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Comprehensive Emissions Test Report

Grede, LLC - Iron Mountain
Particulate, Metals, VOC, SO_2, CO, & Opacity
Compliance Testing

Testing Date(s): April 16-18 & 23-25, 2019
Report Date: June 21, 2019
Revision Date: No revision to date

ACCREDITED
Cert #3819.01 (ISO/IEC 17025:2005)
Cert #3819.02 (ASTM D7036)

STAC
STACK TESTING ACCREDITATION COUNCIL

Subject Facility:
Grede, LLC
Iron Mountain
801 South Carpenter Avenue
Kingsford, MI 49802

Regulatory Permit No.:
MI-ROP-B1577-2014a
SRN: B1577

Subject Emission Sources:

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

Test Locations:

Cupola Baghouse Exhaust	324644
Main Plant Pouring	10 Stacks
Module Pouring	2 Stacks

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Pace Project No. 19-01623

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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-B1577-2014a
Facility ID No.: SRN: B1577

Emission Unit IDs	Emission Unit Name	Regulated Constituent	Regulatory Citations	Regulatory Limit	Average Test Result
324176	Disa Summit	Particulate (front half)	40 CFR 63.7690(a)(5)(i)	≤0.010 GR/DSCF	0.0019 GR/DSCF
324188	Disa Summit				0.0019 GR/DSCF
324196	Disa Summit				0.0022 GR/DSCF
324204	Disa Summit				0.0018 GR/DSCF
324484	Disa Pouring				0.0036 GR/DSCF
324678	Disa Exhaust				0.0032 GR/DSCF
324682	Disa CC Exh.				0.0017 GR/DSCF
334116	Module Exh.				0.0033 GR/DSCF
334176	Module Exh.				0.0024 GR/DSCF
324848	No.5 HMP				0.0022 GR/DSCF
324632	No.6 HMP				0.0031 GR/DSCF
324662	No.7 HMP				0.0050 GR/DSCF
P016/P036	Combined	PM10 (front half)	R 336.1331	9.0 LB/HR	2.98 LB/HR
EU-P009 324644	Cupola Baghouse Exhaust	Carbon Monoxide	R 336.1201(3)	≤21.0 LB/HR	≥65.6 LB/HR
				≤250.0 mg/m^3	≥1035 mg/m^3
		Particulate (front half)	40 CFR 63.7690(a)(2)(i) or (ii) or (iii) or (iv)	0.006 GR/DSCF or 0.10 LB/Ton metal charged	0.0024 GR/DSCF 0.0208 LB/Ton metal charged
		Total Metal HAP		0.0005 GR/DSCF or 0.008 LB/Ton metal charged	0.000029 GR/DSCF 0.00026 LB/Ton metal charged
		Particulate (front half)	R 336.1331	≤0.011 LB/1000 LB exhaust gas	0.0043 LB/1000 LB exhaust gas
		PM-10	R 336.1331	1.30 LB/HR	0.46 LB/HR
		Sulfur Dioxide	R 336.1201(3)	≤170 mg/m^3	58.5 mg/dscm*
				≤13.8 LB/HR	3.26 LB/HR*
		Volatile Organic HAP (VOHAP)	40 CFR 63.7690(a)(8)	≤20 PPMv @ 10% O_2 as hexane	6.5 PPMv @ 10% O_2 as hexane

*Results from a single test run.

Introduction

Pace Analytical Services, LLC personnel conducted particulate, metals, carbon monoxide (CO), total hydrocarbon (THC), sulfur dioxide (SO_2) and opacity emission compliance testing on the Cupola and particulate and opacity compliance testing on twelve Main Plant and Module Plant pouring and cooling exhaust stacks at the Grede, LLC facility located in Kingsford, Michigan. Terry Borgerding, Matt McDermott, Nate Hibbard, Zack Eckstrom, Jack Kokkinen and Isaac Prichett performed on-site testing activities on April 16-25, 2019. Terry Borgerding provided administrative project management. Tom White with Grede, LLC coordinated plant activities during testing. Pace Analytical Services, LLC prepared a comprehensive test protocol that was submitted to the Michigan Department of Environmental Quality (DEQ) 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 exhaust vent.
- Metals, three independent two-hour samplings on the cupola exhaust vent.
- 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
- Volumetric airflow, measurements collected in conjunction with isokinetic testing.

The project objectives were to quantify particulate, metals, 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 1-13 and in the regulatory summary. The front half particulate emission concentration from all of the Main Plant and Module Plant exhaust stacks ranged from 0.0017 GR/DSCF to 0.0050 GR/DSCF and were below the particulate emission concentration limit of 0.010 GR/DSCF for these sources. The front half particulate mass rate of the combined Main Plant and Module Plant exhaust stacks averaged 2.98 LB/HR. The PM-10 operating permit emission limit for the combined Main Plant and Module Plant exhaust stacks is 9.0 LB/HR.

The particulate emission concentration and mass emission rate from the cupola averaged 0.0024 GR/DSCF, 0.0043 LB/1000 LB exhaust gas, and 0.021 LB/Ton metal charged. The MACT limit for this source is 0.006 GR/DSCF or 0.10 LB/Ton metal charged and the operating permit limit is 0.011 LB/1000 LB exhaust gas. The PM-10 emission rate averaged 0.46 LB/HR. The PM-10 operating permit emission limit for this source is 1.30 LB/HR.

Results of metals determinations for the cupola baghouse exhaust are summarized in Table 14. The total metals emission concentration averaged 0.000029 GR/DSCF with a mass emission rate of 0.00026 LB/Ton Charged. Total metals is the sum of the eleven individual HAPs metals listed in Table 14. The total metals emission limit for this source is 0.0005 GR/DSCF or 0.008 LB/Ton Charged

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 front half particulate matter (MACT). The dry catch (EPA Method 5), organic wet catch and inorganic wet catch (EPA Method 202) were combined to report PM-10 on the cupola baghouse exhaust.

Particulate and metals testing on the Cupola baghouse exhaust vent was performed following the procedures of EPA Method 5D and EPA Method 29. Sampling on the Cupola is performed from an area above the baghouse compartments and accessed from an open area along the side of the baghouse. Airflow measurements collected from the inlet to the baghouse were used to calculate particulate and metals mass rates. 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 Field Data Sheets included in Appendix A.

Disa Summit Line Stack 324188 was mislabeled as 324184 at the time sampling was performed. The error was discovered during conversations with MDEQ May 17, 2019. Data sheets and results tables are corrected in this report using the stack identification as 324188. Regulatory correspondence regarding this is included in Appendix F.

Nine of the twelve pouring and cooling exhaust stacks did not meet EPA Method 1 criteria for acceptable sampling locations: four for insufficient distances between disturbances (324176, 324196, 324204, 324848), and five for excessive cyclonic flow and insufficient distances between disturbances (324188, 324484, 324678, 234682, 334176).

Since past testing on these or similar configurations had been accepted for compliance determination, the test team chose to proceed with testing during this mobilization. For sources that exhibited cyclonic flow, testing was conducted with the Alignment Approach Modification from EPA EMC Guideline Document – 008 (EMC GD-008, para. 3). In this approach, the particulate nozzle is turned into the direction of flow (initial yaw angle measurements) for each traverse point. In this manner, accurate gas velocity measurements and isokinetic sampling rates are maintained. Biases from an isokinetic sampling and impact angle are avoided and representative particulate concentrations are achieved. To determine the actual exhaust airflow for emission rate calculations, the yaw angle and velocity for each point are geometrically converted to a lineal movement rate relative to the duct axis. The lineal movement rates are averaged and

combined with the duct cross-sectional area to determine the stack exit flow rate. To maintain consistency, any stack exhibiting greater than 15° average yaw angle was sampled in this manner which included four additional stacks (324176, 324196, 324204, 334116). Three exhaust stacks (324848-No.5 HMP, 324623-No.6 HMP, 324662-No.7 HMP) had minimal or no cyclonic flow present and were sampled with normal Method 5 procedures. Airflow results are reported in Tables 58-70.

For non-compliant distance sources, other factors allow presumption that particulate results are representative of the true conditions. Velocity profiles fit the expected pattern for cyclonic flow sources and suggest that sites are not subject to turbulent (multidirectional) flow. These sources generally exhaust off-gases from pouring and cooling processes where any particulate is "buoyant" or aerodynamically small. Small particulate act as aerosols where inertial forces are not as critical in disturbed flow situations. These sources are also limited on a concentration rather than mass rate basis, so imprecision in airflow measurements would not affect the compliance of the emission units. There is a high degree of confidence that reported particulate results are representative of the sources conditions at the times of the tests.

Results of THC, SO_2, and CO determinations measured from the cupola baghouse inlet are reported in Table 44-45. The THC concentration averaged 6.5 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 58.5 mg/dscm with a mass emission rate of 3.26 LB/HR. The SO_2 emission limit for this source is 170 mg/dscm and 13.8 LB/HR. The CO concentration averaged ≥1035 mg/dscm with a mass emission rate of ≥65.6 LB/HR. The CO emission limit for this source is 250 mg/dscm and 21.0 LB/HR.

The CO concentration spiked over the range of the analyzer numerous times during the monitoring periods. Therefore the CO concentration was analyzed from integrated sample bags collected in conjunction with the metals testing on the cupola. The concentration of the third run was over the 1000 ppm range of the analyzer and was reported as a greater than value. The SO_2 results reported are from a single one-hour

monitoring period. Two other SO_2 test runs did not pass system bias criteria due to a malfunction within the gas conditioning system. The monitoring log and integrated bag sample results are included in Appendix B.

Results of opacity observations from the Main Plant and Module Plant exhaust stacks are reported in Tables 46-57. Most of the 240 observations on each stack were 0% with just a few readings of 5%.

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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Iron Mountain
Kingsford, MI
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Table 1

Results Summary
Main Plant Pouring Disa Summit Stack (324176)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/16/19	4/16/19	4/16/19	
Time of Run	0757-0927	0948-1158	1220-1343	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	12,500	12,800	13,300	12,900
DSCFM	11,700	10,600	10,900	11,100
Gas Temperature, °F	78	81	87	82
Gas Moisture Content, %v/v	0.7	0.5	0.9	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	0.22	0.17	0.16	0.18
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0022	0.0019	0.0017	0.0019

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Table 2

Results Summary
Main Plant Pouring Disa Summit Stack (324188)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/17/19	4/17/19	4/17/19	
Time of Run	0617-0732	0757-0913	0949-1100	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	13,100	12,700	12,600	12,800
DSCFM	12,500	12,100	11,800	12,100
Gas Temperature, °F	67	73	81	74
Gas Moisture Content, %v/v	0.7	0.6	0.1	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	0.22	0.19	0.18	0.19
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0020	0.0019	0.0017	0.0019

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Table 3

Results Summary
Main Plant Pouring Disa Summit Stack (324196)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/17/19	4/18/19	4/18/19	
Time of Run	1235-1454	0615-0743	0810-0932	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	14,500	14,400	14,600	14,500
DSCFM	13,400	13,300	13,500	13,400
Gas Temperature, °F	86	75	76	79
Gas Moisture Content, %v/v	0.7	1.0	0.8	0.9
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	0.30	0.23	0.24	0.26
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0026	0.0020	0.0021	0.0022

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Table 4

Results Summary
Main Plant Pouring Disa Summit Stack (324204)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/18/19	4/18/19	4/18/19	
Time of Run	0956-1151	1215-1330	1348-1510	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	14,200	14,000	14,400	14,200
DSCFM	13,100	12,900	13,300	13,100
Gas Temperature, °F	76	77	75	76
Gas Moisture Content, %v/v	0.9	0.9	0.6	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	0.20	0.21	0.21	0.21
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0018	0.0019	0.0018	0.0018

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Table 5

Results Summary
Main Plant Pouring Disa Exhaust (324484)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/18/19	4/18/19	4/18/19	
Time of Run	0654-0827	0900-1016	1155-1312	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	10,780	10,720	10,670	10,720
DSCFM	9,620	9,410	9,370	9,470
Gas Temperature, °F	96	95	96	96
Gas Moisture Content, %v/v	0.7	2.5	2.3	1.8
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	0.20	0.37	0.30	0.29
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0025	0.0046	0.0037	0.0036

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Table 6

Results Summary
Main Plant Pouring Disa Exhaust (324678)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/16/19	4/16/19	4/17/19	
Time of Run	0800-0928	0950-1213	0623-0751	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	24,300	24,200	23,300	23,900
DSCFM	22,500	22,200	22,000	22,200
Gas Temperature, °F	83	87	75	82
Gas Moisture Content, %v/v	0.6	0.8	0.7	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	0.68	0.63	0.54	0.62
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0035	0.0033	0.0029	0.0032

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Table 7

Results Summary
Main Plant Pouring Disa CC Exhaust (324682)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/17/19	4/17/19	4/17/19	
Time of Run	0850-1021	1035-1256	1326-1605	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	15,500	15,400	15,400	15,400
DSCFM	14,400	14,100	14,200	14,200
Gas Temperature, °F	84	91	90	88
Gas Moisture Content, %v/v	0.3	0.6	0.1	0.3
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	0.21	0.19	0.21	0.20
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0017	0.0016	0.0017	0.0017

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Table 8

Results Summary
Module Pouring Plant Exhaust (334116)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/23/19	4/23/19	4/23/19	
Time of Run	0740-0907	1017-1231	1330-1500	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	8,170	8,370	8,130	8,220
DSCFM	7,480	7,610	7,330	7,470
Gas Temperature, °F	94	97	102	98
Gas Moisture Content, %v/v	0.1	0.3	0.0	0.2
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	0.22	0.19	0.22	0.21
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0035	0.0030	0.0035	0.0033

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Table 9

Results Summary
Module Pouring Plant Exhaust (334176)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/23/19	4/23/19	4/23/19	
Time of Run	0740-0908	1018-1231	1330-1500	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	5,400	5,550	5,420	5,460
DSCFM	4,940	5,050	4,960	4,980
Gas Temperature, °F	94	95	93	94
Gas Moisture Content, %v/v	0.2	0.4	0.1	0.2
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	0.11	0.10	0.10	0.10
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0026	0.0022	0.0025	0.0024

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Table 10

Results Summary
Main Plant Pouring No. 5 HMP - TC Fan (324848)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/24/19	4/24/19	4/24/19	
Time of Run	0705-0820	0855-1017	1120-1238	
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	11,000	11,500	11,300	11,300
DSCFM	10,300	10,800	10,600	10,600
Gas Temperature, °F	77	73	75	75
Gas Moisture Content, %v/v	1.0	0.9	0.8	0.9
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	0.11	0.14	0.35	0.20
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0012	0.0015	0.0039	0.0022

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Table 11

Results Summary
Main Plant Pouring No. 6 HMP - East Hunter (324632)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/24/19	4/24/19	4/24/19	
Time of Run	0705-0820	0855-1020	1120-1238	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	3,860	4,260	4,430	4,180
DSCFM	3,610	3,990	4,090	3,900
Gas Temperature, °F	77	78	87	80
Gas Moisture Content, %v/v	1.2	1.0	0.7	0.9
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	0.08	0.15	0.08	0.10
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0027	0.0045	0.0022	0.0031

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Table 12

Results Summary
Main Plant Pouring No. 7 HMP - West Hunter (324662)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**	**Average**
Date of Run	4/24/19	4/25/19	4/25/19	
Time of Run	1322-1439	0645-0759	0824-0939	
Volumetric Flow Rate (Rounded to 10 CFM)				
ACFM	10,530	11,030	10,870	10,810
DSCFM	9,570	10,030	9,740	9,780
Gas Temperature, °F	98	92	98	96
Gas Moisture Content, %v/v	0.2	0.3	0.7	0.4
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	0.53	0.34	0.38	0.42
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0064	0.0039	0.0046	0.0050

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Table 13

Results Summary
Cupola Baghouse Exhaust
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/23/19	4/24/19	4/24/19	
Time of Run	1005-1355	0702-0927	1055-1320	
Cupola Melt Rate, TPH	14.6	15.5	15.5	15.2
Volumetric Flow Rate*				
ACFM	42,700	43,400	40,500	42,200
DSCFM	15,800	15,400	14,900	15,400
Gas Temperature, °F	124	214	216	185
Gas Moisture Content, %v/v	3.8	7.6	6.6	6.0
Particulate Mass Rate, LB/HR				
Filterable Particulate	0.41	0.29	0.24	0.31
Filterable+Organic Cond.	0.41	0.32	0.26	0.33
Total Particulate (PM-10 Eq.)	0.48	0.45	0.43	0.46
Particulate Concentration, GR/DSCF				
Filterable Particulate	0.0030	0.0022	0.0019	0.0024
Filterable+Organic Cond.	0.0030	0.0024	0.0021	0.0025
Total Particulate (PM-10 Eq.)	0.0036	0.0034	0.0034	0.0035
Regulatory Units, LB/Ton Metal Charged				
Filterable Particulate	0.0280	0.0189	0.0157	0.0208
Filterable+Organic Cond.	0.0283	0.0205	0.0170	0.0219
Total Particulate (PM-10 Eq.)	0.0332	0.0293	0.0281	0.0302
Regulatory Units, LB/1000 LBS of Flue Gas				
Filterable Particulate	0.0056	0.0040	0.0034	0.0043
Filterable+Organic Cond.	0.0056	0.0043	0.0037	0.0045
Total Particulate (PM-10 Eq.)	0.0066	0.0061	0.0061	0.0063

* As measured from the Cupola Baghouse Inlet.

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Table 14

Metals Results Summary
Cupola Baghouse Exhaust
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/24/19	4/25/19	4/25/19	
Time of Run	1420-1740	0708-0933	1021-1319	
Metal Charged, TPH	15.5	15.8	15.8	15.7
Volumetric Flow Rate* (Rounded to 100 CFM)				
ACFM	39,800	50,400	49,900	46,700
DSCFM	14,700	18,200	17,500	16,800
Gas Temperature, °F	209	221	210	213
Gas Moisture Content, %v/v	7.2	7.9	8.8	8.0
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	3.4	3.6	4.1	3.7
Oxygen, O_2	17.8	17.6	17.0	17.5
Nitrogen, N_2 (by difference)	78.8	78.9	78.9	78.9
Constituent Concentration, µg/dscm				
Antimony	0.16	0.04	0.06	0.09
Arsenic	0.37	0.12	0.16	0.22
Beryllium	ND	ND	ND	0.02
Cadmium	17.78	13.71	17.17	16.22
Chromium	0.48	0.23	0.32	0.35
Cobalt	0.05	0.04	0.05	0.05
Lead	12.59	5.68	5.14	7.80
Manganese	29.91	29.15	32.23	30.43
Nickel	2.36	1.51	2.07	1.98
Selenium	3.44	1.08	1.23	1.91
Mercury	2.25	3.12	15.05	6.80
Total Metal HAPs, µg/dscm	69.38	54.67	73.49	65.87
Total Metal HAPs, GR/DSCF	0.000030	0.000024	0.000032	0.000029
Total Metal HAPs, LB/Ton metal charged	0.00025	0.00024	0.00030	0.00026

* As measured from the Cupola Baghouse Inlet.

Detail Tables

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Table 15

Major Gases and Moisture Results
Main Plant Pouring Disa Summit Stack (324176)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/16/19	4/16/19	4/16/19
Time of Run	0757-0927	0948-1158	1220-1343
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	20.81	20.84	20.76
Nitrogen	78.47	78.58	78.31
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	12.2	8.4	14.3
Moisture Content, %v/v	0.69	0.55	0.89
Moisture Content if Saturated, %v/v	3.33	3.75	4.49
Relative Humidity, % rH	21%	15%	20%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.88	28.90	28.86

[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 Disa Summit Stack (324188)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/17/19	4/17/19	4/17/19
Time of Run	0617-0732	0757-0913	0949-1100
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	20.81	20.82	20.93
Nitrogen	78.49	78.52	78.92
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	10.1	9.1	1.6
Moisture Content, %v/v	0.66	0.62	0.12
Moisture Content if Saturated, %v/v	2.30	2.81	3.74
Relative Humidity, % rH	29%	22%	3%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.89	28.89	28.95

[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 17

Major Gases and Moisture Results
Main Plant Pouring Disa Summit Stack (324196)
Test 1

Parameter	Run 1	Run 2	Run 3
Date of Run	4/17/19	4/18/19	4/18/19
Time of Run	1235-1454	0615-0743	0810-0932
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	20.75	20.78
Nitrogen	78.42	78.25	78.35
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	11.9	15.1	13.3
Moisture Content, %v/v	0.75	0.97	0.83
Moisture Content if Saturated, %v/v	4.35	3.14	3.22
Relative Humidity, % rH	17%	31%	26%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.88	28.85	28.87

[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
Main Plant Pouring Disa Summit Stack (324204)
Test 1

Parameter	Run 1	Run 2	Run 3
Date of Run	4/18/19	4/18/19	4/18/19
Time of Run	0956-1151	1215-1330	1348-1510
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	20.82
Nitrogen	78.28	78.34	78.52
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	14.4	13.0	9.8
Moisture Content, %v/v	0.93	0.85	0.62
Moisture Content if Saturated, %v/v	3.22	3.25	3.13
Relative Humidity, % rH	29%	26%	20%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.86	28.87	28.89

[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
Main Plant Pouring Disa Exhaust (324484)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/18/19	4/18/19	4/18/19
Time of Run	0654-0827	0900-1016	1155-1312
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	20.81	20.43	20.47
Nitrogen	78.48	77.07	77.20
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	11.8	37.5	35.0
Moisture Content, %v/v	0.67	2.46	2.30
Moisture Content if Saturated, %v/v	6.12	5.83	5.99
Relative Humidity, % rH	11%	42%	38%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.89	28.69	28.71

[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 20

Major Gases and Moisture Results
Main Plant Pouring Disa Exhaust (324678)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/16/19	4/16/19	4/17/19
Time of Run	0800-0928	0950-1213	0623-0751
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	20.77	20.81
Nitrogen	78.55	78.34	78.49
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	9.0	13.0	10.0
Moisture Content, %v/v	0.58	0.84	0.66
Moisture Content if Saturated, %v/v	3.91	4.49	3.06
Relative Humidity, % rH	15%	19%	21%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.90	28.87	28.89

[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 21

Major Gases and Moisture Results
Main Plant Pouring Disa CC Exhaust (324682)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/17/19	4/17/19	4/17/19
Time of Run	0850-1021	1035-1256	1326-1605
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	20.89	20.83	20.94
Nitrogen	78.78	78.56	78.96
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	4.5	8.5	1.0
Moisture Content, %v/v	0.30	0.57	0.07
Moisture Content if Saturated, %v/v	4.06	5.05	4.94
Relative Humidity, % rH	7%	11%	1%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.93	28.90	28.95

[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 22

Major Gases and Moisture Results
Module Pouring Plant Exhaust (334116)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/23/19	4/23/19	4/23/19
Time of Run	0740-0907	1017-1231	1330-1500
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	20.92	20.88	20.94
Nitrogen	78.90	78.74	78.98
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	2.0	5.0	0.5
Moisture Content, %v/v	0.14	0.34	0.04
Moisture Content if Saturated, %v/v	5.64	6.14	7.10
Relative Humidity, % rH	2%	6%	0%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.94	28.92	28.96

[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 23

Major Gases and Moisture Results
Module Pouring Plant Exhaust (334176)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/23/19	4/23/19	4/23/19
Time of Run	0740-0908	1018-1231	1330-1500
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	20.91	20.87	20.93
Nitrogen	78.86	78.72	78.95
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	2.5	5.0	1.0
Moisture Content, %v/v	0.19	0.37	0.08
Moisture Content if Saturated, %v/v	5.61	5.78	5.46
Relative Humidity, % rH	3%	6%	1%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.94	28.92	28.95

[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 24

Major Gases and Moisture Results
Main Plant Pouring No. 5 HMP - TC Fan (324848)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/24/19	4/24/19	4/24/19
Time of Run	0705-0820	0855-1017	1120-1238
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	20.74	20.77	20.78
Nitrogen	78.22	78.33	78.36
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	13.0	11.8	11.0
Moisture Content, %v/v	1.00	0.86	0.82
Moisture Content if Saturated, %v/v	3.28	2.84	3.10
Relative Humidity, % rH	30%	30%	26%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.85	28.87	28.87

[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 25

Major Gases and Moisture Results
Main Plant Pouring No. 6 HMP - East Hunter (324632)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/24/19	4/24/19	4/24/19
Time of Run	0705-0820	0855-1020	1120-1238
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	20.71	20.75	20.81
Nitrogen	78.10	78.24	78.49
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	15.5	14.5	10.0
Moisture Content, %v/v	1.15	0.98	0.66
Moisture Content if Saturated, %v/v	3.23	3.35	4.45
Relative Humidity, % rH	36%	29%	15%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.83	28.85	28.89

[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 26

Major Gases and Moisture Results
Main Plant Pouring No. 7 HMP - West Hunter (324662)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/24/19	4/25/19	4/25/19
Time of Run	1322-1439	0645-0759	0824-0939
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	20.92	20.89	20.80
Nitrogen	78.88	78.80	78.43
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	20.9	20.9	20.9
Moisture Collected, ml	2.5	4.0	11.0
Moisture Content, %v/v	0.17	0.26	0.74
Moisture Content if Saturated, %v/v	6.26	5.34	6.33
Relative Humidity, % rH	3%	5%	12%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry[1]	28.96	28.96	28.96
Wet	28.94	28.93	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 27

Major Gases and Moisture Results
Cupola Baghouse Exhaust
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/23/19	4/24/19	4/24/19
Time of Run	1005-1355	0702-0927	1055-1320
Major Gas Constituents - Instrumental, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	1.60	4.10	3.23
Oxygen	19.50	17.00	17.80
Nitrogen (by difference)	78.90	78.90	78.97
Wet Basis (calculated)			
Carbon Dioxide	1.54	3.79	3.02
Oxygen	18.77	15.71	16.62
Nitrogen	75.93	72.90	73.74
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	19.7	17.8	18.7
Moisture Collected, ml	73.1	102.6	111.6
Moisture Content, %v/v	3.77	7.60	6.62
Moisture Content if Saturated, %v/v	13.43	*NA (>BP)*	*NA (>BP)*
Relative Humidity, % rH	28%	*NA (>BP)*	*NA (>BP)*
Molecular Weight of Flue Gas, lb/lb-mole			
Dry	29.04	29.34	29.23
Wet	28.62	28.47	28.49

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Table 28

Major Gases and Moisture Results
Cupola Baghouse Exhaust
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/24/19	4/25/19	4/25/19
Time of Run	1420-1740	0708-0933	1021-1319
Major Gas Constituents - Instrumental, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	3.39	3.60	4.09
Oxygen	17.80	17.55	17.02
Nitrogen (by difference)	78.81	78.85	78.89
Wet Basis (calculated)			
Carbon Dioxide	3.15	3.31	3.73
Oxygen	16.52	16.16	15.52
Nitrogen	73.13	72.59	71.93
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	17.7	17.7	17.6
Moisture Collected, ml	112.0	157.4	149.0
Moisture Content, %v/v	7.21	7.93	8.82
Moisture Content if Saturated, %v/v	97.33	NA (>BP)	99.96
Relative Humidity, % rH	7%	NA (>BP)	9%
Molecular Weight of Flue Gas, lb/lb-mole			
Dry	29.25	29.28	29.34
Wet	28.44	28.38	28.34

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Table 29

Major Gases and Moisture Results
Cupola Baghouse Inlet
Test 1

Parameter	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7
Date of Run	4/23/19	4/23/19	4/24/19	4/24/19	4/24/19	4/25/19	4/25/19
Time of Run	1035-1100	1235-1345	0823-0948	1041-1215	1421-1631	0705-0805	1022-1116
Sample Duration, Minutes	25	35	50	60	60	60	54
Average Flue Gas Temperature, °F	674	702	646	629	643	639	636
Major Gas Constituents - Instrumental, % v/v							
Dry Basis (as measured)							
Carbon Dioxide	14.20	14.00	12.94	12.51	14.05	10.90	12.60
Oxygen	6.30	7.00	8.02	9.12	7.39	10.39	8.40
Nitrogen (by difference)	79.50	79.00	79.03	78.37	78.57	78.71	79.00
Wet Basis (calculated)							
Carbon Dioxide	11.49	11.71	10.04	10.05	11.37	8.62	9.63
Oxygen	5.10	5.85	6.22	7.33	5.98	8.22	6.42
Nitrogen	64.32	66.05	61.29	62.96	63.60	62.24	60.41
Portable O_2 Monitor Average, $\%O_2$	7.5	10.0	10.3	9.4	8.1	9.4	7.3
Sample Volume, Meter Conditions, Ft^3	15.53	19.95	26.30	31.66	32.32	30.95	28.56
Sample Volume, Dry Standard, Ft^3	15.44	19.21	26.30	30.55	30.78	30.58	27.36
Moisture Collected, ml	77.4	80.0	161.7	158.8	153.9	171.9	178.9
Moisture Content of Gas Stream, %v/v	19.09	16.39	22.44	19.65	19.05	20.92	23.54
Moisture Content if Saturated, %v/v	NA (>BP)	NA (>BP)	NA (>BP)	NA (>BP)	NA (>BP)	NA (>BP)	NA (>BP)
Relative Humidity, % rH	NA (>BP)	NA (>BP)	NA (>BP)	NA (>BP)	NA (>BP)	NA (>BP)	NA (>BP)
Molecular Weight of Flue Gas, lb/lb-mole							
Dry	30.52	30.52	30.39	30.37	30.54	30.16	30.35
Wet	28.13	28.47	27.61	27.94	28.15	27.62	27.44

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Iron Mountain
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Table 30

Particulate Results
Main Plant Pouring Disa Summit Stack (324176)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/16/19	4/16/19	4/16/19
Time of Run	0757-0927	0948-1158	1220-1343
Sample Duration, Minutes	84	72	72
Average Flue Gas Temperature, °F	77.7	81.3	86.9
Moisture Content of Flue Gas, %v/v	0.7	0.5	0.9
Particulate Collected, mg			
Dry Catch	11.6	8.6	8.2
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	12,500	12,800	13,300
SCFM	11,800	10,700	11,000
DSCFM	11,700	10,600	10,900
Sample Volume, Meter Conditions, Ft^3	84.50	74.15	78.48
Sample Volume, Dry Standard, Ft^3	83.02	71.90	74.74
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0022	0.0019	0.0017
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.22	0.17	0.16

NR=Not required or not requested.

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Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 31

Particulate Results
Main Plant Pouring Disa Summit Stack (324188)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/17/19	4/17/19	4/17/19
Time of Run	0617-0732	0757-0913	0949-1100
Sample Duration, Minutes	72	72	69
Average Flue Gas Temperature, °F	66.8	72.7	81.3
Moisture Content of Flue Gas, %v/v	0.7	0.6	0.1
Particulate Collected, mg			
Dry Catch	9.3	8.2	7.2
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	13,100	12,700	12,600
SCFM	12,600	12,200	11,800
DSCFM	12,500	12,100	11,800
Sample Volume, Meter Conditions, Ft^3	71.08	69.61	65.89
Sample Volume, Dry Standard, Ft^3	71.03	68.36	63.88
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0020	0.0019	0.0017
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.22	0.19	0.18

NR=Not required or not requested

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Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 32

Particulate Results
Main Plant Pouring Disa Summit Stack (324196)
Test 1

Parameter	Run 1	Run 2	Run 3
Date of Run	4/17/19	4/18/19	4/18/19
Time of Run	1235-1454	0615-0743	0810-0932
Sample Duration, Minutes	72	72	72
Average Flue Gas Temperature, °F	86.0	75.4	76.2
Moisture Content of Flue Gas, %v/v	0.7	1.0	0.8
Particulate Collected, mg			
Dry Catch	12.6	9.5	10.1
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	14,500	14,400	14,600
SCFM	13,500	13,400	13,600
DSCFM	13,400	13,300	13,500
Sample Volume, Meter Conditions, Ft^3	76.85	74.43	77.62
Sample Volume, Dry Standard, Ft^3	74.14	72.61	74.48
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0026	0.0020	0.0021
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.30	0.23	0.24

NR=Not required or not requested

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Table 33

Particulate Results
Main Plant Pouring Disa Summit Stack (324204)
Test 1

Parameter	Run 1	Run 2	Run 3
Date of Run	4/18/19	4/18/19	4/18/19
Time of Run	0956-1151	1215-1330	1348-1510
Sample Duration, Minutes	72	72	72
Average Flue Gas Temperature, °F	76.3	76.5	75.4
Moisture Content of Flue Gas, %v/v	0.9	0.9	0.6
Particulate Collected, mg			
Dry Catch	8.4	8.8	8.7
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	14,200	14,000	14,400
SCFM	13,200	13,000	13,400
DSCFM	13,100	12,900	13,300
Sample Volume, Meter Conditions, Ft^3	75.64	74.93	78.22
Sample Volume, Dry Standard, Ft^3	72.33	71.35	74.33
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0018	0.0019	0.0018
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.20	0.21	0.21

NR=Not required or not requested

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Table 34

Particulate Results
Main Plant Pouring Disa Exhaust (324484)
Test 1

Parameter	Run 1	Run 2	Run 3
Date of Run	4/18/19	4/18/19	4/18/19
Time of Run	0654-0827	0900-1016	1155-1312
Sample Duration, Minutes	84	72	72
Average Flue Gas Temperature, °F	96.4	94.8	95.7
Moisture Content of Flue Gas, %v/v	0.7	2.5	2.3
Particulate Collected, mg			
Dry Catch	13.0	20.8	16.8
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	10,780	10,720	10,670
SCFM	9,690	9,650	9,590
DSCFM	9,620	9,410	9,370
Sample Volume, Meter Conditions, Ft^3	84.00	72.35	72.65
Sample Volume, Dry Standard, Ft^3	82.04	69.92	70.01
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0025	0.0046	0.0037
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.20	0.37	0.30

NR=Not required or not requested

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Table 35

Particulate Results
Main Plant Pouring Disa Exhaust (324678)
Test 1

Parameter	Run 1	Run 2	Run 3
Date of Run	4/16/19	4/16/19	4/17/19
Time of Run	0800-0928	0950-1213	0623-0751
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	82.5	86.9	75.3
Moisture Content of Flue Gas, %v/v	0.6	0.8	0.7
Particulate Collected, mg			
Dry Catch	16.6	15.4	13.2
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	24,300	24,200	23,300
SCFM	22,600	22,400	22,100
DSCFM	22,500	22,200	22,000
Sample Volume, Meter Conditions, Ft^3	74.20	75.30	71.05
Sample Volume, Dry Standard, Ft^3	72.81	71.87	71.13
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0035	0.0033	0.0029
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.68	0.63	0.54

NR=Not required or not requested

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Table 36

Particulate Results
Main Plant Pouring Disa CC Exhaust (324682)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/17/19	4/17/19	4/17/19
Time of Run	0850-1021	1035-1256	1326-1605
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	83.9	90.8	90.0
Moisture Content of Flue Gas, %v/v	0.3	0.6	0.1
Particulate Collected, mg			
Dry Catch	7.8	7.2	7.7
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	15,500	15,400	15,400
SCFM	14,500	14,200	14,200
DSCFM	14,400	14,100	14,200
Sample Volume, Meter Conditions, Ft^3	72.30	73.35	72.45
Sample Volume, Dry Standard, Ft^3	70.44	69.35	69.40
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0017	0.0016	0.0017
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.21	0.19	0.21

NR=Not required or not requested

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Table 37

Particulate Results
Module Pouring Plant Exhaust (334116)
Test 1

Parameter	Run 1	Run 2	Run 3
Date of Run	4/23/19	4/23/19	4/23/19
Time of Run	0740-0907	1017-1231	1330-1500
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	94.3	97.0	101.8
Moisture Content of Flue Gas, %v/v	0.1	0.3	0.0
Particulate Collected, mg			
Dry Catch	15.3	13.4	15.0
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	8,170	8,370	8,130
SCFM	7,480	7,630	7,340
DSCFM	7,480	7,610	7,330
Sample Volume, Meter Conditions, Ft^3	68.60	71.00	69.30
Sample Volume, Dry Standard, Ft^3	67.94	69.30	66.75
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0035	0.0030	0.0035
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.22	0.19	0.22

NR=Not required or not requested

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Table 38

Particulate Results
Module Pouring Plant Exhaust (334176)
Test 1

Parameter	Run 1	Run 2	Run 3
Date of Run	4/23/19	4/23/19	4/23/19
Time of Run	0740-0908	1018-1231	1330-1500
Sample Duration, Minutes	84	84	84
Average Flue Gas Temperature, °F	94.1	95.0	93.2
Moisture Content of Flue Gas, %v/v	0.2	0.4	0.1
Particulate Collected, mg			
Dry Catch	10.1	9.1	9.8
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	5,400	5,550	5,420
SCFM	4,950	5,070	4,970
DSCFM	4,940	5,050	4,960
Sample Volume, Meter Conditions, Ft^3	61.90	63.70	63.80
Sample Volume, Dry Standard, Ft^3	61.25	62.68	61.39
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0026	0.0022	0.0025
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.11	0.10	0.10

NR=Not required or not requested

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Table 39

Particulate Results
Main Plant Pouring No. 5 HMP - TC Fan (324848)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/24/19	4/24/19	4/24/19
Time of Run	0705-0820	0855-1017	1120-1238
Sample Duration, Minutes	72	72	72
Average Flue Gas Temperature, °F	77.1	72.8	75.4
Moisture Content of Flue Gas, %v/v	1.0	0.9	0.8
Particulate Collected, mg			
Dry Catch	4.8	6.3	15.8
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	11,000	11,500	11,300
SCFM	10,400	10,900	10,700
DSCFM	10,300	10,800	10,600
Sample Volume, Meter Conditions, Ft^3	60.70	65.55	65.60
Sample Volume, Dry Standard, Ft^3	60.64	63.68	62.55
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0012	0.0015	0.0039
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.11	0.14	0.35

NR=Not required or not requested

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Table 40

Particulate Results
Main Plant Pouring No. 6 HMP - East Hunter (324632)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/24/19	4/24/19	4/24/19
Time of Run	0705-0820	0855-1020	1120-1238
Sample Duration, Minutes	72	72	72
Average Flue Gas Temperature, °F	76.8	77.9	86.7
Moisture Content of Flue Gas, %v/v	1.2	1.0	0.7
Particulate Collected, mg			
Dry Catch	11.0	20.2	10.0
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	3,860	4,260	4,430
SCFM	3,650	4,020	4,120
DSCFM	3,610	3,990	4,090
Sample Volume, Meter Conditions, Ft^3	62.40	70.60	73.80
Sample Volume, Dry Standard, Ft^3	62.55	69.24	70.87
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0027	0.0045	0.0022
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.08	0.15	0.08

NR=Not required or not requested

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Table 41

Particulate Results
Main Plant Pouring No. 7 HMP - West Hunter (324662)
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/24/19	4/25/19	4/25/19
Time of Run	1322-1439	0645-0759	0824-0939
Sample Duration, Minutes	72	72	72
Average Flue Gas Temperature, °F	97.6	92.2	97.8
Moisture Content of Flue Gas, %v/v	0.2	0.3	0.7
Particulate Collected, mg			
Dry Catch	29.4	18.1	20.6
Inorganic Wet Catch	*NR*	*NR*	*NR*
Organic Wet Catch	*NR*	*NR*	*NR*
Volumetric Flow Rate (Rounded to 10 CFM)			
ACFM	10,530	11,030	10,870
SCFM	9,580	10,050	9,810
DSCFM	9,570	10,030	9,740
Sample Volume, Meter Conditions, Ft^3	74.80	73.81	73.43
Sample Volume, Dry Standard, Ft^3	70.35	71.46	69.53
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0064	0.0039	0.0046
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.53	0.34	0.38

NR=Not required or not requested

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Table 42

Particulate Results
Cupola Baghouse Exhaust
Test 1

Parameter	Run 1	Run 2	Run 3
Date of Run	4/23/19	4/24/19	4/24/19
Time of Run	1005-1355	0702-0927	1055-1320
Sample Duration, Minutes	120	120	120
Average Flue Gas Temperature, °F	124.2	214.1	216.2
Moisture Content of Flue Gas, %v/v	3.8	7.6	6.6
Particulate Collected, mg			
Dry Catch	17.1	8.4	9.1
Inorganic Wet Catch	3.0	3.9	6.4
Organic Wet Catch	0.2	0.7	0.8
Volumetric Flow Rate* (Rounded to 100 CFM)			
ACFM	42,700	43,400	40,500
SCFM	19,500	19,800	18,500
DSCFM	15,800	15,400	14,900
Sample Volume, Meter Conditions, Ft^3	90.85	60.98	78.99
Sample Volume, Dry Standard, Ft^3	87.86	58.70	74.05
Particulate Concentration, GR/DSCF			
Filterable Particulate	0.0030	0.0022	0.0019
Inorganic Condensables	0.0005	0.0010	0.0013
Organic Condensables	0.0000	0.0002	0.0002
Filterable+Organic Cond.	0.0030	0.0024	0.0021
Total Particulate (PM-10 Eq.) (F+I+O)	0.0036	0.0034	0.0034
Particulate Emission Rate, LB/HR			
Filterable Particulate	0.41	0.29	0.24
Inorganic Condensables	0.07	0.14	0.17
Organic Condensables	0.00	0.02	0.02
Filterable+Organic Cond.	0.41	0.32	0.26
Total Particulate (PM-10 Eq.) (F+I+O)	0.48	0.45	0.43

* As measured from the Cupola Baghouse Inlet.

NR=Not required or not requested

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Table 43a

Metals Concentration Results
Cupola Baghouse Exhaust
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/24/19	4/25/19	4/25/19
Time of Run	1420-1740	0708-0933	1021-1319
Sample Duration, Minutes	110	120	120
Average Flue Gas Temperature, °F	208.7	220.9	209.6
Moisture Content of Flue Gas, %v/v	7.2	7.9	8.8
Sample Volume, Meter Conditions, Ft^3	72.36	90.70	77.99
Sample Volume, Dry Standard, Ft^3	67.83	85.96	72.49
Sample Volume, Dry Standard, m^3	1.92	2.43	2.05
Constituent Concentration, µg/dscm			
Antimony	0.160	0.043	0.059
Arsenic	0.37	0.12	0.16
Beryllium	<0.026	<0.021	<0.024
Cadmium	17.8	13.7	17.2
Chromium	0.48	0.23	0.32
Cobalt	0.052	0.041	0.049
Lead	12.6	5.7	5.1
Manganese	29.9	29.2	32.2
Nickel	2.4	1.5	2.1
Selenium	3.4	1.1	1.2
Mercury	2.3	3.1	15.0

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Table 43b

Metals Mass Rate Results
Cupola Baghouse Exhaust
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	4/24/19	4/25/19	4/25/19
Time of Run	1420-1740	0708-0933	1021-1319
Sample Duration, Minutes	110	120	120
Volumetric Flow Rate* (Rounded to 100 CFM)			
ACFM	39,800	50,400	49,900
SCFM	18,200	23,000	22,800
DSCFM	14,700	18,200	17,500
Constituent Mass Rate, LB/HR			
Antimony	0.000009	0.000003	0.000004
Arsenic	0.000020	0.000008	0.000011
Beryllium	<0.000001	<0.000001	<0.000002
Cadmium	0.0010	0.0009	0.0011
Chromium	0.000026.	0.000016.	0.000021.
Cobalt	0.000003	0.000003	0.000003
Lead	0.00069	0.00039	0.00034
Manganese	0.0016	0.0020	0.0021
Nickel	0.00013	0.00010	0.00014
Selenium	0.000190	0.000073	0.000080
Mercury	0.00012	0.00021	0.00098

* As measured from the Cupola Baghouse Inlet.

Non-detect results are shown as less than (<) the sum of fraction LRLs

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Table 44

Gas Monitoring Results
Cupola Baghouse Inlet
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/24/19	4/24/19	4/24/19	
Time of Run	0820-0920	1218-1318	1424-1638	
Sample Duration (Minutes)	60	60	60	
Stack Temperature (°F)	648	646	645	646
Duct Moisture Content (%v/v)	22.4	19.7	19.1	20.4
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	43,400	40,500	39,800	41,200
SCFM	19,800	18,500	18,200	18,800
DSCFM	15,400	14,900	14,700	15,000
Constituent Concentration, PPMv - Dry				
Total Hydrocarbons (as Hexane)	2.02	4.39	16.9	7.78
Sulfur Dioxide	*	22.0	*	
Constituent Concentration, mg/dscm				
Sulfur Dioxide	*	58.5	*	
Corrected Constituent Concentrations, PPM, dry @ 10% Oxygen				
Total Hydrocarbons (as Hexane)	1.71	4.07	13.7	6.48
Constituent Mass Rate, LB/HR				
Sulfur Dioxide	*	3.26	*	

* Runs did not meet system bias criteria.

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Table 45

Gas Monitoring Results
Cupola Baghouse Exhaust
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/24/19	4/25/19	4/25/19	
Time of Run	1420-1740	708-933	1021-1319	
Sample Duration (Minutes)	110	120	120	
Stack Temperature (°F)	124	214	216	185
Duct Moisture Content (%v/v)	3.8	7.6	6.6	6.0
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	39,800	50,400	49,900	46,700
SCFM	18,200	23,000	22,800	21,300
DSCFM	14,700	18,200	17,500	16,800
Constituent Concentration, PPMv - Dry				
Carbon Monoxide	767	900	>1000	≥889
Constituent Concentration, mg/dscm				
Carbon Monoxide	893.1	1,048.0	>1164.4	≥1035.2
Constituent Mass Rate, LB/HR				
Carbon Monoxide	49.3	71.3	>76.1	≥65.6

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Table 46

Opacity Observations
Main Plant Pouring Disa Summit Stack (324176)
Test 1

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: Isaac Prichett
Date of test: 4/16/2019
Time of test: 955-1055

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

Grede, LLC

Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 47

Opacity Observations
Main Plant Pouring Disa Summit Stack (324188)
Test 1

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: Isaac Prichett
Date of test: 4/17/2019
Time of test: 902-1002

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

Grede, LLC

Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 48

Opacity Observations
Main Plant Pouring Disa Summit Stack (324196)
Test 1

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: Isaac Prichett
Date of test: 4/18/2019
Time of test: 902-1002

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

Grede, LLC

Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 49

Opacity Observations
Main Plant Pouring Disa Summit Stack (324204)
Test 1

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: Isaac Prichett
Date of test: 4/18/2019
Time of test: 1350-1450

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

Grede, LLC

Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 50

Opacity Observations
Main Plant Pouring Disa Exhaust (324484)
Test 1

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: Isaac Prichett
Date of test: 4/18/2019
Time of test: 902-1002

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

Grede, LLC

Iron Mountain
Kingsford, MI
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Table 51

Opacity Observations
Main Plant Pouring Disa Exhaust (324678)
Test 1

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: Isaac Prichett
Date of test: 4/16/2019
Time of test: 955-1055

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

Grede, LLC

Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 52

Opacity Observations
Main Plant Pouring Disa CC Exhaust (324682)
Test 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	0.0	6	0.0
2	0.0	7	0.0
3	0.0	8	0.0
4	0.0	9	0.2
5	0.0	10	0.2

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

Observer: Isaac Prichett
Date of test: 4/17/2019
Time of test: 902-1004

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

Grede, LLC

Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 53

Opacity Observations
Module Pouring Plant Exhaust (334116)
Test 1

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: Mathew McDermott
Date of test: 4/25/2019
Time of test: 650-749

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

Grede, LLC

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Kingsford, MI
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Table 54

Opacity Observations
Module Pouring Plant Exhaust (334176)
Test 1

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: Mathew McDermott
Date of test: 4/23/2019
Time of test: 650-749

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

Grede, LLC

Iron Mountain
Kingsford, MI
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Table 55

Opacity Observations
Main Plant Pouring No. 5 HMP - TC Fan (324848)
Test 1

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: 0
Date of test: 4/25/2019
Time of test: 810-909

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

Grede, LLC

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Table 56

Opacity Observations
Main Plant Pouring No. 6 HMP - East Hunter (324632)
Test 1

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: Matt McDermott
Date of test: 4/25/2019
Time of test: 810-909

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

Grede, LLC

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Table 57

Opacity Observations
Main Plant Pouring No. 7 HMP - West Hunter (324662)
Test 1

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: Matt McDermott
Date of test: 4/25/2019
Time of test: 810-909

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

Grede, LLC

Iron Mountain
Kingsford, MI
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Table 58

Yaw Angle Adjusted Airflow Results
Main Plant Pouring Disa Summit Stack (324176)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/16/19	4/16/19	4/16/19	
Time of Measurement	0757	0948	1220	
Barometric Pressure, Inches Hg	28.72	28.72	28.72	28.72
Static Pressure, Inches WC	-0.12	-0.12	-0.12	-0.12
Absolute Gas Pressure (In. Hg)	28.71	28.71	28.71	28.71
Average Gas Temperature, °F	78	81	87	82
Moisture Determination Procedure	Method 4			
Average Moisture Content, %v/v	0.7	0.5	0.9	0.7
Gas Molecular Weight (Ambient), lb/lb-mole				
Dry	29.0	29.0	29.0	29.0
Wet	28.9	28.9	28.9	28.9
Flue Gas Average Velocity, FPS	30.33	30.92	32.36	31.20
Average Yaw Angle	17.5	17.5	17.5	
Range of Yaw Angles	5 to 35	5 to 35	5 to 35	
Duct Cross-sectional Area, Sq. Ft.	6.87	6.87	6.87	6.87
Volumetric Flow Rate (Rounded to 1 CFM)				
ACFM	12,510	12,750	13,348	12,869
SCFM	11,788	11,941	12,363	12,031
DSCFM	11,707	11,882	12,252	11,947

Grede, LLC

Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 59

Yaw Angle Adjusted Airflow Results
Main Plant Pouring Disa Summit Stack (324188)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/17/19	4/17/19	4/17/19	
Time of Measurement	0617	0757	0949	
Barometric Pressure, Inches Hg	28.83	28.83	28.83	28.83
Static Pressure, Inches WC	-0.13	-0.13	-0.13	-0.13
Absolute Gas Pressure (In. Hg)	28.82	28.82	28.82	28.82
Average Gas Temperature, °F	67	73	81	74
Moisture Determination Procedure	Method 4			
Average Moisture Content, %v/v	0.7	0.6	0.1	0.5
Gas Molecular Weight (Ambient), lb/lb-mole				
Dry	29.0	29.0	29.0	29.0
Wet	28.9	28.9	29.0	28.9
Flue Gas Average Velocity, FPS	31.30	30.50	30.16	30.65
Average Yaw Angle	20.4	20.4	20.4	
Range of Yaw Angles	10 to 30	10 to 30	10 to 30	
Duct Cross-sectional Area, Sq. Ft.	6.96	6.96	6.96	6.96
Volumetric Flow Rate (Rounded to 1 CFM)				
ACFM	13,074	12,741	12,598	12,804
SCFM	12,621	12,165	11,837	12,208
DSCFM	12,533	12,092	11,825	12,150

Grede, LLC

Iron Mountain
Kingsford, MI
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Table 60

Yaw Angle Adjusted Airflow Results
Main Plant Pouring Disa Summit Stack (324196)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/17/19	4/18/19	4/18/19	
Time of Measurement	1235	0615	0810	
Barometric Pressure, Inches Hg	28.83	28.28	28.28	28.46
Static Pressure, Inches WC	-0.13	-0.13	-0.13	-0.13
Absolute Gas Pressure (In. Hg)	28.82	28.27	28.27	28.45
Average Gas Temperature, °F	86	75	76	79
Moisture Determination Procedure	Method 4			
Average Moisture Content, %v/v	0.7	1.0	0.8	0.8
Gas Molecular Weight (Ambient), lb/lb-mole				
Dry	29.0	29.0	29.0	29.0
Wet	28.9	28.9	28.9	28.9
Flue Gas Average Velocity, FPS	34.27	33.98	34.46	34.24
Average Yaw Angle	17.9	17.9	17.9	
Range of Yaw Angles	10 to 30	10 to 30	10 to 30	
Duct Cross-sectional Area, Sq. Ft.	7.07	7.07	7.07	7.07
Volumetric Flow Rate (Rounded to 1 CFM)				
ACFM	14,536	14,413	14,616	14,522
SCFM	13,541	13,440	13,604	13,528
DSCFM	13,446	13,306	13,495	13,416

Grede, LLC

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Table 61

Yaw Angle Adjusted Airflow Results
Main Plant Pouring Disa Summit Stack (324204)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/18/19	4/18/19	4/18/19	
Time of Measurement	0956	1215	1348	
Barometric Pressure, Inches Hg	28.28	28.28	28.28	28.28
Static Pressure, Inches WC	-0.13	-0.13	-0.13	-0.13
Absolute Gas Pressure (In. Hg)	28.27	28.27	28.27	28.27
Average Gas Temperature, °F	76	77	75	76
Moisture Determination Procedure	Method 4			
Average Moisture Content, %v/v	0.9	0.9	0.6	0.8
Gas Molecular Weight (Ambient), lb/lb-mole				
Dry	29.0	29.0	29.0	29.0
Wet	28.9	28.9	28.9	28.9
Flue Gas Average Velocity, FPS	33.38	32.92	33.89	33.40
Average Yaw Angle	19.8	19.8	19.8	
Range of Yaw Angles	10 to 30	10 to 30	10 to 30	
Duct Cross-sectional Area, Sq. Ft.	7.07	7.07	7.07	7.07
Volumetric Flow Rate (Rounded to 1 CFM)				
ACFM	14,158	13,962	14,373	14,164
SCFM	13,177	12,971	13,403	13,184
DSCFM	13,059	12,854	13,322	13,079

Grede, LLC

Iron Mountain
Kingsford, MI
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Table 62

Yaw Angle Adjusted Airflow Results
Main Plant Pouring Disa Exhaust (324484)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/18/19	4/18/19	4/18/19	
Time of Measurement	0654	0900	1155	
Barometric Pressure, Inches Hg	28.36	28.36	28.36	28.36
Static Pressure, Inches WC	-0.61	-0.61	-0.61	-0.61
Absolute Gas Pressure (In. Hg)	28.32	28.32	28.32	28.32
Average Gas Temperature, °F	96	95	96	96
Moisture Determination Procedure	Method 4			
Average Moisture Content, %v/v	0.7	2.5	2.3	1.8
Gas Molecular Weight (Ambient), lb/lb-mole				
Dry	29.0	29.0	29.0	29.0
Wet	28.9	28.7	28.7	28.8
Flue Gas Average Velocity, FPS	36.60	36.38	36.22	36.40
Average Yaw Angle	44.6	44.6	44.6	
Range of Yaw Angles	25 to 65	25 to 65	25 to 65	
Duct Cross-sectional Area, Sq. Ft.	4.91	4.91	4.91	4.91
Volumetric Flow Rate (Rounded to 1 CFM)				
ACFM	10,779	10,716	10,666	10,721
SCFM	9,687	9,648	9,586	9,640
DSCFM	9,619	9,407	9,365	9,464

Grede, LLC

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Kingsford, MI
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Table 63

Yaw Angle Adjusted Airflow Results
Main Plant Pouring Disa Exhaust (324678)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/16/19	4/16/19	4/17/19	
Time of Measurement	0800	0950	0623	
Barometric Pressure, Inches Hg	28.72	28.72	28.83	28.76
Static Pressure, Inches WC	-0.30	-0.30	-0.30	-0.30
Absolute Gas Pressure (In. Hg)	28.70	28.70	28.81	28.73
Average Gas Temperature, °F	83	87	75	82
Moisture Determination Procedure	Method 4			
Average Moisture Content, %v/v	0.6	0.8	0.7	0.7
Gas Molecular Weight (Ambient), lb/lb-mole				
Dry	29.0	29.0	29.0	29.0
Wet	28.9	28.9	28.9	28.9
Flue Gas Average Velocity, FPS	42.01	41.91	40.35	41.42
Average Yaw Angle	20.0	20.0	20.0	
Range of Yaw Angles	20 to 20	20 to 20	20 to 20	
Duct Cross-sectional Area, Sq. Ft.	9.62	9.62	9.62	9.62
Volumetric Flow Rate (Rounded to 1 CFM)				
ACFM	24,250	24,194	23,295	23,913
SCFM	22,617	22,400	22,136	22,384
DSCFM	22,481	22,221	21,981	22,227

Grede, LLC

Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 64

Yaw Angle Adjusted Airflow Results
Main Plant Pouring Disa CC Exhaust (324682)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/17/19	4/17/19	4/17/19	
Time of Measurement	0850	1035	1326	
Barometric Pressure, Inches Hg	28.83	28.83	28.83	28.83
Static Pressure, Inches WC	-0.40	-0.40	-0.40	-0.40
Absolute Gas Pressure (In. Hg)	28.80	28.80	28.80	28.80
Average Gas Temperature, °F	84	91	90	88
Moisture Determination Procedure	Method 4			
Average Moisture Content, %v/v	0.3	0.6	0.1	0.3
Gas Molecular Weight (Ambient), lb/lb-mole				
Dry	29.0	29.0	29.0	29.0
Wet	29.0	28.9	29.0	29.0
Flue Gas Average Velocity, FPS	26.82	26.73	26.71	26.76
Average Yaw Angle	39.6	39.6	39.6	
Range of Yaw Angles	30 to 55	30 to 55	30 to 55	
Duct Cross-sectional Area, Sq. Ft.	9.62	9.62	9.62	9.62
Volumetric Flow Rate (Rounded to 1 CFM)				
ACFM	15,483	15,431	15,420	15,445
SCFM	14,465	14,234	14,249	14,316
DSCFM	14,422	14,149	14,235	14,269

Grede, LLC

Iron Mountain
Kingsford, MI
Pace Project No. 19-01623

Table 65

Yaw Angle Adjusted Airflow Results
Module Pouring Plant Exhaust (334116)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/23/19	4/23/19	4/23/19	
Time of Measurement	0000	0000	0000	
Barometric Pressure, Inches Hg	28.76	28.76	28.76	28.76
Static Pressure, Inches WC	-0.09	-0.09	-0.09	-0.09
Absolute Gas Pressure (In. Hg)	28.75	28.75	28.75	28.75
Average Gas Temperature, °F	94	97	102	98
Moisture Determination Procedure	Method 4			
Average Moisture Content, %v/v	0.1	0.3	0.1	0.2
Gas Molecular Weight (Ambient), lb/lb-mole				
Dry	29.0	29.0	29.0	29.0
Wet	29.0	29.0	29.0	29.0
Flue Gas Average Velocity, FPS	27.74	28.43	27.59	27.92
Average Yaw Angle	16.7	16.7	16.7	
Range of Yaw Angles	5 to 30	5 to 30	5 to 30	
Duct Cross-sectional Area, Sq. Ft.	4.91	4.91	4.91	4.91
Volumetric Flow Rate (Rounded to 1 CFM)				
ACFM	8,171	8,373	8,127	8,223
SCFM	7,484	7,628	7,337	7,483
DSCFM	7,476	7,605	7,330	7,470

Grede, LLC

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Table 66

Yaw Angle Adjusted Airflow Results
Module Pouring Plant Exhaust (334176)
Test 1

Parameter	Run 1	Run 2	Run 3	Average
Date of Run	4/23/19	4/23/19	4/23/19	
Time of Measurement	0740	1018	1330	
Barometric Pressure, Inches Hg	28.76	28.76	28.76	28.76
Static Pressure, Inches WC	-0.08	-0.08	-0.08	-0.08
Absolute Gas Pressure (In. Hg)	28.75	28.75	28.75	28.75
Average Gas Temperature, °F	94	95	93	94
Moisture Determination Procedure	Method 4			
Average Moisture Content, %v/v	0.2	0.4	0.1	0.2
Gas Molecular Weight (Ambient), lb/lb-mole				
Dry	29.0	29.0	29.0	29.0
Wet	29.0	29.0	29.0	29.0
Flue Gas Average Velocity, FPS	18.34	18.84	18.39	18.52
Average Yaw Angle	40.8	40.8	40.8	
Range of Yaw Angles	25 to 50	25 to 50	25 to 50	
Duct Cross-sectional Area, Sq. Ft.	4.91	4.91	4.91	4.91
Volumetric Flow Rate (Rounded to 1 CFM)				
ACFM	5,403	5,548	5,415	5,455
SCFM	4,949	5,072	4,969	4,997
DSCFM	4,939	5,052	4,964	4,985

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Table 67

Preliminary Airflow Measurements
Main Plant Pouring No. 5 HMP - TC Fan (324848)
Test 1

Parameter		**Run 1**
Date of Run		4/24/19
Time of Measurement		1600
Barometric Pressure, Inches Hg		28.76
Static Pressure, Inches WC		-2.09
Absolute Gas Pressure (In. Hg)		28.61
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		54.33
Duct Cross-sectional Area, Sq. Ft.		3.14
Volumetric Flow Rate (Rounded to 10 CFM)		
ACFM		10,240
SCFM		9,660
DSCFM		9,570

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Table 68

Preliminary Airflow Measurements
Main Plant Pouring No. 6 HMP - East Hunter (324632)
Test 1

Parameter		**Run 1**
Date of Run		4/23/19
Time of Measurement		1600
Barometric Pressure, Inches Hg		28.79
Static Pressure, Inches WC		-0.35
Absolute Gas Pressure (In. Hg)		28.76
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		22.52
Duct Cross-sectional Area, Sq. Ft.		3.14
Volumetric Flow Rate (Rounded to 10 CFM)		
ACFM		4,240
SCFM		3,950
DSCFM		3,910

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Table 69

Preliminary Airflow Measurements
Main Plant Pouring No. 7 HMP - West Hunter (324662)
Test 1

Parameter		**Run 1**
Date of Run		4/24/19
Time of Measurement		1300
Barometric Pressure, Inches Hg		28.79
Static Pressure, Inches WC		-0.50
Absolute Gas Pressure (In. Hg)		28.75
Average Gas Temperature, °F		98
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		52.87
Duct Cross-sectional Area, Sq. Ft.		3.41
Volumetric Flow Rate (Rounded to 10 CFM)		
ACFM		10,810
SCFM		9,830
DSCFM		9,740

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Table 70

Airflow Measurement Results
Cupola Baghouse Inlet
Test 1

Parameter	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7
Date of Run	4/23/19	4/23/19	4/24/19	4/24/19	4/24/19	4/25/19	4/25/19
Time of Measurement	0635	1220	0840	1230	1345	0645	1030
Barometric Pressure, Inches Hg	28.82	28.79	28.77	28.77	28.77	28.52	28.52
Static Pressure, Inches WC	-1.09	-1.35	-1.42	-1.29	-1.68	-1.63	-1.49
Absolute Gas Pressure (In. Hg)	28.74	28.69	28.66	28.67	28.64	28.40	28.41
Average Gas Temperature, °F	650	726	648	646	645	639	636
Corresponding M-4 Run Number	1	2	3	4	5	0	0
Average Moisture Content, %v/v	19.1	16.4	22.4	19.7	19.1	20.9	23.5
Gas Molecular Weight (Instrumental), lb/lb-mole							
Dry	30.52	30.52	30.39	30.37	30.54	30.16	30.35
Wet	28.13	28.47	27.61	27.94	28.15	27.62	27.44
Flue Gas Average Velocity, FPS	56.67	65.84	57.54	53.74	52.73	66.81	66.15
Duct Cross-sectional Area, Sq. Ft	12.57	12.57	12.57	12.57	12.57	12.57	12.57
Volumetric Flow Rate (Rounded to 100 CFM)							
ACFM	42,700	49,600	43,400	40,500	39,800	50,400	49,900
SCFM	19,500	21,200	19,800	18,500	18,200	23,000	22,800
DSCFM	15,800	17,700	15,400	14,900	14,700	18,200	17,500

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. The pouring rates for the six days of testing ranged from 5.23 TPH to 8.48 TPH. The cupola melt rate was 14.55 TPH, 15.45 TPH and 15.8 TPH for the three days of testing on the cupola.

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.

Discussion of test sites in regard to Method 1 criteria is included in the Results Summary.

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 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.

Bag Method: Method 10 defines procedures to measure carbon monoxide (CO) emissions from stationary sources. Flue gas samples are collected at a rate proportional to the stack velocity into Tedlar™, or equivalent, gas-tight bags. Gas tanks may be used in place of bags if analyzed within one week. A diaphragm pump transfers the gas sample from the bag to a gas filter correlation non-dispersive infrared analyzer. The analyst manually records the CO concentration value from the digital display of the analyzer. Prior to analysis, the analyst calibrates the system in accordance with EPA Method 7E. The analyst verifies zero and span gases periodically and at the conclusion of sample batches. The operator also maintains comprehensive test records. Equipment used to conduct Method 10 bag method includes:

Bag Sampler:	Evacuation Vessel
Filter Material:	Glass-fiber Filter or equivalent
Moisture Removal:	Condenser
Bag Material:	Tedlar™, Aluminized Mylar™, or equivalent, or sample tank.
Analytical Technique:	Gas Filter Correlation NDIR
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.
- Three point analyzer calibration. Analyzer calibration error is determined before initial sample.
- Purge time of ≥ 2x the response time observed before starting data collection.

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.

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.

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)

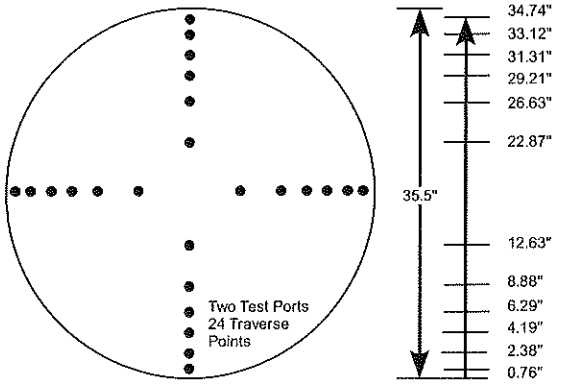
The Pace FSD QMS includes:

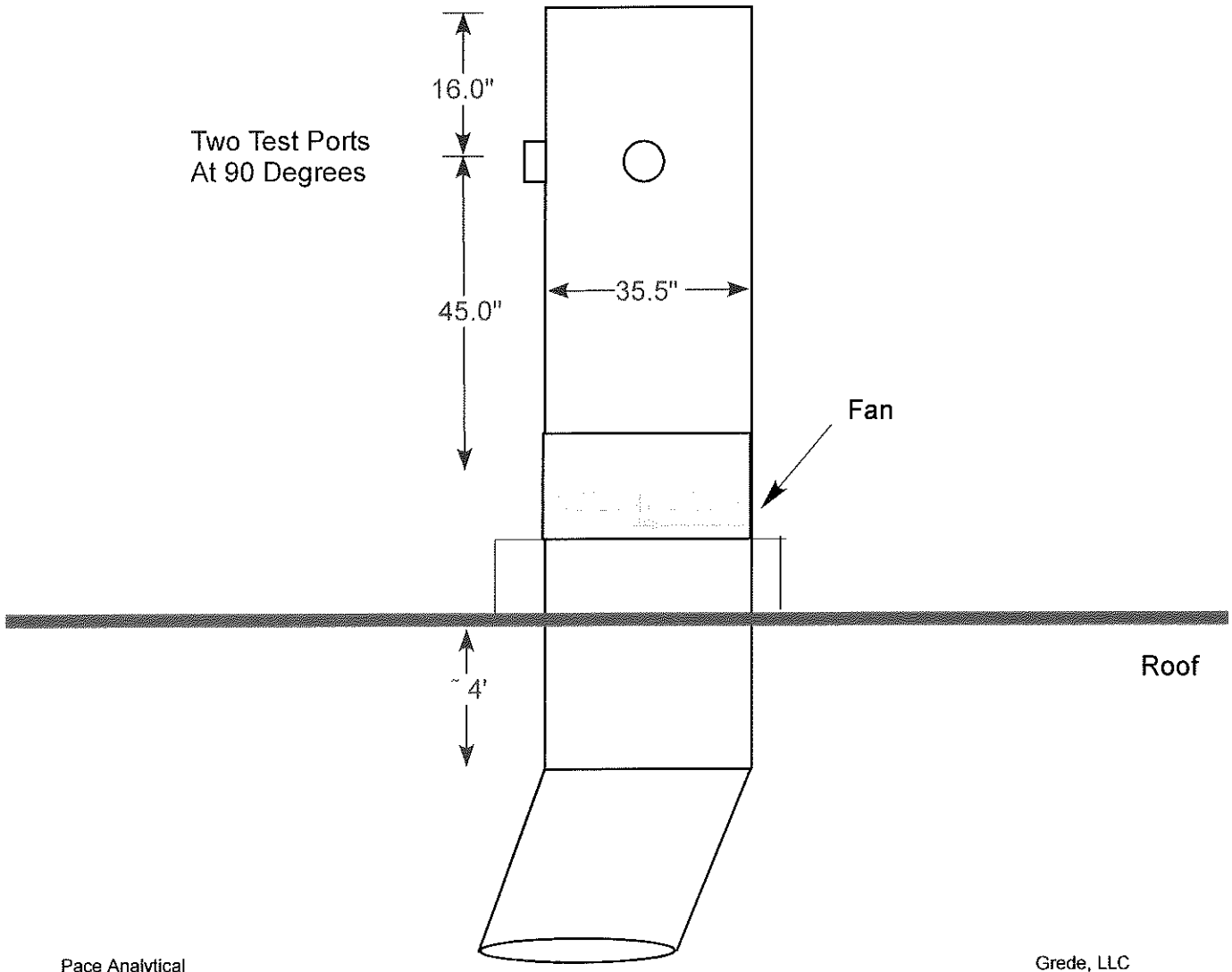
- Quality Programs
  - Ethics policy and training.
  - Corrective Action and Preventative Action (CAPA).
  - Continuous Process Improvement.
  - Documented Demonstrations of Capability.
  - Internal and third party proficiency testing.
  - Qualified Individual program (QI)
  - Internal and external audits.
  - 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.

Pace Analytical
Field Services Division

Figure 1
Grede, LLC
Kingsford, MI
Main Plant Pouring Disa Summit Stack (324176)
tjb \ 6/17/2019





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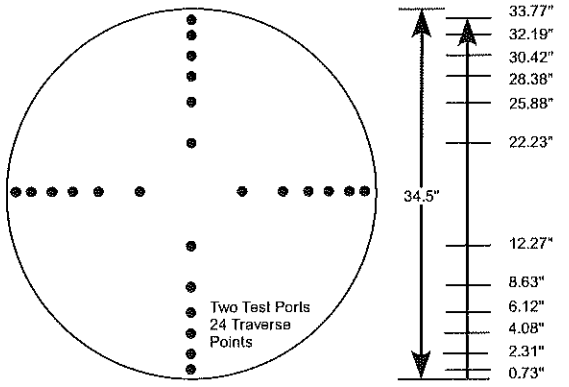
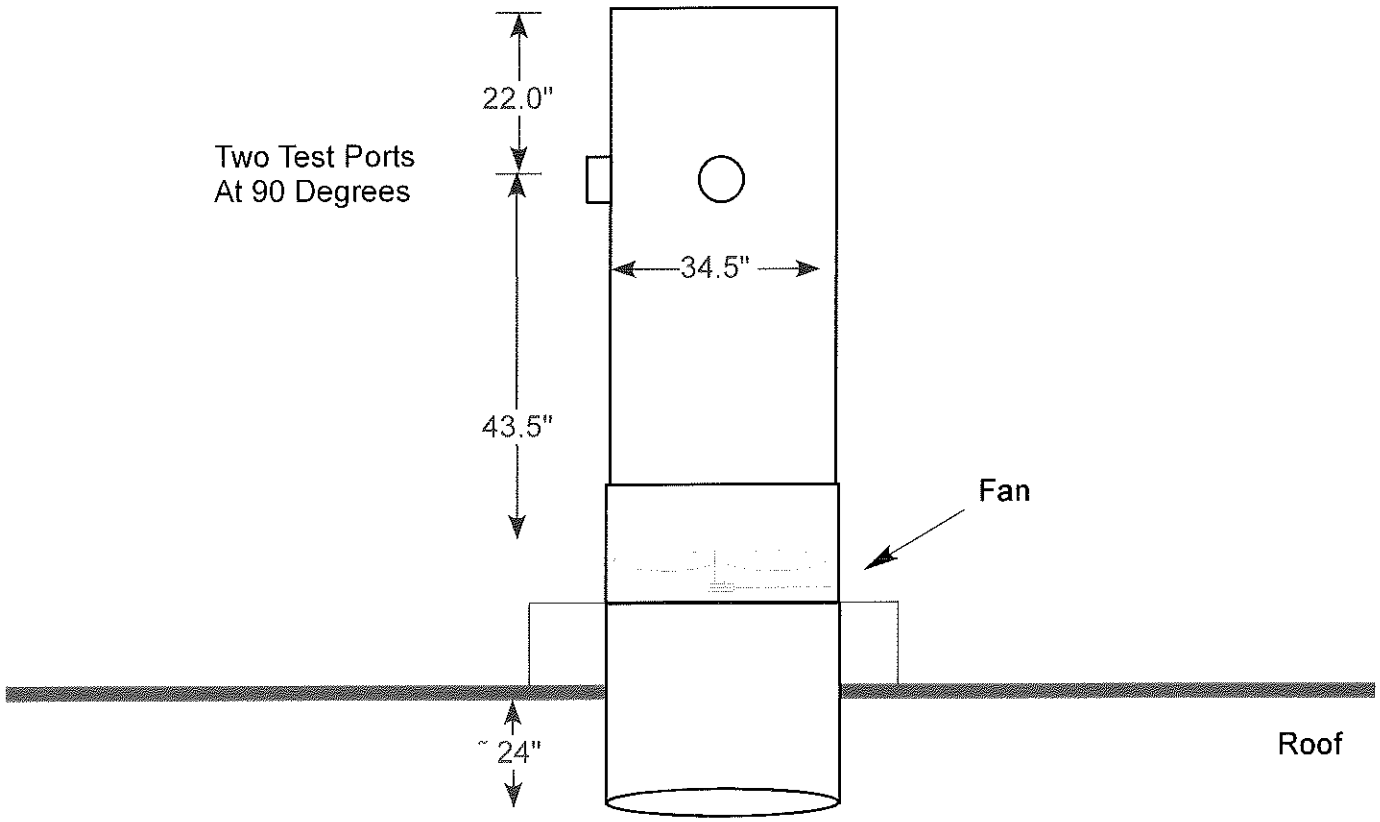
Field Services Division

Figure 2
Grede, LLC
Kingsford, MI
Main Plant Pouring Disa Summit Stack (324188)
tjb \ 6/17/2019





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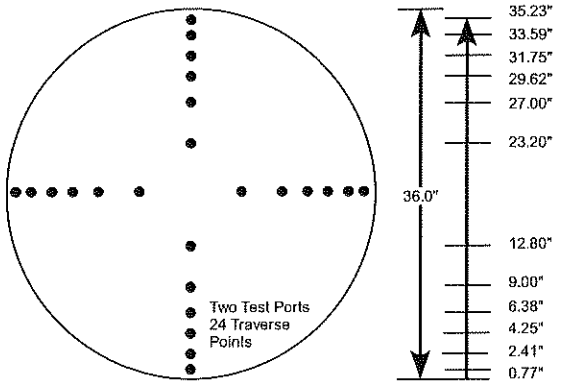
Field Services Division

Figure 3
Grede, LLC
Kingsford, MI
Main Plant Pouring Disa Summit Stack (324196)
tjb \ 6/17/2019



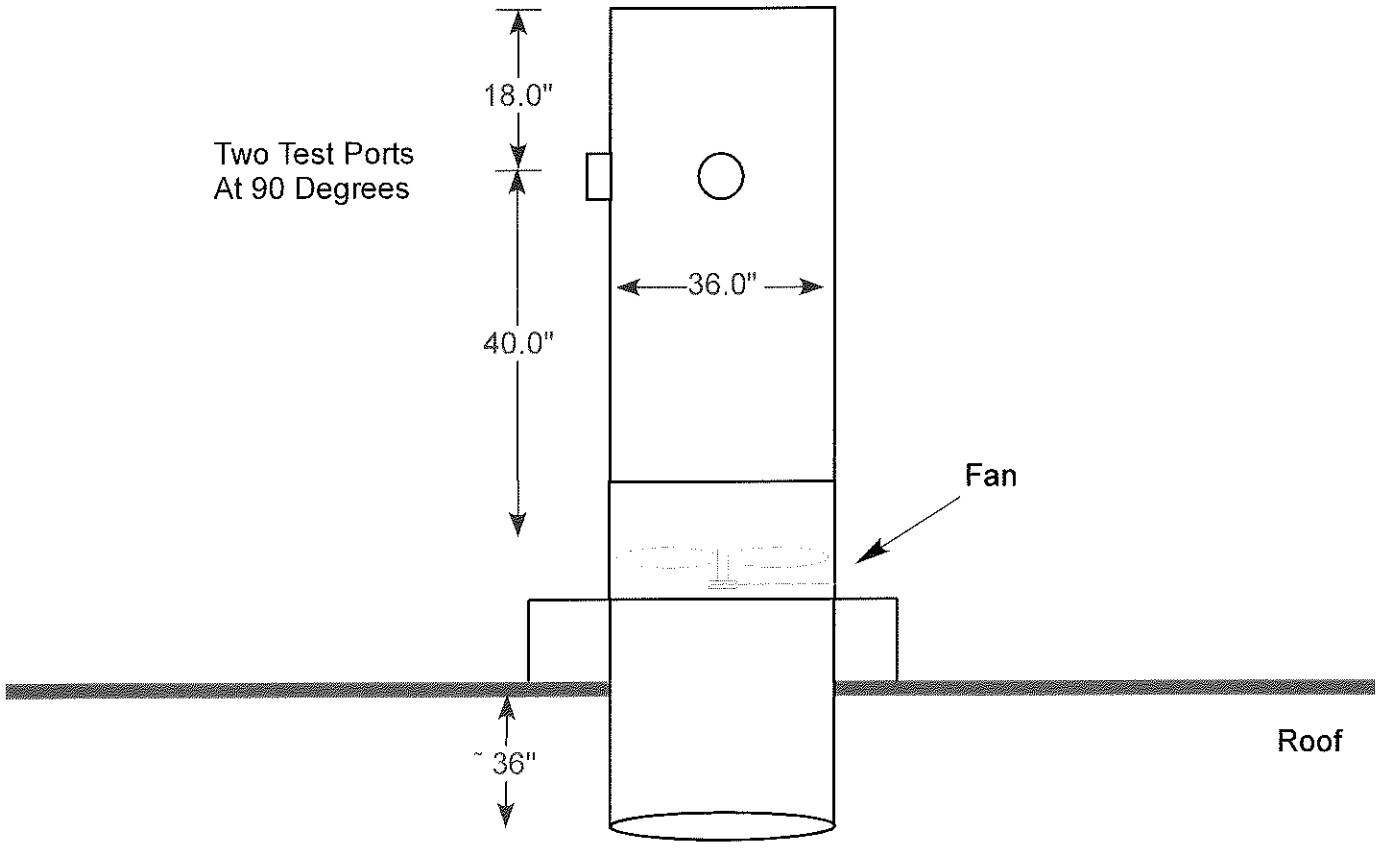


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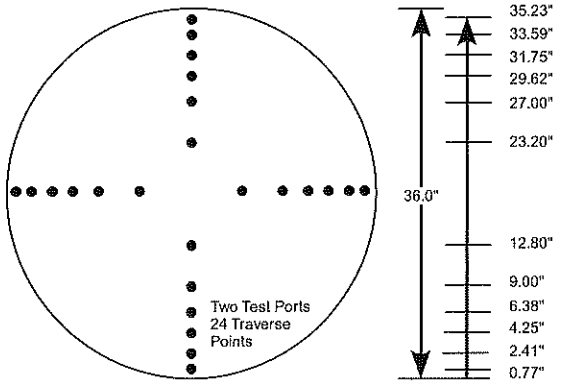
Figure 4
Grede, LLC
Kingsford, MI
Main Plant Pouring Disa Summit Stack (324204)
tjb \ 6/17/2019



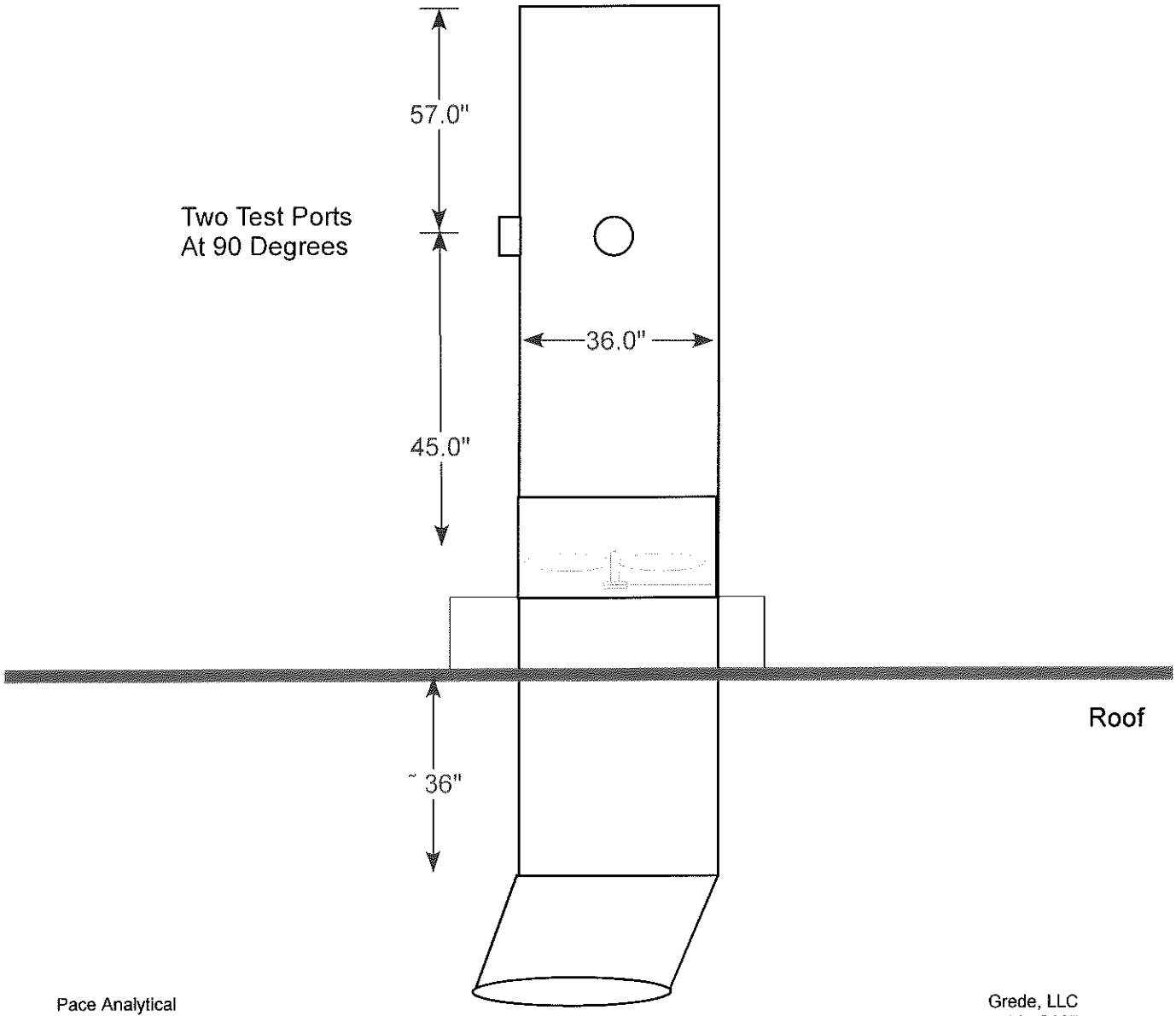


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Figure 5
Grede, LLC
Kingsford, MI
Main Plant Pouring Disa Exhaust (324484)
NWH \ 05/30/2019

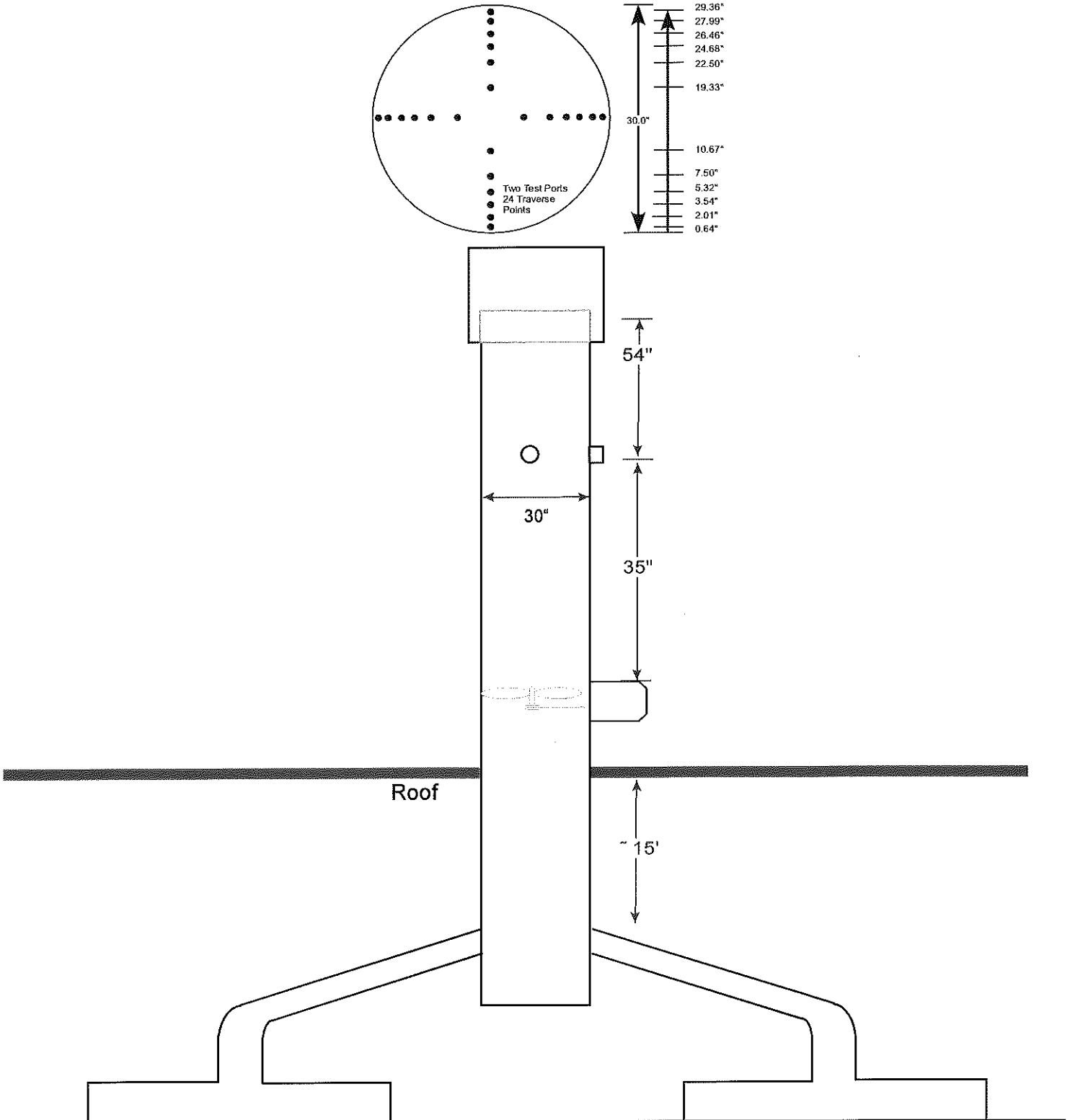

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Figure 6
Grede, LLC
Kingsford, MI
Main Plant Pouring Disa Exhaust
tjb \ 6/17/2019

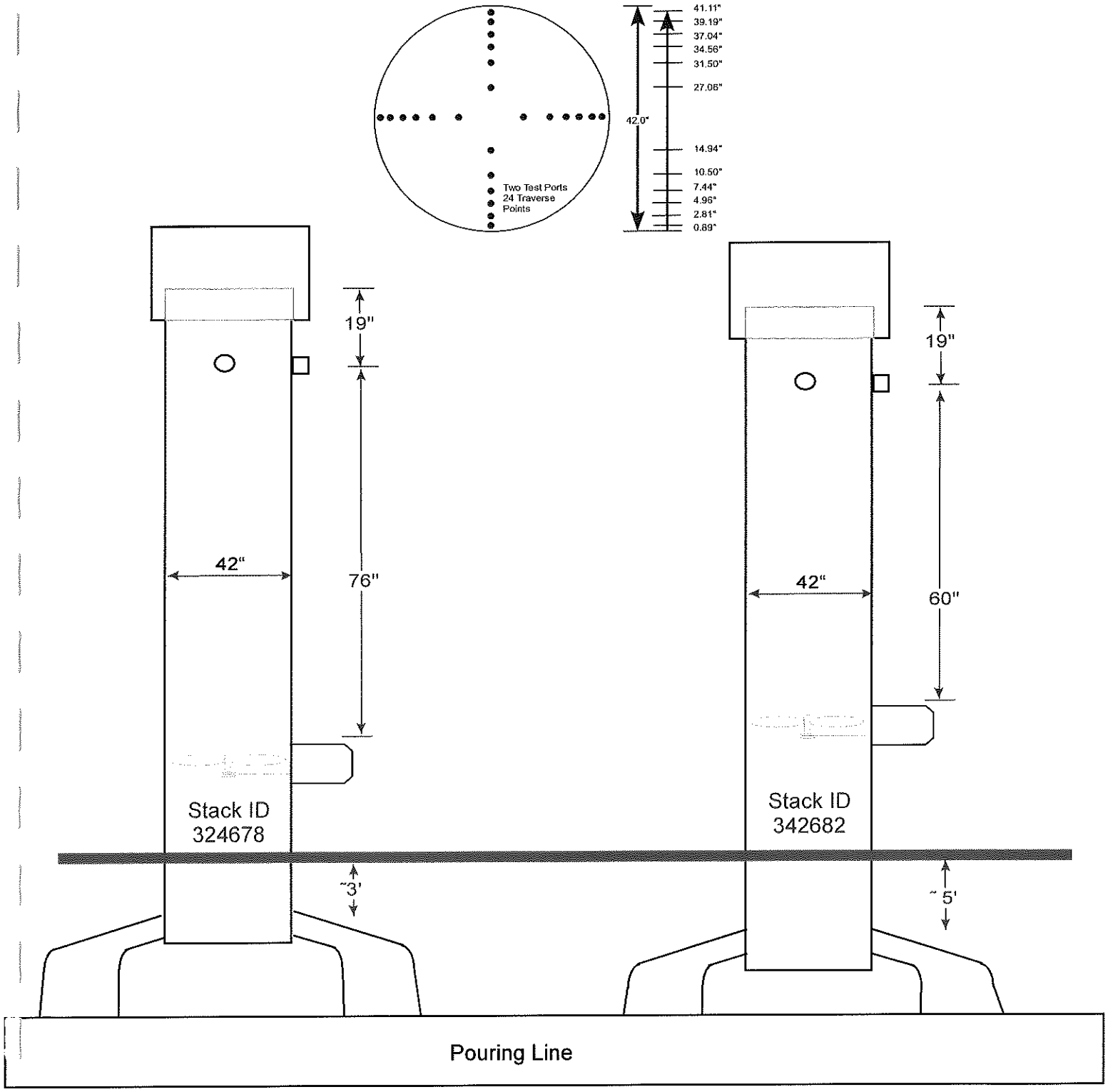

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Figure 7
Grede, LLC
Kingsford, MI
Module Pouring Plant Exhaust
tjb/ 6/17/2019

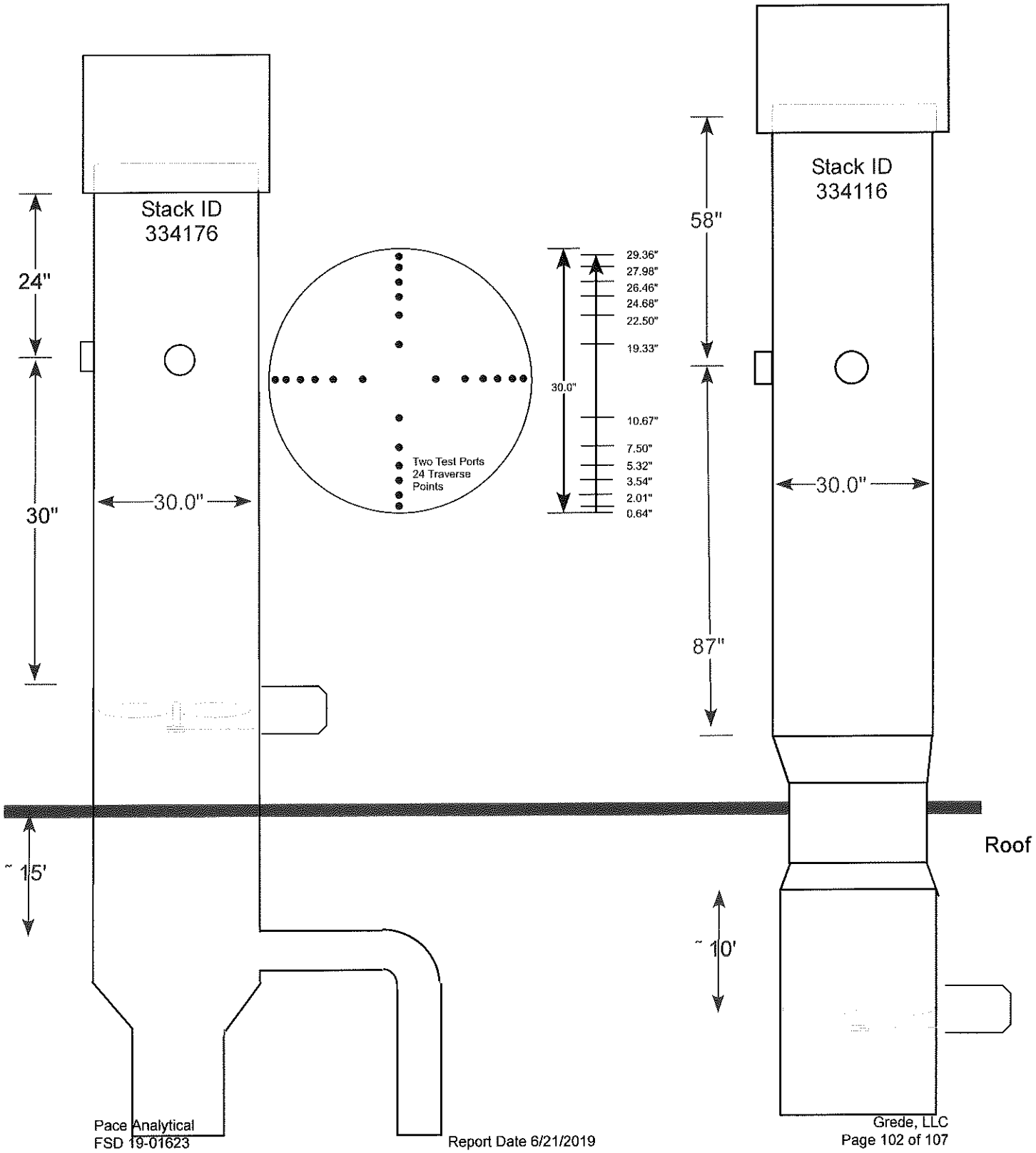

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Figure 8
Grede, LLC
Kingsford, MI
Main Pouring Plant No. 5 HMP - TC Fan (324848)
tjb \ 6/17/2019

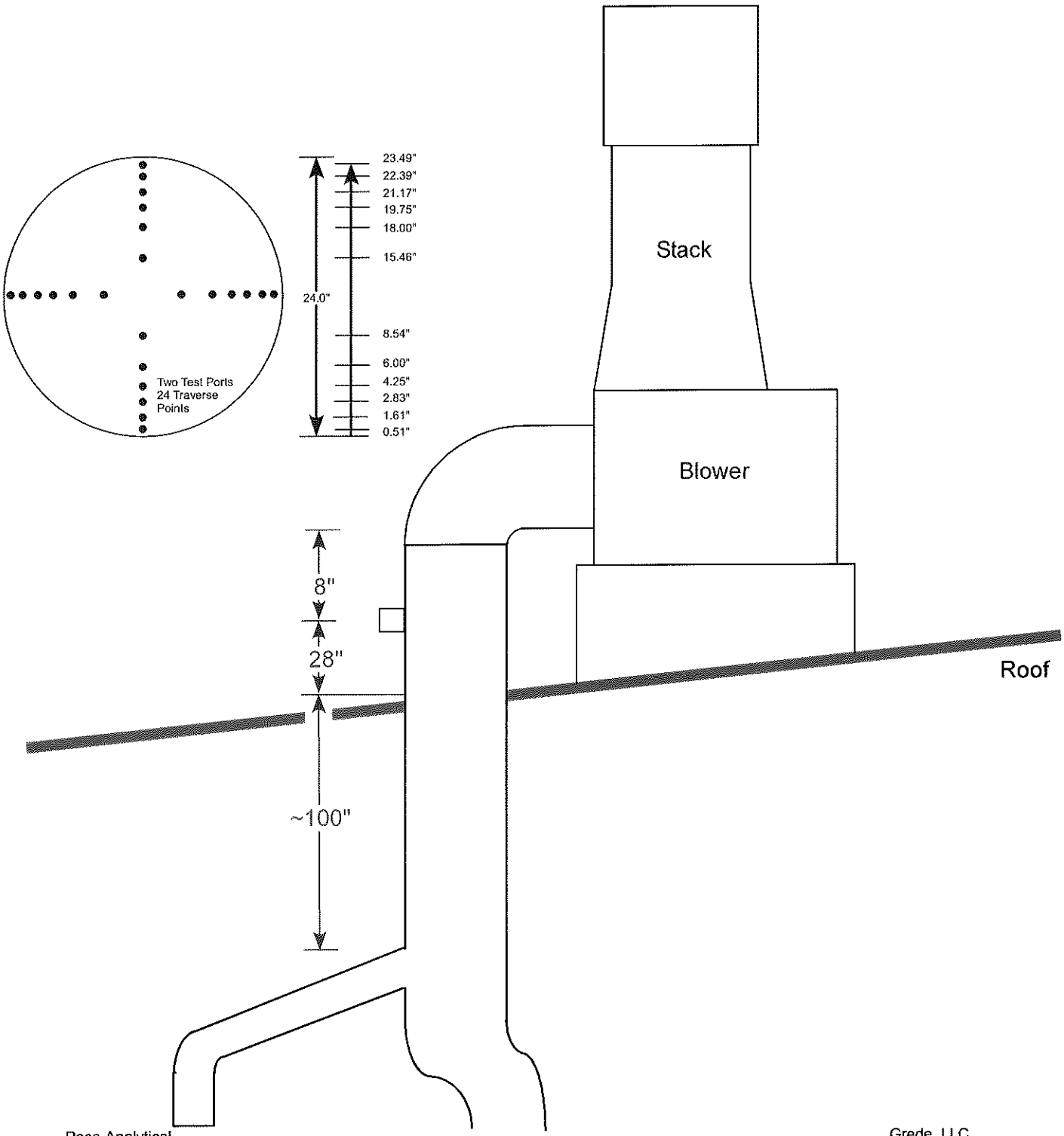

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Figure 9
Grede, LLC
Kingsford, MI
Main Pouring Plant No. 6 HMP - East Hunter (324632)
NWH \ 5/30/2019

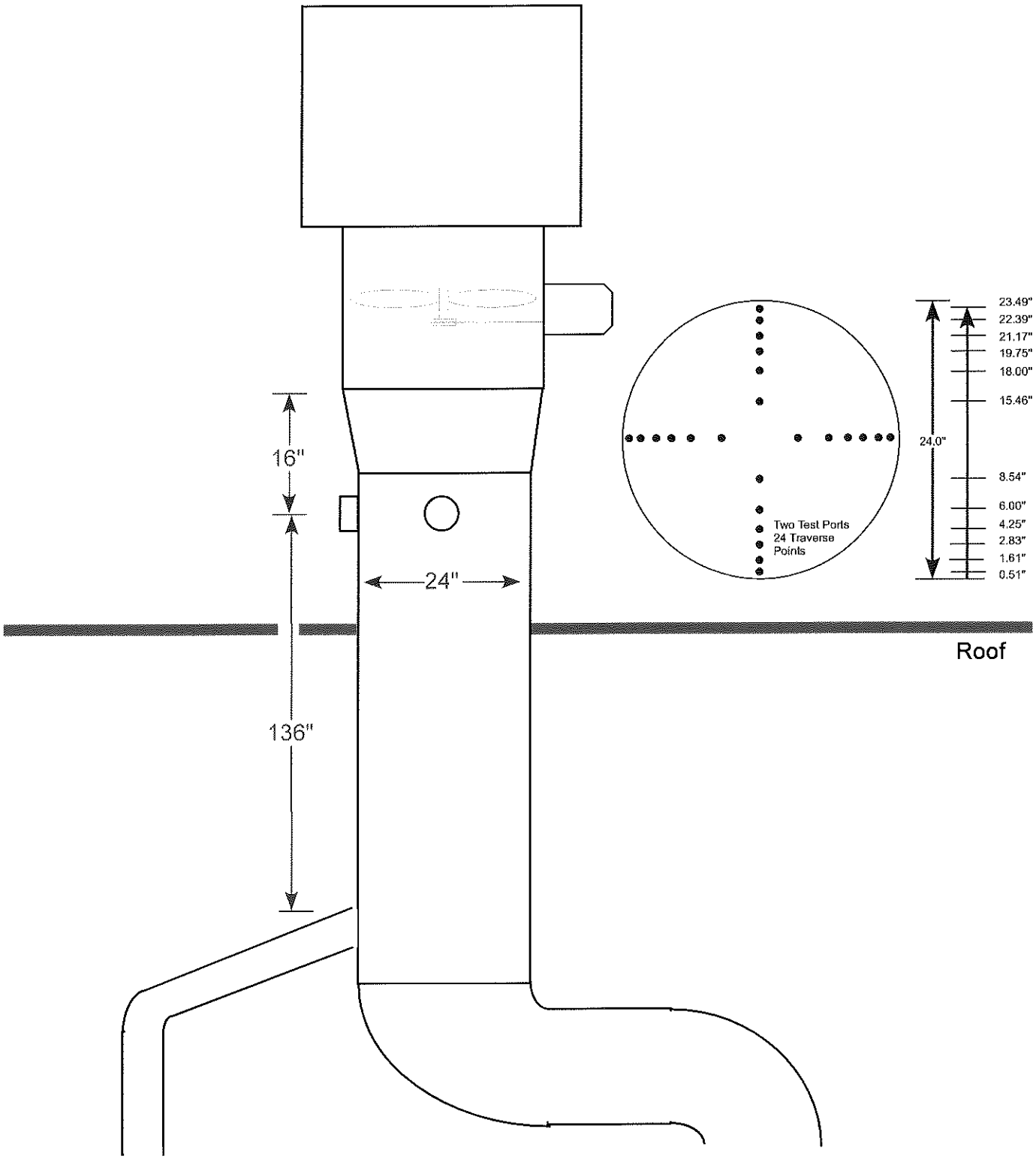

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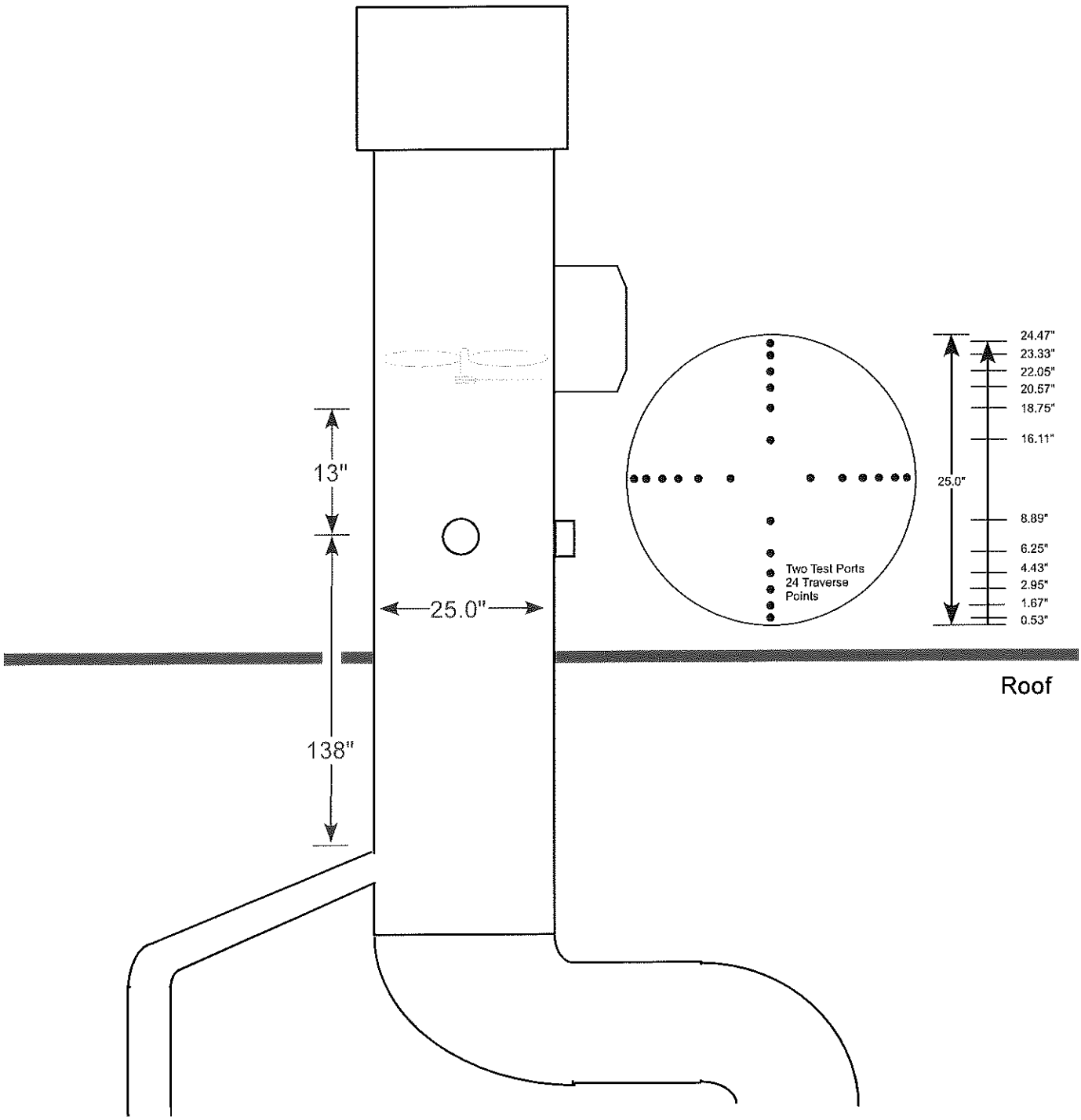
Figure 10
Grede, LLC
Kingsford, MI
Main Pouring Plant No. 7 HMP - West Hunter (324662)
tjb\ 6/17/2019



Pace Analytical
Field Services Division

Figure 11
Grede, LLC
Kingsford, MI
Cupola Baghouse Exhaust (EU-P009)
TJB \ 08/05