EMISSIONS TEST PROTOCOL

EAGLE FOUNDRY COMPANY

MAIN FOUNDRY AND COOLING BUNKER BAGHOUSES EMISSION FACTOR VERIFICATION

Oregon Department of Environmental Quality
Air Contaminant Discharge Permit No. 03-2631-ST-01

Prepared for:

Eagle Foundry Co.
23123 SE Eagle Creek Rd.
Eagle Creek, OR 97022

Prepared by:

Bison Engineering, Inc.
3143 E Lyndale Ave.
Helena, MT 59601
(406) 442-5768
www.bison-eng.com

Project Number: EFC223119
Protocol Revision 01 Prepared: February 7, 2023

STAC STACK TESTING ACCREDITATION COUNCIL

ACCREDITED TO ASTM D7036 ONLY CERT #4675.01

BISON ENGINEERING, INC.

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PLANT REPRESENTATIVE ENDORSEMENT

I have reviewed the information being submitted in its entirety and, based on information and belief formed after reasonable inquiry, I certify that the statements and information contained in this submittal are true, accurate, and complete.

Plant Official: JACK E. SCOTT

Title: G.M.

Signature: [signature]

Date: 2-7-23

PROTOCOL ENDORSEMENT

Bison Engineering, Inc. certifies that emissions testing will be conducted as described in this protocol. Every effort will be made to obtain reliable, repeatable, and representative data using approved test methods and following procedures listed in Bison Engineering, Inc.'s quality manual and American Society for Testing and Materials (ASTM) D7036-04.

Project Manager: Jacob Rankin, QSTI, EIT

Title: Helena Source Team Lead

Signature: Jacob Rankin

Date: 02/07/2023

1.0 INTRODUCTION

Eagle Foundry Co. (Eagle Foundry) has contracted Bison Engineering, Inc. (Bison) to perform emission tests for emission factor verification on the melt and pour/cooling area baghouses inlets and outlets at the Eagle Foundry facility in Eagle Creek, Oregon. Testing will be conducted to determine speciated metals (aluminum (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), phosphorus (P), selenium (Se), silver (Ag), thallium (Tl), vanadium (V), zinc (Zn)) and hexavalent chromium (Cr6). Molybdenum is not a toxic air contaminant and is not being measured in the emission factor verification. Bison will also evaluate whether the main foundry and cooling bunker areas meet criteria to be considered permanent total enclosures (PTE).

The Eagle Foundry facility is subject to the provisions of Oregon Department of Environmental Quality (ODEQ) Standard Air Contaminant Discharge Permit Number 03-2631-ST-01. All testing will be performed in accordance with the Environmental Protection Agency (EPA) testing methodologies in Title 40 Code of Federal Regulations, Part 60 (40 CFR 60) Appendix A as outlined in this protocol.

Eagle Foundry produces cast metal parts consisting of white iron alloys and steel alloys. These alloys are defined by the ratios of specifically added metal elements that are controlled in the raw material mixture. These metals are manganese, chromium, nickel, and molybdenum. All other metals being measured during the proposed testing are trace elements. In order for Eagle Foundry to use the results of this testing campaign to determine daily and annual emission rates for a variety of alloys produced, the purpose of this test will be to develop emission factors. For those metals specifically added, the facility can determine an amount in the raw material. These metals will have emission factors reported in pounds of metal emitted emitted/pounds of metal element in the raw material processed. This will provide emission factors that can be applied as needed to specific alloys. For metals that are present in trace quantities, emission factors will be reported in pounds of metal element emitted/ton of metal processed as these metals could exist in trace quantities in any of the alloys produced.

2.0 KEY PERSONNEL AND CONTACT INFORMATION

The Eagle Foundry emission factor verification test will be performed by Bison's Helena-based source testing team with assistance from Bison's Billings, Montana and Tucson, Arizona source testing personnel. Jacob Rankin, Qualified Source Testing Individual (QSTI), Helena Source Team Lead, will serve as project manager and facilitate communications. Mr. Rankin will lead on-site testing. Six to seven additional source team personnel will assist Mr. Rankin on-site. Mr. Rankin will process the test data and draft the test report. A member of Bison's quality management team will perform a final quality assurance review of all test data and the report. Mr. Rankin will perform the project manager's review and submit the final report.

Facility:	**Eagle Foundry Company**
Address:	23123 SE Eagle Creek Rd. Eagle Creek, OR 97022
Contact:	Jack Scott
Phone:	(503) 637-3048
Email:	jacks@eaglefoundryco.com

Consultant:	**Bison Engineering, Inc.**
Address:	3143 E Lyndale Ave. Helena, MT 59601
Contact:	Jacob Rankin
Phone:	(208) 954-7138
Email:	jrankin@bison-eng.com

State Authority:	**Oregon Department of Environmental Quality**
Address:	Northwest Region 700 NE Multnomah St., Suite 600 Portland, OR 97232
Contact:	Julia DeGagne
Phone:	(503) 866-9643
Email:	julia.degagne@deq.oregon.gov

Contract Laboratory:	**Chester LabNet**
Address:	12242 SW Garden Pl. Tigard, OR 97223
Contact:	Paul Duda
Phone:	(503) 624-2183 ext. 100
Website:	www.chesterlab.net

3.0 SUMMARY OF TEST PROGRAM

3.1 Facility Description

Eagle Foundry owns and operates a white iron and steel alloy casting facility in Eagle Creek, Oregon. The facility specializes in custom cast metal components for end users in the recycling, asphalt, cement, wood products, and mining industries, among others. The casting facility generally operates during normal business hours and normal business days per week and is capable of pouring up to 8,060 tons of metal per year.

3.2 Process Information

Eagle Foundry operates four small induction furnaces. Two furnaces melt and hold the white iron and the other two furnaces melt and hold various steel alloys. For this emission factor verification test, the facility will be producing white iron and a combination of a chrome steel and a manganese steel alloy. Eagle Foundry will use two of their larger furnaces to complete the melting of the separate products. The two furnaces each have a 3,000-pound capacity and must operate in alternating fashion due to the limited power available to run the furnaces.

The white iron product represents a high chromium product as well as representing Eagle Foundry's main alloy that they produce. The two steel products are the second most frequently produced metal alloys. These two steel products were chosen to ensure a high manganese alloy was tested while also including an alloy that contains chromium and nickel to ensure that emission factors could be developed for all three metals.

The emissions from the melting and holding furnaces area are ducted to a baghouse identified as Main Foundry Baghouse in this test plan. The pouring and casting area emissions are ducted to a separate baghouse identified as Cooling Bunker Baghouse in this test plan. Bison will adhere to this naming convention in all subsequent documentation following the submission of this test plan.

3.3 Emission Source Description

The two baghouses to be tested are 50,000 cubic feet per minute (cfm) Donaldson baghouses. Test ports will be placed at locations on the inlets and outlets of both baghouses that meet EPA Method 1 minimum duct diameter requirements.

The inlet and outlet exhaust stacks are of unknown diameter and height above ground level; Bison will measure these parameters prior to testing. Purpose-built test ports will be accessed via a manlift for the outlets and rooftop platform for the inlets. EPA Methods 1 and 2 will be used to verify all testing locations and flows are appropriate for sampling prior to testing. Figure 1 presents a photo of the stacks.

Figure 1 Aerial Photo of Baghouses

3.4 Test Plan

All testing will be performed in accordance with EPA test methods. PTE verification and emissions testing will be conducted as described in the following sections.

3.4.1 PTE Verification

Bison will follow EPA Method 204 to determine whether the main foundry and cooling bunker areas meet the criteria to qualify as permanent total enclosures. Eagle Foundry has already worked to ensure the main foundry and cooling bunker areas meet the criteria to assume 100% capture efficiency (CE) and the emission factor verification testing will not start until PTE status has been confirmed. Table 1 summarizes the Method 204 criteria that will be used to evaluate the PTE status of the main foundry and cooling bunker areas. Table 2 describes the test methods that will be used to perform the verification testing.

Table 1 PTE Evaluation Criteria

Parameter	Units	Limit
NEAR Ratio	%	≤ 5
FV (via differential pressure measurement approach)*	Inches of water	≤ -0.007
Distances of NDO	Feet	At least four equivalent opening diameters from each PM emitting point to any NDO.
Inward direction of airflow	NA	If the FV is less than 500 fpm, the inward direction of flow will be monitored for at least one hour. This verification will be documented photographically using streamers at 10-minute intervals.

NDO – natural draft opening
NEAR – NDO to enclosure area ratio
FV – facial velocity
fpm – feet per minute
NA – not applicable
PM – particulate matter
* EPA Method 204, Section 8.3, states that FV shall be at least 3,600 meters/hour (m/hr) which is equivalent to 200 fpm. Alternatively, pressure differential across the enclosure may be measured. A pressure drop of 0.013 millimeters mercury (0.007 inches water) corresponds to a FV of 3,600 m/hr (200 fpm).

Table 2 Main Foundry and Cooling Bunker PTE Test Matrix

Source	EPA Method	Parameter	Details
Main Foundry and Cooling Bunker	204	Verification of PTE	Distances from PM emitting points to all NDOs. Differential pressure measurements and air flow direction. Measurement of area of each NDO and enclosure.

All direct measurements of differential pressure will be made using a Shortridge ADM-850L micromanometer with a four decimal place display and current calibration certificate demonstrating instrument accuracy to differential pressures as low as 0.01 inches of water. If any of the differential pressure measurements are between 0.01 and 0.007 inches of water, Bison will send the micromanometer for a post-test validation calibration to a lower range. Differential pressure will be measured at least 15 times per location. Measurements will be recorded in a series of three rounds; during each round, five measurements will be recorded per location. One hundred percent of all measurements must indicate a pressure drop of at least 0.007 inches of water to demonstrate containment.

3.4.2 Emission Factor Verification

Bison plans to perform the emission factor verification testing on the inlets and outlets of both baghouses simultaneously. Bison assumes the oxygen and carbon dioxide percentages on the baghouse outlets are the same as the inlets because there is no process equipment between the two points of sampling that would consume any available oxygen from the inlet side of the baghouses.

For the emission testing campaign, Eagle Foundry will switch between producing, pouring, and casting white iron and chrome-moly/manganese steel so that each operation can be isolated to determine separate emission factors.

Eagle Foundry will melt and cast 12,000 pounds of white iron product in the first test runs on each day of testing, provide a break for production to change over and Bison to prepare for the next test run, and then melt and cast 6,000 pounds of chrome-moly steel and 6,000 pounds of manganese steel during the second test runs of each day. This equates to four full furnace pot charges of white iron, which will move through the entire process from melting and holding to pouring and casting, and two full furnace pot charges of each steel. This will be repeated two more times on subsequent days to achieve three test runs on each product type, white iron and steel.

Tables 3-6 detail the test methods Bison will employ during this test campaign. Table 7 provides a detailed testing schedule.

Table 3 Main Foundry and Cooling Bunker Baghouse Outlets – White Iron Test Matrix

Source	EPA Method	Parameter	Details
Baghouse Outlets (2) – White Iron	1	Sampling locations	Performed once, prior to testing.
	2	Volumetric flow	Three, 180- to 240-minute test runs.*
	3A	O_2 and CO_2	
	4	Moisture	
	29	Speciated metals	
	0061	Cr6	

* This is an estimate of the amount of time required to process 12,000 pounds of white iron, from melting the first 3,000-pound furnace pot to pouring and casting the last 3,000-pound furnace pot. Bison will sample for the entirety of this process time to complete one test run. Bison will determine the sampling time at each traverse point based on the estimated maximum amount of time the batch will take to complete (approximately 240 minutes) and adjust the isokinetic calculations in the event any total test run time is less than or greater than the maximum.

Table 4 Main Foundry and Cooling Bunker Baghouse Inlets – White Iron Test Matrix

Source	EPA Method	Parameter	Details
Baghouse Inlets (2) – White Iron	1	Sampling locations	Performed once, prior to testing.
	2	Volumetric flow	Concurrent with Method 29 test runs.
	3A	O_2 and CO_2	Assumed to be equal to outlet O_2 and CO_2.
	4	Moisture	Concurrent with outlet test runs.
	29	Speciated metals	

Table 5 Main Foundry and Cooling Bunker Baghouse Outlets – Steel Alloys Test Matrix

Source	EPA Method	Parameter	Details
Baghouse Outlets (2) – Steel Alloys	1	Sampling locations	Performed once, prior to testing.
	2	Volumetric flow	Three, 240- to 300-minute test runs.*
	3A	O_2 and CO_2	
	4	Moisture	
	29	Speciated metals	
	0061	Cr6	

* This is an estimate of the amount of time required to process 12,000 pounds of white iron, from melting the first 3,000-pound furnace pot to pouring and casting the last 3,000-pound furnace pot. Bison will sample for the entirety of this process time to complete one test run. Bison will determine the sampling time at each traverse point based on the estimated maximum amount of time the batch will take to complete (approximately 300 minutes) and adjust the isokinetic calculations in the event any total test run time is less than or greater than the maximum.

Table 6 Main Foundry and Cooling Bunker Baghouse Inlets – Steel Alloys Test Matrix

Source	EPA Method	Parameter	Details
Baghouse Inlets (2) – Steel Alloys	1	Sampling locations	Performed once, prior to testing.
	2	Volumetric flow	Concurrent with Method 29 test runs.
	3A	O_2 and CO_2	Assumed to be equal to outlet O_2 CO_2.
	4	Moisture	Concurrent with outlet test runs.
	29	Speciated metals	

Estimated in-stack detection limits are provided in Appendix B of this test protocol. EPA Method 29 states that a nominal one hour test run should result in 1.25 dry standard cubic meters (dscm) of sample volume collected through the sample train. Assuming the least amount of sample time possible for both product scenarios, the minimum sample volumes for both Method 29 and Method 0061 are 3.75 dscm for white iron and 5 dscm for the steel alloy combination.

Bison will follow EPA Method 0061 for measurement of hexavalent chromium. Bison would like to request a method deviation for the use of sodium bicarbonate as the impinger solution instead of potassium hydroxide. Chester LabNet has advised the use of sodium bicarbonate as the impinger solution because the Cr6 background readings are lower than the potassium hydroxide. Bison plans to use a 1.0N concentrate of the sodium bicarbonate solution to ensure the pH stays above the minimum pH of 8.0 prescribed in California Air Resources Board Method 425 for the use of sodium bicarbonate. Bison will document the pre-test and post-test pH readings of the sodium bicarbonate solution. A higher concentration of sodium bicarbonate will be available on-site to stabilize any samples that read at a pH of 8.0 post-test. This will preserve the hexavalent chromium over the course of the testing campaign and during transit to Chester LabNet.

The emission factor verification test will take place within 60 days of approval of this source test protocol. Tentatively, testing is scheduled to take place March 20–31, 2023. The PTE verification will be completed in the two days prior to the start of emission factor verification testing. Emission factor verification testing is expected to follow the schedule outlined in Table 7.

Table 7 Proposed Test Schedule

Day	Source	Details
1	N/A	Travel from Bison offices to Portland, OR.
2		Finish travel and setup testing equipment. Perform Method 204 measurements on the Main Foundry and Cooling Bunker areas.
3	Baghouse Inlets and Outlets (all 4 sampling locations)	Perform run #1 for white iron. Break for equipment and process turnaround. Perform run #1 for steel alloy combination.
4	Baghouse Inlets and Outlets (all 4 sampling locations)	Perform run #2 for white iron. Break for equipment and process turnaround. Perform run #2 for steel alloy combination.
5	Baghouse Inlets and Outlets (all 4 sampling locations)	Perform run #3 for white iron. Break for equipment and process turnaround. Perform run #3 for steel alloy combination.
6	N/A	Deliver samples to Chester LabNet and begin return travel.
7		Complete return travel from Portland, OR to Bison offices.

The schedule above assumes that testing proceeds as planned with minimal interruptions or process downtime. Bison will inform ODEQ of any changes to the schedule ahead of testing. A finalized test report will be submitted to ODEQ on or before 60 days after the conclusion of testing.

3.5 Responsibilities of Plant

Eagle Foundry will be responsible for:

- Assuring availability of the processes on the scheduled test days as needed to facilitate the test program.
- Providing safe and secure access to the sampling ports.
- Recording pertinent operational details to include:
  - Identity of the product that is melted and poured during each test run
  - Pounds of product melted and poured during each test run
  - Pounds of each metal element specifically added during each test run
  - Final melt temperature (°C or °F) before pouring
- Ensuring the furnaces and pour/cooling area operate at a normal maximum capacity during testing.

Only regular operating staff may adjust the production process and emission control parameters during the emission factor verification test. Any operating adjustments made during testing, which are a result of consultation during the test with source testing personnel, equipment vendors or consultants, may render the emission factor verification test invalid.

3.6 Plant Entry and Safety Requirements

Bison personnel receive annual training on and will adhere to Bison's Health, Safety and Environmental Management System (HSEMS). They will also comply with all facility safety requirements and will attend Eagle Foundry's standard safety briefing for visitors. Bison crew members will complete an on-site job safety analysis prior to the start of work and provide their own personal protective equipment, including hard hats, gloves, long sleeves, steel toe boots, safety glasses, and hearing protection.

4.0 EMISSION TEST METHODS AND PROCEDURES

4.1 Instrumentation and Equipment

Bison will conduct the emission factor verification testing using the following instrumental analyzer: Servomex Model 1440 O_2/CO_2. Gaseous analyzers are calibrated using EPA Protocol gases at appropriate concentrations. The metals and hexavalent chromium isokinetic testing will use equipment from Bison's Helena and Billings offices that is appropriate for completing the testing safely, efficiently and in line with all method requirements. Other instrumentation may be used depending on availability. All field equipment will be calibrated, at a minimum, in accordance with method requirements.

Instrumental analyzers used by Bison to measure pollutant and diluent concentrations in stack gas are purpose-built by reputable companies and have been subjected to comprehensive interference response test procedures by their respective manufacturers. Further documentation regarding interferences for individual analyzers can be provided upon request.

4.2 Test Methods and Descriptions

Testing will be performed using the following EPA test methods as described in 40 CFR 60, and as approved and adopted by the appropriate regulatory agency.

EPA Reference Method 1, "Sample and Velocity Traverses for Stationary Sources." The objective of Method 1 is to determine a suitable location for testing and to determine the velocity and/or sample points for the source. The results of Method 1 sampling location and sample or velocity point measurement locations are included in the appendices.

EPA Reference Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube)." The objective of Method 2 is to determine volumetric flow. The average velocity, temperature, static pressure, and source area are used to calculate volumetric flow for the source.

EPA Reference Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)." The objective of Method 3A is to determine the O_2 and CO_2 concentrations in the stack gas stream.

EPA Reference Method 4, "Determination of Moisture Content in the Stack Gases." The objective of Method 4 is to determine the moisture content of a gas stream. This method is incorporated within the performance of Method 29.

EPA Reference Method 29, "Determination of Metals Emissions from Stationary Sources" (Methods 2 & 4 Inclusive). The objective of Method 29 is to determine particulate matter and metals emissions from a source. Method 29 is an isokinetic sampling method. The exhaust gas stream is sampled along a cross-section of the stack and metal emissions are captured within the front-half and back-half of the sampling system. The front-half includes the nozzle, probe, filter-bell, and glass fiber filter. The back-half consists of the impinger solutions. The front-half and back-half samples are sent to a contract lab for analysis. Method 29 incorporates Method 2 "velocity measurements" and Method 4 "moisture measurements".

EPA Method 0061, "Determination of Hexavalent Chromium Emission from Stationary Sources" (Methods 2 & 4 Inclusive). The objective of Method 0061 is to determine hexavalent chromium emission from a source. Method 0061 is an isokinetic sampling method. The exhaust gas stream is sampled along a cross-section of the stack and hexavalent chromium emissions are captured within the back-half of the sampling system. The front-half includes the nozzle and probe. The back-half consists of the impinger solution and an aspirating system. The back-half samples are sent to a contract lab for analysis. Method 0061 incorporates Method 2 "velocity measurements" and Method 4 "moisture measurements".

4.3 Analytical Methods

Sampling procedures are cited in the appropriate methods and there will be no deviation from those methods. All samples collected during the test campaign will remain in the custody of Bison until all testing has been completed. Bison plans to hand-deliver all samples collected during the campaign to Chester LabNet at the conclusion of testing. Chain of custody forms will be maintained throughout the test campaign and will be included in the appendices of the test report. Chester LabNet will perform all sample analyses after the samples have been delivered.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES

5.1 Sampling Protocol and Collection Procedures

All testing will be performed in accordance with the specified test methods and their prescribed quality control procedures.

As stated in section 4.3, Bison will maintain Chester LabNet chain of custody forms for all samples collected during testing.

Test data will be recorded electronically using a data acquisition system. Field data, such as flow measurements, temperatures, and volumes, will be entered directly into spreadsheets for subsequent calculations. The data can also be recorded on hand-written datasheets if requested by the client or the regulatory agency.

5.2 Equipment and Instrument Calibration, Audits and Maintenance

Ongoing calibrations and audits of the testing equipment comprise a preventive maintenance program. Bison personnel calibrate equipment and instruments according to a set schedule and with standards traceable to the National Institute of Standards and Technology (NIST). All equipment requiring calibration will be calibrated according to the criteria specified in the proposed test methods. Equipment and instrument calibration results will be included in an appendix to the final test report.

5.3 Data Collection, Reduction and Validation

Emissions test data is subject to multiple levels of validation. Bison has self-auditing spreadsheets that alert the field technician when data may be entered incorrectly by flagging calculation results that are outside of expected or reasonable values. Data is also audited during data processing and report generation. Quality assurance and quality control checks associated with testing (such as on-site analyzer calibrations, spikes and pre- or post-test equipment certifications) are audited during the review process.

A final draft of the test report is reviewed for technical content by a member of Bison's quality management team and the project manager. All field data and spreadsheets will be supplied in an appendix to the test report.

5.4 Internal Audits and Corrective Action

When departures from policies or procedures in Bison's quality system or technical operations are identified, Bison's quality management team meets with the personnel involved to evaluate the significance of the non-conforming work and discuss appropriate corrective action. Corrective actions are given the highest priority and determined immediately after identifying non-conforming work. The format for implementing corrective action follows ASTM D7036-04.

5.5 Documentation, Tracking and Certifications

Bison has assigned this project a unique number for document control and record keeping. The tracking number for this project is **EFC223119**.

Electronic project records are maintained on Bison's server for a minimum of five years. The project manager and a member of the quality management team will sign a certification page to document and authenticate that testing was performed according to the appropriate methods, applicable regulatory requirements and Bison's quality manual. This certification page will accompany the final report.

Should a situation arise that warrants a deviation from the approved protocol, it will be discussed with the client and/or regulatory agency. If necessary, approval to modify the test plan will be obtained from the regulatory agency. Any modification to the test plan or deviation from approved test methods will be documented in the final test report.

5.6 Audit Samples

The stationary source audit program (SSAP) is effectively suspended as of March 2022 because there are currently no independent accredited audit sample providers (AASP).

APPENDIX A: EXAMPLE TEST REPORT FORMAT

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APPENDIX B: ESTIMATED IN-STACK DETECTION LIMITS

Eagle Foundry Co. - Estacada, OR
Estimated In-Stack Detection Limit Summary

Analyte	White Iron							
	Main Foundry Baghouse - Inlet		Cooling Bunker Baghouse - Inlet		Main Foundry Baghouse - Outlet		Cooling Bunker Baghouse - Outlet	
	Front Half (µg/dscm)	Back Half (µg/dscm)	Front Half (µg/dscm)	Back Half (µg/dscm)	Front Half (µg/dscm)	Back Half (µg/dscm)	Front Half (µg/dscm)	Back Half (µg/dscm)
Hexavalent Chromium	N/A	N/A	N/A	N/A	N/A	1.60E-03	N/A	1.60E-03
Aluminum	6.67E-02	2.67E-02	6.67E-02	2.67E-02	6.67E-02	2.67E-02	6.67E-02	2.67E-02
Antimony	3.33E-01	1.33E-01	3.33E-01	1.33E-01	3.33E-01	1.33E-01	3.33E-01	1.33E-01
Arsenic	4.67E-01	1.87E-01	4.67E-01	1.87E-01	4.67E-01	1.87E-01	4.67E-01	1.87E-01
Barium	3.33E-02	1.33E-02	3.33E-02	1.33E-02	3.33E-02	1.33E-02	3.33E-02	1.33E-02
Beryllium	1.33E-02	5.33E-03	1.33E-02	5.33E-03	1.33E-02	5.33E-03	1.33E-02	5.33E-03
Cadmium	2.67E-02	1.07E-02	2.67E-02	1.07E-02	2.67E-02	1.07E-02	2.67E-02	1.07E-02
Chromium	5.33E-02	2.13E-02	5.33E-02	2.13E-02	5.33E-02	2.13E-02	5.33E-02	2.13E-02
Cobalt	3.33E-02	1.33E-02	3.33E-02	1.33E-02	3.33E-02	1.33E-02	3.33E-02	1.33E-02
Copper	3.33E-01	1.33E-01	3.33E-01	1.33E-01	3.33E-01	1.33E-01	3.33E-01	1.33E-01
Lead	3.33E-01	1.33E-01	3.33E-01	1.33E-01	3.33E-01	1.33E-01	3.33E-01	1.33E-01
Manganese	2.00E-02	8.00E-03	2.00E-02	8.00E-03	2.00E-02	8.00E-03	2.00E-02	8.00E-03
Mercury	4.67E-04	1.87E-04	4.67E-04	1.87E-04	4.67E-04	1.87E-04	4.67E-04	1.87E-04
Nickel	2.00E-01	8.00E-02	2.00E-01	8.00E-02	2.00E-01	8.00E-02	2.00E-01	8.00E-02
Phosphorus	1.33E+00	5.33E-01	1.33E+00	5.33E-01	1.33E+00	5.33E-01	1.33E+00	5.33E-01
Selenium	1.00E+00	4.00E-01	1.00E+00	4.00E-01	1.00E+00	4.00E-01	1.00E+00	4.00E-01
Silver	1.33E-01	5.33E-02	1.33E-01	5.33E-02	1.33E-01	5.33E-02	1.33E-01	5.33E-02
Thallium	6.67E-01	2.67E-01	6.67E-01	2.67E-01	6.67E-01	2.67E-01	6.67E-01	2.67E-01
Vanadium	1.00E+00	4.00E-01	1.00E+00	4.00E-01	1.00E+00	4.00E-01	1.00E+00	4.00E-01
Zinc	2.00E-01	8.00E-02	2.00E-01	8.00E-02	2.00E-01	8.00E-02	2.00E-01	8.00E-02

Analyte	Steel Alloys							
	Main Foundry Baghouse - Inlet		Cooling Bunker Baghouse - Inlet		Main Foundry Baghouse - Outlet		Cooling Bunker Baghouse - Outlet	
	Front Half (µg/dscm)	Back Half (µg/dscm)	Front Half (µg/dscm)	Back Half (µg/dscm)	Front Half (µg/dscm)	Back Half (µg/dscm)	Front Half (µg/dscm)	Back Half (µg/dscm)
Hexavalent Chromium	N/A	N/A	N/A	N/A	N/A	1.20E-03	N/A	1.20E-03
Aluminum	5.00E-02	2.00E-02	5.00E-02	2.00E-02	5.00E-02	2.00E-02	5.00E-02	2.00E-02
Antimony	2.50E-01	1.00E-01	2.50E-01	1.00E-01	2.50E-01	1.00E-01	2.50E-01	1.00E-01
Arsenic	3.50E-01	1.40E-01	3.50E-01	1.40E-01	3.50E-01	1.40E-01	3.50E-01	1.40E-01
Barium	2.50E-02	1.00E-02	2.50E-02	1.00E-02	2.50E-02	1.00E-02	2.50E-02	1.00E-02
Beryllium	1.00E-02	4.00E-03	1.00E-02	4.00E-03	1.00E-02	4.00E-03	1.00E-02	4.00E-03
Cadmium	2.00E-02	8.00E-03	2.00E-02	8.00E-03	2.00E-02	8.00E-03	2.00E-02	8.00E-03
Chromium	4.00E-02	1.60E-02	4.00E-02	1.60E-02	4.00E-02	1.60E-02	4.00E-02	1.60E-02
Cobalt	2.50E-02	1.00E-02	2.50E-02	1.00E-02	2.50E-02	1.00E-02	2.50E-02	1.00E-02
Copper	2.50E-01	1.00E-01	2.50E-01	1.00E-01	2.50E-01	1.00E-01	2.50E-01	1.00E-01
Lead	2.50E-01	1.00E-01	2.50E-01	1.00E-01	2.50E-01	1.00E-01	2.50E-01	1.00E-01
Manganese	1.50E-02	6.00E-03	1.50E-02	6.00E-03	1.50E-02	6.00E-03	1.50E-02	6.00E-03
Mercury	3.50E-04	1.40E-04	3.50E-04	1.40E-04	3.50E-04	1.40E-04	3.50E-04	1.40E-04
Nickel	1.50E-01	6.00E-02	1.50E-01	6.00E-02	1.50E-01	6.00E-02	1.50E-01	6.00E-02
Phosphorus	1.00E+00	4.00E-01	1.00E+00	4.00E-01	1.00E+00	4.00E-01	1.00E+00	4.00E-01
Selenium	7.50E-01	3.00E-01	7.50E-01	3.00E-01	7.50E-01	3.00E-01	7.50E-01	3.00E-01
Silver	1.00E-01	4.00E-02	1.00E-01	4.00E-02	1.00E-01	4.00E-02	1.00E-01	4.00E-02
Thallium	5.00E-01	2.00E-01	5.00E-01	2.00E-01	5.00E-01	2.00E-01	5.00E-01	2.00E-01
Vanadium	7.50E-01	3.00E-01	7.50E-01	3.00E-01	7.50E-01	3.00E-01	7.50E-01	3.00E-01
Zinc	1.50E-01	6.00E-02	1.50E-01	6.00E-02	1.50E-01	6.00E-02	1.50E-01	6.00E-02

Chester LabNet
Analytical Detection Limits

Analyte	MDL (µg/L)	MDL (µg/mL)	Front Half (250 mL) MDL (µg)	Back Half (100 mL) MDL (µg)
Ag	2.000	2.00E-03	0.50	0.20
As	7.000	7.00E-03	1.75	0.70
Ba	0.500	5.00E-04	0.13	0.05
Be	0.200	2.00E-04	0.05	0.02
Cd	0.400	4.00E-04	0.10	0.04
Co	0.500	5.00E-04	0.13	0.05
Cr	0.800	8.00E-04	0.20	0.08
Cu	5.000	5.00E-03	1.25	0.50
Hg	0.007	7.00E-06	0.02	0.03
Mn	0.300	3.00E-04	0.08	0.03
Ni	3.000	3.00E-03	0.75	0.30
P	20.000	2.00E-02	5.00	2.00
Pb	5.000	5.00E-03	1.25	0.50
Sb	5.000	5.00E-03	1.25	0.50
Se	15.000	1.50E-02	3.75	1.50
Tl	10.000	1.00E-02	2.50	1.50
Zn	3.000	3.00E-03	0.75	0.30
V	15.000	1.50E-02	3.75	1.50
Al	1.000	1.00E-03	0.25	0.10
Cr6*	0.010	1.00E-05	N/A	0.006

* Cr6 back half analytical sample volume is 600 mL.

MDL - Method Detection Limit

In-Stack Detection Limit
Sample Calculation

Estimated In-Stack Detection Limit for Aluminum

ISDL = A x B / C =		6.67E-02	µg/dscm
Where:			
A =	analytical detection limit =	1.00E-03	µg/mL
B =	liquid volume of digested sample =	250	mL
C =	volume of stack gas sampled (3-hour run)	3.75	dscm

A nominal one-hour test run should yield a stack gas sample volume of 1.25 dscm.
A three hour test run should yield 3.75 dscm.
A four hour test run should yield 5 dscm.

This is the last page of the protocol.