
      - SV-S016-324632
      - SV-S016-324662
      - SV-S016-324678
      - SV-S016-324682
      - SV-S016-324484
      - SV-S016-324848

- REPORT
  - All process data listed above to include:
    - Each individual reading.
    - Average/total for each run.
  - Results from audit samples.
  - All pre-test and post-test meter box calibration, pitot tube calibration, nozzle calibration and field data sheets.
  - All calibration and cyclonic flow checks.
  - All data reported in tabular format.
  - Certificate of Analysis sheets for all calibration gases used.
  - All aborted, failed or repeated runs must be included in the report.

Please submit a complete copy of the final test report to both:

Mr. Michael Conklin
Environmental Engineer
Upper Peninsula District Office
EGLE-Air Quality Division
1504 West Washington Street
Marquette, Michigan 49855

Ms. Karen Kajiya-Mills
Supervisor
Technical Programs Unit
EGLE-Air Quality Division
Constitution Hall, 2nd Floor South
525 West Allegan Street
Lansing, Michigan 48909

Please inform Michael Conklin, of the Marquette District Office, at 906-202-0013 or conklinm1@michigan.gov and me of any change in the test date. If you have any questions regarding this letter, please contact me at the telephone number or email address listed below.

Sincerely,

Jeremy Howe
Environmental Quality Analyst
Air Quality Division
231-878-6687 / howej1@michigan.gov

cc/via email: Mr. Tyler Hill, Grede, LLC – Iron Mountain
Mr. Thomas Halverson, Pace Analytical
Mr. Terry Borgerding, Pace Analytical
Mr. Paul Blindauer, GEI Consultants
Ms. Karen Kajiya-Mills, EGLE
Mr. Ed Lancaster, EGLE
Mr. Michael Conklin, EGLE

Test Protocol Document

Pace Analytical
Environmental Sciences
Field Services Division

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

Particulate, Metals, VOC, SO_2, CO, Opacity Emissions Testing Protocol

Plant Name:	Grede, LLC - Iron Mountain
Protocol Date:	November 13, 2020
Revision Date:	No revisions to date
Testing Dates:	Dec. 8-10 & 15-17, 2020

ACCREDITED
Cert #3819.01 (ISO/IEC 17025:2005)
Cert #3819.02 (ASTM D7036)

STAC
STACK TESTING ACCREDITATION COUNCIL

NEFAP ACCREDITED
TNI

Client Test Coordinator:

Tyler Hill
Grede, LLC - Iron Mountain
801 South Carpenter Avenue
Kingsford, MI 49802

Telephone No.: (906) 779-0201
E-mail Address: tyler.hill@grede.com

Subject Facility:

Grede, LLC - Iron Mountain
801 South Carpenter Avenue
Kingsford, MI 49802

Regulatory Permit No.:
MI-ROP-B1577-2020
SRN: B1577

Subject Emission Sources:

Cupola	EU-P009
Module Pouring & Cooling	EU-P036
Main Plant Pouring & Cooling	EU-P016

Test Locations:

Cupola Baghouse Exhaust	324644
Module Pouring & Cooling	2 Stacks
Main Plant Pouring & Cooling	6 Stacks

Testing Firm Coordinator:

Terry Borgerding
Pace Analytical Services, LLC
1700 Elm Street, Suite 200
Minneapolis, MN 55414
Telephone No.: (612) 607-6374
Facsimile No.: (612) 607-6388
E-mail Address: terry.borgerding@pacelabs.com

Table of Contents

Plant/Source Information

Subject Facility:	Grede, LLC - Iron Mountain 801 South Carpenter Avenue Kingsford, MI 49802
Plant Contact:	Tom White
Company Affiliation:	Grede, LLC - Iron Mountain
Office Address:	801 South Carpenter Avenue Kingsford, MI 49802
Telephone Number:	(906) 779-0257
Facsimile Number:	-
E-mail Address:	tom.white@grede.com
Reason for Test:	ROP Permit Requirement 40 CFR Part 63 Subpart EEEEE (Steel Foundry MACT)

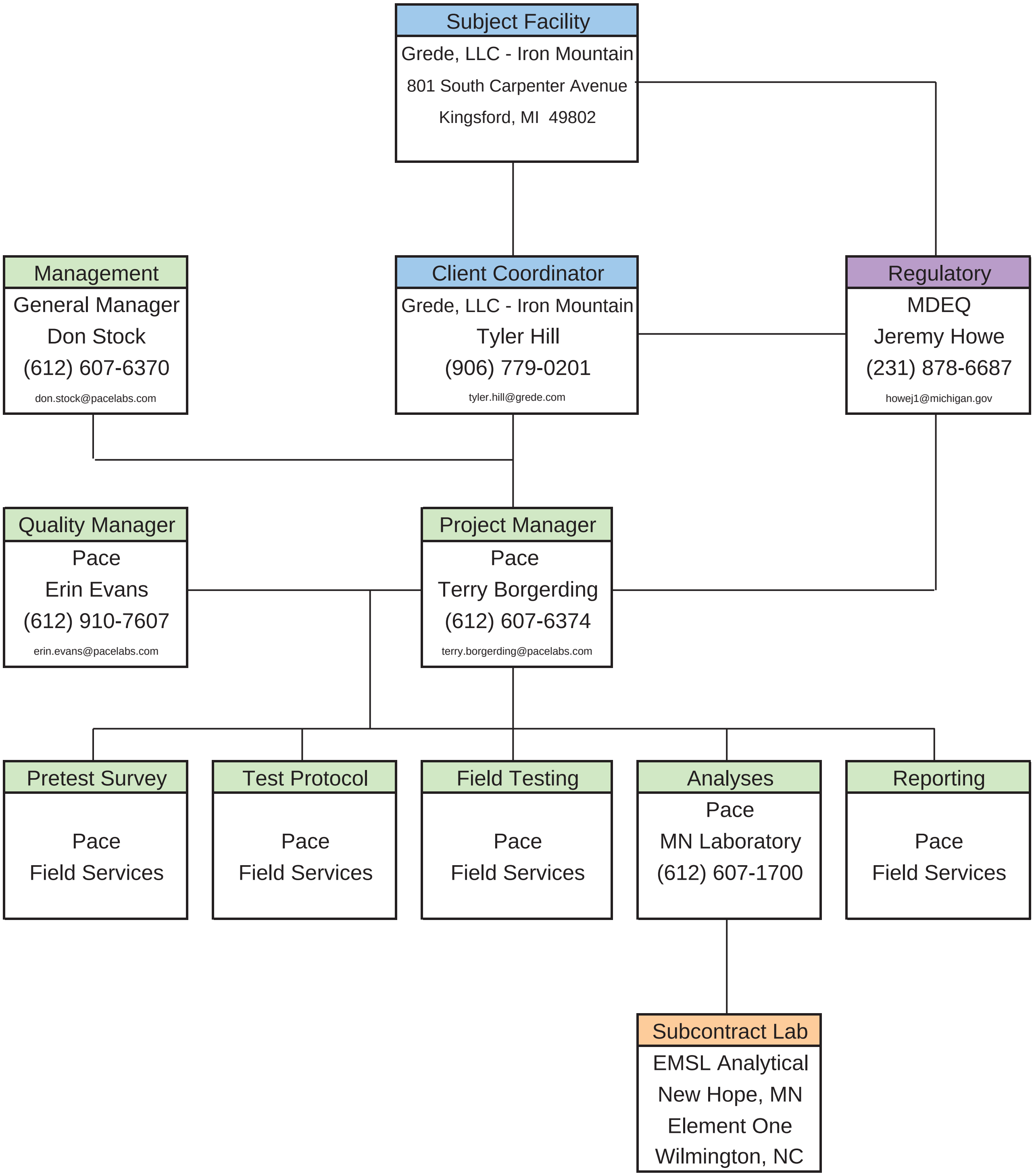
Testing Firm Information

Project Contact:	Terry Borgerding
Testing Firm:	Pace Analytical Services, LLC
Office Location:	1700 Elm Street, Suite 200 Minneapolis, MN 55414
Telephone Number:	(612) 607-6374
Facsimile Number:	(612) 607-6388
E-mail Address	terry.borgerding@pacelabs.com
Subcontractors:	EMSL Analytical Element One

Regulatory Contact Information

Regulatory Agency:	Michigan Department of Environmental Quality
Testing Contact:	Jeremy Howe
Office Location:	Cadillac District Office 120 West Chapin Street Cadillac, MI 49601
Telephone Number:	(231) 878-6687
Facsimile Number:	(231) 775-4050
E-mail Address	howej1@michigan.gov

Project Organization



Note: Chart based on anticipated participants at the time of protocol development and is subject to change.

Facility and Process Description

Target Operating Conditions: Single Condition at 90+% Capacity

The Grede, LLC - Iron Mountain (Grede) facility produces gray iron castings, typically for industrial machinery and various transportation industry customers. The major processes at Grede include raw material handling (metals, fluxes, and metallurgical coke), metal melting, mold and core production, casting and finishing.

Grede operates a main foundry and a module foundry under one roof. A single WRIB Company high efficiency cupola (EU-P009) provides all of the molten iron used by the main and module foundry. The cupola has a maximum melt rate of 20 tons per hour. Molten iron is stored in an electric holding furnace with a capacity of 28 tons prior to pouring. Emission control equipment for the cupola exhaust includes four natural gas afterburners for VOC and CO, a low efficiency scrubber (quench tank) for SO_2, and a Hartzell Engineering Corp. baghouse for particulate.

Sources to be tested include:
EU-P009 – Cupola
EU-P016 & EU-P036 Pouring & Cooling
    334176 – Module Plant Exhaust
    334116 – Module Plant Exhaust
    324662 – No. 7 Hunter
    324848 – No. 5 Hunter
    324632 – No. 6 Hunter
    324484 – Main Plant Pouring Disa
    324678 – Main Plant Pouring Disa
    324682 – Main Plant Pouring Disa

Test related process and operational details will be recorded by Grede personnel and included in the final report.

Testing Schedule

Testing is presently planned to be conducted over a two week time frame as follows and is subject to change based on production schedules:

Week 1				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
12/7/2020	12/8/2020	12/9/2020	12/10/2020	12/11/2020
Travel / Safety Review / Set Up	Test 3 Stacks Main Plant 324484, 324632, 324662 (PM)	Test 3 Stacks Main Plant 324678, 324682, 324848 (PM)	Test 2 Stacks Module Plant 334116, 334176 (PM)	

Week 2				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
12/14/2020	12/15/2020	12/16/2020	12/17/2020	12/18/2020
Travel / Safety Review / Set Up	Test Cupola Inlet 324644 (VOC, SO_2, CO)	Test Cupola Exhaust 324644 (PM & Fugitive Emissions)	Test Cupola Exhaust 324644 (Total Metal HAPs)	

The final test report will be submitted by Grede to the Michigan Department of Environmental Quality (MDEQ) within 60 days of the completion of testing. In cases where multiple sources are tested during a single mobilization, the last day of testing will dictate the start of the 60 days. All sources evaluated during a mobilization will be summarized in a single report.

EU-P009 - Cupola
Testing Requirements

Emissions Testing Constituents

Source No.	Source Identification	Regulated Constituents	Applicable Rules or Regulations	Emission Limits
EU-P009 324644	Cupola Baghouse Exhaust	Carbon Monoxide	R 336.1201(3)	≤21.0 LB/HR
				≤250.0 mg/m^3, corrected to 70°F and 29.92 inches Hg
		Total Metals HAP	40 CFR 63.7690(a)(2)(i) or (ii) or (iii) or (iv)	≤0.0005 GR/DSCF or ≤0.008 LB/Ton metal charged
		Particulate (filterable)	R 336.1331	≤0.011 LB/1000 LB exhaust gas
		PM-10	R 336.1331	≤1.30 LB/HR
		Sulfur Dioxide	R 336.1201(3)	≤170 mg/m^3, corrected to 70°F and 29.92 inches Hg
				≤13.8 LB/HR
		Volatile Organic HAP (VOHAP)	40 CFR 63.7690(a)(8)	≤20 PPMv @ 10% O_2 as hexane
		Opacity (fugitive)	40 CFR 63.7690(a)(7)	≤20% 6-minute average, except for one 6-minute average per hour that does not exceed 27%

Process Monitoring Parameters

Source No.	Process Parameter	Monitoring Method	Target Range
EU-P009	Cupola Melt Rate	Manual Log	20 TPH
	Baghouse Pressure Drop	Pressure Transducer	≥1 Inch WC
	Afterburner Temperature	Thermocouple	≥1,300°F
	Control System Fan Amperage		115 - 281 amps

Emissions Testing Methods

Parameter	Test Method	No. of Runs	Length of Run	Sample Vol/Rate	Report Units	Detection Limit
Locate Test Ports & Traverse Points	EPA Method 1 (details below)	1	NA	NA	NA	NA
Volumetric Airflow (Inlet)	EPA Method 2	3	NA	NA	ACFM SCFM DSCFM	4 Ft./Sec.
Gas Composition (Inlet & Outlet)	Modified EPA Method 3/3A	3	1 Hour	30 Liters	% v/v Mole. Wt. %EA	0.1% v/v
Moisture Content (Outlet for all testing, Inlet during THC, CO, and SO_2 testing)	EPA Method 4	3	2 Hour	0.5 CFM	% v/v Mole. Wt.	0.3% v/v
Moisture Content (Inlet during PM and Metals testing)	EPA Method 4 Alternative, Wet/dry bulb temp	3	NA	NA	% v/v Mole. Wt.	0.2% v/v
Particulate (Filterable) (Outlet, with PM-10)	EPA Method 5	3	2 Hour	60 DSCF	LB/1000 LB exhaust gas	0.0008 GR/DSCF
PM-10 Particulate (Outlet)	EPA Method 5 EPA Method 202	3	2 Hour	60 DSCF	LB/HR	0.0008 GR/DSCF
Sulfur Dioxide (Inlet)	EPA Method 6C	3	1 Hour	>0.5 LPM	LB/HR mg/m^3	5 PPM v/v
Carbon Monoxide (Inlet)	EPA Method 10	3	1 Hour	>0.5 LPM	LB/HR mg/m^3	1 PPM v/v
Visible Emissions (Fugitive) Observations at the north and south side of the process operation building.	EPA Method 9	3	1 Hour	NA	% Opacity	0 Percent (5% Incr.)
Total Hydrocarbons (Inlet)	EPA Method 25A	3	1 Hour	1 LPM	PPMv @ 10% O_2 as hexane	2 PPM v/v
Multiple Metals (Outlet) (Antimony, Arsenic, Beryllium, Cadmium, Chromium, Cobalt, Lead, Manganese, Nickel, Selenium, and Mercury)	EPA Method 29	3	2 Hour	60 DSCF	GR/DSCF LB/Ton metal charged	Varies

Test Location Details: See test location schematic in Attachment 1.

Special Considerations: The baghouse outlet test location is a mono-vent. The baghouse outlet sampling points are above the baghouse compartments. Using a 12' probe, 24 points will be monitored as diagramed in Figure 1. Airflow, VOC, SO_2, and CO will be measured at the inlet duct on the baghouse.

Audit samples will be provided for Antimony, Arsenic, Beryllium, Cadmium, Chromium, Cobalt, Lead, Manganese, Nickel, Selenium, and Mercury.

Mass rate results for measurements collected at the mono-vent outlet will be adjusted following the temperature differential dilution calculations from EPA Method 5D or other procedure as approved by the regulatory administrator. Concentration results are not adjusted.

EU-P016 & EU-P036 - Main Plant Pouring and Cooling & Module Pouring and Cooling (8 Stacks) Testing Requirements

Emissions Testing Constituents

Source No.	Source Identification	Regulated Constituents	Applicable Rules or Regulations	Emission Limits
EU-P016 EU-P036	Main Plant Pouring and Cooling & Module Pouring and Cooling	Particulate (filterable)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF
		PM-10	R 336.1331	≤9.0 LB/HR

Process Monitoring Parameters

Source No.	Process Parameter	Monitoring Method	Target Range
EU-P016	Main Plant Pour Rate	Process Log	9-34 TPH
EU-P036	Module Pour Rate	Process Log	7-13 TPH

Emissions Testing Methods

Parameter	Test Method	No. of Runs	Length of Run	Sample Vol/Rate	Report Units	Detection Limit
Locate Test Ports & Traverse Points	EPA Method 1 (details below)	1	NA	NA	NA	NA
Volumetric Airflow	EPA Method 2	3	NA	NA	ACFM SCFM DSCFM	4 Ft./Sec.
Gas Composition Emitting Essentially Air	EPA Method 3 EPA Method 2.8.6	NA	NA	NA	% v/v Mole. Wt.	Assigned Values
Moisture Content	EPA Method 4	3	1.5+ Hour	0.5 CFM	% v/v Mole. Wt.	0.3% v/v
Particulate (Filterable) (with PM-10)	EPA Method 5	3	1.5+ Hour	60 DSCF	GR/DSCF	0.0008 GR/DSCF
PM-10 Particulate	EPA Method 5 EPA Method 202	3	1.5 Hour+	60 DSCF	GR/DSCF LB/HR	0.0008 GR/DSCF

Test Location Details: See test location schematics in Attachment 1. The Pouring and Cooling Stack structures will be modified to meet EPA Method 1 minimum distance criteria to mitigate cyclonic flow.

Special Considerations: While significant investment was made to modify some stacks to mitigate cyclonic flow, if cyclonic flow in excess of 20 degrees is encountered, we will implement the procedures EPA Guidance Document 8 – Particulate Matter Sampling in Cyclonic Flow or the Draft Revision to GD-8 (2003) upon approval from a regulatory administrator. If EPA Guidance Document 8 procedures are not approved, cyclonic flow stacks will not be tested.

Test Report

A final test report will be compiled by Pace Analytical at the completion of testing. The report will be submitted to the client within 30 days of the last day of sampling. The client will be responsible for submitting report copies as required by regulatory agencies. An electronic copy of the test report will be delivered via e-mail. The final test report will include the following information:

- Name and location of emission facility.
- Identification of emission unit.
- Date of tests.
- Name and address of testing company.
- Certification of project information (client signatures also required).
- Reasons and constituents for test.
- Names of observers and witnesses
- Emission results expressed in the units of the emission limitation criteria.
- Process descriptions as provided by the client.
- Process rate information as provided by the client.
- Descriptions of maintenance activities as provided by the client.
- Discussions of problems or errors encountered.
- Sampling and analytical procedures.
- Analytical results of fuels or process samples as appropriate.
- Dimensioned drawing of sampling location.
- Copies of raw field data.
- Copies of laboratory analytical reports.
- Calculation equations.
- Sampling train calibration data
- Laboratory quality assurance information as appropriate
- Copy of this test plan and other pertinent pretest correspondence.

Safety Considerations

Safety is an important aspect of sampling programs, especially when test teams and observers are in unfamiliar plant surroundings. Plants are required to provide test ports, safe test platforms and access routes. The test firm is required to follow plant safety protocols and rules as well as their own safety program. Attention must be given to special considerations related to testing such as overhead work, solvent usage, compressed gases, flammable materials, open ports and electrical appliances. Observers and regulatory witnesses must comply with both plant and test firm safety protocols. Pace cannot provide PPE for visitors and observers. The following protocols and Personal Protection Equipment (PPE) will be required for this site.

Safety Requirements	**Pace Protocol**	**Plant Protocol**
No Smoking	X	X
Safety Shoes	X	X
Metatarsal Guards		
ESD Shoes or Strap		
Hard Hat	X	X
Safety Glasses	X	X
Full-Face Shield		
Chemical Resistant Gloves		
Abrasion Resistant Gloves	X	
Temperature Insulating Gloves	X	
Full Length Trousers (Waist to Ankle)	X	X
Long-Sleeved Shirt		
Fire Retardant Clothing		
Chemical Resistant Suit/Clothing		
Hearing Protection		X
No Facial Hair		
Dust Respirator		
Half-Face Air Purifying Respirator		
Full-Face Air Purifying Respirator		
Self Contained Breathing Apparatus		
Supplied Air Respirator		
Plant Security Log In		X
Plant Safety Training - Facility EHS training will be provided at the facility prior to testing.		X
Facility point-of-contact will be assigned to Pace personnel while on-site.		X
Spark Permit/Protocols		
Electronic Device Restrictions		
Designated Break/Smoking Areas		X
Safety Climb System		
Fall Protection (Harness/Tie-off)		X

Attachments

Attachment 1	Test Location Schematics
Attachment 2	Abbreviations, Symbols, and Nomenclature
Attachment 3	Calculation Equations
Attachment 4	Test Method Summaries
Attachment 5	Quality Statement

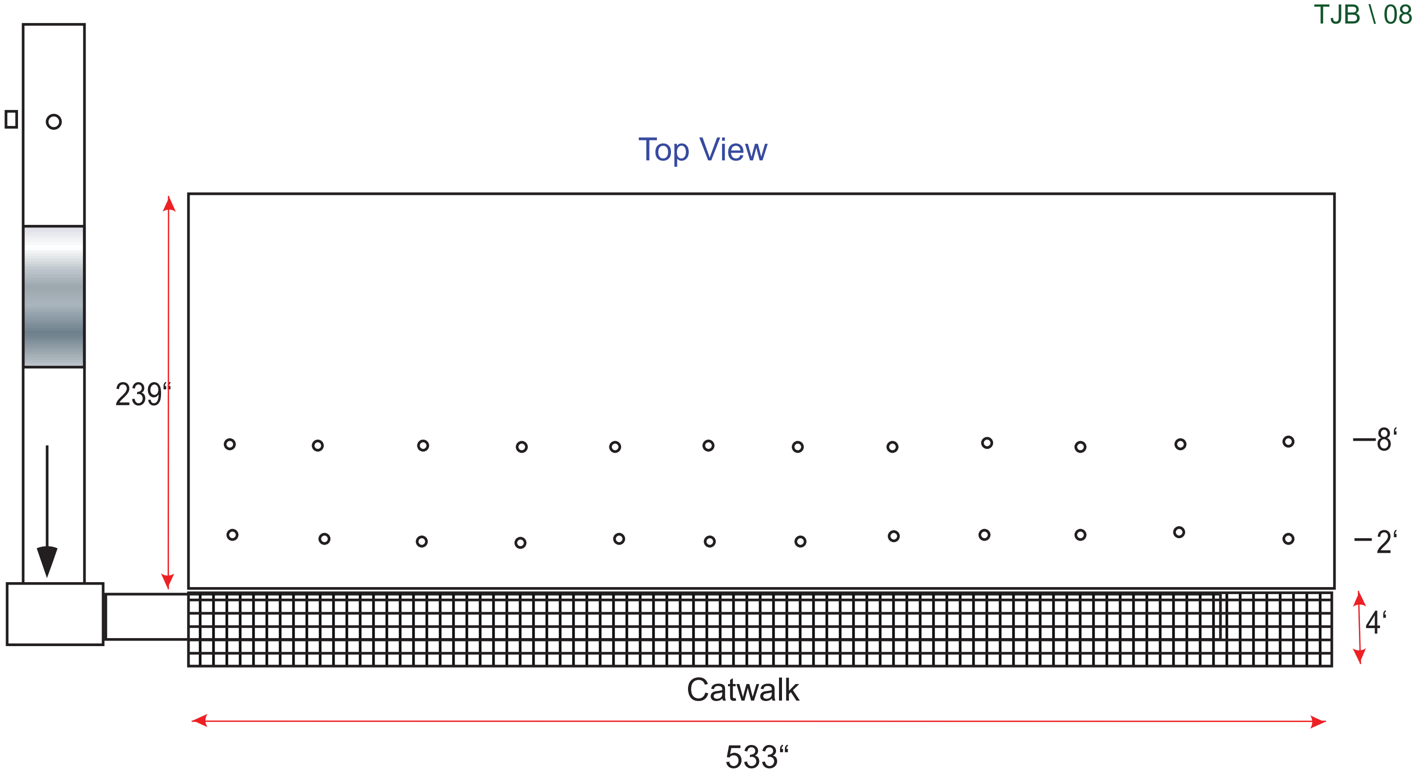
Attachment 1

Test Location Schematics

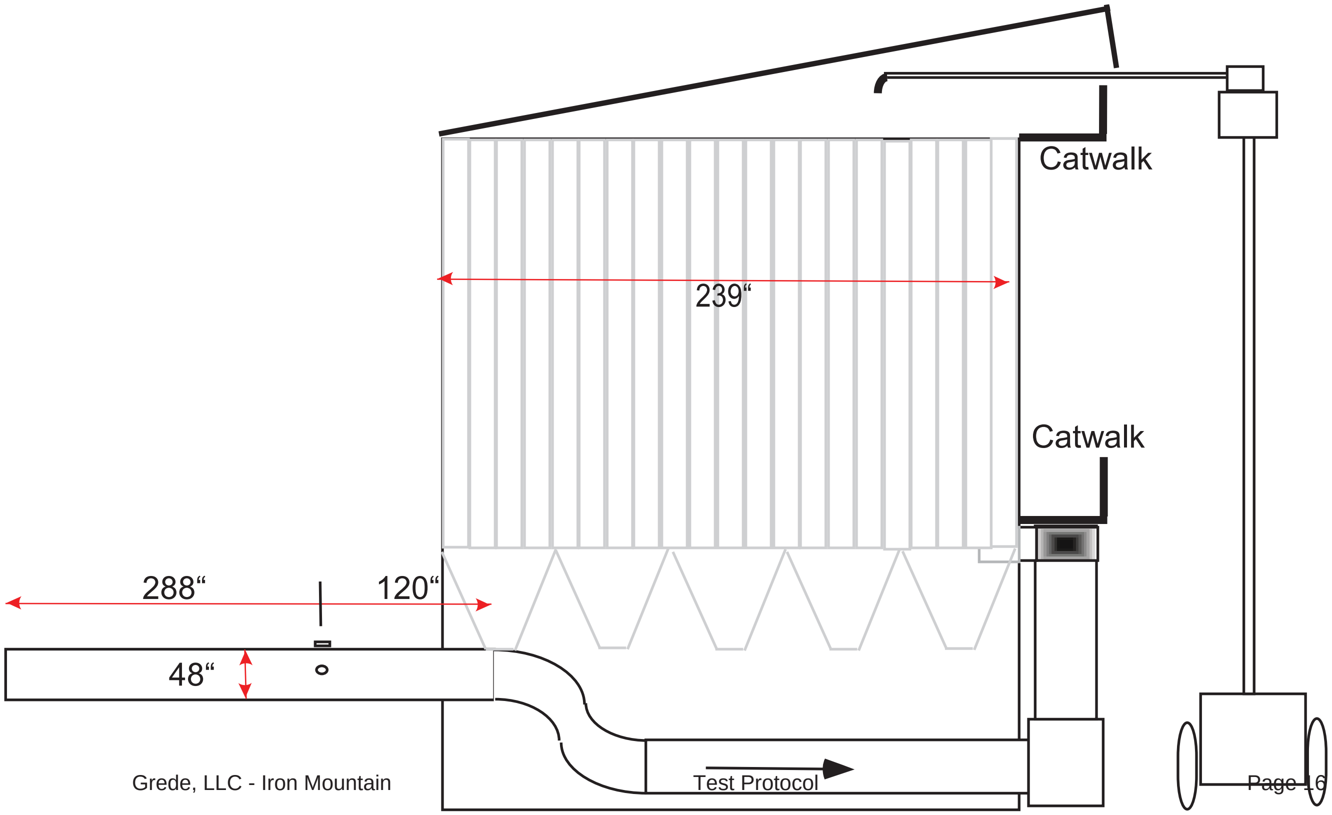
Pace Analytical
Field Services Division

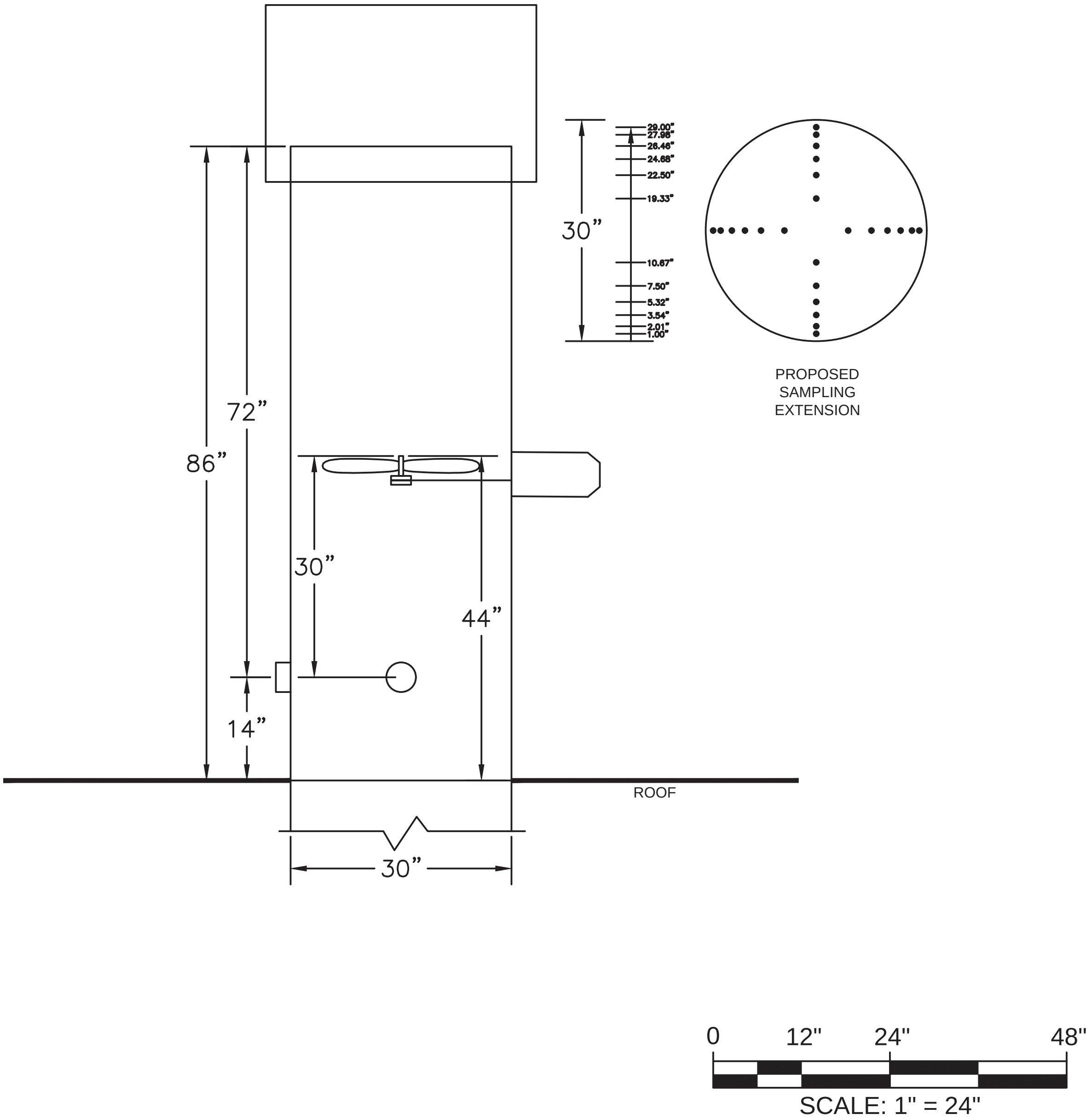
Figure 1
Grede, LLC
Kingsford, MI
Cupola Baghouse Exhaust (EU-P009)
TJB \ 08/05

Top View



Side View





MODULE PLANT EXHAUST	GEI Consultants	STACK ID 334176 PROPOSED
GREDE, LLC KINGSFORD, MI	Project 2003802	NOV 2020 Fig. 2

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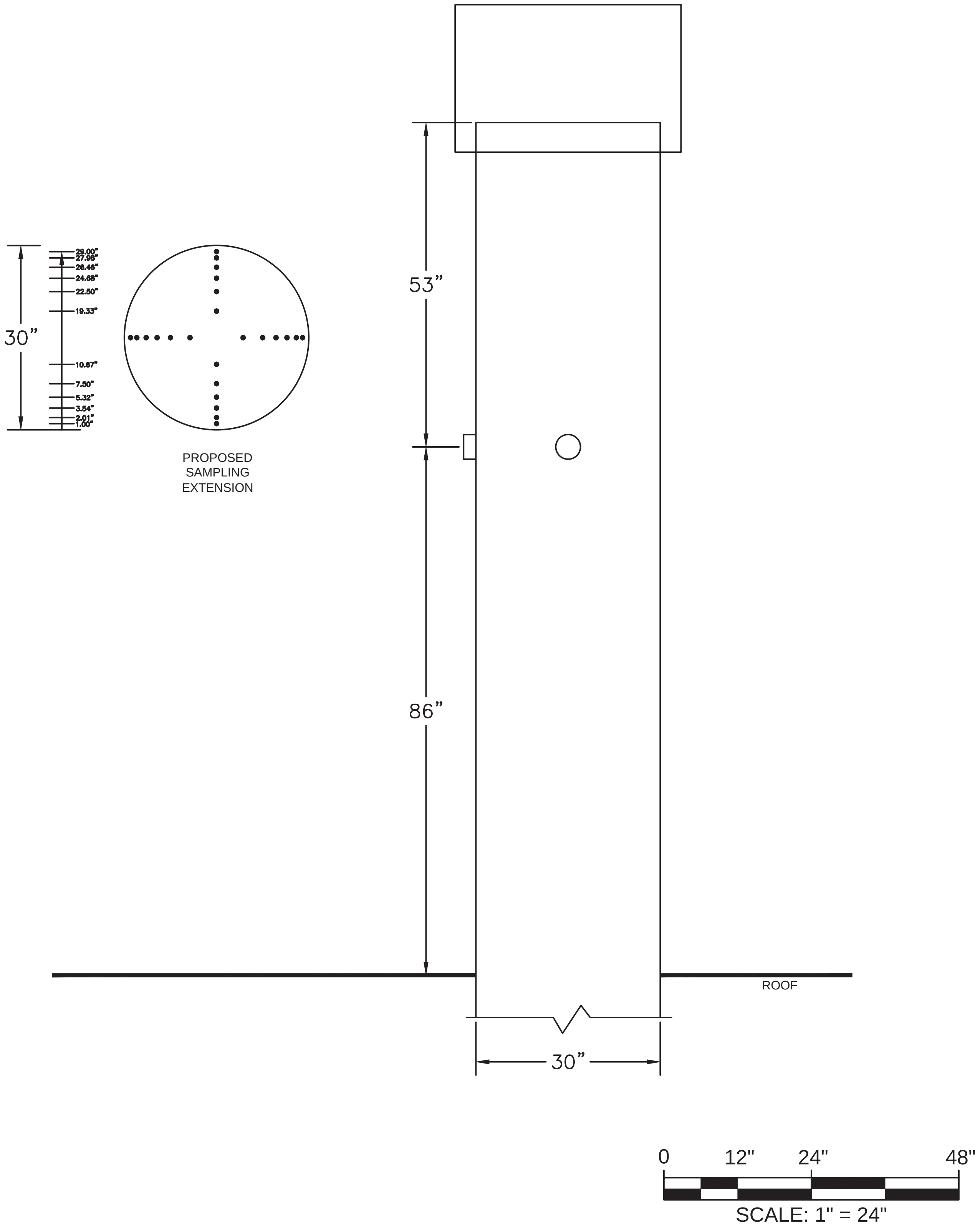

MODULE PLANT EXHAUST

GREDE, LLC
KINGSFORD, MI

GEI Consultants

Project 2003802

STACK ID 334116
CURRENT

NOV 2020

Fig. 2

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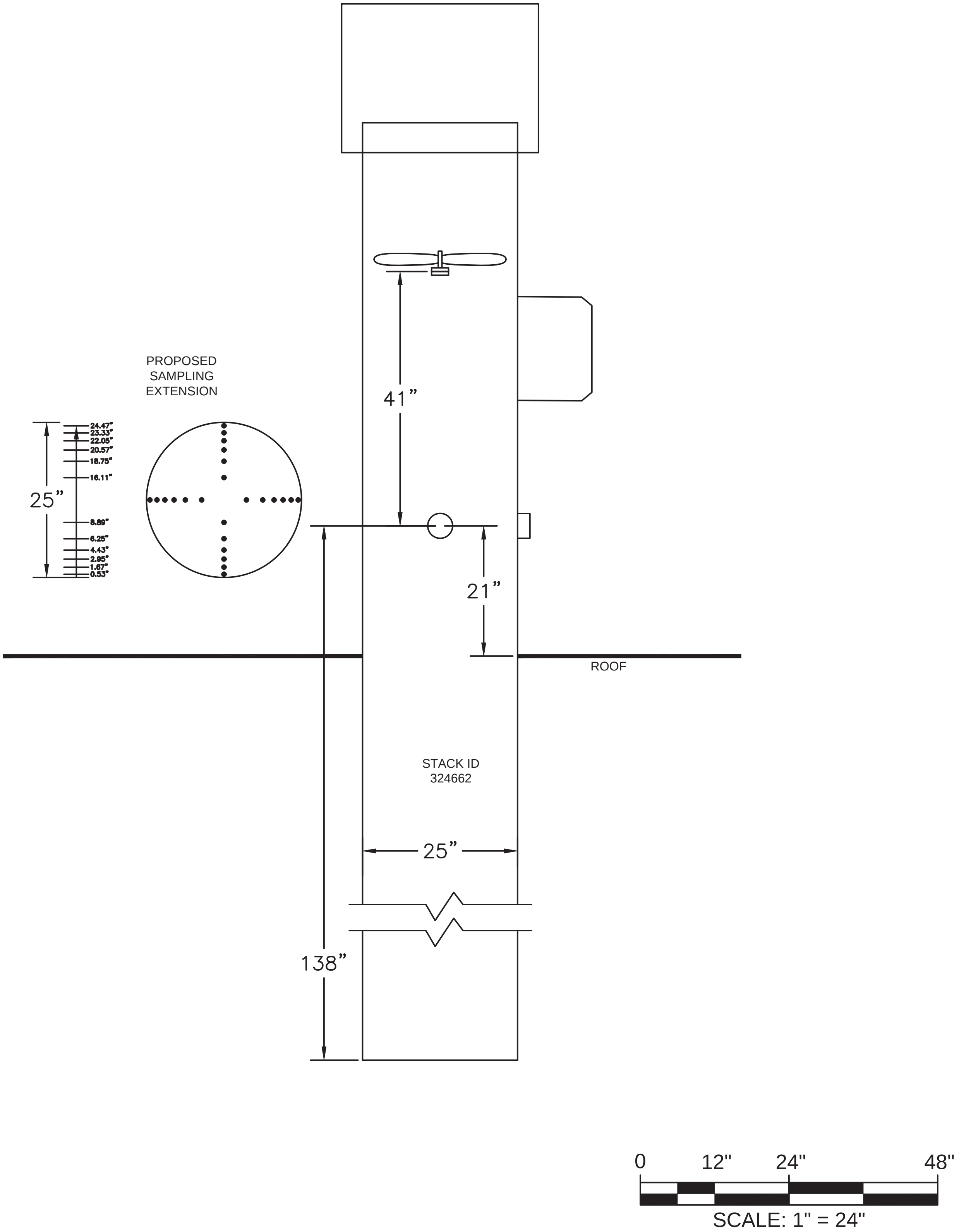

#7 HUNTER	GEI Consultants	STACK ID 324662
GREDE, LLC KINGSFORD, MI	Project 2003802	NOV 2020 Fig. 3

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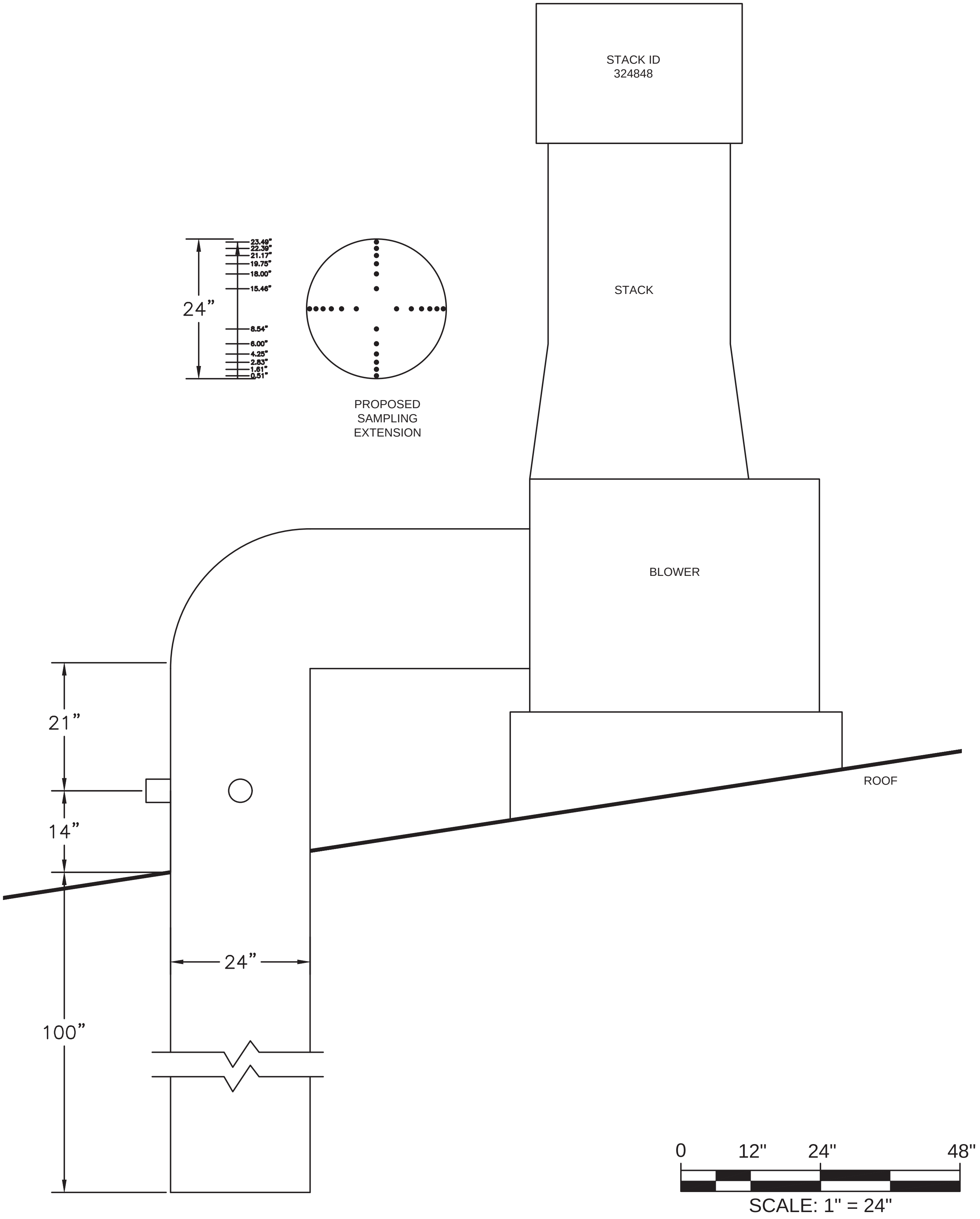
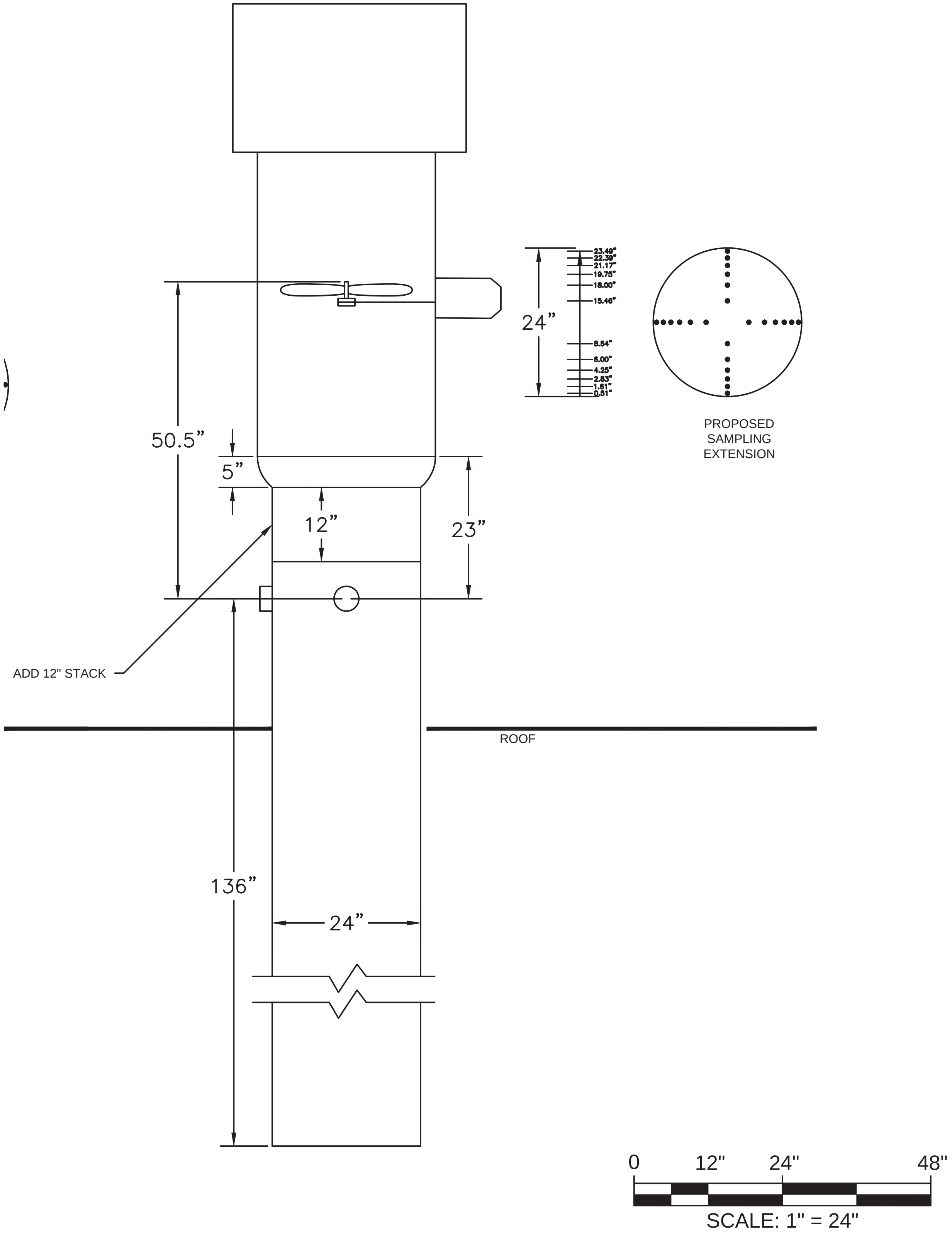


#5 HUNTER	GEI Consultants	STACK ID 324848 PROPOSED
GREDE, LLC KINGSFORD, MI	Project 2003802	NOV 2020 Fig. 6



#6 HUNTER

GREDE, LLC
KINGSFORD, MI

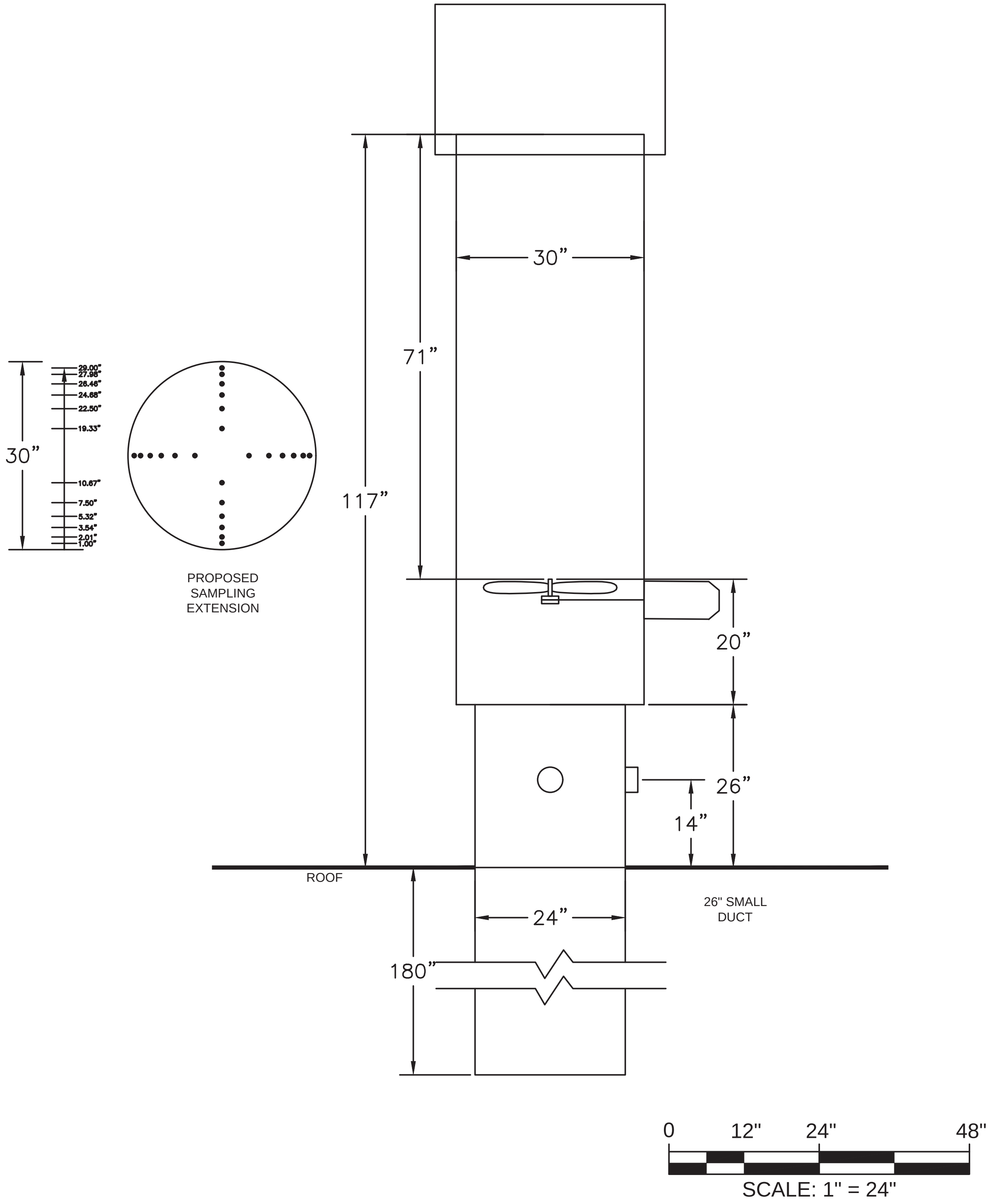
GEI Consultants

Project 2003802

STACK ID 324632
PROPOSED

NOV 2020

Fig. 8



MAIN PLANT POURING DISA

GREDE, LLC
KINGSFORD, MI

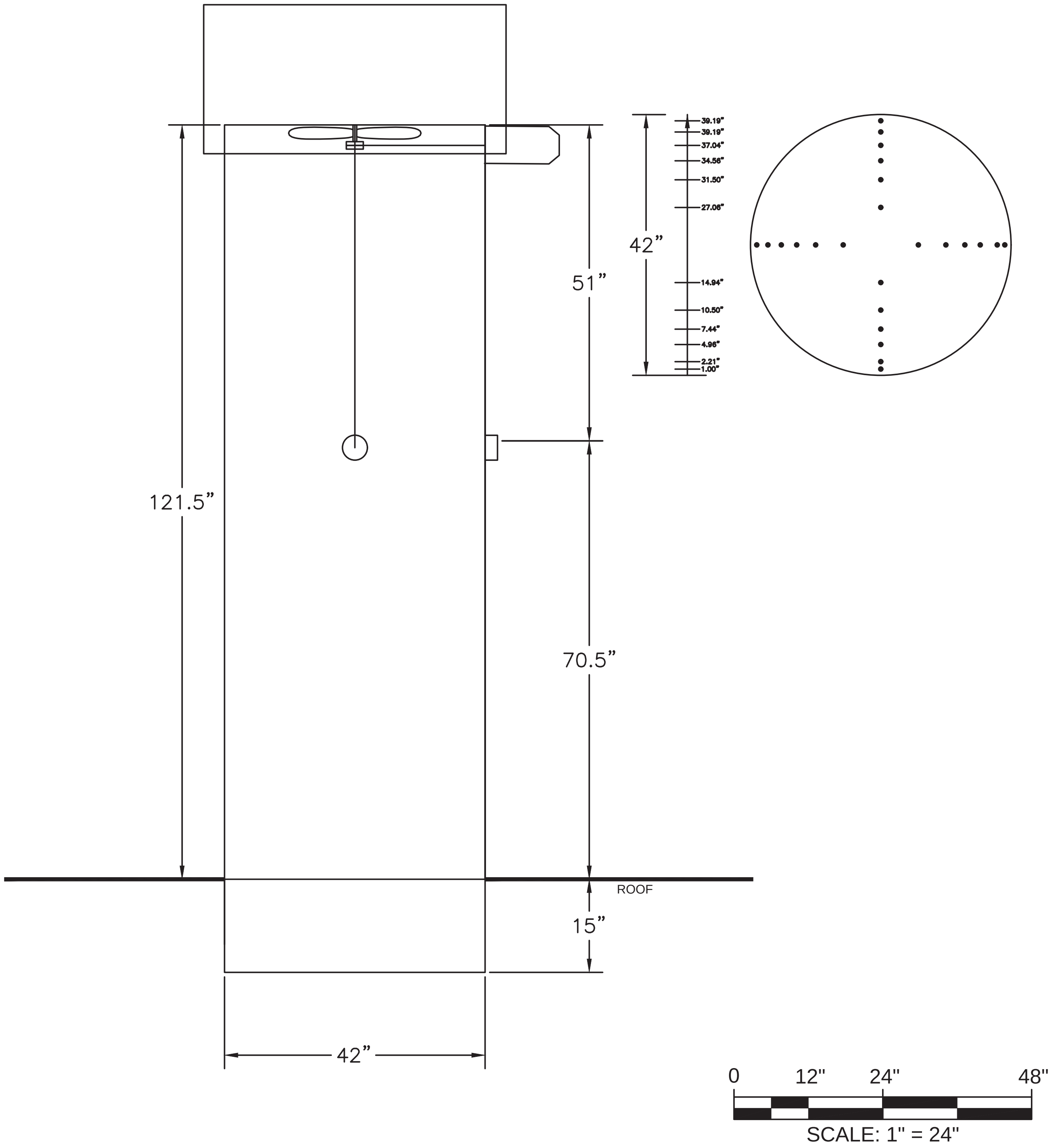
GEI Consultants

Project 2003802

STACK ID 324484
PROPOSED

NOV 2020

Fig. 10



MAIN PLANT POURING DISA

GREDE, LLC
KINGSFORD, MI

GEI Consultants

STACK ID 324678
PROPOSED

Project 2003802

NOV 2020

Fig. 12

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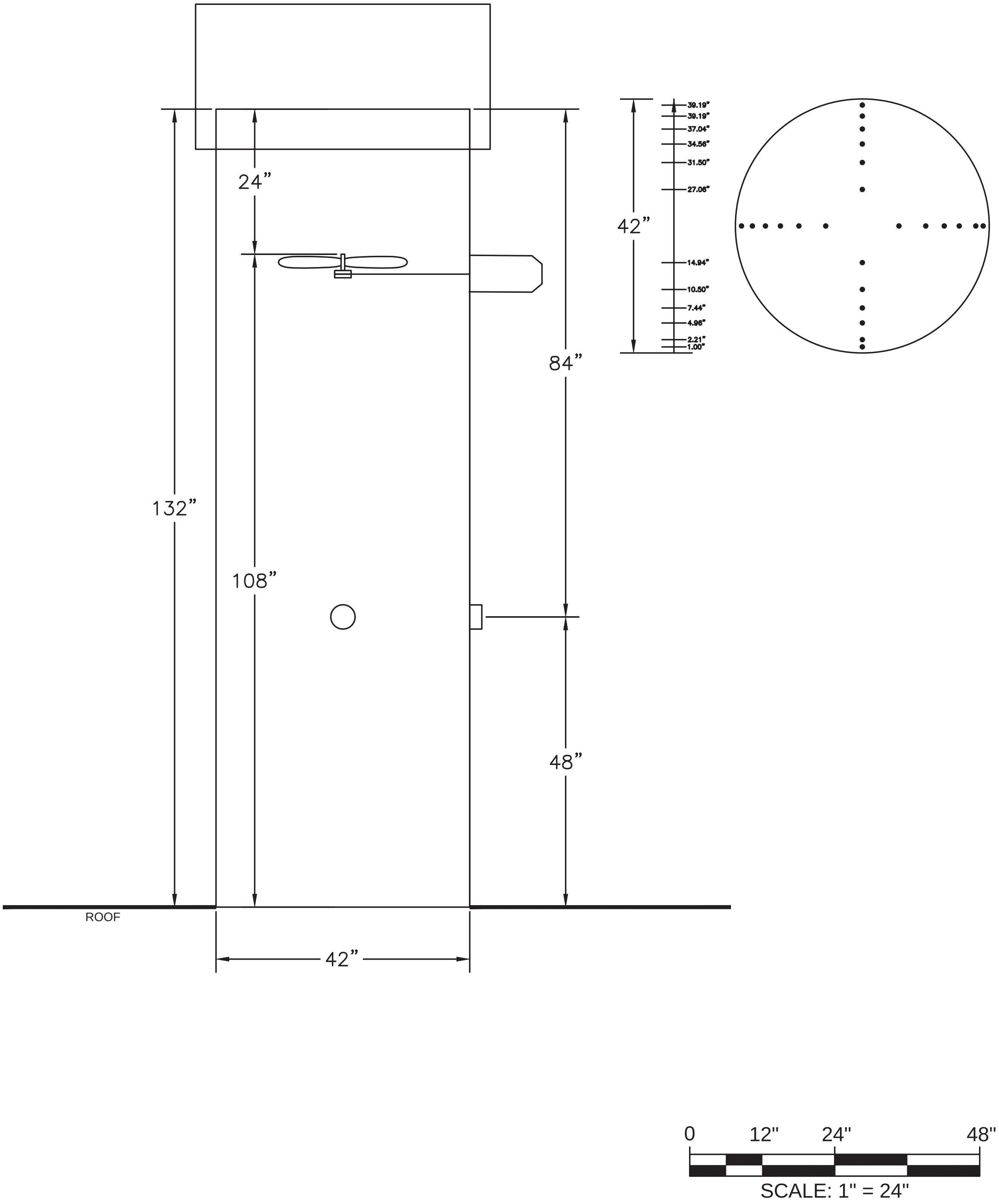

MAIN PLANT POURING DISA

GREDE, LLC
KINGSFORD, MI

GEI Consultants

Project 2003802

STACK ID 324682
PROPOSED

NOV 2020

Fig. 14

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Attachment 2

Abbreviations, Symbols, and Nomenclature

Abbreviations, Symbols, and Nomenclature

“Hg	Inches of Mercury (pressure)
“WC	Inches Water Column (pressure)
°C	Degrees Centigrade or Celsius
°F	Degrees Fahrenheit
°K	Degrees Kelvin (absolute)
°R	Degrees Rankin (absolute)
% v/v	Percent by volume
% w/w	Percent by weight
ACFM	Actual Cubic Feet per Minute
AP-42	Compilation of Air Pollutant Emission Factors, Volume I, Stationary Point and Area Sources.
BACT	Best Available Control Technology
BH	Baghouse
BHP	Brake Horsepower
BTU	British Thermal Unit
c	Centimeter
c^3	Cubic Centimeter
cc	Cubic Centimeter
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CE	Control Equipment (in Reg. ID Nos.)
CE	Control Efficiency
CEM	Continuous Emissions Monitor
CEMS	Continuous Emissions Monitoring System
CF	Cubic Feet
CFR	Code of Federal Regulations
C_1	Carbon (as carbon)
CH_4	Methane
C_3H_8	Propane
cm	Cubic Meter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DGS	Distiller’s Grains with Solubles
DDGS	Dry Distiller’s Grains with Solubles
DRE	Destruction/Reduction Efficiency
DSCF	Dry Standard Cubic Feet
DSCFM	Dry Standard Cubic Feet per Minute
dscm	Dry Standard Cubic Meter
dscmm	Dry Standard Cubic Meter per Minute
dsl	Dry Standard Liter
EPA	Environmental Protection Agency
EP	Emission Point
ESP	Electrostatic Precipitator
EU	Emission Unit
FID	Flame Ionization Detector
FGR	Flue Gas Recirculation
FPD	Flame Photometric Detector
FPM	Feet Per Minute
FPS	Feet Per Second
FR	Federal Register
FT or ft	Foot or Feet
FT^3	Cubic Feet
FTIR	Fourier Transform Infrared
g	Gram
GC	Gas Chromatograph(y)
GPD	Gallons Per Day
GPH	Gallons Per Hour
GR	Grains
H_2O	Water
H_2S	Hydrogen Sulfide
HAP	Hazardous Air Pollutant
HAPs	Hazardous Air Pollutants
Hg	Mercury
HP	Horsepower
HR	Hour
In.	Inch or Inches
KLB	Thousand Pounds
kW	Kilowatt
kWH	Kilowatt Hour
l	liter
LB	Pound or Pounds
LDAR	Leak Detection and Repair
m	Meter
m^3	Cubic Meter
MACT	Maximum Achievable Control Technology
MC	Moisture Content
µg	Microgram
µl	Microliter
µm	Micrometer (micron)
mg	Milligram
MGAL	Thousand Gallons
Min.	Minute or Minutes
ml	Milliliter
mm	Millimeter
MMBTU	Million British Thermal Units
MMSCF	Million Standard Cubic Feet
MS	Mass Spectrometry
MSDS	Material Safety Data Sheet
mW	Megawatt
MW	Molecular Weight
N_2	Nitrogen
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides (quantified as NO_2)
NSPS	New Source Performance Standard
O_2	Oxygen
PEMS	Parametric (or Predictive) Emissions Monitoring System
PID	Photo Ionization Detector
PM	Particulate Matter

PM_{10}	Particulate Matter with an aerodynamic diameter equal to or less than 10 microns
PM-10	PM_{10}
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter equal to or less than 2.5 microns
PM-2.5	$PM_{2.5}$
PPB	Parts Per Billion (see variation below)
PPM	Parts Per Million
PPMv	Part Per Million by volume
PPMv-dry	Parts Per Million by volume, dry basis
PPMv-wet	Parts Per Million by volume, wet basis
PPMw	Parts Per Million by Weight (mg/l)
PSIA	Pounds per Square Inch, Absolute
PSIG	Pounds per Square Inch, Gauge
PTE	Permanent Total Enclosure
RA	Relative Accuracy
RATA	Relative Accuracy Test Audit
rH	Relative Humidity
RTO	Regenerative Thermal Oxidizer or Recuperative Thermal Oxidizer
SCF	Standard Cubic Feet
SCFM	Standard Cubic Feet per Minute
scm	Standard Cubic Meter
scmm	Standard Cubic Meter per Minute
Scr.	Scrubber
SIC	Standard Industrial Classification
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
Sq. Ft.	Square Feet
TCD	Thermal Conductivity Detector
TO	Thermal Oxidizer
TPD	Tons Per Day
TPH	Tons Per Hour
TPY	Tons per year
TRS	Total Reduced Sulfur
TSP	Total Suspended Particulate Matter
TTE	Temporary Total Enclosure
USEPA	United States Environmental Protection Agency
VHAP	Volatile Hazardous Air Pollutant
VOC	Volatile Organic Compound
VOCs	Volatile Organic Compounds
WC	Water Column
WDGS	Wet Distiller’s Grains with Solubles

State Environmental Agency Acronyms

ADEM	Alabama Department of Environmental Management
ADEC	Alaska Department of Environmental Conservation
ADEQ	Arizona Department of Environmental Quality
ADEQ	Arkansas Department of Environmental Quality
CARB	California Air Resources Board
CDPHE	Colorado Department of Public Health & Environment
CDEP	Connecticut Department of Environmental Protection
DNREC	Delaware Natural Resources & Environmental Control
FDEP	Florida Department of Environmental Protection
GEPD	Georgia Environmental Protection Division
IDEQ	Idaho Department of Environmental Quality
IEPA	Illinois Environmental Protection Agency
IDNR	Iowa Department of Natural Resources
KDHE	Kansas Department of Health & Environment
KDEP	Kentucky Department for Environmental Protection
LDEQ	Louisiana Department of Environmental Quality
MDEP	Maine Department of Environmental Protection
MDE	Maryland Department of the Environment
MDEP	Massachusetts Department of Environmental Protection
MDEQ	Michigan Department of Environmental Quality
MPCA	Minnesota Pollution Control Agency
MDEQ	Mississippi Department of Environmental Quality
MDNR	Missouri Department of Natural Resources
MDEQ	Montana Department of Environmental Quality
NDEQ	Nebraska Department of Environmental Quality
NDEP	Nevada Division of Environmental Protection
NHDES	New Hampshire Department of Environmental Services
NJDEP	New Jersey Department of Environmental Protection
NMED	New Mexico Environment Department
NYSDEC	New York State Department of Environmental Conservation
NCDENR	North Carolina Department of Environment & Natural Resources
NDDH	North Dakota Department of Health
OEPA	Ohio Environmental Protection Agency
ODEQ	Oklahoma Department of Environmental Quality
ODEQ	Oregon Department of Environmental Quality
PDEP	Pennsylvania Department of Environmental Protection
RIDEM	Rhode Island Department of Environmental Management
SCDHEC	South Carolina Department of Health & Environmental Control
SDDENR	South Dakota Department of Environment & Natural Resources
TDEC	Tennessee Department of Environment & Conservation
TCEQ	Texas Commission on Environmental Quality
UDEQ	Utah Department of Environmental Quality
VANR	Vermont Agency of Natural Resources
VDEQ	Virginia Department of Environmental Quality
WSDNR	Washington State Department of Natural Resources
WVDEP	West Virginia Division of Environmental Protection
WDNR	Wisconsin Department of Natural Resources

Attachment 3

Calculation Equations

EPA Method 2 Calculations

Flue Gas Linear Velocity

$$V_s = 85.49 \times C_p \times \sqrt{\Delta P} \times \sqrt{\frac{\overline{T_s}}{P_s \times M_s}}$$

Volumetric Flow Rates - ACFM, SCFM & DSCFM

$$Q = 60 \times v_s \times A$$

$$Q_s = Q \times \left(\frac{528}{T_s}\right) \times \left(\frac{P_s}{29.92}\right) = Q \times 17.647 \times \left(\frac{P_s}{T_s}\right)$$

$$Q_{sd} = Q_s \times (1 - B_{ws})$$

Mass Flow Rate of Wet Flue Gas

$$m_g = \frac{4.995 \times Q_{sd} \times G_d}{1 - B_{ws}}$$

Actual Gas Density

$$\rho = \frac{0.04585 \times P_s \times M_s}{\overline{T_s}}$$

Where:

A = Cross-sectional area of duct at sample point (sq. ft.).
B_{ws} = Water vapor in gas stream (proportion by volume).
C_p = Pitot tube calibration coefficient.
G_d = Flue gas specific gravity relative to air, dimensionless.
m_g = Mass flow rate of wet flue gas (LB/HR).
M_s = Molecular weight of wet flue gas (LB/LB-mole).
P_s = Absolute gas pressure of duct (Inches Hg).
ΔP = Velocity pressure measured by pitot tube (Inches WC).
Q = Actual flue gas volumetric flow rate (ACFM).
Q_s = Volumetric gas flow at standard conditions (SCFM).
Q_{sd} = Dry standard volumetric gas flow rate (DSCFM).
T_s = Flue gas temperature (°R).
V_s = Flue gas linear velocity (feet per second).
ρ = Actual flue gas density (LB/CF).

EPA Method 3 Calculations

Dry Molecular Weight of Flue Gas

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

Wet Molecular Weight of Flue Gas

$$M_s = M_d \times (1 - B_{ws}) + (18 \times B_{ws})$$

Percent Excess Air

$$\%EA = 100 \times \left(\frac{\%O_2 - (0.05 \times \%CO)}{(0.264 \times \%N_2) - \%O_2 + (0.5 \times \%CO)} \right)$$

Fuel F-factor (for comparison)

$$F_o = \frac{20.9 - \%O_2}{\%CO_2}$$

Where:

B_{ws} = Water vapor in gas stream (proportion by volume).

%CO = Carbon monoxide in gas stream (percent).

$\%CO_2$ = Carbon dioxide in gas stream (percent).

%EA = Excess air for combustion (percent).

F_o = Fuel F-factor for results comparison.

M_d = Molecular weight of dry flue gas (LB/LB-mole).

M_s = Molecular weight of wet flue gas (LB/LB-mole).

$\%N_2$ = Nitrogen in gas stream (percent).

$\%O_2$ = Oxygen in gas stream (percent).

EPA Method 4 Calculations

Sample Volume, Standard Conditions

$$V_{std} = 17.647 \times V_m \times Y \times \left(\frac{P_b + \frac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right)$$

Volume of Water Vapor Sampled

$$V_w = 0.047070 \times V_{lc}$$

Proportion of Water Vapor in Sampled Gas

$$B_{ws} = \frac{V_w}{V_w + V_{std}}$$

Moisture Content of Sampled Gas

$$MC = B_{ws} \times 100$$

Where:

B_{ws} = Water vapor in gas stream (proportion by volume).

ΔH = Orifice meter differential pressure (Inches WC).

MC = Moisture Content, % v/v

P_b = Barometric pressure (Inches Hg).

T_m = Sampling train meter temperature (°R).

V_{lc} = Total volume of liquid collected in sampling train (mls).

V_m = Volume of gas sample measured by gas meter (CF).

V_{std} = Gas volume corrected to standard conditions (DSCF).

V_w = Volume of water vapor in gas sample (SCF).

Y = Dry gas meter calibration coefficient.

EPA Method 5 Calculations

Sample Volume, Standard Conditions

$$V_{std} = 17.647 \times V_m \times Y \times \left(\frac{P_b + \frac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right)$$

Isokinetic Variation

$$I = 0.09450 \times \left(\frac{\overline{T_s} \times V_{std}}{P_s \times V_s \times A_n \times \theta \times (1 - B_{ws})} \right)$$

Particulate Concentration

$$C_s = 15.432 \times \left(\frac{m_n}{V_{std}} \right)$$

Particulate Mass Rate

$$m_p = 0.008571 \times C_s \times Q_{sd}$$

Where:

A_n	=	Cross-sectional area of nozzle opening (square feet).
B_{ws}	=	Water vapor in gas stream (proportion by volume).
C_s	=	Particulate concentration of gas stream (GR/DSCF).
ΔH	=	Orifice meter differential pressure (Inches WC).
I	=	Isokinetic variation of sampling rate (percent).
m_n	=	Total particulate collected in sampling train (grams).
m_p	=	Particulate mass flow rate (LB/HR).
P_b	=	Barometric pressure (Inches Hg).
P_s	=	Absolute gas pressure of duct (Inches Hg).
Q_{sd}	=	Dry standard volumetric gas flow rate (DSCFM).
T_m	=	Sampling train meter temperature (°R).
T_s	=	Flue gas temperature (°R).
V_m	=	Volume of gas sample measured by gas meter (CF).
V_{std}	=	Gas volume corrected to standard conditions (DSCF).
V_s	=	Flue gas linear velocity (feet per second).
Y	=	Dry gas meter calibration coefficient.
θ	=	Total sampling time of run (minutes).

Volatile Organic Compound Calculations

Weight/Volume Concentration

$$C_{VOC} = \frac{m_{VOC}}{V_{std}}$$

Volume/Volume Concentration

$$C_{PPM} = \frac{C_{voc} \times 24.04}{MW_{VOC}}$$

VOC Emission Rate

$$E_{VOC} = (6.242 \times 10^{-8}) \times 60 \times C_{VOC} \times DSCFM$$

Where:

C_{VOC}	=	Volatile organic compound (VOC) concentration, mg/dscm
C_{PPM}	=	Volatile organic compound (VOC) concentration, PPM v/v
DSCFM	=	Volumetric airflow, Dry Standard Cubic Feet per Minute
E_{VOC}	=	Volatile organic compound (VOC) emission rate, LB/HR
M_{VOC}	=	Mass of volatile organic compound collected, µg
MW_{VOC}	=	Molecular weight of volatile organic compound
V_{std}	=	Standard volume of air sample, liters
$(6.242 \text{x} 10^{-8})$	=	Conversion from mg/dscm to LB/DSCF
60	=	Conversion from minutes to hours

Combustion Source Emissions
Concentration Correction Factors

Concentration Correction for Oxygen Basis

$$C_{P(x\%\,O_2)} = C_P \times \frac{20.9 - \%O_{2-Basis}}{20.9 - \%O_2}$$

Concentration Correction for Carbon Dioxide Basis

$$C_{P(x\%\,CO_2)} = C_P \times \frac{\%CO_{2-Basis}}{\%CO_2}$$

Where:

C_P = Pollutant concentration in units of the emission standard.

$C_{P(x\%\ O2)}$ = Pollutant concentration corrected to the target percent oxygen basis in units of the emission standard.

$C_{P(x\%\ CO2)}$ = Pollutant concentration corrected to the target percent carbon dioxide basis in units of the emission standard.

$\%CO_2$ = Carbon dioxide in gas stream (percent).

$\%CO_{2\_Basis}$ = Target correction basis for carbon dioxide (percent).

$\%O_2$ = Oxygen in gas stream (percent).

$\%O_{2\text{-Basis}}$ = Target correction basis for oxygen (percent).

20.9 = Average concentration of oxygen in the atmosphere.

Instrumental Analyzer Calculations
EPA Methods 3A, 6C, 7E and 10

Analyzer Calibration Error

$$A_E = \frac{C_{AR} - C_{Cyl}}{S_{FS}} \times 100$$

System Calibration Bias

$$B_{Sys} = \frac{C_{SR} - C_{AR}}{S_{FS}} \times 100$$

System Drift

$$D_{Sys} = \frac{C_{SR_F} - C_{SR_I}}{S_{FS}} \times 100$$

Gas Concentration Corrected for System Bias

$$C_{PPM} = \left(\overline{C} - C_{0_{SR}}\right) \frac{C_{Cyl}}{\left(\frac{C_{SR_I} + C_{SR_F}}{2}\right) - C_{0_{SR}}}$$

Conversion to Weight/Volume Units

$$C_{mg/dscm} = C_{PPM} \times \frac{M_{Gas}}{24.04}$$

Emission Rate Calculation

$$E_R = 6.243 \times 10^{-8} \times C_{mg/dscm} \times DSCFM \times 60$$

Where:

A_E = Analyzer calibration error, percent of span.
B_{Sys} = System calibration bias, percent of span.
D_{Sys} = System calibration drift, percent of span.
$\overline{C}$ = Average gas concentration response from analyzer, PPM (or %).
C_{0SR} = Average of initial and final system calibration bias check responses for the zero gas, PPM (or %).
C_{AR} = Analyzer direct calibration response, PPM (or %).
C_{Cyl} = Actual concentration of calibration gas, PPM (or %).
C_{SR} = System calibration response, PPM (or %).
C_{SRF} = Final system calibration response, PPM (or %).
C_{SRI} = Initial system calibration response, PPM (or %).
C_{PPM} = Concentration adjusted for system bias, PPM (or %).
$C_{mg/dscm}$ = Constituent concentration converted to mg/dscm.
M_{Gas} = Molecular weight of target constituent, lb/lb-mole.
E_R = Emission rate of constituent, LB/HR.
S_{FS} = System measurement span, full scale.
DSCFM = Dry standard cubic feet per minute.
$6.243\text{x}10^{-8}$ = Conversion factor, mg/cm to LB/CF.
60 = Conversion factor, minutes to hours.

Gas Concentration Calculations

Weight/Volume Concentration

$$C_{mg/dscm} = \frac{m}{V_{std}}$$

Volume/Volume Concentration

$$C_{PPM} = \frac{C_{mg/cm}\ x\ 24.055}{MW}$$

Emission Rate

$$E_{Gas} = \left(6.242\ x\ 10^{-8}\right) x\ 60\ x\ C_{mg/dscm}\ x\ DSCFM$$

Where:

$C_{mg/cm}$ = Compound Concentration, mg/cubic meter.

C_{ppm} = Compound Concentration, PPM v/v.

DSCFM = Volumetric Airflow, dry standard cubic feet per minute.

E_{Gas} = Compound Emission Rate, LB/HR.

m = Mass of Compound Collected, µg.

MW = Molecular Weight of Compound.

V_{std} = Standard Volume of Air Sample, liters.

(6.242×10^{-8}) = Conversion From mg/dscm To LB/CF.

60 = Conversion From Minutes to Hours.

Volatile Organic Compound Calculations
EPA Method 25A

Convert Analyzer Response to Carbon Basis

$$C_{ppm-C1} = C_{propane}\ x\ 3$$

Methane Corrected Concentration (as carbon)

$$C_{ppm-(C1-CH4)} = C_{ppm-C1} - C_{ppm-CH4}$$

Weight/Volume Concentration (as carbon)

$$C_{VOC-C1} = \frac{C_{ppm-C1}\ x\ 12.01}{24.04} = C_{ppm-C1}\ x\ 0.5 \quad or \quad C_{ppm-(C1-CH4)}\ x\ 0.5$$

Emission Rate (as carbon)

$$E_{VOC-C1} = \left(6.242\ x\ 10^{-8}\right) x\ 60\ x\ C_{VOC-C1}\ x\ SCFM$$

Where:

C_{voc-C1}	=	VOC Concentration as Carbon, mg/scm.
C_{ppm-C1}	=	VOC Concentration as Carbon, PPM v/v.
$C_{ppm-(C1-CH4)}$	=	Methane Corrected Concentration as Carbon, PPM v/v.
$C_{ppm-CH4}$	=	Methane Concentration, PPM v/v.
$C_{propane}$	=	Average THC Analyzer Concentration, PPM as propane.
SCFM	=	Volumetric Airflow, Standard Cubic Feet Per Minute.
E_{voc-C1}	=	VOC Emission Rate as Carbon, LB/HR.
12.01	=	Molecular Weight of Carbon.
(6.242×10^{-8})	=	Conversion From mg/scm To LB/SCF.
60	=	Conversion from Minutes to Hours.

Attachment 4

Method Summaries

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.
Project situational deviations are documented at the time of the test.

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.
Project situational deviations are documented at the time of the test.

Modified EPA Method 3/3A defines procedures to quantify carbon dioxide (CO_2) and oxygen (O_2) concentrations from stationary combustion sources. An integrated gas sample is collected simultaneously with other emissions testing. Sample gases are extracted from an emission stream at a constant rate over the course of a test period equal to other test constituents. A Tedlar™, aluminized Mylar™, or other inert material bag contains the collected gas sample prior to sample analyses. Instrumental gas analyzers compliant to EPA Method 3A quantify the CO_2 and O_2 concentrations. Three point instrument calibrations (zero, mid, and high span) are performed to certify the instruments for gas analyses. The technician maintains comprehensive test records on EPA Method 3 and Gas Analysis Field Data Sheets. Equipment used for measuring gas composition includes:

Filter Material:	Glass-fiber Filter or equivalent
Moisture removal:	Condenser and/or sorbent
Bag Material:	Tedlar™ or Aluminized Mylar™ or equivalent
Gas Analyzer:	Non-dispersive Infrared Detector (CO_2) Paramagnetic Detector (O_2)
Calibration Gases:	EPA Protocol 1

Method Defined Quality Control:

- Sampling bag leak check.

Pace FSD conducts the method as written with the following routine sampling deviation:

In the field, the gas sample is analyzed within two hours of collection using a portable O_2 detector. At a later time, potentially outside of the eight hour hold period, the gas sample is re-analyzed using an EPA Method 3A (Orsat) gas analyzer to quantify CO_2 and O_2 concentrations.

The preliminary analysis result from the portable O_2 detector is used to validate the Orsat results. The results are acceptable when the O_2 result from the field and the O_2 result from the lab differ by ≤ 0.3%.

Project situational deviations are documented at the time of the test.

EPA Method 4 - Isokinetic defines procedures to measure the moisture content of emission gas streams from stationary sources. The moisture content of the gas stream is determined in conjunction with an isokinetic sampling train. Collected water condensate is measured from the back half of the isokinetic train. Method 4 equations convert the condensed liquid volume to a gas volume. The water vapor volume compared with the dry standard gas volume collected through the isokinetic train determines the moisture content of the emissions gas stream and is reported in percent by volume. Test records are included on the associated isokinetic method data sheet. Equipment used for measuring moisture content includes:

Probe Material:	Borosilicate glass or Stainless Steel
Filter Media:	Glass or Quartz fiber
Impinger Train Material:	Borosilicate Glass
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%).
- Gas meter volumes are verified at each traverse point by calculating the expected gas volume for each interval and comparing the gas volume metered during the interval.
- 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.

The metering system verification cited above is a method QC alternative but considered more rigorous. Pace FSD conducts the method as written with no routine sampling deviations.
Project situational deviations are documented at the time of testing.

EPA Method 5 defines procedures to measure particulate emissions from stationary sources. Using traverse points determined from EPA Method 1 and incorporating procedures from EPA Methods 2, 3, and 4, a sample gas stream is isokinetically drawn from the emission stream. The particulate dry fraction collects in the sampling probe and on a quartz or glass-fiber filter. The probe and filter components of the sampling train are heated to 248°F (±25°F) to prevent moisture condensation and preserve sample integrity. The filtered sample gas stream passes through a series of impingers to condense water vapor and collect gaseous constituents. The first two impingers initially contain deionized water, and the third impinger is empty. A desiccant packed drying column follows the impingers to quantitatively collect the remaining moisture. An ice bath maintains the impinger train temperature (outlet) at 68°F or less. The impinger contents can be discarded or saved for additional analyses. Sample recovery and train clean up are performed after each run using procedures to ensure sample integrity and quantitative recovery. The train operator maintains comprehensive test records on EPA Method 5 Field Data Sheet, Isokinetic Particulate Sampling. Details of particulate testing are outlined below:

Nozzle/Probe Material:	Stainless Steel and Borosilicate Glass
Filter Holder Material:	Borosilicate Glass with glass or Teflon support
Filter Media:	Quartz or Glass-fiber, >99.95% efficient at 0.3μm
Impinger Train Material:	Borosilicate Glass
Impinger Reagents:	Deionized Water
Recovery Reagents:	Acetone Deionized water
Control Train:	Gas meter, orifice, differential pressure gauges, pump, valves, temperature monitors and controllers
Analytical Techniques:	Gravimetric

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).
- Gas meter volumes are verified at each traverse point by calculating the expected gas volume for each interval and comparing the gas volume metered during the interval.
- 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.
- Sampling is performed at an isokinetic rate between 90 and 110%.
- A field blank is collected to verify site conditions to be non-contaminating.
- Sampling and recovery reagents are reagent grade or better.
- Analytical balances are calibrated and certified on an annual basis by an external service provider and verified before each use using stainless steel reference weights traceable to national standards maintained by NIST.
- 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.

The metering system verification cited above is a method QC alternative but considered more rigorous. Pace FSD conducts the method as written with no routine sampling deviations.
Project situational deviations are documented at the time of testing.

EPA Method 202 defines procedures to determine organic and inorganic condensable particulate matter (CPM) emissions from stationary sources. The CPM is collected in a condensate knock-out impinger and Teflon filter after filterable PM has been collected by either Method 5 or Method 201A. The gas stream is sample isokinetically following EPA Method 5 or Method 201A procedures. The gas stream is initially cooled with a spiral condenser using recirculated cool water to maintain a sample gas temperature of 85°F or less. Condensate from the spiral condenser collects in glass, stemless, dropout impingers. The intent of the condenser and dropout impinger is to minimize gas/water contact to reduce collection of unintended artifacts. The dropout impinger is followed by a second impinger to provide overflow capacity. A Teflon^{TM} filter, also maintained at 85°F or less is used to collect any remaining organic CPM. The filter is followed by an iced, water prepared impinger and desiccant packed drying column to quantitatively collect remaining moisture. Immediately after sampling, the Method 202 CPM condensate is purged with nitrogen (N_2) to liberate dissolved sulfur dioxide (SO_2) gases. The contents of the dropout and backup impingers prior to the CPM filter are measured, weighed, and transferred to an appropriate sample bottle. CPM is quantitatively recovered with water, acetone, and hexane rinses. The CPM filter and water are extracted with hexane and combined with solvent rinses to determine the organic CPM. Following extraction, the water is dried and the residue measured as the inorganic CPM. The combination of both fractions represents the total condensable particulate matter (CPM). The train operator maintains comprehensive test records on appropriate Field Data Sheets.

Filter Holder Material:	Glass, Stainless Steel (316 or equivalent), or Fluoropolymer-coated Stainless Steel

Filter Media:	Teflon, >99.95% efficient at 0.3 um
Impinger Train Material:	Borosilicate Glass
Impinger Reagents:	Deionized Water
Recovery Reagents:	Acetone Hexane Deionized Water
Control Train:	EPA Method 5
Analytical Technique:	Gravimetric

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).
- Gas meter volumes are verified at each traverse point by calculating the expected gas volume for each interval and comparing the gas volume metered during the interval.
- 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.
- Sampling is performed at an isokinetic rate between 90 and 110%.
- A field blank is collected to verify site conditions to be non-contaminating.
- Sampling and recovery reagents are reagent grade or better.
- Analytical balances are calibrated and certified on an annual basis by an external service provider and verified before each use using stainless steel reference weights traceable to national standards maintained by NIST.

The metering system verification cited above is a method QC alternative but considered more rigorous. Pace FSD conducts the method as written with no routine sampling deviations.
Project situational deviations are documented at the time of testing.

EPA Method 6C defines procedures to measure sulfur dioxide (SO_2) 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 fluorescence gas analyzer to quantify SO_2 emissions. Zero grade cylinder air or a zero gas generator provides zero gas. Span gases include varying concentrations of EPA Protocol 1 SO_2 standards specific to the target calibration range. A computerized data acquisition system logs SO_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 on the electronic Project Results Instrumental Workbook. Equipment used for SO_2 testing includes:

Probe Material:	Stainless Steel
Moisture Removal:	Thermo-electric
Transfer Line:	Teflon™
Analytical Technique:	Fluorescence Detector
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.
Project situational deviations are documented at the time of the test.

EPA Method 9 defines procedures to evaluate the opacity of the plume emitted from a source stack. An independently certified visible emissions observer visually estimates the opacity of the non-moisture plume from the source. The observer positions themselves with the sun (or other light source) at their back and perpendicular to the plume when directly facing the emission point. The observer must also ensure a clear and contrasting background behind the plume. The certified observer then estimates (based on certification trials) the percentage of the background blocked by the source plume (plume opacity) in increments of 5%. Observed opacity readings are recorded at 15-second intervals throughout the run. Tabulated results include run average and successive six-minute averages. The spreadsheet software also searches the data set for any group of 24 consecutive readings that yield the highest possible six-minute average. The train operator maintains comprehensive test records on the Visible Emission Observation Form. Details of the opacity evaluation are outlined below:

Evaluation Period:	One hour
Observation Frequency:	15 Seconds
No. of Observations:	240
No. of Six-minutes Averages:	10
Observer Certifications:	Semi-annual

Pace FSD conducts the method as written with no routine deviations.
Project situational deviations are documented at the time of the test.

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.
Project situational deviations are documented at the time of the test.

EPA Method 25A defines procedures used to measure total hydrocarbons from stationary sources. A stainless steel sampling probe and heat-traced Teflon™ sampling line draw a sample of the gas stream from the duct directly to the analytical system. A total hydrocarbon monitor utilizing a flame ionization detector (FID) quantifies total hydrocarbon concentrations. Zero grade cylinder air or a zero gas generator provides zero gas. Span gases include varying concentrations of EPA Protocol 1 propane (C_3H_8) standards specific to the target calibration range. A computerized data acquisition system logs THC concentrations for one-minute averages. The logged results are integrated to test periods and tabulated with standardized and validated spreadsheets in Microsoft Excel. The analyzer results are multiplied by 3 to report results as carbon (C_1). The operator also maintains comprehensive test records in the electronic Project Results Instrumental Workbook. Equipment used for THC testing includes:

Probe Material:	Stainless Steel
Transfer Line:	Teflon™, (heated)
Analytical Technique:	Flame Ionization Detector (FID)
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.
- 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.

Project situational deviations are documented at the time of the test.

Multimetal: EPA Method 29 defines procedures to measure metal emissions from stationary sources. Using traverse points determined from EPA Method 1 and incorporating procedures from EPA Methods 2, 3, 4, and 5, a sample gas stream is isokinetically drawn from the emission stream. The particulate fraction of metals emissions collects in the sampling probe and on a quartz-fiber filter. The probe and filter components of the sampling train are heated to 248°F (±25°F) to prevent moisture condensation and preserve sample integrity. The filtered sample gas stream passes through a series of reagent-filled impingers to collect the vapor fraction of metals emissions. The first two impingers are prepared with a 5% nitric acid (HNO_3)/10% hydrogen peroxide (H_2O_2) solution and are followed by a dry impinger. Impingers 4 and 5 are prepared with a 4% potassium permanganate ($KMnO_4$)/10% sulfuric acid (H_2SO_4) absorbing solution followed by another dry impinger. A desiccant packed drying column follows the impingers to quantitatively collect the remaining moisture. A dry impinger may precede the reagent impingers for additional condensate capacity in high moisture sources. An ice bath maintains the impinger train temperature (outlet) at 68°F or less. Sample recovery and train clean-up are performed after each run using procedures to ensure sample integrity and quantitative recovery. The train operator maintains comprehensive test records on EPA Method 29 Field Data Sheet. Details of metals testing are outlined below:

Nozzle/Probe Material:	Quartz and Borosilicate Glass
Filter Holder Material:	Borosilicate Glass and Teflon™ Filter Support
Filter Media:	Quartz Fiber, >99.95% efficient at 0.3 µm
Impinger Train Material:	Borosilicate Glass
Impinger Reagents:	5% HNO_3 and 10% H_2O_2 4% $KMnO_4$ and 10% H_2SO_4
Recovery Reagents:	Acetone (front-half only) 0.1 N HNO_3 (front-half only) 4% $KMnO_4$ and 10% H_2SO_4 8N HCl Deionized Water
Control Train:	EPA Method 5
Analytical Technique:	Inductively Coupled Plasma-Mass Spectrometry Cold Vapor Atomic Absorption Spectroscopy

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).

- Gas meter volumes are verified at each traverse point by calculating the expected gas volume for each interval and comparing the gas volume metered during the interval.
- 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.
- Sampling is performed at an isokinetic rate between 90 and 110%.
- A field blank is collected to verify site conditions to be non-contaminating.
- Sampling and recovery reagents are reagent grade or better.
- Multipoint analytical systems calibration.
- Analytical calibration is verified hourly.
- 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.

The metering system verification cited above is a method QC alternative but considered more rigorous. Pace FSD conducts the method as written with no routine sampling deviations.
Project situational deviations are documented at the time of testing.

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.

Attachment 5

Quality Statement

Quality Assurance/Quality Control

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. Documentation of the Pace Analytical Quality Assurance Program will be available on-site.