SOURCE TEST REPORT
2021 COMPLIANCE EMISSIONS TESTING

CLEVELAND-CLIFFS INC.
DEARBORN WORKS (CCDW)
DEARBORN, MICHIGAN

BASIC OXYGEN FURNACE (EUBOF)
ELECTROSTATIC PRECIPITATOR (ESP)

Prepared For:

Cleveland-Cliffs Inc., Dearborn Works
4001 Miller Road
Dearborn, MI 48120

For Submittal To:

EGLE
525 West Allegan Street
Lansing, MI 48933

Prepared By:

Montrose Air Quality Services, LLC
4949 Fernlee Avenue
Royal Oak, MI 48073

Document Number:	**MW049AS-010123-RT-888**
Test Date:	**November 17, 2021**
Submittal Date:	**December 17, 2021**

ACCREDITED
TO ASTM D7036 ONLY
CERT #3925.01

MONTROSE
AIR QUALITY SERVICES

REVIEW AND CERTIFICATION

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project.

Signature: David Trahan Date: 12 / 19 / 2021

Name: David Trahan Title: Field Project Manager

I have reviewed, technically and editorially, details, calculations, results, conclusions, and other appropriate written materials contained herein. I hereby certify that, to the best of my knowledge, the presented material is authentic, accurate, and conforms to the requirements of the Montrose Quality Management System and ASTM D7036-04.

Signature: Todd Wessel Date: 12 / 19 / 2021

Name: Todd Wessel Title: Client Project Manager

TABLE OF CONTENTS

LIST OF APPENDICES

MONTROSE AIR QUALITY SERVICES

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Cleveland-Cliffs Inc., Dearborn Works (CCDW) (State Registration Number: A8640) contracted Montrose Air Quality Services, LLC (Montrose) to perform a retest compliance test program on the Basic Oxygen Furnace (EUBOF) Electrostatic Precipitator (ESP) at the CCDW facility located in Dearborn, Michigan. Testing was performed on November 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. M I-ROP-A8640-2016a and evaluating compliance with PM_{10} and $PM_{2.5}$ emission limits after the completion of Phase I of the ESP rebuild project.

The specific objectives were to:

- Verify the emissions of filterable particulate matter (FPM), total particulate matter (Total PM), Particulate Matter less than 10 microns (PM_{10}) and particulate matter less than 2.5 microns ($PM_{2.5}$) from the ESP exhaust stack serving the EUBOF
- Verify the percent opacity of visible emissions (VE) from the EUBOF 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. All Total PM emissions are to be considered as PM_{10} and $PM_{2.5}$ for compliance determination.

TABLE 1-1
SUMMARY OF TEST PROGRAM

Test Date(s)	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
11/17/2021	EUBOF/ESP	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	97.5-105 (2 heats)
11/17/2021	EUBOF/ESP	O_2, CO_2	EPA 3	3	97.5-105 (2 heats)
11/17/2021	EUBOF/ESP	Moisture	EPA 4	3	97.5-105 (2 heats)
11/17/2021	EUBOF/ESP	Total PM, PM_{10}, $PM_{2.5}$	EPA 5/202	3	97.5-105 (2 heats)
11/17/2021	EUBOF Roof Monitor	VE	EPA 9	4 Heats	262

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 Table 1-2. 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 1-3. The tests were conducted according to the test plan dated October 20, 2021, and subsequent discussions between CCDW and EGLE prior to the test.

TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS - EUBOF/ESP
NOVEMBER 17, 2021

Parameter/Units	Average Results	Emission Limits
Filterable Particulate Matter (FPM)		
lb/hr	20.3	62.6
gr/dscf	0.0042	0.0152
Particulate Matter <10 µm (PM_{10})		
lb/hr	23.0	47.5
Particulate Matter <2.5 µm ($PM_{2.5}$)		
lb/hr	23.0	46.85
Visible Emissions (VE)		
% (Highest 3-minute average)	4	15 (FGBOFSHOP) 20 (EUBOF)

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location: Cleveland-Cliffs Dearborn Works
4001 Miller Road
Dearborn, MI 48120
Project Contact: David Pate
Role: Senior Environmental Engineer
Company: Cleveland-Cliffs Dearborn Works
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:	Todd Wessel	David Trahan
Title:	Client Project Manager	Field Project Manager
Telephone:	248-548-8070	248-548-8070
Email:	twessel@montrose-env.com	dtrahan@montrose-env.com

Laboratory Information

Laboratory:	Montrose Air Quality Services
City, State:	Royal Oak, MI 48073
Method:	EPA Method 5
Laboratory:	Enthalpy Analytical, LLC
City, State:	Durham, NC 27713
Method:	EPA Method 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
David Koponen	Montrose	Field Technician
Michael Nummer	Montrose	Senior Field Technician
Scott Dater	Montrose	Field Technician, QI
Jeffrey Peitzsch	Montrose	VE Observer, QI
David Pate	CCDW	Observer/Client Liaison/Test Coordinator
Regina Angelotti	EGLE	Observer

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

Cleveland-Cliffs Inc., Dearborn Works owns and operates an electrostatic precipitator (ESP) located in Dearborn, Michigan. Scrap steel is charged into the basic oxygen furnace (BOF) vessel and then molten iron is charged into the vessel on top of the scrap. Fluxing agents are also added during the steelmaking process. Oxygen is blown into the molten iron/scrap mixture causing the scrap to melt and refining the iron into steel by reducing the carbon content. The heat for the steelmaking process comes from the reaction of oxygen with the dissolved carbon in the molten iron.

Particulate emissions consisting of iron oxides and various other metal oxides are also produced. In order to remove the large amounts of particulate, flue gas is controlled by an ESP. The ESP is considered to be the "Primary" control device in the steel making process at CCDW's BOF shop. The dust-laden gases enter the ESP where the d ust particulates are electrically charged. The charged particles then migrate over to the positively charged collector plates, where the particulate matter is collected. Rappers are used to impart a vibration to both the discharge electrodes and the collection plates to dislodge the accumulated dust. The clean gases pass through the ID fans and are discharged out the stack. A continuous opacity monitor (COMS) measures opacity of the clean gas on the stack.

In addition to the ESP, a Secondary Emission Control Baghouse (BOF Baghouse) is in operation at the facility, which collects and controls particulate emissions during the hot metal charging and tapping operations that occur at the BOF vessels during the steel making heats. Additionally, the BOF Secondary Baghouse controls emissions generated by the iron reladling operation. The ESP and BOF were in operation for this testing event.

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 Downstream EPA "B" (in./dia.)	Distance from Nearest Disturbance Upstream EPA "A" (in./dia.)	Number of Traverse Points
EUBOF ESP Exhaust Duct	204.0	1,200.0 / 5.9	600.0 / 2.9	Isokinetic: 24 (6/port);

See Appendix A.1 for more information.

2.3 OPERATING CONDITIONS AND PROCESS DATA

Emission tests were performed while the EUBOF and air pollution control devices were operating at the conditions specified in the test plan. The EUBOF was tested when operating normally for a minimum of two process heats for each 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:

- Production rate, TPH
- Steel production cycle and oxygen blow periods, start/stop times
- Number and identification of ESP compartments and fields in operation
- Average ESP inlet draft measured per heat
- Average primary louver position of the blowing vessel per heat
- ESP COMS data, 6-minute and 1-hour block average data

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.

4.1.1 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.

4.1.2 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 m easure the g as temperature using a cal ibrated 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.

4.1.3 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 s tack 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, three single-point grab samples per run were taken.

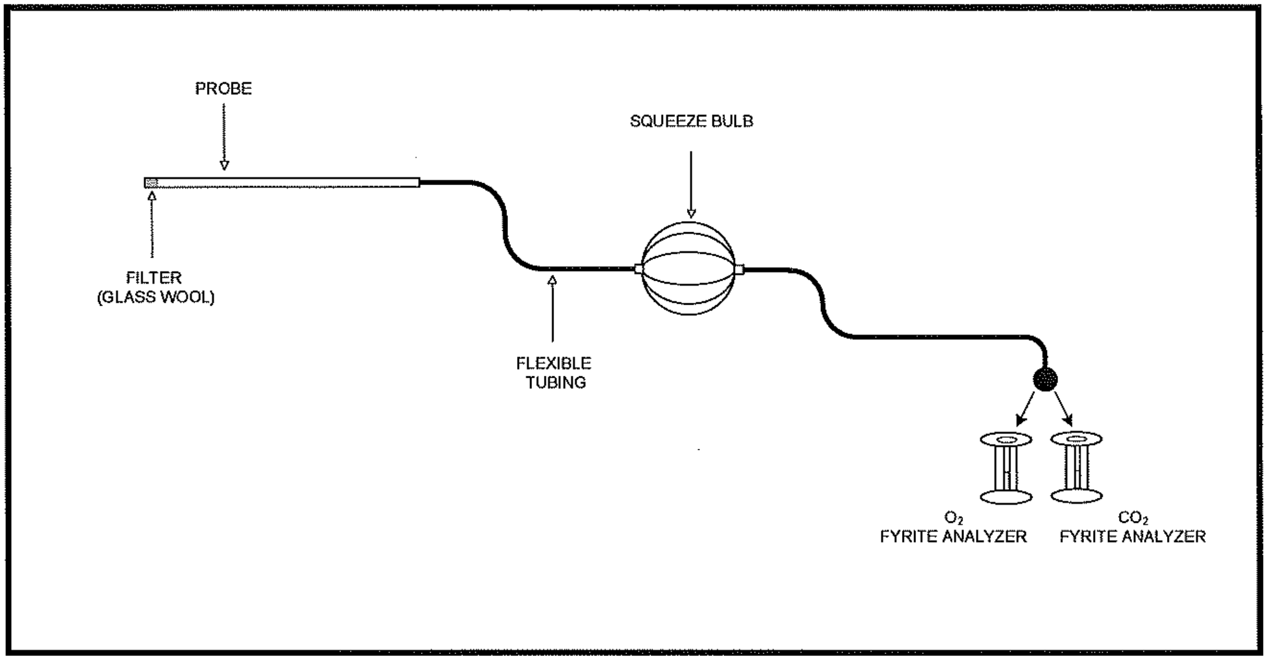
The typical sampling system is detailed in Figure 4-1.

4.1.4 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 sampling system is detailed in Figure 4-2.

FIGURE 4-1
EPA METHOD 3 (FYRITE ANALYZER) SAMPLING TRAIN



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

EPA Method 5 is a m anual, isokinetic method used to m easure filterable particulate matter (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 4-2.

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

Condensable Particulate Matter (CPM) is collected in dry impingers after Filterable Particulate Matter (FPM) 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 c ondenser 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.

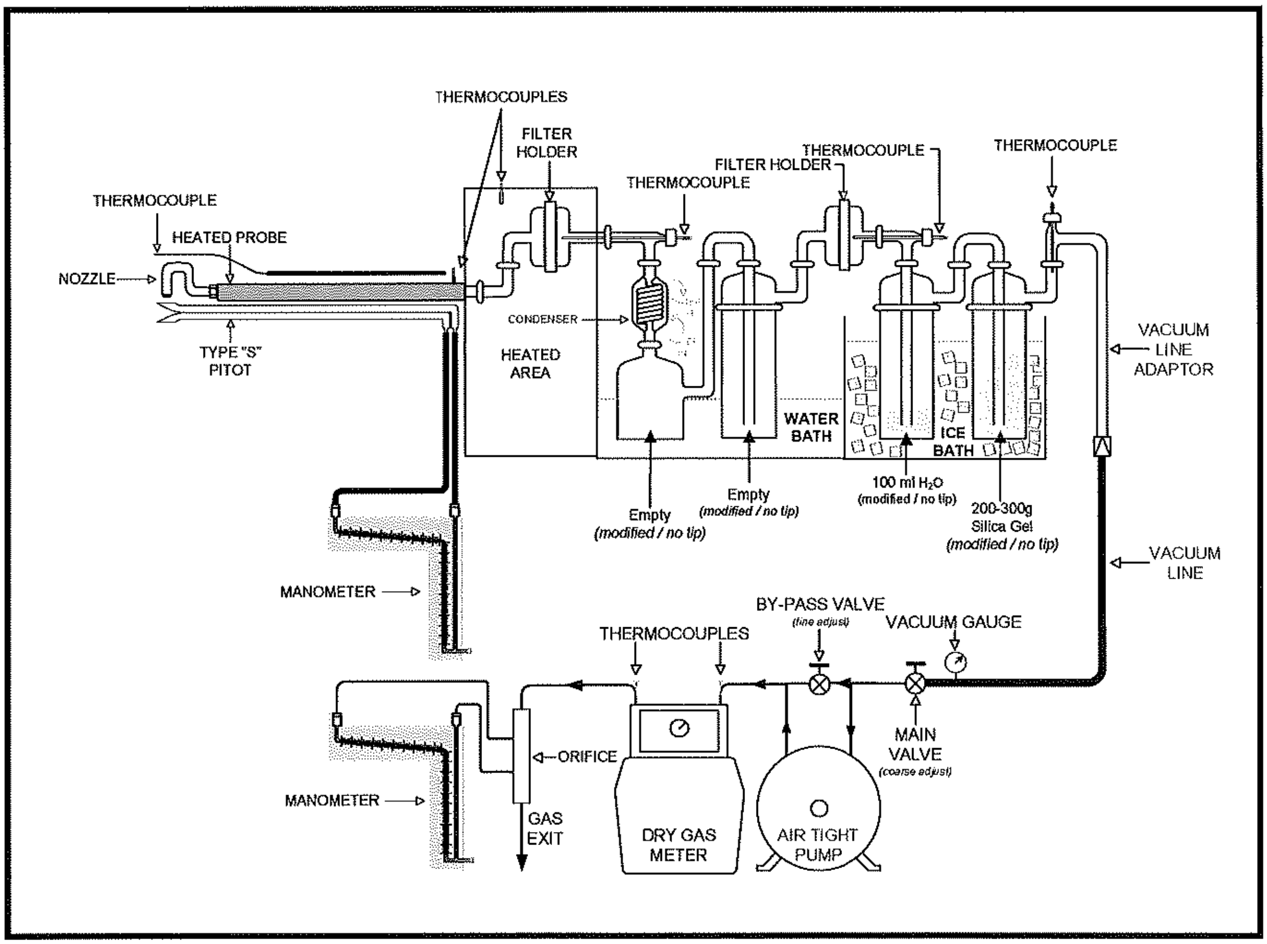
CPM is collected in the water dropout impinger, the modified Greenburg Smith impinger, and the CPM filter of the sampling train as described in this method. The impinger contents are purged with nitrogen immediately after sample collection to remove dissolved SO_2 gases from the impinger. The CPM filter 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 FPM and CPM fraction.

The typical sampling system is detailed in Figure 4-2.

FIGURE 4-2
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 TEST DISCUSSION AND RESULTS

4.1 FIELD TEST DEVIATIONS AND EXCEPTIONS

Faulty equipment was detected during Run 1 at the EUBOF ESP Exhaust Duct. Run 1 was voided, and an additional run (Run 4) was performed. Run 1 field data has been included in the appendix for informational purposes only. It should be noted that Run 1 was voided early in the run prior to any oxygen blowing. Therefore, no analytical samples were collected.

4.2 PRESENTATION OF RESULTS

The average results are compared to the permit limits in Table 1-2. The results of individual compliance test runs performed are presented in Table 4-1. 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.

In addition to the emission sampling performed, visible emissions observations were performed at the EUBOF roof monitor. The maximum 3-minute averages of opacity measured are displayed in Table 4-2.

4.3 TEST COMMENTS AND METHOD DEVIATIONS

1. CCDW operates 2 BOF Vessels that exhaust to a common ESP. While oxygen blowing can only take place on one vessel at a time, oxygen blowing could be occurring on a vessel while performing charging, tapping, slag blowing, and slag dumping on t he other vessel. Consequently, it is likely that there will be some overlap into a heat on the other vessel when the end of a production cycle is reached on a vessel. In this case, as specified in the test plan, all runs were ended at the end of the production cycle regardless of what was taking place on the other vessel. Production calculations used a pro-rated production to account for occurrences where there was overlap.

2. No port changes took place during oxygen blowing. When it was time for a port change, the probe was left at the same point until the completion of the oxygen blow. Once the point was completed, the probe was moved to the next port and sampling was resumed at the first point. This method was different than specified in the test plan but was selected after consultation with EGLE's technical staff. Refer to Appendix E for details.

3. In cases where the end of the sampling run did not correspond with the end of a heat, the traverse was restarted at the first port and continued in order until the heat was completed. This is necessary to sample for integral heats and was performed in accordance with the test plan.

TABLE 4-1
TPM EMISSIONS RESULTS - EUBOF

Run Number	2	3	4	Average
Date	11/17/2021	11/17/2021	11/17/2021	--
Time	9:42-11:52	13:04-15:30	16:22-18:13	--
Process Data *				
Production rate, TPH	264.1	266.9	330.8	287.3
Flue Gas Parameters				
O_2, % volume dry	19.00	19.00	19.00	19.00
CO_2, % volume dry	2.00	2.00	2.00	2.00
flue gas temperature, °F	192.0	186.5	186.4	188.3
moisture content, % volume	12.01	9.07	12.98	11.36
volumetric flow rate, dscfm	546,349	571,773	566,368	561,497
Filterable Particulate Matter (FPM)				
gr/dscf	0.0039	0.0044	0.0043	0.0042
lb/hr	18.2	21.6	20.9	20.3
Condensable Particulate Matter (CPM)				
gr/dscf	0.00091	0.00039	0.00041	0.00057
lb/hr	4.2	1.9	2.0	2.7
Total Particulate Matter (Total PM) †				
lb/hr	22.5	23.5	22.9	23.0

* Process data was provided by Cleveland-Cliffs Dearborn Works personnel.

† Total PM emissions are to be considered as PM_{10} and $PM_{2.5}$ for compliance determination.

TABLE 4-2
VISIBLE EMISSIONS RESULTS -
EUBOF ROOF MONITOR

Sampling Location	Gate 1	Gate 12
Date	11/17/2021	11/17/2021
Time	9:42-11:52	13:04-15:30
Process Data *		
Production rate, TPH	264.1	266.9
Heats	13257, 13258	52663, 13259
Opacity Observations		
Minimum reading, %-opacity	0	0
Maximum reading, %-opacity	5	10
Highest 3-Minute Average, %-opacity	2	4

5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA/QC AUDITS

The meter box and sampling train 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 5.2. 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 1.61 mg, and 1.61 mg was subtracted.

5.2 QA/QC DISCUSSION

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

5.3 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 D 7036-04 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).