1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Cleveland-Cliffs Dearborn Works (CCDW) (Facility ID: A8640) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance test program on the No. 1 Ladle Refining Furnace (EULADLEREFINE1) at the Cleveland-Cliffs Dearborn Works (CCDW) facility located in Dearborn Michigan. Testing was performed on August 16-17, 2021, for the purpose of satisfying the emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operation Permit No. MI-ROP-A8640-2016a and 40 CFR Part 63, Subpart FFFFF.

The specific objectives were to:

- Verify the emissions of particulate matter (PM (PM_{10}/$PM_{2.5}$)) and lead (Pb) from the baghouse exhaust stack (SVLADLEREFINE1) serving EULADLEREFINE1
- Verify the percent opacity of visible emissions (VE) from the EULADLEREFINE1 Baghouse Exhaust Stack and the EULADLEREFINE1 roof monitor
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

TABLE 1-1
SUMMARY OF TEST PROGRAM

Test Date(s)	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
8/16/2021	EULADLEREFINE1 Exhaust Stack	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	80-95
8/16/2021	EULADLEREFINE1 Exhaust Stack	O_2, CO_2	EPA 3	3	50-60
8/16/2021	EULADLEREFINE1 Exhaust Stack	Moisture	EPA 4	3	80-95
8/16/2021	EULADLEREFINE1 Exhaust Stack	PM/$PM_{2.5}$/PM_{10}	EPA 5/202	3	80-95
8/16/2021	EULADLEREFINE1 Roof Monitor	Opacity	EPA 9	3	80-95
8/17/2021	EULADLEREFINE1 Exhaust Stack	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	80-91

TABLE 1-1
SUMMARY OF TEST PROGRAM continued

Test Date(s)	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
8/17/2021	EULADLEREFINE1 Exhaust Stack	Moisture	EPA 4	3	80-91
8/17/2021	EULADLEREFINE1 Exhaust Stack	Opacity	EPA 9	3	79-91
8/17/2021	EULADLEREFINE1 Exhaust Stack	Pb	EPA 12	3	80-91

To simplify this report, a list of Units and Abbreviations is included in Appendix D.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized and compared to their respective permit limits in Tables 1-2 and 1-3. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-4. The tests were conducted according to the Intent-to-Test notification dated June 15, 2021 that was submitted to EGLE.

TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS - EULADLEREFINE1
AUGUST 16-17, 2021

Parameter/Units	Average Results	Emission Limits
Particulate Matter (PM)		
lb/hr	0.31	6.33
gr/dscf	0.0005	0.005*, 0.01†
Particulate Matter <10 Microns (PM_{10})		
lb/hr	0.99	6.65
Particulate Matter <2.5 Microns ($PM_{2.5}$)		
lb/hr	0.99	6.65
Visible Emissions - LRF1 Roof Monitor		
% (Highest 3-minute average)	0%	0%*, 20%†
Lead (Pb)		
lb/hr	0.0004	0.022
Visible Emissions - LRF1 Baghouse Exhaust Stack		
% (Highest 6-minute average)	0%	5%

* MI-ROP-A8640-2016a emission limit

† 40 CFR Part 63, Subpart FFFFF emission limit

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location:	Cleveland-Cliffs Dearborn Works (CCDW) 4001 Dearborn Road Dearborn, MI 48120
Project Contact:	David Pate
Role:	Senior Environmental Engineer
Company:	Cleveland-Cliffs Dearborn Works (CCDW)
Telephone:	313-323-1261
Email:	david.pate@clevelandcliffs.com

Agency Information

Regulatory Agency:	EGLE
Agency Contact:	Karen Kajiya-Mills
Telephone:	517-256-0880
Email:	Kajiya-millsk@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC	
Contact:	Matthew Young	David Trahan
Title:	District Manager	Field Project Manager
Telephone:	248-548-8070	248-548-8070
Email:	myoung@montrose-env.com	dtrahan@montrose-env.com

Laboratory Information

Laboratory:	Montrose
City, State:	Royal Oak, MI
Method:	EPA 5 and 201A
Laboratory:	Enthalpy Analytical, LLC
City, State:	Durham, NC
Method:	EPA 12 and 202

Test personnel and observers are summarized in Table 1-3.

TABLE 1-3
TEST PERSONNEL AND OBSERVERS

Name	Affiliation	Role/Responsibility
David Trahan	Montrose	Field Project Manager, QI
Mike Nummer	Montrose	Field Technician
David Koponen	Montrose	Field Technician
Jeff Peitzsch	Montrose	Visible Emissions Observer
David Pate	Cleveland-Cliffs Dearborn Works (CCDW)	Observer/Client Liaison/Test Coordinator
Regina Angellotti	EGLE	Observer
Katherine Koster	EGLE	Observer

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

Cleveland-Cliffs Dearborn Works owns and operates a ladle refining furnace (LRF). The No. 1 LRF dust collector is a continuous automatic, suction type, pulse-jet baghouse. The baghouse consists of five chambers in parallel and is manufactured by Flakt. One main induced draft (ID) fan provides the suction for moving the fume and dust laden gases through the fume control system. The fan is of the radial tip design and designed to handle 75,000 actual cubic feet per minute (acfm).

2.2 FLUE GAS SAMPLING LOCATION

Information regarding the sampling location is presented in Table 2-1.

TABLE 2-1
SAMPLING LOCATION

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EULADLEREFINE1 Exhaust Stack	108	720.0 / 6.7	480.0 / 4.4	Isokinetic: 16 (8/port)

The sampling location was verified in the field to conform to EPA Method 1. Acceptable cyclonic flow conditions were confirmed prior to testing using EPA Method 1, Section 11.4. See Appendix A.1 for more information.

2.3 OPERATING CONDITIONS AND PROCESS DATA

Emission tests were performed while EULADLEREFINE1 and air pollution control devices were operating at the conditions required by the permit. EULADLEREFINE1 was tested when operating normally and during a minimum of one process heat per sampling run.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B. Data collected includes the following parameters:

- Heat number with start and stop times
- Steel processed, tons
- Type and amount of alloys added per heat
- Baghouse compartment and overall pressure drop, DP per heat
- Baghouse PM monitor readings
- Number of baghouse compartments in use

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TEST METHODS

The test methods for this test program were presented previously in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 1, Sample and Velocity Traverses for Stationary Sources

EPA Method 1 is used to assure that representative measurements of volumetric flow rate are obtained by dividing the cross-section of the stack or duct into equal areas, and then locating a traverse point within each of the equal areas. Acceptable sample locations must be located at least two stack or duct equivalent diameters downstream from a flow disturbance and one-half equivalent diameter upstream from a flow disturbance.

3.1.2 EPA Method 2, Determination of Stack gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

EPA Method 2 is used to measure the gas velocity using an S-type pitot tube connected to a pressure measurement device, and to measure the gas temperature using a calibrated thermocouple connected to a thermocouple indicator. Typically, Type S (Stausscheibe) pitot tubes conforming to the geometric specifications in the test method are used, along with an inclined manometer. The measurements are made at traverse points specified by EPA Method 1.

3.1.3 EPA Method 3, Gas Analysis for the Determination of Dry Molecular Weight

EPA Method 3 is used to calculate the dry molecular weight of the stack gas using one of three methods. The first choice is to measure the percent O_2 and CO_2 in the gas stream. A gas sample is extracted from a stack by one of the following methods: (1) single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analyzed for percent CO_2 and percent O_2 using either an Orsat or a Fyrite analyzer. The second choice is to use stoichiometric calculations to calculate dry molecular weight. The third choice is to use an assigned value of 30.0, in lieu of actual measurements, for processes burning natural gas, coal, or oil. For this test, grab samples were taken during each run and were analyzed for percent O_2 and CO_2.

3.1.4 EPA Method 4, Determination of Moisture Content in Stack Gas

EPA Method 4 is a manual, non-isokinetic method used to measure the moisture content of gas streams. Gas is sampled at a constant sampling rate through a probe and impinger train. Moisture is removed using a series of pre-weighed impingers containing methodology-specific liquids and silica gel immersed in an ice water bath. The impingers are weighed after each run to determine the percent moisture.

The typical sampling system is detailed in Figures 3-1 and 3-2

3.1.5 EPA Method 5, Determination of Particulate Matter from Stationary Sources

EPA Method 5 is a manual, isokinetic method used to measure FPM emissions. The samples are analyzed gravimetrically. This method is performed in conjunction with EPA Methods 1 through 4. The stack gas is sampled through a nozzle, probe, filter, and impinger train. FPM results are reported in emission concentration and emission rate units.

The typical sampling system is detailed in Figure 3-2.

3.1.6 EPA Method 9, Visual Determination of the Opacity of Emissions

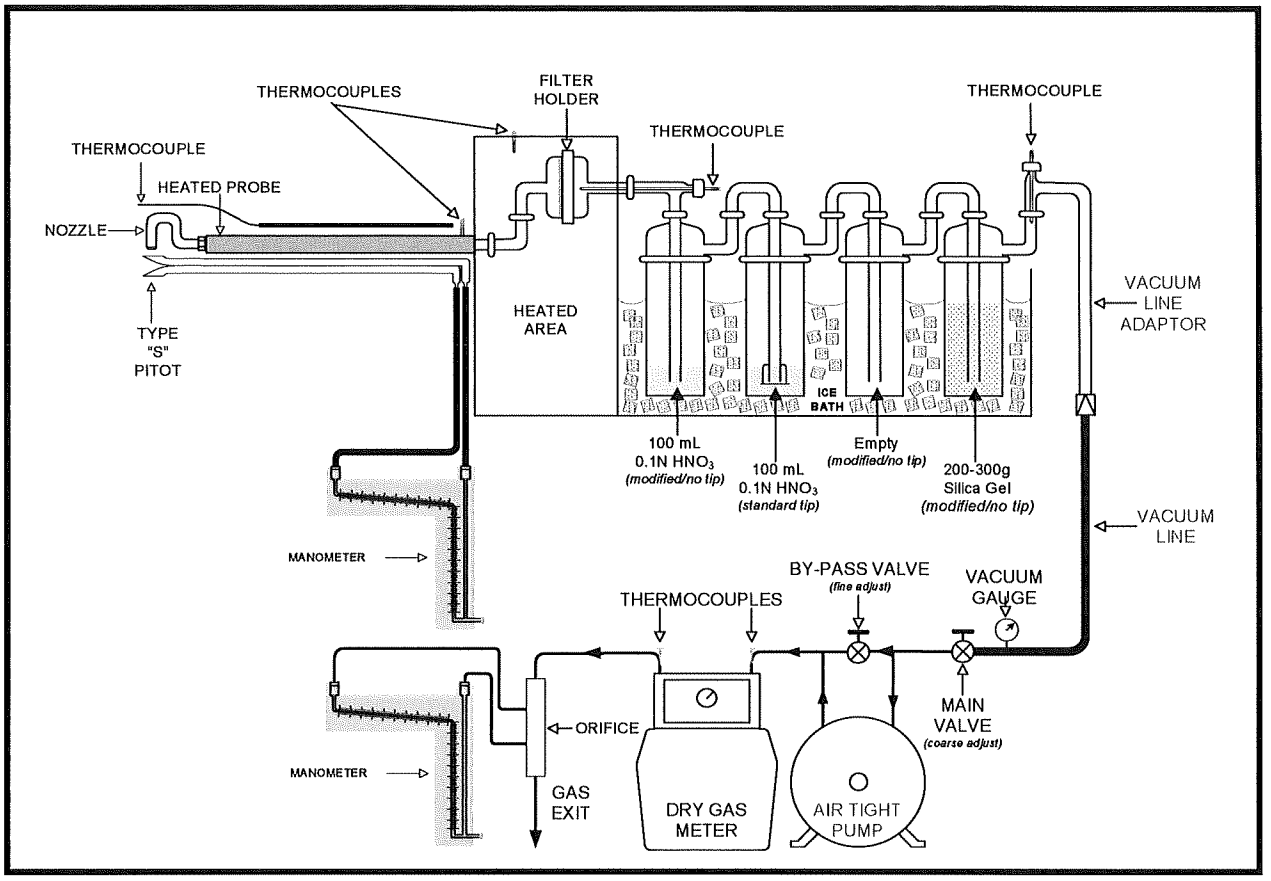
EPA Method 9 is used to observe the visual opacity of emissions (opacity). The observer stands at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to their back. The line of vision is perpendicular to the plume direction and does not include more than one plume diameter. Observations are recorded at 15-second intervals and are made to the nearest 5% opacity. The qualified observer is certified according to the requirements of EPA Method 9, Section 3.1.

3.1.7 EPA Method 12, Determination of Inorganic Leak Emissions from Stationary

EPA Method 12 is a manual, isokinetic test method used to measure emissions of Pb. Particulate and gaseous Pb emissions are withdrawn isokinetically from the source and are collected on a filter and in dilute nitric acid. The collected samples are digested in acid solution and are analyzed by atomic absorption spectrophotometry using an air/acetylene flame.

The typical sampling system is detailed in Figure 3-1.

FIGURE 3-1
EPA METHOD 12 SAMPLING TRAIN



3.1.8 EPA Method 202, Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources

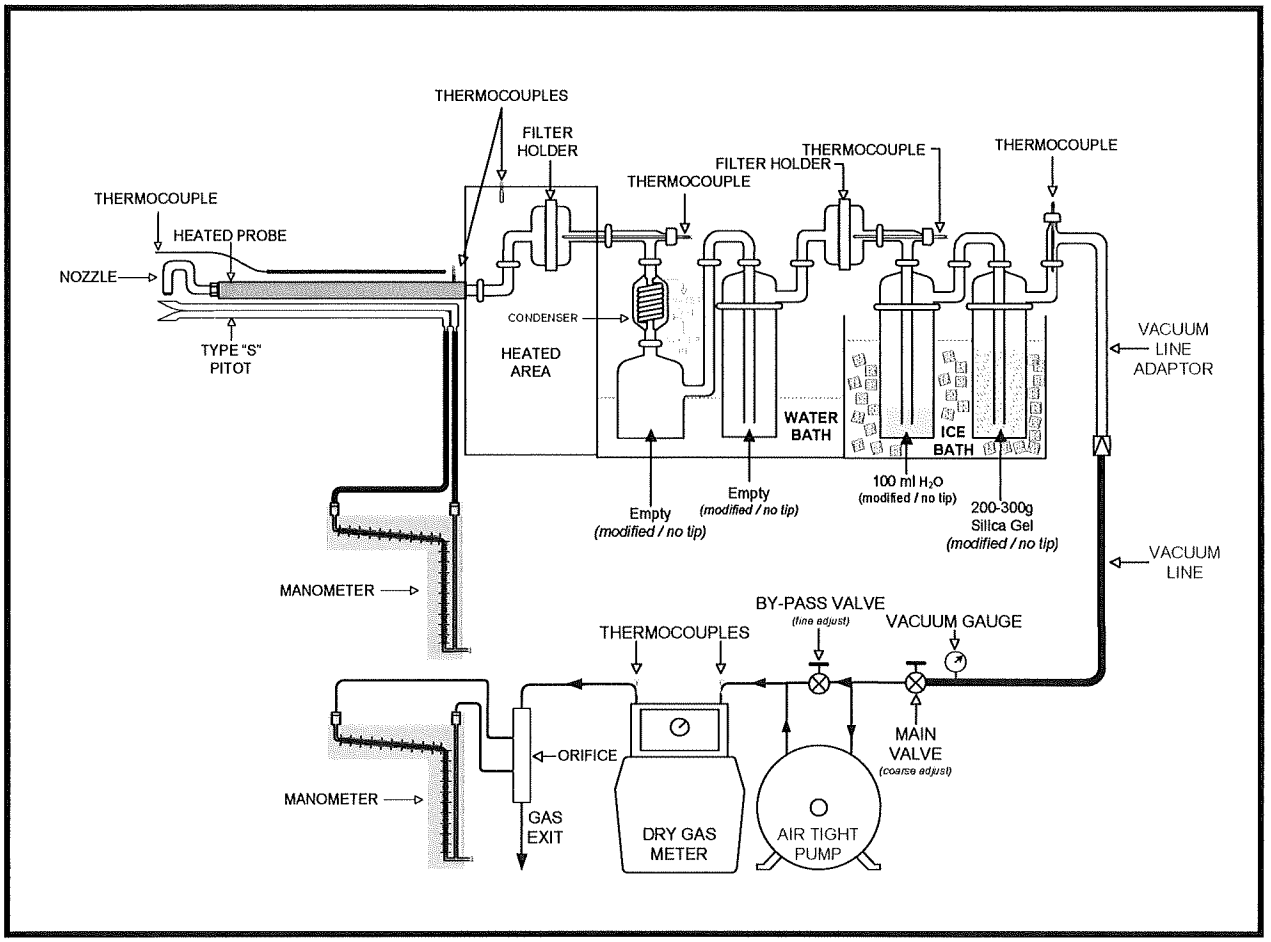
The CPM is collected in dry impingers after filterable PM has been collected on a filter maintained as specified in either Method 5 of Appendix A-3 to 40 CFR 60, Method 17 of Appendix A-6 to 40 CFR 60, or Method 201A of Appendix M to 40 CFR 51. The organic and aqueous fractions of the impingers and an out-of-stack CPM filter are then taken to dryness and weighed. The total of the impinger fractions and the CPM filter represents the CPM. Compared to the version of Method 202 that was promulgated on December 17, 1991, this method eliminates the use of water as the collection media in impingers and includes the addition of a condenser followed by a water dropout impinger immediately after the final in-stack or heated filter. This method also includes the addition of one modified Greenburg Smith impinger (backup impinger) and a CPM filter following the water dropout impinger.

CPM is collected in the water dropout impinger, the modified Greenburg Smith impinger, and the CPM filter of the sampling train as described in this method. The impinger contents are purged with nitrogen immediately after sample collection to remove dissolved SO_2 gases from the impinger. The CPM filter is extracted with water and hexane. The impinger solution is then extracted with hexane. The organic and aqueous fractions are dried and the residues are weighed. The total of the aqueous and organic fractions represents the CPM.

The potential artifacts from SO_2 are reduced using a condenser and water dropout impinger to separate CPM from reactive gases. No water is added to the impingers prior to the start of sampling. To improve the collection efficiency of CPM, an additional filter (the "CPM filter") is placed between the second and third impingers. For this test, PM_{10} and $PM_{2.5}$ were assumed to be the sum of the PM and CPM fraction.

The typical sampling system is detailed in Figure 3-2.

FIGURE 3-2
EPA METHOD 5/202 SAMPLING TRAIN



3.2 PROCESS TEST METHODS

The test plan did not require that process samples be collected during this test program; therefore, no process sample data are presented in this test report.

4.0 NESHAP TESTING REQUIREMENTS

Table 4-1 summarizes the NESHAP conditions as they relate to testing and notification requirements:

TABLE 4-1
NESHAP TESTING REQUIREMENTS

NESHAP Reference	ROP Reference	NESHAP/ROP Language	Comments
40 CFR 63.7821	EULADLEREFINE1 V.1	Conduct performance tests for particulate matter emissions and opacity at least once every 5 years (or ROP Renewal Cycle).	Previous performance test was conducted on August 20-24, 2018. This test was completed with 5 years of the completion of the previous test.
40 CFR 63.7822(b)(1)	N/A	Determine the concentration of particulate matter according to the listed test methods in 40 CFR 63.7822(b)(1)(i-v)	The particulate matter concentration was determined in accordance with the required test methods.
40 CFR 63.7822(b)(2)	N/A	Collect a minimum of 60 dry standard cubic feet of gas during each particulate matter test run. Three valid test runs are needed to comprise a performance test.	A minimum of 60 dry standard cubic feet of gas was collected during each particulate matter test run.
40 CFR 63.7822(h)	EULADLEREFINE1 V.2	Sampling during the performance test will occur only when the operations being controlled are in operation.	Sampling only took place when a heat was in the LRF and the hood was down. Testing was paused between heats.

TABLE 4-1 continued
NESHAP TESTING REQUIREMENTS

NESHAP Reference	ROP Reference	NESHAP/ROP Language	Comments
40 CFR 63.7823(b)	N/A	Performance tests for visible emissions shall be conducted such that opacity observations overlap with the performance tests for particulate.	All opacity observations on the roof monitor overlapped with the performance tests for particulate.
40 CFR 63.7823(d)(1)(ii)	N/A	Record observations to the nearest 5 percent at 15-second intervals for at least three steel production cycles rather than using the procedure specified in Section 2.4 of Method 9.	A minimum of one complete steel production cycle was observed during each PM test run for a minimum of three steel production cycles per LRF.
40 CFR 63.7823(d)(1)(iii)	N/A	Determine the 3-minute block average opacity from the average of 12 consecutive observations recorded at 15-second intervals.	Opacity was calculated using the 3-minute block averages in accordance with this requirement.
40 CFR 63.7840(d)	EULADLEREFINE1 VII.4	Submit a notification of intent to perform any performance testing under 40 CFR Part 63, Subpart FFFFF at least 60 calendar days before testing is to begin.	The notification was submitted on June 15, 2021, 62 days prior to the start of the testing.

5.0 TEST DISCUSSION AND RESULTS

5.1 FIELD TEST DEVIATIONS AND EXCEPTIONS

While audit samples are not strictly required due to the presence of only a single commercial provider of audit samples, AQD requested audit samples for lead on filter paper and lead in impinger solution for USEPA Method 12 in the test plan approval letter. Montrose received the audit samples but inadvertently forgot to send them to the lab for analysis with the other samples. This was discussed with AQD and AQD specified that the audit may be omitted from this test while making clear their position that AQD would continue to request audit samples in the future, and the expectation is that the audits will be performed.

All other method deviations were presented within the test plan (section 3.4 of the test plan) and approved by EGLE in the test plan approval letter. Both are attached in Appendix E.

5.2 PRESENTATION OF RESULTS

The average results are compared to the permit limits in Tables 1-2 and 1-3 The results of individual compliance test runs performed are presented in Tables 4-1 and 4-2. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

TABLE 5-1
PM AND VISIBLE EMISSIONS RESULTS - EULADLEREFINE1 (8/16/2021)

Run Number	1	2	3	Average
Date	8/16/2021	8/16/2021	8/16/2021	--
Time	10:40-12:06	12:58-14:34	15:31-17:52	--
Process Data				
production rate, tons/hr	368.7	332.3	325.9	342.3
Flue Gas Parameters				
O_2, % volume dry	20.9	20.9	20.9	20.9
CO_2, % volume dry	0.0	0.0	0.0	0.0
flue gas temperature, °F	147.6	161.9	150.4	153.3
moisture content, % volume	1.96	2.12	2.17	2.08
volumetric flow rate, dscfm	77,275	71,861	74,337	74,491
Filterable Particulate Matter (FPM)				
gr/dscf	0.00071	0.00050	0.00025	0.00049
lb/hr	0.47	0.31	0.16	0.31
Condensable Particulate Matter (CPM)				
gr/dscf	0.0024	0.0003	0.0004	0.0010
lb/hr	1.57	0.20	0.26	0.68
Particulate Matter (PM)				
gr/dscf	0.0031	0.0008	0.0007	0.0015
lb/hr	2.04	0.51	0.42	0.99
Visible Emissions *				
% (Highest 3-minute average)	0.0	0.0	0.0	-

* Visible Emissions observed at Roof Monitor location

TABLE 5-2
Pb AND VISIBLE EMISSIONS RESULTS - EULADLEREFINE1 (8/17/2021)

Run Number	1	2	3	Average
Date	8/17/2021	8/17/2021	8/17/2021	--
Time	8:47-10:47	11:57-13:29	14:27-15:57	--
Process Data				
production rate, tons/hr	323.8	341.1	349.4	338.1
Flue Gas Parameters				
O_2, % volume dry*	20.9	20.9	20.9	20.9
CO_2, % volume dry*	0.0	0.0	0.0	0.0
flue gas temperature, °F	144.2	141.2	144.9	143.4
moisture content, % volume	2.45	2.21	2.51	2.39
volumetric flow rate, dscfm	72.281	77,795	75,984	75,353
Lead (Pb)				
mg/dscm	0.0018	0.0012	0.0011	0.0014
lb/hr	0.00049	0.00035	0.00031	0.00038
Visible Emissions †				
% (Highest 6-minute average)	0.0	0.0	0.0	-

* O_2 and CO_2 values are utilized from the previous test day

† Visible Emissions observed at the Baghouse Exhaust Stack

6.0 INTERNAL QA/QC ACTIVITIES

6.1 QA/QC AUDITS

The meter boxes and sampling trains used during sampling performed within the requirements of their respective methods. All post-test leak checks, minimum metered volumes, minimum sample durations, and percent isokinetics met the applicable QA/QC criteria.

Fyrite analyzer audits were performed during this test in accordance with EPA Method 3, Section 10.1 requirements. The results were within ± 0.5% of the respective audit gas concentrations.

EPA Method 9 was performed by a certified Visible Emissions Evaluator. For quality assurance, the observer obtained a view of the emissions with the best available contrasting background and with the sun oriented in the 140° sector to their back. Readings were taken every 15 seconds and made to the nearest 5% opacity.

EPA Method 5 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met, except if noted in Section 6.2. An EPA Method 5 reagent blank was analyzed. The maximum allowable amount that can be subtracted is 0.001% of the weight of the acetone blank. The blank did not exceed the maximum residue allowed.

EPA Method 202 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met. An EPA Method 202 Field Train Recovery Blank (FTRB) was performed for each source category. The maximum allowable amount that can be subtracted is 0.002 g (2.0 mg). For this project, the FTRB had a mass of 2.3 mg, and 2.0 mg was subtracted.

6.2 QA/QC DISCUSSION

All QA/QC criteria were met during this test program.

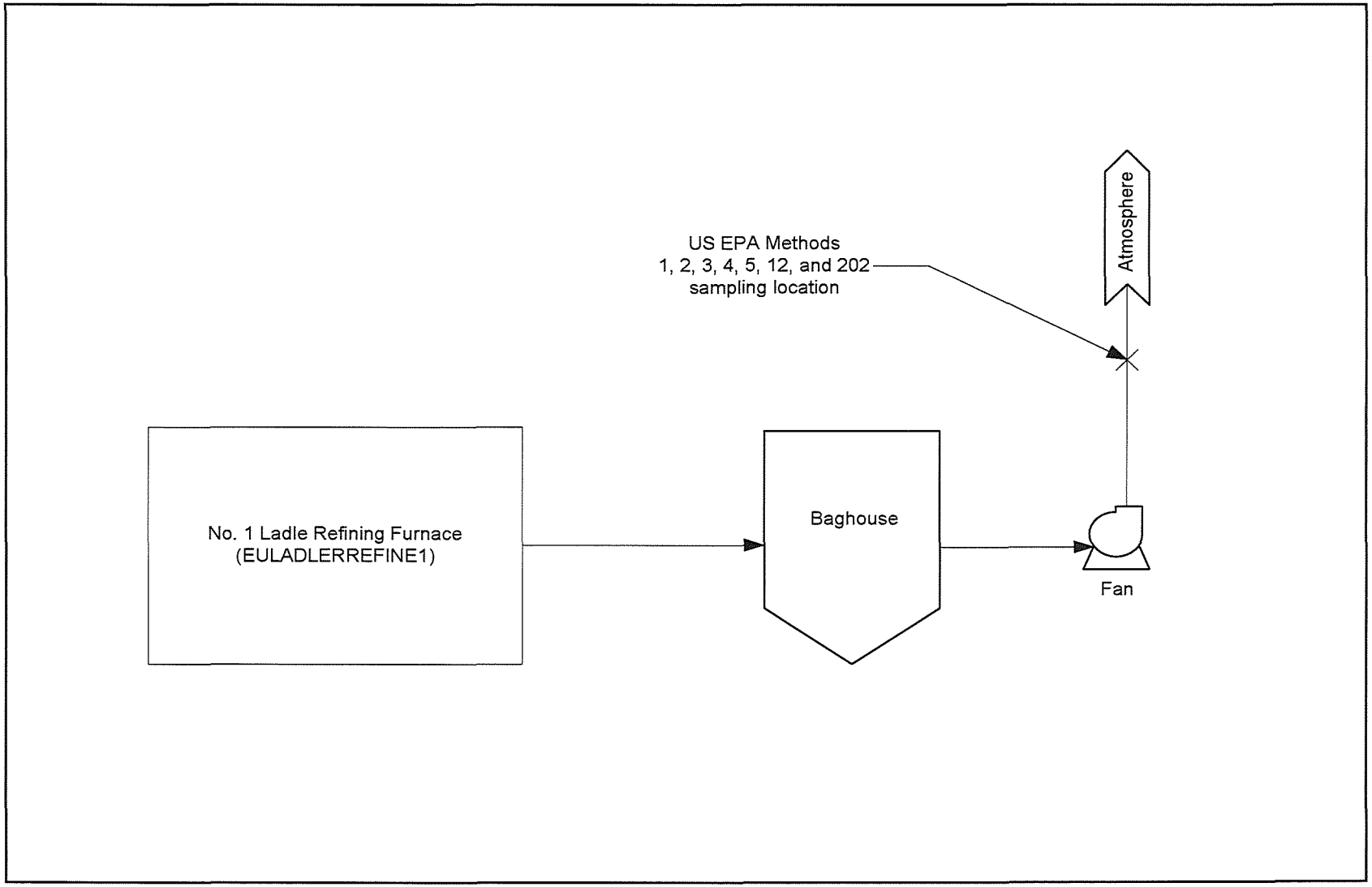
6.3 QUALITY STATEMENT

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).

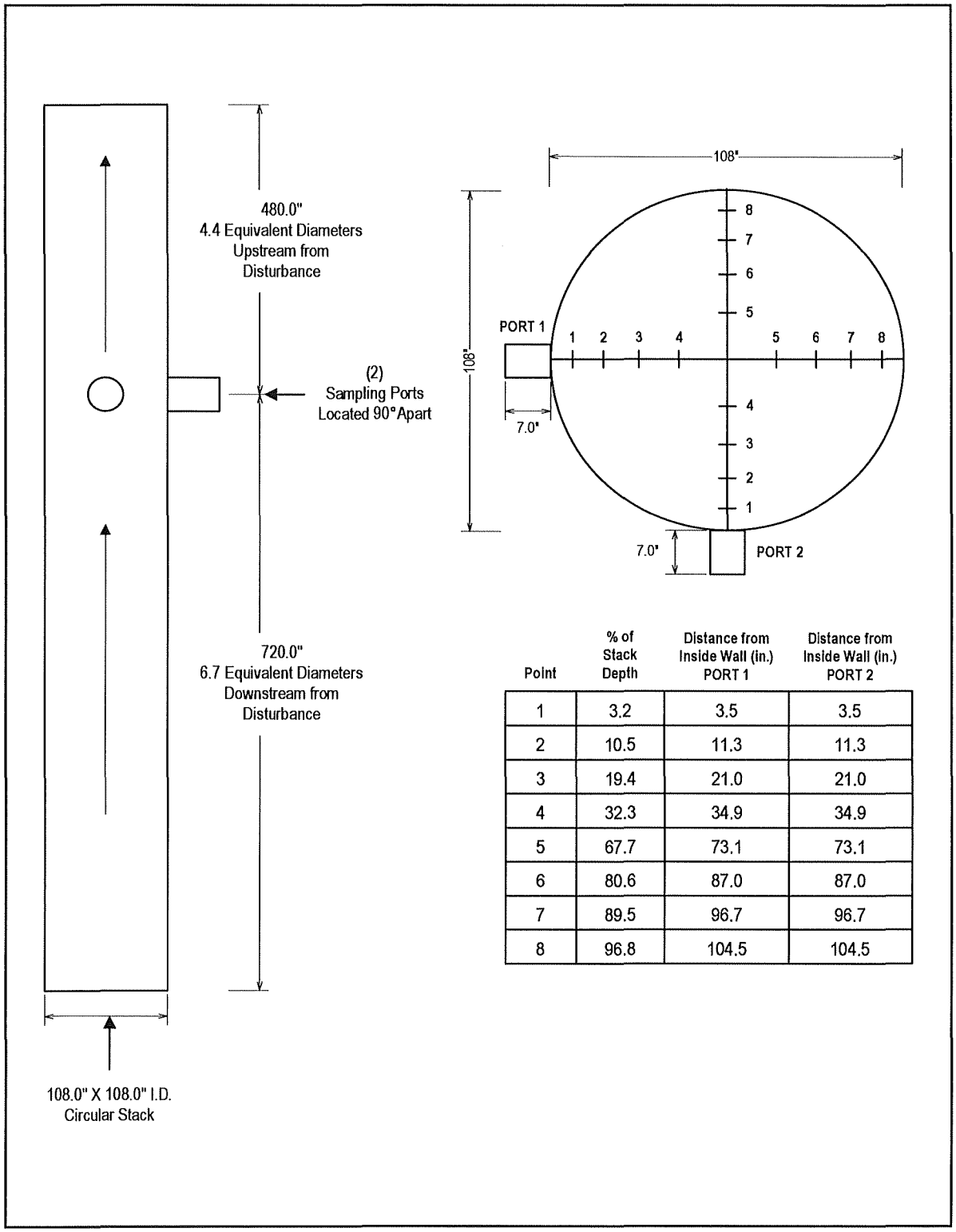
APPENDIX A
FIELD DATA AND CALCULATIONS

Appendix A.1
Sampling Locations

EULADLEREFINE1 PROCESS AND SAMPLING LOCATION SCHEMATIC



EULADERFINE1 EXHAUST TRAVERSE POINT LOCATION DRAWING



Point	% of Stack Depth	Distance from Inside Wall (in.) PORT 1	Distance from Inside Wall (in.) PORT 2
1	3.2	3.5	3.5
2	10.5	11.3	11.3
3	19.4	21.0	21.0
4	32.3	34.9	34.9
5	67.7	73.1	73.1
6	80.6	87.0	87.0
7	89.5	96.7	96.7
8	96.8	104.5	104.5