Derenzo and Associates, Inc.
Environmental Consultants

November 3, 2014

Mr. Chris Hare
Saginaw Bay District Supervisor
MDEQ – Air Quality Division
401 Ketchum Street, Suite B
Bay City, MI 48708

Subject: Stack test report for compliance testing of the Main Ventilation Air Raise operated at the Eagle Mine, LLC located in Michigamme Township, MI - SRN: N7581

Dear Mr. Hare:

Derenzo and Associates, Inc. is submitting, on behalf of Eagle Mine, LLC (Eagle Mine), the enclosed stack test report for compliance testing of the Main Ventilation Air Raise (MVAR) exhaust at the Eagle Mine facility in Michigamme Township, Michigan. The test event was performed on September 16, 2014.

The purpose of the test was to verify compliance with conditions of the facility's Permit to Install No.: 50-06B issued by the MDEQ-AQD on June 28, 2013. The testing consisted of measurements of particulate matter, copper, and nickel concentrations and mass emission rates associated with the operation of MVAR system.

Contact information is provided in the test report if you have any questions.

Sincerely,
DERENZO AND ASSOCIATES, INC.

Tyler J. Wilson
Environmental Consultant

Enclosure

c. Karen Kajiya-Mills, Supervisor – MDEQ-AQD-Technical Programs Unit

Derenzo and Associates, Inc.
Environmental Consultants

November 3, 2014

Ms. Karen Kajiya-Mills
Supervisor – Technical Programs Unit
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION
Constitution Hall, 2nd Floor South
525 W. Allegan Street
P.O. Box 30260
Lansing, MI 48909

Subject: Stack test protocol for compliance testing of the Main Ventilation Air Raise operated at the Eagle Mine, LLC located in Champion, MI - SRN: N7581

Dear Mr. Hare:

Derenzo and Associates, Inc. is submitting, on behalf of Eagle Mine, LLC (Eagle Mine), the enclosed stack test report for compliance testing of the Main Ventilation Air Raise (MVAR) exhaust at the Eagle Mine facility in Michigamme Township, Michigan. The test event was performed on September 16, 2014.

The purpose of the test was to verify compliance with conditions of the facility's Permit to Install No.: 50-06B issued by the MDEQ-AQD on June 28, 2013. The testing consisted of measurements of particulate matter, copper, and nickel concentrations and mass emission rates associated with the operation of MVAR system.

Contact information is provided in the test report if you have any questions.

Sincerely,
DERENZO AND ASSOCIATES, INC.

Tyler J. Wilson
Environmental Consultant

Enclosure

c. Chris Hare Saginaw Bay District Supervisor – MDEQ-AQD

EMISSION TEST REPORT

Report Title TEST REPORT FOR THE VERIFICATION OF PARTICULATE MATTER, COPPER, AND NICKEL EMISSION RATES

Report Date November 3, 2014

Test Date(s) September 16, 2014

Facility Information	
Name	Eagle Mine, LLC
Street Address	6510 AAA Road
City, County	Michigamme, Marquette County
Phone	(906) 204-9867

Facility Permit Information			
State Registration No.:	N7581	Permit to Install No.:	50-06B

Testing Contractor	
Company	Derenzo and Associates, Inc.
Mailing Address	39395 Schoolcraft Road Livonia, Michigan 48150
Phone	(734) 464-3880
Project No.	1404014

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

TEST REPORT
FOR THE
VERIFICATION OF PARTICULATE MATTER,
COPPER, AND NICKEL EMISSION RATES

EAGLE MINE, LLC
CHAMPION, MI

TEST DATE(s): September 16, 2014

1.0 INTRODUCTION

Eagle Mine, LLC (Eagle Mine), State Registration No. N7581, operates an underground nickel and copper mine located in Michigamme Township, Marquette County, Michigan. The mine is equipped with a fresh air ventilation system to supply fresh air to workers underground. The ventilation system exhausts to atmosphere through the Main Ventilation Air Raise (MVAR) system.

Installation and operation of the MVAR (identified as emission unit EUMVAR) is permitted by Michigan Department of Environmental Quality, Air Quality Division (MDEQ-AQD) Permit to Install No.50-06B, issued to Eagle Mine, LLC on June 28, 2013. Condition EUMVAR V.1, Testing/Sampling, of the permit requires Eagle Mine to perform testing to verify the particulate matter (PM), copper, and nickel emission rates from EUMVAR.

The PM, copper, and nickel emission testing was performed September 16, 2014 by Derenzo and Associates, Inc., personnel Tyler Wilson and Jason Logan. The project was coordinated by Ms. Jennifer Nutini, Environmental Engineer for Eagle Mine. Mr. Tom Gasloli and Ed Lancaster from the MDEQ-AQD were on-site to observe portions of the compliance testing.

A test protocol was submitted to the MDEQ-AQD prior to the testing project and a test plan approval letter was issued by the regulatory agency. The following items provide information required in MDEQ-AQD *Format for Submittal of Source Emission Test Plans and Reports*, dated December 2013.

Appendix A provides a copy of the MDEQ-AQD test plan approval letter.

Questions regarding this emission test report should be directed to:

Ms. Jennifer Nutini, P.E.
Environmental Engineer
Eagle Mine, LLC
4547 County Road 601
Champion, MI 49814
(906) 204-9867
jennifer.nutini@lundinmining.com

Tyler J. Wilson
Environmental Consultant
Derenzo and Associates, Inc.
39395 Schoolcraft Road
Livonia, MI 48150
(734) 464-3880
twilson@derenzo.com

Report Certification

This test report was prepared by Derenzo, Associates, Inc. based on field sampling data collected by Derenzo and Associates, Inc. Facility process data were collected and provided by Eagle Mine employees or representatives. This test report has been reviewed by Eagle Mine representatives and approved for submittal to the Michigan Department of Environmental Quality (MDEQ).

I certify that the testing was conducted in accordance with the approved test plan unless otherwise specified in this report. I believe the information provided in this report and its attachments are true, accurate, and complete.

Report Prepared By:

Tyler J. Wilson
Environmental Consultant

Reviewed By:

Robert L. Harvey, P.E.
General Manager

Based on information and belief formed after reasonable inquiry, I believe the statements and information in this report are true, accurate and complete. The testing was performed in accordance with the approved test plan.

Facility Certification By:

Jennifer Nutini, P.E.
Environmental Engineer

2.0 SUMMARY OF TEST RESULTS

Exhaust air from the MVAR was sampled for three (3) two-hour test periods that were coordinated with facility operations to include the major components of the underground mining activities. Particulate matter (PM) in the MVAR exhaust gas was determined using US Environmental Protection Agency (USEPA) Method 5; copper and nickel concentrations and emission rates were determined using USEPA Method 29.

PM, copper, and nickel exhaust gas emission rates (pounds per hour) were calculated for each two-hour test period then converted to pounds per day (PPD) emission rates for comparison to the emission limits specified in PTI No. 50-06B.

Table 2.1 presents a summary of the measured PM, copper, and nickel exhaust gas emission rates.

The measured emission rates are less than the allowable PPD emission rates specified in PTI 50-06B for PM, copper, and nickel for all processes combined and exhausted to the MVAR (232 PPD, 0.21 PPD, and 0.18 PPD, respectively).

Table 2.1 Summary of measured PM, copper, and nickel emissions

Source ID	Exhaust Flowrate (dscfm)	PM Emissions (PPD)	Copper Emissions (PPD)	Nickel Emissions (PPD)
EUMVAR	259,040	34.5	0.061	0.050
Permit Limit	--	232	0.21	0.18

3.0 SOURCE DESCRIPTION

Eagle Mine operates an underground nickel and copper mine and surface support activities. Processes and activities that occur underground include vehicle travel, drilling, blasting, ore handling, and development rock handling. The underground mine is equipped with a fresh air ventilation system. Fresh air that is drawn into the underground mine through the mine entrance portal is returned to the atmosphere by the Main Ventilation Air Raise (MVAR) system, which primarily consists of two 300,000 cubic feet per minute (cfm) capacity fans connected to a vertical exhaust stack.

The underground activities operate on a 12-hour cycle. Material (ore, development rock) handling occurs, in general, at the beginning of each 12-hour shift, though this can continue as long as necessary to manage materials. This is followed by bolting and drilling to install a round of explosives. A blast occurs near the end of each 12-hour work shift.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A description of the sampling and analytical procedures is provided in the Test Plan dated July 7, 2014, which was approved by the MDEQ-AQD. This section provides a summary of those procedures.

4.1 Summary of Test Procedures

Exhaust air from the MVAR was sampled for three (3) two-hour test periods that were coordinated with facility operations to include the major components of the underground mining activities. The exhaust gas sampling was performed aboveground in the 126-inch diameter MVAR vertical exhaust stack.

Appendix B provides process records for the periods in which the sampling was performed.

Appendix C provides a diagram for the sampling location.

Derenzo and Associates, Inc. performed the specified pollutant measurements in accordance with the following USEPA reference test methods:

USEPA Reference	Property or Analyte Measured	Analytical Methodology
Method 1	Sample and traverse points	Selection of sample and traverse locations based on physical measurements
Method 2	Volumetric flowrate	Gas velocity measurements using type-S Pitot tube
Method 3	Molecular weight	Exhaust gas O_2 and CO_2 content by Fyrite® analyzer
Method 4	Exhaust gas moisture	Isokinetic sampling and gravimetric analysis of net weight gain in chilled impingers
Method 5	Particulate Matter emissions	Isokinetic sampling and gravimetric analysis of recovered filterable PM
Method 29	Copper and Nickel emissions	Isokinetic sampling and inductively coupled plasma mass spectrometry (ICP-MS) procedure

4.2 USEPA Method Sampling Procedures

4.2.1 Velocity traverse locations, stack gas velocity measurements (USEPA Method 1 and 2)

The sampling location and traverse points were determined in accordance with USEPA Method 1 by; (1) measuring the location of the sample ports with respect to upstream and downstream disturbances, and (2) verifying the absence of cyclonic flow.

Stack gas velocity was measured using USEPA Method 2 during the isokinetic sampling periods. Gas velocity (pressure) measurements were performed at each stack traverse point with an S-type Pitot tube and red-oil manometer connected to the isokinetic sampling train. Temperature measurements were performed at each traverse point using a K-type thermocouple and a calibrated digital thermometer.

4.2.2 Measurement of exhaust gas CO_2 and O_2 content (USEPA Method 3)

The properties of the MVAR exhaust was similar to that of ambient air. USEPA Method 3 was used to determine exhaust gas molecular weight by measuring the oxygen (O_2) and carbon dioxide (CO_2) content in the exhaust gas using a Fyrite® gas analyzer that contains scrubbing solutions to selectively remove O_2 and CO_2 from the gas sample.

Samples were withdrawn from the air stream using a sample probe and hand-held aspirator and introduced to the Fyrite® solutions through the scrubbing tube inlet valve. The sampled gas was passed through the appropriate scrubbing solution several times and the gas concentration (O_2 or CO_2) was determined by the solution volume change as indicated by the calibrated scale on the Fyrite® scrubber chamber. Leak checks were performed prior to and following each use and chemicals are changed as needed to maintain reactivity.

4.2.3 Determination of moisture content (USEPA Method 4)

Exhaust gas moisture content was measured using the PM/nickel/copper sampling train and determined in accordance with USEPA Method 4. Moisture from the exhaust gas sample was removed by the chilled impingers in the isokinetic sampling train. The net moisture gain in the chilled impingers was determined by gravimetric analysis of the impingers. Percent moisture was calculated based on the measured net gain from the impingers and the metered gas sample volume of dry air.

4.2.4 Determination of PM, copper and nickel emissions (USEPA Method 5/29)

Exhaust gas was withdrawn from the MVAR exhaust stack at an isokinetic sampling rate using an appropriately-sized glass sample nozzle and heated probe. The collected exhaust gas was passed through a pre-tared glass fiber filter that was housed in a heated filter box and bubbled

through an aqueous acidified solution of hydrogen peroxide in glass impingers. The gas sampling rate was measured using a calibrated dry gas meter.

At the conclusion of each two-hour test period, the sample train was leak-checked and disassembled. The filter was removed and stored in a sealed petri dish. The sample nozzle, glass probe liner, and front half of the filter holder were brushed and rinsed with 100 mL of acetone followed by a rinsed with 100 ml of 0.1 N HNO_3 . The rinses were collected into uniquely labeled sample containers.

The impingers were weighed to determine moisture gain. The impinger contents were recovered into a sample container and each impinger, the back half of the filter holder and connecting glassware were rinsed 100 ml of 0.1 N HNO_3. The rinses were added to the impinger contents sample container.

The recovered filter and rinses were stored in sealed containers and sent to Element One, Inc. (Wilmington, NC) for analysis. The filter and acetone rinses were dried and weighed according to USEPA Method 5 to determine the amount of filterable particulate matter captured by the sampling train.

The glass fiber filter was digested, combined with the impinger contents and rinses, and analyzed by inductively coupled plasma mass spectrometry (ICP-MS) pursuant to the USEPA Method 29 to determine the amount of copper and nickel captured by the sample train.

4.3 Quality Assurance/Quality Control Procedures

The Nutech® Model 2010 sampling console and dry gas meter, which was used to extract a metered amount of exhaust gas from the stacks was calibrated prior to and after the test event. The calibration procedure uses the critical orifice calibration technique presented in USEPA Methods 5 and 29. The digital pyrometer in the Nutech metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

The Pitot tube used for velocity pressure measurements was inspected for mechanical integrity and physical design prior to the field measurements. The gas velocity measurement train (Pitot tube, connecting tubing and incline manometer) was leak-checked prior to the field measurements and periodically throughout the testing period.

Appendix D provides information and quality assurance data for the equipment used for the test periods (Pitot tube integrity inspection sheets, and meter box critical orifice calibration records).

The glassware used in the impinger trains was washed and rinsed prior to use in accordance with the procedures of USEPA Methods 5 and 29.

All recovered samples were stored and shipped in pre-rinsed glass sample bottles with Teflon® lined caps. The liquid level on each bottle was marked with a permanent marker prior to shipment and the caps were secured closed with tape. Samples of the reagents used in the test event were sent to the laboratory for analysis with the test samples. The deionized high-purity water and acetone were analyzed according to USEPA Method 5 to verify that the reagents have low particulate matter residues. The deionized Type II water, 0.1 N nitric acid and 5 percent nitric acid/10 percent hydrogen peroxide reagents were analyzed by the laboratory using the procedures of USEPA Method 29 to verify that the reagents have low copper and nickel residue values.

The laboratory analyses were conducted by Element One, Inc. laboratory in accordance with the appropriate QA/QC procedures of the associated USEPA methodologies and are included on the final laboratory report.

Appendix E provides a copy of the laboratory analytical report.

5.0 TEST RESULTS AND DISCUSSION

Appendix F provides field sampling data sheets and computer-generated calculation sheets for each test period for the emission sources identified in this section.

5.1 Test Results for the MVAR

The MVAR was tested for PM, copper, and nickel emissions using USEPA Methods 5 and 29. The MVAR exhaust gas has an average measured volumetric flowrate of 259,040 dry standard cubic feet per minute (dscfm) and average PM, copper, and nickel emission rates of 34.5 PPD, 0.061 PPD, and 0.050 PPD, respectively.

Pound per hour (lb/hr) emission rates were calculated using the following equation:

((total pollutant (µg)) / Vm) * Qstd * 60 min/hr * g/10.0E06 µg * lb/453.6 g

Vm = Measured sample volume in ft^3
Qstd = Dry standard flowrate

PPD emission rates were calculated by multiplying lb/hr emission rates by 24-hours.

Table 5.3 presents PM, copper, and nickel emission rates for the MVAR.

5.2 Process Operating Conditions During the Compliance Test Periods

The testing was conducted while the associated processes of drilling, bolting, materials handling, vehicle travel, and blasting were operating.

Table 5.1 presents a summary of the mining activity schedule on the day of testing.

Table 5.1 Summary of mining activity schedule

Mining Activity	Time
Mucking	Morning
Drilling	Afternoon
Blasting	During Test No. 2 (~17:00)

Appendix B provides process data collected by Eagle Mine representatives.

Table 5.2 presents a summary of MVAR fan process data from the day of testing.

Table 5.2 Summary of MVAR fan process data

	Fan power (amps)	Fan load (%)	Fan flowrate (kcfm)	Air rise temperature (°F)	Ambient temperature (°F)
Test No. 1*	51	75	283	64.2	67.2
Test No. 2	51	75	285	65.5	68.4
Test No. 3	51	75	275 - 290	62.9	65.9

Notes

* Test No. 1 process data was estimated using Test No. 2 and Test No. 3 process data

Table 5.3 Emission rates for the Main Ventilation Air Raise (MVAR)

Source	**MVAR**	**MVAR**	**MVAR**	**MVAR**
Test No.	**1**	**2**	**3**	**Avg**
Date	9/16/14	9/16/14	9/16/14	
Time	11:55-14:10	15:00-17:11	17:59-20:10	
Exhaust Gas Properties				
Exhaust gas flow (dscfm)	256,035	256,769	264,317	259,040
Temperature (°F)	60	60	58	59
Moisture (%H_2O)	1.4	1.5	1.5	1.5
Sample Train Data				
Sample volume (dscf)	93.7	93.9	97.1	94.9
Sample train PM catch (mg)	5.2	3.7	3.7	4.2
Sample train copper catch (µg)	9.4	9.0	4.0	7.5
Sample train nickel catch (µg)	4.3	9.0	5.1	6.1
Emission Rates				
PM Emission Rate (lb/hr)	1.80	1.25	1.26	1.44
PM Emission Rate (PPD)	--	--	--	34.5
Copper Emission Rate (lb/hr)	0.003	0.003	0.001	0.003
Copper Emission Rate (PPD)	--	--	--	0.061
Nickel Emission Rate (lb/hr)	0.001	0.003	0.002	0.002
Nickel Emission Rate (PPD)	--	--	--	0.050

APPENDIX A

TEST PLAN APPROVAL LETTER

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

RICK SNYDER
GOVERNOR

DAN WYANT
DIRECTOR

July 30, 2014

Ms. Jennifer Nutini
Eagle Mine, LLC
4547 County Road 601
Champion, Michigan 49814

Dear Ms. Nutini:

SUBJECT: Eagle Mine, EUMVAR, Emission Testing, Permit: 50-06B, SRN: N7581

The Department of Environmental Quality (DEQ), Air Quality Division (AQD), has reviewed the protocol for testing EUMVAR at Eagle Mine. EUMVAR is the outlet of the main ventilation system for the mine. The EUMVAR stack will be tested for particulate, nickel and copper emissions. This testing is required by permit 50-06B.

Testing will be performed in accordance with Title 40 of the Code of Federal Regulations, Part 60, Appendix A, Methods 1, 2, 3, 4, 5, and 29, and State of Michigan Part 10 rules. Three 120-minute runs will be performed. One sample will be taken during drilling operations. One sample will be taken during blasting and rock removal. One sample will be taken during rock removal and development. Testing will begin during the drilling prior to the first blast of the day. Testing will be used to develop an emission factor to determine compliance with the pounds per day limits.

All requirements and specifications of the above methods apply; any modifications of the test methods onsite must be approved by the Air Quality Division.

The following process data will be recorded during testing:

- fan amperage and fan percent load will be recorded once during each run
- drilling and blasting times will be recorded during testing
- the production rate, the estimated tonnes of ore and waste removed, will be recorded for the day of testing

The test report will include:

- all pre-test and post-test meter box calibration, pitot tube calibration, and field data sheets
- all laboratory data including quality control audits
- the process data listed above

All aborted or failed runs must be included in the report.

A complete copy of the test report should be sent to:

Mr. Ed Lancaster
Department of Environmental Quality
Air Quality Division
1504 West Washington Street
Marquette, Michigan 49855

Ms. Karen Kajiya-Mills
Department of Environmental Quality
Air Quality Division
Supervisor, TPU
PO Box 30260
Lansing, Michigan 48909-7760

Testing is scheduled for the week of September 17, 2014. Please inform Mr. Ed Lancaster, of the Upper Peninsula District Office, at 906-250-5124, and myself, of any change in the test dates. If you have any questions regarding this letter, please contact me by telephone or e-mail at gaslolit@michigan.gov.

Sincerely,

Tom Gasloli
Technical Programs Unit
Field Operations Section
Air Quality Division
517-284-6778

cc: Mr. Robert Harvey, Derenzo
Mr. Michael Bracki, Derenzo
Mr. Ed Lancaster, DEQ
Mr. Chris Hare, DEQ

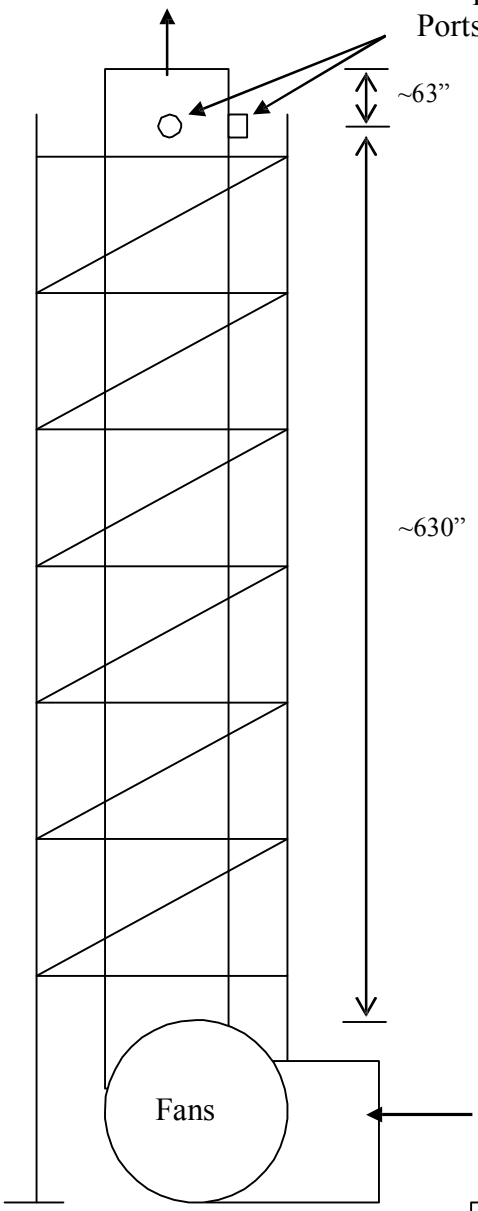
APPENDIX B

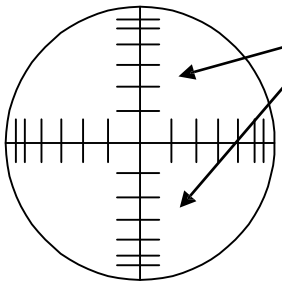
PROCESS DATA

Activity	Start	End	Duration	Tonnes	Rock Type
Drill					
	1:30 PM	3:30 PM	2 hrs	296	Ore
Material Handling U/G					
Total				572	Ore
Material Removed to Surface					
Total				736	Ore
Blast					
265 Level	5:00 PM	-	-	445.4	Ore

APPENDIX C

EXHAUST DUCT SAMPLING LOCATION





Diameter = 126”

Sampling Point	Distance from stack wall
1	2.65
2	8.44
3	14.87
4	22.30
5	31.50
6	44.86
7	81.14
8	94.50
9	103.70
10	111.13
11	117.56
12	123.35

- diagram not to scale
- measurements estimated
- actual values to be presented in test report

Figure 1. Measurement and Sampling locations for the EUMVAR PM and Metals Compliance Demonstration at the Eagle Mine LLC facility in Michigamme, Michigan

Derenzo and Associates, Inc.

Sampling Date(s): September 16, 2014

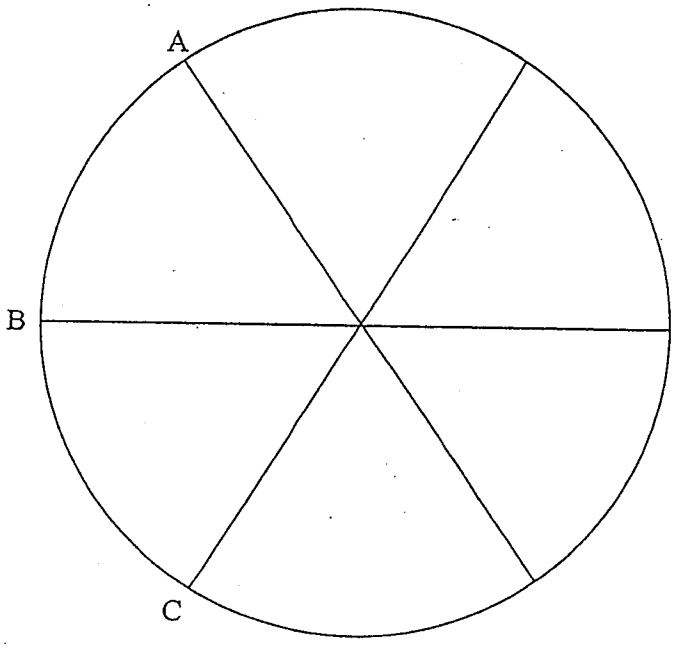
APPENDIX D

EQUIPMENT CALIBRATION DATA

NOZZLE INSPECTION
CRITERIA CHECKLIST

Nozzle ID: EM-MVAR Nozzle (Glass)

Date: 9/16/14



A: 0.218

B: 0.219

C: 0.219

Average: 0.2187

Comments: _____

_____

PROBE AND PITOT TUBE INSPECTION
CRITERIA CHECKLIST

Probe #: 6F

Date: 9/16/14

Figure

A. x ≥ 1.9 cm

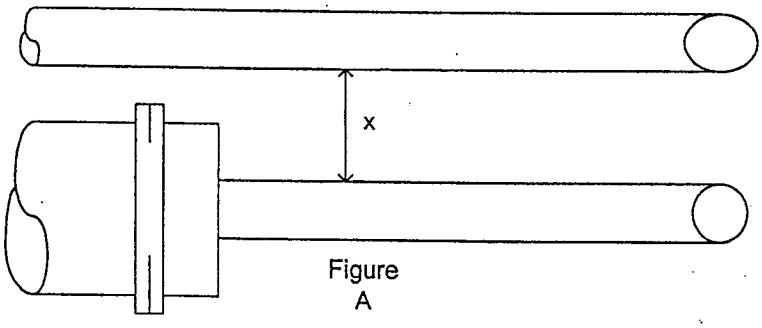


Figure A

A. (Yes) No

B1. z ≥ 1.9 cm
w ≥ 7.62 cm

or

B2. Z ≥ 5.08 cm

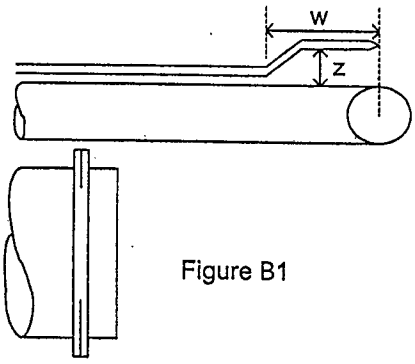


Figure B1

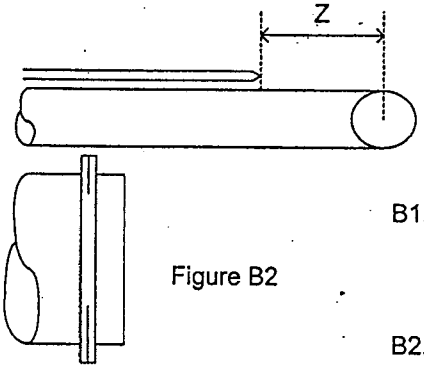


Figure B2

B1. Yes No

or

B2. (Yes) No

C. Y ≥ 7.62 cm

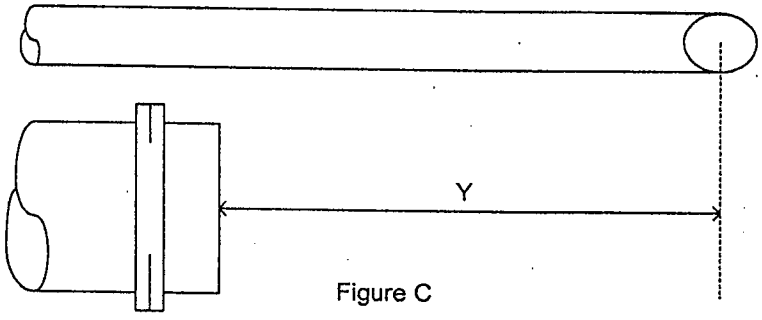


Figure C

C (Yes) No

Pitot Tube Correction Factor: 0.84

Derenzo and Associates, Inc.

Field Data Sheet

Facility: Eagle Mine — Test No. Cal.

Source: MVAR — Date: 9/16/14

Description: Scale Calibration — Operator: TW

	Expected (g)	Actual (g)			
	1000	999.7			
	500	499.9			
	200	200.1			
	~~1~~00	~~1~~00.0			
	50	50.0			
	20	20.0			
	10	10.0			
	5	5.0			
	2	2.0			
	1	1.0			

Derenzo and Associates, Inc.

Field Data Sheet

Facility: Eagle Mine — Test No. Cal.

Source: MVAR — Date: 9/14/14

Description: Mini Barometer Calibration — Operator: TW

	Expected (in)	Actual (in)			
	29.43	29.43			

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

DERENZO & ASSOCIATES, INC

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at maximum attainable vacuum (open coarse valve, close fine valve),
   for period of 5 minutes minimum for large orifice up to 10 minutes for smallest orifice.
4) Record readings in outlined boxes below, other columns are automatically calculated.

DATE:	9/12/14	METER SERIAL #:	N1	BAROMETRIC PRESSURE (in Hg):	INITIAL 29.63 / FINAL 29.62 / AVG (P_{bar}) 29.625
METER PART #:	N1	CRITICAL ORIFICE SET SERIAL #:	1316		

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS (FT^3) FINAL	DGM READINGS (FT^3) NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	TEMPERATURES °F DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH ($in\ H_2O$)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)
#29	1	0.7968	18	50.005	55.06	5.055	64	69	76	63	64	68	5.00	3.7	5.0521	5.1575	1.0209	
Brass	2	0.7968	18	55.06	60.14	5.080	64	76	75	64	65	70	5.00	3.7	5.0579	5.1575	1.0197	
	3	0.7968	18	60.14	65.230	5.090	65	75	76	65	66	70.5	5.00	3.7	5.0631	5.1526	1.0177	
																AVG =	1.0194	0.56
#24	1	0.6534	20	65.230	73.67	8.440	65	76	75	66	67	71	10.00	2.5	8.3627	8.4506	1.0105	
Brass	2	0.6534	20	73.67	82.17	8.500	65	75	76	67	68	71.5	10.00	2.5	8.4142	8.4506	1.0043	
	3	0.6534	20	82.17	90.68	8.514	65	76	76	68	69	72.25	10.00	2.5	8.4162	8.4506	1.0041	
																AVG =	1.0063	-0.73
#20	1	0.5333	21.5	90.684	97.55	6.866	66	76	76	69	69	72.5	10.00	1.5	6.7672	6.8907	1.0183	
Brass	2	0.5333	21.5	97.55	104.44	6.890	66	76	76	69	70	72.75	10.00	1.5	6.7876	6.8907	1.0152	
	3	0.5333	21.5	104.44	111.35	6.907	67	76	77	70	71	73.5	10.00	1.5	6.7948	6.8842	1.0132	
																AVG =	1.0155	0.18

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.0138

Y-5%= 0.963 1.064

Delta H@ 1.898

Kiso 1639.548

(1) $V_m\ (std) = K_1\ V_m \dfrac{P_{bar} + (\Delta H/13.6)}{T_m}$ = Net volume of gas sample passed through DGM, corrected to standard conditions

K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

(2) $V_{cr}\ (std) = K' \sqrt{\dfrac{P_{bar}\,\theta}{T_{amb}}}$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

(3) $Y = \dfrac{V_{cr}\ (std)}{V_m\ (std)}$ = DGM calibration factor

PYROMETER CALIBRATION

Meter	32	100	252	500	1000	1499
Omega	32	100	250	500	1000	1500
% Difference	0.0	0.0	0.8	0.0	0.0	-0.1

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

DERENZO & ASSOCIATES, INC

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at maximum attainable vacuum (open coarse valve, close fine valve),
   for period of 5 minutes minimum for large orifice up to 10 minutes for smallest orifice.
4) Record readings in outlined boxes below, other columns are automatically calculated.

			INITIAL	FINAL	AVG (P_{bar})
DATE:	9/30/14	METER SERIAL #:	N1	BAROMETRIC PRESSURE (in Hg):	29.63	29.63	29.63
METER PART #:	N1	CRITICAL ORIFICE SET SERIAL #:	1316				

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS (FT^3) FINAL	DGM READINGS (FT^3) NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH ($in H_2O$)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)
#29	1	0.7968	18.5	427.615	432.64	5.025	69	75	76	70	69	72.5	5.00	3.2	4.9743	5.1339	1.0321	
Brass	2	0.7968	18.5	432.64	437.73	5.090	69	76	77	69	70	73	5.00	3.2	5.0339	5.1339	1.0199	
	3	0.7968	18.5	437.73	442.812	5.082	69	77	77	70	70	73.5	5.00	3.2	5.0213	5.1339	1.0224	
																AVG =	1.0248	0.73
#24	1	0.6534	20	442.812	451.25	8.438	69	77	77	70	71	73.75	10.00	2.5	8.3190	8.420	1.0121	
Brass	2	0.6534	20	451.25	459.73	8.480	69	77	78	71	71	74.25	10.00	2.5	8.3526	8.420	1.0081	
	3	0.6534	20	459.73	468.23	8.499	69	78	78	71	72	74.75	10.00	2.5	8.3634	8.420	1.0068	
																AVG =	1.0090	-0.83
#20	1	0.5333	21	468.229	475.09	6.861	69	78	78	72	72	75	10.00	1.5	6.7318	6.8723	1.0209	
Brass	2	0.5333	21	475.09	481.97	6.880	69	78	78	72	73	75.25	10.00	1.5	6.7473	6.8723	1.0185	
	3	0.5333	21	481.97	488.87	6.901	69	78	78	73	73	75.5	10.00	1.5	6.7647	6.8723	1.0159	
																AVG =	1.0184	0.10

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.0174

Y-5%= 0.967 1.068

Delta H@ 1.811

Kiso 1583.118

(1) $V_m(std) = K_1 V_m \frac{P_{bar} + (\Delta H/13.6)}{T_m}$ = Net volume of gas sample passed through DGM, corrected to standard conditions

K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

(2) $V_{cr}(std) = K' \sqrt{\frac{P_{bar}\,\theta}{T_{amb}}}$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

(3) $Y = \frac{V_{cr}(std)}{V_m(std)}$ = DGM calibration factor

PYROMETER CALIBRATION

Meter	32	100	251	500	1001	1502
Omega	32	100	250	500	1000	1500
% Difference	0.0	0.0	0.4	0.0	0.1	0.1

APPENDIX E

LABORATORY ANALYTICAL REPORT

Derenzo and Associates, Inc.

39395 Schoolcraft Road
Livonia, MI 48150

Project No: 140414

Particulate Matter, Copper and Nickel

EPA Methods 5 & 29 Analyses

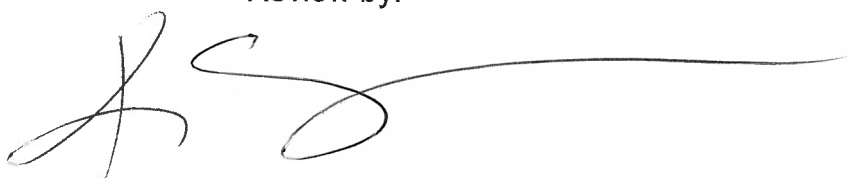
Analytical Report
23131

el1

Element One, Inc.
6319-D Carolina Beach Rd., Wilmington, NC 28412
910-793-0128 FAX: 910-792-6853 e1lab@e1lab.com

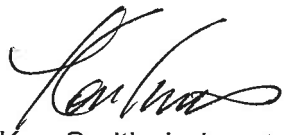
The following data for Analytical Report 23131
has been reviewed for completeness, accuracy,
adherence to method protocol,
and compliance with quality assurance guidelines.

Review by:



Katie Strickland, B.S. Chemist
October 6, 2014

Report Reviewed and Finalized By:



Ken Smith, Laboratory Director
October 6, 2014

SUMMARY OF RESULTS

Summary of Analysis

Summary of Method 5 Particulate Analysis

Fraction	Test 1 e23131-1 Catch, mg	Test 2 e23131-2 Catch, mg	Test 3 e23131-3 Catch, mg	Reagent Blank e23131-4 Catch, mg
Filter	0.2	0.1	< 0.1	< 0.1
Rinse	5.0	3.6	3.6	1.5
Total PM	5.2	3.7	3.6	1.5

Front Half - Summary of Method 29 Metals Analysis

Element	Test 1 e23131-1 FH Total µg	Test 2 e23131-2 FH Total µg	Test 2 e23131-2 FH dup Total µg	Test 3 e23131-3 FH Total µg	Reagent Blank e23131-4 FH Total µg
Copper	4.70	7.55	7.18	3.39	2.06
Nickel	3.83	8.47	8.14	4.57	2.46

Back Half - Summary of Method 29 Metals Analysis

Element	Test 1 e23131-1 BH Total µg	Test 2 e23131-2 BH Total µg	Test 2 e23131-2 BH dup Total µg	Test 3 e23131-3 BH Total µg	Reagent Blank e23131-4 BH Total µg
Copper	4.69	1.48	1.47	0.61	< 0.1
Nickel	0.465	0.478	0.485	0.502	0.346

ANALYTICAL NARRATIVE

Element One Analytical Narrative

Client:	Derenzo and Associates, Inc.	Element One #:	23131
Client ID:	140414	Analyst:	LAW & DBW
Method:	Method 5 & 29	Dates Received:	09/22/14
Analytes:	PM, Cu & Ni	Dates Analyzed:	09/25-29/14

Summary of Analysis

The Method 5 particulate samples were analyzed in accordance with EPA Method 5 guidelines. Particulate samples were weighed to a constant weight of ±0.5mg and reported to the nearest 0.1mg. The Method 29 samples were digested, prepared, and analyzed according to Method 29 protocol. The samples were analyzed for metals on a PerkinElmer ELAN 6100 ICP-MS.

Detection Limits

The ICP-MS instrument reporting limit was 1.0µg/L for the metals.

Analysis QA/QC

Duplicate analyses relative percent difference (RPD), spike sample recovery, and second source calibration verification data are summarized in the Quality Control Section. All QA/QC data was within the criteria of the method.

Additional Comments

The reported results have not been corrected for any blank values or spike recovery values. The reported results relate only to the items tested or calibrated.

The ICP-MS analysis of the Reagent Blank samples revealed detectable concentrations of metals. The unprepared 0.1N HNO_3 front half rinse and the unprepared combined FH/BH samples were analyzed, resulting in low concentrations of copper and nickel, suggesting the metals were in the filter portion of the sample.

QUALITY CONTROL SUMMARY

Summary of Quality Control Data

Metals Duplicate Analysis RPD

(Method 29 QC limits: < 20% for RPD)

Element	Test 2 Front Half RPD	Test 2 Back Half RPD
Copper	5.0%	0.6%
Nickel	4.1%	1.4%

Metals Analysis Spike Recoveries

(Method 29 QC limits: 75-125% for Spike Recoveries)

Element	Test 3 Front Half Recovery	Test 3 Back Half Recovery
Copper	82%	96%
Nickel	92%	99%

Second Source Calibration Check Recoveries

(Method 29 QC limits: ±10% for Second Source Continuing Check Standard)*

Element	1 ppb	50 ppb	100 ppb*	250 ppb
Copper	116%	107%	108%	104%
Nickel	112%	106%	107%	105%

SAMPLE CUSTODY

Element One, Inc.
6319-D Carolina Beach Road
Wilmington, NC 28412

CHAIN OF CUSTODY

Lab ID # e23131 Page 1 of 2

Phone 910-793-0128 / FAX 792-6853
email e1lab@e1lab.com

Contact: Jason Logan	PO #.	~~1881~~ 1811	
Company: Derenzo and Associates, Inc.	Phone	734 464 3880	
Address: 39395 Schoolcraft Rd. Livonia, MI 48150	Fax	734 464 4368	
	Email	jlogan@derenzo.com	
	Email		
Project ID: 140404	Email		
Billing information if different:			

Delivery Due Date
- ☐ Normal
- ☐ 5 day *
- ☐ 3 day *
- ☐ 2 day *
- ☐ 1 day *

* Rush work needs prior lab approval. Additional charges will apply.

☒ Compliance ☐ Non-Compliance

Sample Description / ID	Date	Time	Type[1]	Matrix[2]	# Cntrs	pH	Remarks	Method 5	Method 29	Container Type, Plastic or Glass	None	Ascorbic	NaS_2O_3	NaOH	H_2SO_4	HNO_3	HCl
Test NO. 1 cont. no. 2	9-16						acetone FH	x									
Test no. 2 cont. no. 2	9-16						acetone FH	x									
Test no. 3 cont. no. 2	9-16						acetone FH	x									
Cont # 7	9-16						acetone blank	x									
Test no. 1 cont no. 1	9-16						filter	x	x								
Test no. 2 cont no. 1	9-16						filter	x	x								
Test no. 3 cont no. 1	9-16						filter	x	x								
Cont 12	9-16						filter blank	x	x								
cont 8b	9-16						H_2O blank	x	x								

[1] Type: **C**-Composite, **G**-Grab

[2] Matrix: **BA**-Bottom Ash, **FA**-Fly Ash, **CA**-Combined Ash, **SO**-Soil, **AQ**-Aqueous, **NA**-Non-aqueous, **OT**-Other

Print	Signature	Company	Date	Time	Via	Additional instructions / Lab Notes
Relinquished by: Jason Logan		Derenzo and Associates	9-18	4:00p	Fedex	
Received by:						
Relinquished by:						
Received by: Print Julie Congleton	Julie Congleton	Element One	9-22	9:45	Fed Ex	Rec'd in good condition w/ empty containers.

Element One, Inc. Form 117.1 Revision 3.1

Per client via phone, analyze for Cu + Ni - 2x8 9.23.14
Per client via email, FH/BH separate - 2x8 9.18.14

Element One, Inc.
6319-D Carolina Beach Road
Wilmington, NC 28412

CHAIN OF CUSTODY

Lab ID # e 23131 Page 2 of 2

Phone 910-793-0128 / FAX 792-6853
email e1lab@e1lab.com

Contact: Jason Logan	PO #:	1811	
Company: Derenzo and Associates, Inc.	Phone	734 464 3880	
Address: 39395 Schoolcraft Rd. Livonia, MI	Fax		
	Email	jlogan@derenzo.com	
	Email		
Project ID: 1404014	Email		
Billing information if different:			

Analyses Requested: Method 29 - copper; Method 29 - nickel

Container Type, Plastic or Glass

Delivery Due Date
- ☐ Normal
- ☐ 5 day *
- ☐ 3 day *
- ☐ 2 day *
- ☐ 1 day *

* Rush work needs prior lab approval. Additional charges will apply.

Sample Description / ID	Date	Time	Type[1]	Matrix[2]	# Cntrs	pH	☒ Compliance ☐ Non-Compliance Remarks	Method 29 - copper	Method 29 - nickel	Container Type	None	Ascorbic	NaS_2O_3	NaOH	H_2SO_4	HNO_3	HCl
Trst no. 1 cont no. 3	9-16			AQ	1		FH 0.1N HNO_3	x	x	P						x	
Trst no. 2 cont no. 3	9-16			AQ	1		"	x	x	P						x	
Trst no. 3 cont no. 3	9-16			AQ	1		"	x	x	P						x	
Trst no. 1 cont no. 4	9-16			AQ	1		BH 5/10	x	x	P						x	
Trst no. 2 cont no. 4	9-16			AQ	1		"	x	x	P						x	
Trst no. 3 cont no. 4	9-16			AQ	1		"	x	x	P						x	
cont 8a	9-16			AQ	1		0.1N HNO_3 blank	x	x	P						x	
cont 9	9-16			AQ	1		5/10 blank	x	x	P						x	

[1] Type: **C**-Composite, **G**-Grab

[2] Matrix: **BA**-Bottom Ash, **FA**-Fly Ash, **CA**-Combined Ash, **SO**-Soil, **AQ**-Aqueous, **NA**-Non-aqueous, **OT**-Other

Print	Signature	Company	Date	Time	Via	Additional instructions / Lab Notes
Relinquished by: Jason Logan		Derenzo and Associates	9-18	4:00p	Fedex	
Received by:						
Relinquished by:						
Received by: Print Julie Congleton	Julie Congleton	Element One Lab	9.23.14	1155	FedEx	Rec'd in good condition No empty containers

Element One, Inc. Form 117.1 - Revision 3.1

Tared Filter Weights

Tyler Wilson <twilson@derenzo.com>

Tue 9/23/2014 1:10 PM

To:Lisa Braton <lisa.braton@e1lab.com>;

Hi Lisa,

Tared filter weights are below:

0022614022 = 346.72 mg
0022614023 = 346.27 mg
0022614024 = 349.35 mg
0022614025 = 348.13 mg

Thank you,

Tyler J. Wilson
Environmental Consultant
Derenzo and Associates, Inc.
39395 Schoolcraft Road
Livonia MI 48150

Office: (734) 464-3880
Fax: (734) 464-4368
Email: twilson@derenzo.com
Website: www.derenzo.com

ANALYTICAL DATA

Analytical Calculations

Metals-

Element Results (µg) =ICP Results (µg/L)*Dilution*Final Volume (L)

Where-

ICP Results= Raw sample concentration (ppb)--*ICP-Data Sheet*

Dilution= $\frac{\text{Diluted Volume}}{\text{Aliquot}}$--*ICP-MS Run Sheet*

Final Volume=FH=Final Volume (FV)--*Sample Submission*

BH=$\frac{\text{Received Volume (BV)}}{\text{Aliquot (Used)}}$.*Final Volume (FV)--*Sample Submission*

Analytical Calculations

Spike Recovery-

$$\textbf{Spike (\%)} = \frac{\textbf{(Spiked Result (µg/L) – Sample Result (µg/L))}}{\textbf{Spike Amount (µg/L)}} \textbf{ X100}$$

Where-

Spike Result = Raw sample concentration (ppb)--*ICP-Data Sheet*

Sample Result = Raw sample concentration (ppb)--*ICP-Data Sheet*

Spike Amount--*ICP-MS Spike Table*

Duplicate Analysis RPD-

$$\textbf{RPD (\%)} = \frac{\textbf{(Duplicate Result (µg/L) - Sample Result (µg/L))}}{\textbf{Average (µg/L)}} \textbf{ X100}$$

Where-

Sample Result and Duplicate Results=Raw sample concentration (ppb)--*ICP-Data Sheet*

Average=$\frac{\textit{(Duplicate + Sample Results)}}{2}$

elementOne **AIR TESTING SAMPLE SUBMISSION FORM** **Lab ID 23131**

FH / BH Separate

Analysis Due Date 09.30.14
QA/QC/Report Due Date 10.02.14

Client:	Derenzo & Associates, Inc.
Project No	140414

Date Received	09.22.14
Time Received	0945

HNO_3 Lot: 113120	HF Lot: 5113050	HCl Lot: 35187	**Ref. Method: 29/5**
Volume Marked (Y) / N	Volume Loss Y / (N) ?		

Sample Identification

1	M29/5-R1	4	Reagent Blank		
2	M29/5-R2				
	M29/5-R2 Duplicate				
3	M29/5-R3				
	M29/5-R3 Spike				

Analyses Requested	Samples 1-4	Cu, Ni
	Samples 1-4	PM

Runs / FB	Fil / Ace (FH) pH <2.0 Y / N		HNO_3 (FH) pH <2.0 (Y) / N		5% HNO_3/10% H_2O_2 (BH) pH <2.0 Y / N			HNO_3 (A) pH <2.0 Y / N		$KMnO_4$ (B) pH <2.0 Y / N		HCl (C) pH <2.0 Y / N	
Lab ID	Fil ID	BV ml	BV ml	FV ml	BV ml	Used	FV ml	BV ml	FV ml	BV ml	FV ml	BV ml	FV ml
1	4022	88	105	100	305	153	50						
2.D	4023	88	105	"	290	145	"						
3.S	4024	90	105	↓	305	153	↓						

M-29 Reagent Blank

Lab ID	Fraction			BV, ml	FV, ml	Comments
4	C 7	FH	Acetone Blank			
	C 8A	FH	0.1N HNO_3	315	100	used 100 mL for FH
	C 8A	A	0.1N HNO_3			
	C 8B	B	DI H_2O			
	C 9	BH	5% HNO_3/10% H_2O_2	200	50	used 200 mL C9, 100mL C8A cooked down 150 ml
	C 10	B	4% $KMnO_4$ /10%H_2SO_4			
	C 11	C	8N HCl DI H_2O			
	C 12	FH	Filter 4025			

Lab Communications

LRB FH+, BH+ spiked w/ 100 uL of Std A, B (25ppm) & Filter

Per client via e-mail, FH / BH separate---LLB 09.23.14

Fractions Received C1, C2, C3, C4: RB: C12,C7, C8A, C8B, C9---LLB 09.22.14

SS Page1 of 1
9/23/2014 9:16:22 PM
SS by LLB
Labeled By/Date LAW 9.23.14

FH Prep By/Date LAW 9.26.14 A Prep By/Date —
BH Prep By/Date LAW 9.26.14 B Prep By/Date —
BH/FH Prep By/Date LAW 9.26.14 C Prep By/Date —
PM Prep By/Date LAW 9.23.14 ID Verification By / Date PDS 9.23.14

elementOne

Method 5 Particulate

Lab # 23131

Page 1 of 1

Client Derenzo

Balance checks Date: 09.25.14 2g = 2.0000
Date: 09.26.14 2g = 2.0000
Date:

Acetone Concentration 1.86E-05 mg/mg

Filters

Sample ID #	Filter ID	Tin ID	A	B		B		B		
			Filter Tare, g	Date - 09.25.14 Initals - LAW		Date - 09.26.14 Initals - LAW		Date Initals		Catch Description and Loading
				Time	Filter Weight, g	Time	Filter Weight, g	Time	Filter Weight, g	
23131-1	4022	1	0.3467	10:45	0.3472	8:30	0.3469			
23131-2	4023	2	0.3463	10:45	0.3466	8:30	0.3464			
23131-3	4024	3	0.3494	10:45	0.3493	8:30	0.3493			
Client Blk-4	4025	4	0.3481	10:45	0.3481	8:30	0.3481			
E1 Blank										

Acetone Rinses

Sample ID #	Sample Volume, ml	Bag ID	C	D		D		D		
			Bag Tare, g	Date - 09.25.14 Initals - LAW		Date - 09.26.14 Initals - LAW		Date Initals		Catch Description and Loading
				Time	Bag & Sample Weight, g	Time	Bag & Sample Weight, g	Time	Bag & Sample Weight, g	
23131-1	88	X83	11.1374	10:45	11.1426	8:30	11.1424			
23131-2	88	601	10.2007	10:45	10.2046	8:30	10.2043			
23131-3	90	786	10.8987	10:45	10.9028	8:30	10.9023			
Client Ace Blk-4	102	792	10.6720	10:45	10.6737	8:30	10.6735			
E1 Acetone Blank	100	811	9.8351	10:45	9.8355	8:30	9.8352			

Total Catches

Sample ID #	Filter ID	Filter Tare, g	Final Filter + Catch, g	Filter Catch, mg		Acetone Bag ID	Bag Tare, g	Final Bag + Ace Catch, g	Acetone Catch, mg	Total Catch, mg
23131-1	4022	0.3467	0.3469	0.2		X83	11.1374	11.1424	5.0	5.2
23131-2	4023	0.3463	0.3464	0.1		601	10.2007	10.2043	3.6	3.7
23131-3	4024	0.3494	0.3493	< 0.1		786	10.8987	10.9023	3.6	3.6
Client Blk-4	4025	0.3481	0.3481	< 0.1		792	10.6720	10.6735	1.5	1.5
E1 Blank						811	9.8351	9.8352	0.1	0.1

Element One, Inc. Form 123 - Revision 2.01.24.12

Luke Webb

elementOne **Method 29 Microwave Worksheet** Lab ID # e 23131

Client: Derenzo

Date Digested: 9/26/14 Initials: DBL Worksheet Prepared by: DBL

Auto Sample Loc.	Sample Lab ID	Sample Weight (g)	# of filters digested	Spike	Prep Volume (ml)	Weight In Micro / Weight Out Micro	Units
1	LRB +		—	0.1mL	Combine w/ FV#1 FV=100		
3	LRB		—		↓		
5	23131-1		1		↓		
7	-2		1		↓		
9	-3		1		↓		
11	-4		1		✓		
2	Cleaning						
4	↓						
6							
8							
10							
12							
13							
14							
15							
16	✓						

To LRB+ added 0.1 mL of 25ppm Lot 021414-A,B DBL
6mL HNO3 Lot # K14034
2mL HF Lot# 55115

Element One, Inc. Form 104 - Revision 1.0

Sample/Batch Report

User Name: icp
Computer Name: ICP-MS
Sample File: C:\elandata_icp\Sample\x6.sam
Report Date/Time: Monday, September 29, 2014 11:41:25

A/S Loc.	Batch ID	Sample ID	Description	Sample Type	Init. Quant.	Prep. Vol.	Aliquot Vol.	Diluted Vol.	Solids Ratio
5		QC STD 2		Sample					
301		LRB FH		Sample					
302	s	LRB FH		Spike - 1 of 2					
303		23131-1 FH	Derenzo	Sample					
304		23131-2 FH	Derenzo	Sample					
305	d	23131-2 FH	Derenzo	Duplicate of 5					
306		23131-3 FH	Derenzo	Sample					
307	s	23131-3 FH	Derenzo	Spike - 1 of 7					
308		23131-4 FH	Derenzo	Sample					
309		LRB BH		Sample					
310	s	LRB BH		Spike - 1 of 10					
311		23131-1 BH	Derenzo	Sample					
312		23131-2 BH	Derenzo	Sample					
313	d	23131-2 BH	Derenzo	Duplicate of 13					
314		23131-3 BH	Derenzo	Sample					
315	s	23131-3 BH	Derenzo	Spike - 1 of 15					
316		23131-4 BH	Derenzo	Sample					
317		23131-4 FH u	Derenzo	Sample					
318		23131-4 FHB	Derenzo	Sample					
319		23131-4 FH	Derenzo	Sample					

Dataset Report

User Name: icp
Computer Name: ICP-MS
Dataset File Path: C:\elandata_icp\DataSet\092914-2\
Report Date/Time: Monday, September 29, 2014 11:41:20

9/29/14

Autosampler Position: 306

The Dataset

Time	Sample ID	Batch ID	Read Type	Description	Init. Quant	Prep. Vol.	Aliquot. Vol.	Diluted Vol
10:52:37 Mon 29-Sep-14	Blank		Blank					
10:53:51 Mon 29-Sep-14	Standard 1		Standard #1					
10:55:04 Mon 29-Sep-14	Standard 2		Standard #2					
10:56:18 Mon 29-Sep-14	Standard 3		Standard #3					
10:57:32 Mon 29-Sep-14	QC Std 1		QC Std #1					
10:58:46 Mon 29-Sep-14	QC Std 2		QC Std #2					
10:59:59 Mon 29-Sep-14	QC Std 3		QC Std #3					
11:01:14 Mon 29-Sep-14	QC Std 4		QC Std #4					
11:02:29 Mon 29-Sep-14	QC Std 5		QC Std #5					
11:03:42 Mon 29-Sep-14	QC Std 6		QC Std #6					
11:04:56 Mon 29-Sep-14	QC Std 7		QC Std #7					
11:06:10 Mon 29-Sep-14	QC STD 2		Sample					
11:07:24 Mon 29-Sep-14	LRB FH		Sample					
11:08:38 Mon 29-Sep-14	LRB FH	s	Spike - 1 of 13					
11:09:52 Mon 29-Sep-14	23131-1 FH		Sample	Derenzo				
11:11:05 Mon 29-Sep-14	23131-2 FH		Sample	Derenzo				
11:12:19 Mon 29-Sep-14	23131-2 FH	d	Duplicate of 16	Derenzo				
11:13:32 Mon 29-Sep-14	23131-3 FH		Sample	Derenzo				
11:14:46 Mon 29-Sep-14	23131-3 FH	s	Spike - 1 of 18	Derenzo				
11:15:59 Mon 29-Sep-14	23131-4 FH		Sample	Derenzo				
11:17:13 Mon 29-Sep-14	LRB BH		Sample					
11:18:26 Mon 29-Sep-14	LRB BH	s	Spike - 1 of 21					
11:19:42 Mon 29-Sep-14	QC Std 1		QC Std #1					
11:20:56 Mon 29-Sep-14	QC Std 4		QC Std #4					
11:22:12 Mon 29-Sep-14	23131-1 BH		Sample	Derenzo				
11:23:25 Mon 29-Sep-14	23131-2 BH		Sample	Derenzo				
11:24:39 Mon 29-Sep-14	23131-2 BH	d	Duplicate of 26	Derenzo				
11:25:53 Mon 29-Sep-14	23131-3 BH		Sample	Derenzo				
11:27:06 Mon 29-Sep-14	23131-3 BH	s	Spike - 1 of 28	Derenzo				
11:28:20 Mon 29-Sep-14	23131-4 BH		Sample	Derenzo				
11:29:35 Mon 29-Sep-14	QC Std 1		QC Std #1					
11:30:49 Mon 29-Sep-14	QC Std 4		QC Std #4					
11:34:59 Mon 29-Sep-14	23131-4 FH unprep		Sample	Derenzo				
11:36:13 Mon 29-Sep-14	23131-4 FHBH unprep		Sample	Derenzo				
11:37:59 Mon 29-Sep-14	23131-4 FH		Sample	Derenzo				
11:39:15 Mon 29-Sep-14	QC Std 1		QC Std #1					
11:40:29 Mon 29-Sep-14	QC Std 4		QC Std #4					

elementOne
Analyst:--DBW--

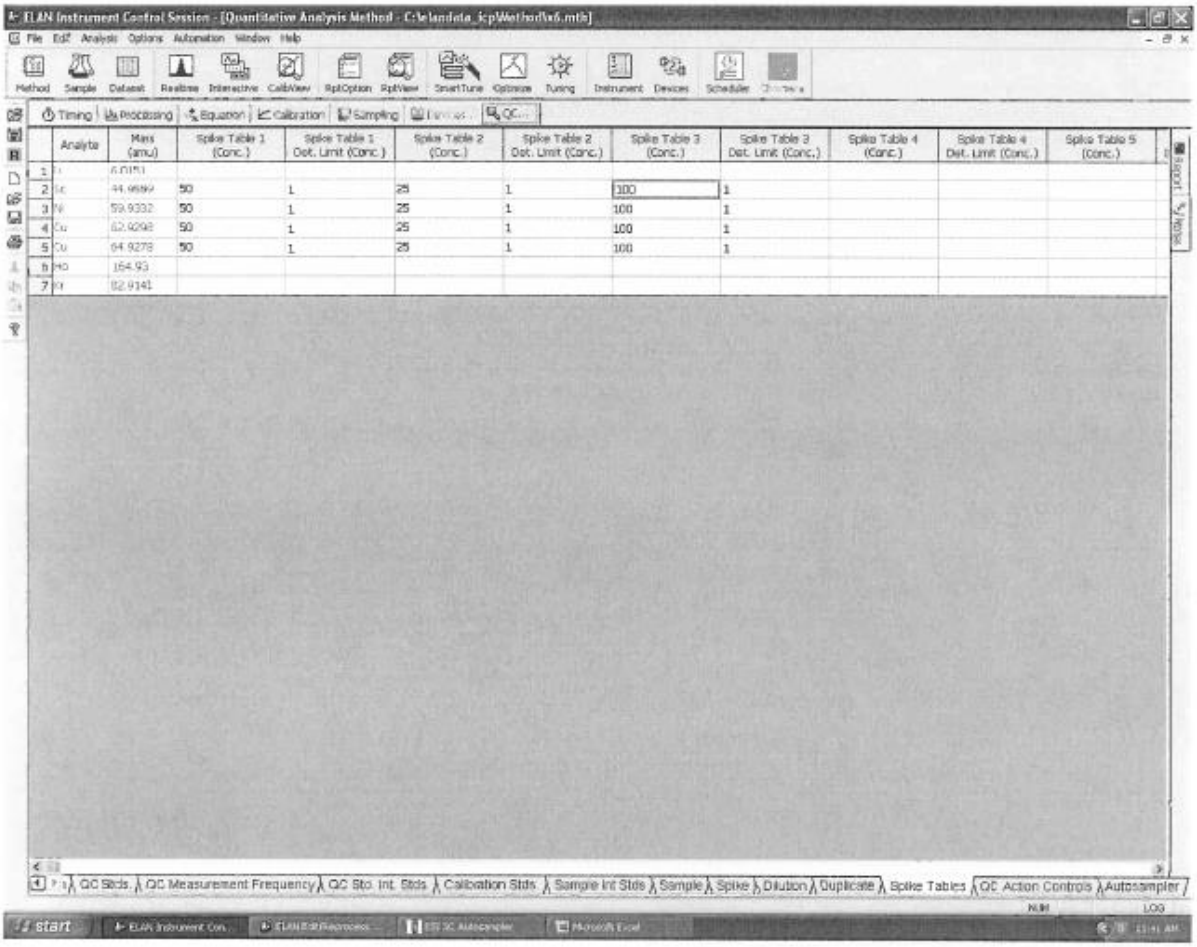
ICP-MS RUN SHEET
9/29/2014

Job Number:
14

A/S Loc.	Dilution	Sample ID	Client	Type	Weight (g)	Prep Vol (ml)
5		QC STD 2		Sample		
301		LRB FH		Sample		100
302	s	LRB FH		Spike - 1 of 2		100
303		23131-1 FH	Derenzo	Sample		100
304		23131-2 FH	Derenzo	Sample		100
305	d	23131-2 FH	Derenzo	Duplicate of 5		100
306		23131-3 FH	Derenzo	Sample		100
307	s	23131-3 FH	Derenzo	Spike - 1 of 7		100
308		23131-4 FH	Derenzo	Sample		100
309		LRB BH		Sample		50
310	s	LRB BH		Spike - 1 of 10		50
311		23131-1 BH	Derenzo	Sample		50x2
312		23131-2 BH	Derenzo	Sample		50x2
313	d	23131-2 BH	Derenzo	Duplicate of 13		50x2
314		23131-3 BH	Derenzo	Sample		50x2
315	s	23131-3 BH	Derenzo	Spike - 1 of 15		50x2
316		23131-4 BH	Derenzo	Sample		50x2
317		23131-4 FH unprep	Derenzo	Sample		315
318		23131-4 FHBH unpre	Derenzo	Sample		300
319		23131-4 FH	Derenzo	Sample		100

Spikes are post at 0.02mL of 25ppm spiking solutions lot 021414-AB in a final volume of 10mL

Submitted for QC by:	Date/Time:		QC Review By:	Date/Time:	
DBW	9/29/14 11:42		RS	10/6/14 @ 1242	
Re-Test Required:	No: ✓	Yes:	Comments:		
Resubmitted for QC by:	Date/Time:		QC Review:	By:	Date/Time:



Monday, Sep 29, 2014 11:41 AM

ICP-MS QC Values Table

Element or Test	ICP Element Mass	Element symbol	Lowest Reported Value (ug)	Upper Reported Value (ug)	Reporting Unit	QC #1	QC #2	QC #3	QC #4	QC #5	QC #6 A	QC #7 AB	QC #8 .25	QC #9 LRB	QC #10 LRB+	QC #11 LRB+
Lithium	6	*Li*														
Lithium	7	Li	1	500	mg/L	0	1	250	100	50				0	50	100
Beryllium	9	Be	1	500	mg/L	0	1	250	100	50			0.25	0	50	100
Boron	10	*B*	5	500	mg/L	0	1	250	100	50				0	50	100
Boron	11	B	5	500	mg/L	0	1	250	100	50				0	50	100
Sodium	23	Na	20	5500	mg/L	0	21	2500	1100	250				0	718	
Magnesium	24	Mg	20	5500	mg/L	0	21	2500	1100	250				0	550	
Magnesium	25	*Mg*	20	5500	mg/L	0	21	2500	1100	250				0	550	
Aluminum	27	Al	1	500	mg/L	0	1	250	100	50				0	50	100
Phosphorus	31	P	20	5000	mg/L	0	20	2500	1000	250				0	200	
Potassium	39	K	20	5500	mg/L	0	20	2000	1000	200				0	500	
Calcium	44	Ca	50	5500	mg/L	0	21	2500	1100	250				0	550	
Scandium	45															
Titanium	47	Ti	1	500	mg/L	0	1	250	100	50			0.25	0	50	100
Titanium	49	Ti	1	500	mg/L	0	1	250	100	50			0.25	0	50	100
Vanadium	51	V	1	500	mg/L	0	1	250	100	50	0	20	0.25	0	50	100
Vanadium	51	V	1	500	mg/L	0	1	250	100	50	0	20	0.25	0	50	100
Chromium	52	Cr	1	500	mg/L	0	1	250	100	50		10	0.25	0	50	100
Chromium	53	*Cr*	1	500	mg/L	0	1	250	100	50		10	0.25	0	50	100
Iron	54	Fe	20	5500	mg/L	0	21	2500	1100	250	0			0		
Manganese	55	Mn	1	500	mg/L	0	1	250	100	50	0	10	0.25	0	50	100
Iron	57	Fe	20	5500	mg/L	0	21	2500	1100	250	0			0		
Cobalt	59	Co	1	500	mg/L	0	1	250	100	50	0	20	0.25	0	50	100
Nickel	60	Ni	1	500	mg/L	0	1	250	100	50	0	20	0.25	0	50	100
Copper	63	Cu	1	500	mg/L	0	1	250	100	50	0	10	0.25	0	50	100
Copper	65	Cu	1	500	mg/L	0	1	250	100	50	0	10	0.25	0	50	100
Zinc	66	Zn	1	500	mg/L	0	1	250	100	50	0	10	0.25	0	50	100
Zinc	67	*Zn*	1	500	mg/L	0	1	250	100	50	0	10	0.25	0	50	100
Zinc	68	*Zn*	1	500	mg/L	0	1	250	100	50	0	10	0.25	0	50	100
Germanium	72	Ge	1	500	mg/L	0	1	250	100	50				0	50	100
Arsenic	75	As	1	500	mg/L	0	1	250	100	50	0	10	0.25	0	50	100
Selenium	77	*Se*	1	500	mg/L	0	1	250	100	50	0	10	0.25	0	50	100
Selenium	82	Se	1	500	mg/L	0	1	250	100	50	0	10	0.25	0	50	100
Strontium	88	Sr	1	500	mg/L	0	1	250	100	50	0			0	50	100
Molybdenum	95	*Mo*	1	500	mg/L	0	1	250	100	50			0.25	0	50	100
Molybdenum	97	*Mo*	1	500	mg/L	0	1	250	100	50			0.25	0	50	100
Molybdenum	98	Mo	1	500	mg/L	0	1	250	100	50			0.25	0	50	100
Rhodium	103															
Silver	107	Ag	1	500	mg/L	0	1	250	100	50	0	10		0	50	100
Silver	109	*Ag*	1	500	mg/L	0	1	250	100	50	0	10		0	50	100
Cadmium	111	Cd	1	500	mg/L	0	1	250	100	50	0	5	0.25	0	50	100
Cadmium	114	*Cd*	1	500	mg/L	0	1	250	100	50	0	5	0.25	0	50	100
Tin	118	Sn	1	500	mg/L	0	1	250	100	50	0			0	50	100
Antimony	121	*Sb*	1	500	mg/L	0	1	250	100	50	0		0.25	0	50	100
Antimony	123	Sb	1	500	mg/L	0	1	250	100	50	0		0.25	0	50	100
Tellurium	128	Te	1	500	mg/L	0	1	250	100	50				0	50	100
Cesium	133															
Barium	135	*Ba*	1	500	mg/L	0	1	250	100	50	0			0	50	100
Barium	137	Ba	1	500	mg/L	0	1	250	100	50	0			0	50	100
Lanthanum	139	La	1	500	mg/L	0	1	250	100	50				0	50	100
Tantalum	159	Ta	1	500	mg/L	0	1	250	100	50				0	50	100
Platinum	195	Pt	1	500	mg/L	0	1	250	100	50				0	50	100
Gold	181	Au	1	500	mg/L	0	1	250	100	50				0	50	100
Thallium	205	Tl	1	500	mg/L	0	1	250	100	50	0			0	50	100
Lead	208	Pb	1	500	mg/L	0	1	250	100	50	0		0.25	0	50	100
Bismuth	209	Bi	1	500	mg/L	0	1	250	100	50				0	50	100
Thorium	232	Th	1	500	mg/L	0	1	250	100	50				0	50	100
Uranium	238	U	1	500	mg/L	0	1	250	100	50				0	50	100
Krypton	83															

Method 6020 & 200.8 Metals Summary Report
Sample ID: Blank
Sample Da Monday, September 29, 2014 10:52:37
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	142299.8		ppb
|-	Sc	45	463654.3		ppb
|	Ni	60	62.7		ppb
|	Cu	63	342		ppb
|	Cu	65	181		ppb
|>	Rh	103	804145		ppb
	Ho	165	1555757.5		ppb
	Kr	83	960.7		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: Standard 1
Sample Da Monday, September 29, 2014 10:53:51
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	149247.7		ppb
|-	Sc	45	492034.8		ppb
|	Ni	60	4803.9	1.11242	ppb
|	Cu	63	11554	1.14896	ppb
|	Cu	65	5687.1	1.15528	ppb
|>	Rh	103	847351.1		ppb
	Ho	165	1635162.6		ppb
	Kr	83	571.4		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: Standard 2
Sample Da Monday, September 29, 2014 10:55:04
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	146490.5		ppb
|-	Sc	45	485784.2		ppb
|	Ni	60	451699.5	106.08949	ppb
|	Cu	63	1041729.4	106.93698	ppb
|	Cu	65	512682.1	107.75607	ppb
|>	Rh	103	847033.6		ppb
	Ho	165	1639860.9		ppb
	Kr	83	-29424.6		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: Standard 3
Sample Da Monday, September 29, 2014 10:56:18
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	139623.8		ppb
|-	Sc	45	489113.3		ppb
|	Ni	60	2030080.3	498.78188	ppb
|	Cu	63	4642802.2	498.61231	ppb
|	Cu	65	2266907.9	498.44848	ppb
|>	Rh	103	810007.5		ppb
	Ho	165	1604399.6		ppb
	Kr	83	-145839.7		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 1
Sample Da Monday, September 29, 2014 10:57:32
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	143852.1		ppb
|-	Sc	45	475939.2		ppb
|	Ni	60	136.3	0.01676	ppb
|	Cu	63	727.7	0.03831	ppb
|	Cu	65	337.3	0.03138	ppb
|>	Rh	103	840475.4		ppb
	Ho	165	1609668.1		ppb
	Kr	83	909		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 2
Sample Da Monday, September 29, 2014 10:58:46
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	142243.3		ppb
|-	Sc	45	477771.3		ppb
|	Ni	60	4748.9	1.1191	ppb
|	Cu	63	11464.2	1.16053	ppb
|	Cu	65	5723.5	1.18425	ppb
|>	Rh	103	832846		ppb
	Ho	165	1596670.6		ppb
	Kr	83	626.2		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 3
Sample Da Monday, September 29, 2014 10:59:59
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	132287.5		ppb
|-	Sc	45	466412.3		ppb
|	Ni	60	1015426.5	261.34376	ppb
|	Cu	63	2306846.5	259.52987	ppb
|	Cu	65	1182484.9	272.39341	ppb
|>	Rh	103	773042.9		ppb
	Ho	165	1514421.4		ppb
	Kr	83	-68238.5		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 4
Sample Da Monday, September 29, 2014 11:01:14
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	144719.4		ppb
|-	Sc	45	484065.3		ppb
|	Ni	60	458781.2	106.5426	ppb
|	Cu	63	1058938	107.4829	ppb
|	Cu	65	524257.5	108.95473	ppb
|>	Rh	103	856734.2		ppb
	Ho	165	1649582.5		ppb
	Kr	83	-30220.8		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 5
Sample Da Monday, September 29, 2014 11:02:29
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	147114		ppb
|-	Sc	45	490352.9		ppb
|	Ni	60	229331.3	53.14429	ppb
|	Cu	63	530621.6	53.73796	ppb
|	Cu	65	259948.2	53.898	ppb
|>	Rh	103	858354.2		ppb
	Ho	165	1648312.4		ppb
	Kr	83	928.6		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 6
Sample Da Monday, September 29, 2014 11:03:42
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	147018.3		ppb
|-	Sc	45	565556.1		ppb
|	Ni	60	19967.9	4.63078	ppb
|	Cu	63	18130.7	1.80735	ppb
|	Cu	65	10194.4	2.08328	ppb
|>	Rh	103	855053.5		ppb
	Ho	165	1767803.5		ppb
	Kr	83	958.8		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 7
Sample Da Monday, September 29, 2014 11:04:56
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	152742.8		ppb
|-	Sc	45	573239.3		ppb
|	Ni	60	98181.7	22.02928	ppb
|	Cu	63	117396.2	11.48593	ppb
|	Cu	65	58843.2	11.78588	ppb
|>	Rh	103	886292.4		ppb
	Ho	165	1844662.4		ppb
	Kr	83	959.7		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC STD 2
Sample Da Monday, September 29, 2014 11:06:10
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	139862.4		ppb
|-	Sc	45	444423.3		ppb
|	Ni	60	4586.5	1.12244	ppb
|	Cu	63	11164.2	1.17398	ppb
|	Cu	65	5467.3	1.17425	ppb
|>	Rh	103	801965.9		ppb
	Ho	165	1560969		ppb
	Kr	83	621.6		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: LRB FH
Sample Da Monday, September 29, 2014 11:07:24
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	156589.2		ppb
|-	Sc	45	542669.6		ppb
|	Ni	60	5458.3	1.23296	ppb
|	Cu	63	12338.7	1.19693	ppb
|	Cu	65	6032.7	1.1952	ppb
|>	Rh	103	869840.5		ppb
	Ho	165	1718658.6		ppb
	Kr	83	876.6		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: LRB FH
Sample Da Monday, September 29, 2014 11:08:38
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	160175.3		ppb
|-	Sc	45	543027.1		ppb
|	Ni	60	226790.9	52.41779	ppb
|	Cu	63	524472.5	52.97324	ppb
|	Cu	65	257992.5	53.35309	ppb
|>	Rh	103	860553		ppb
	Ho	165	1737189.8		ppb
	Kr	83	850		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-1 FH
Sample Da Monday, September 29, 2014 11:09:52
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	96194.1		ppb
|-	Sc	45	1119506.4		ppb
|	Ni	60	141497.9	38.26642	ppb
|	Cu	63	397677.7	46.99781	ppb
|	Cu	65	217895.6	52.72689	ppb
|>	Rh	103	735459.9		ppb
	Ho	165	1611759.9		ppb
	Kr	83	-614765.4		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-2 FH
Sample Da Monday, September 29, 2014 11:11:05
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	82486.1		ppb
|-	Sc	45	1085231.7		ppb
|	Ni	60	318030	84.73652	ppb
|	Cu	63	648115.3	75.47303	ppb
|	Cu	65	344640.3	82.17814	ppb
|>	Rh	103	746608.8		ppb
	Ho	165	1634908.7		ppb
	Kr	83	-650619.5		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-2 FH
Sample Da Monday, September 29, 2014 11:12:19
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	78550.1		ppb
|-	Sc	45	1110770		ppb
|	Ni	60	315211.5	81.37156	ppb
|	Cu	63	636218.5	71.7775	ppb
|	Cu	65	336689.2	77.77581	ppb
|>	Rh	103	770543.4		ppb
	Ho	165	1687975.4		ppb
	Kr	83	-664520.2		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-3 FH
Sample Da Monday, September 29, 2014 11:13:32
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	78478.9		ppb
|-	Sc	45	1119481.9		ppb
|	Ni	60	177101.9	45.66901	ppb
|	Cu	63	301292.5	33.94088	ppb
|	Cu	65	171231.3	39.49924	ppb
|>	Rh	103	771272.7		ppb
	Ho	165	1681886		ppb
	Kr	83	-671889.5		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-3 FH
Sample Da Monday, September 29, 2014 11:14:46
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	73558		ppb
|-	Sc	45	1127747.1		ppb
|	Ni	60	349568.1	91.47587	ppb
|	Cu	63	653757.1	74.76548	ppb
|	Cu	65	343299.8	80.3895	ppb
|>	Rh	103	760158.2		ppb
	Ho	165	1674936		ppb
	Kr	83	-664809.2		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-4 FH
Sample Da Monday, September 29, 2014 11:15:59
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	68265.3		ppb
|-	Sc	45	984812.6		ppb
|	Ni	60	93213.2	24.5911	ppb
|	Cu	63	178837.4	20.60079	ppb
|	Cu	65	108975	25.70983	ppb
|>	Rh	103	753752.2		ppb
	Ho	165	1665538.8		ppb
	Kr	83	-664530.7		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: LRB BH
Sample Da Monday, September 29, 2014 11:17:13
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	137915.4		ppb
|-	Sc	45	612398.5		ppb
|	Ni	60	3354.3	0.59773	ppb
|	Cu	63	11227.3	0.86055	ppb
|	Cu	65	5540.4	0.86691	ppb
|>	Rh	103	1088201.7		ppb
	Ho	165	1972594.5		ppb
	Kr	83	1045		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: LRB BH
Sample Da Monday, September 29, 2014 11:18:26
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	146773.4		ppb
|-	Sc	45	657686.1		ppb
|	Ni	60	278465.3	51.13663	ppb
|	Cu	63	619423.5	49.70407	ppb
|	Cu	65	304902.7	50.09543	ppb
|>	Rh	103	1083162.3		ppb
	Ho	165	1985668.2		ppb
	Kr	83	957.8		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 1
Sample Da Monday, September 29, 2014 11:19:42
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	127370.8		ppb
|-	Sc	45	498182.3		ppb
|	Ni	60	116.3	0.00823	ppb
|	Cu	63	635	0.01964	ppb
|	Cu	65	317	0.0178	ppb
|>	Rh	103	975290		ppb
	Ho	165	1792909.8		ppb
	Kr	83	1069.9		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 4
Sample Da Monday, September 29, 2014 11:20:56
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	127194.2		ppb
|-	Sc	45	516393.2		ppb
|	Ni	60	474566.9	96.49196	ppb
|	Cu	63	1080777.7	96.04544	ppb
|	Cu	65	533695.2	97.10872	ppb
|>	Rh	103	978397.1		ppb
	Ho	165	1821347.2		ppb
	Kr	83	-35015.6		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-1 BH
Sample Da Monday, September 29, 2014 11:22:12
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	136986.3		ppb
|-	Sc	45	624885.3		ppb
|	Ni	60	24476.2	4.6501	ppb
|	Cu	63	562991.1	46.8724	ppb
|	Cu	65	274856.9	46.84999	ppb
|>	Rh	103	1044198.2		ppb
	Ho	165	1969103.8		ppb
	Kr	83	-942.4		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-2 BH
Sample Da Monday, September 29, 2014 11:23:25
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	130891.7		ppb
|-	Sc	45	567678.1		ppb
|	Ni	60	24553.4	4.78176	ppb
|	Cu	63	173995.3	14.82322	ppb
|	Cu	65	85035.3	14.83031	ppb
|>	Rh	103	1018478.4		ppb
	Ho	165	1887685.6		ppb
	Kr	83	-500.2		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-2 BH
Sample Da Monday, September 29, 2014 11:24:39
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	134450.3		ppb
|-	Sc	45	583099.5		ppb
|	Ni	60	25062.5	4.84992	ppb
|	Cu	63	174124.8	14.74004	ppb
|	Cu	65	86076.9	14.91649	ppb
|>	Rh	103	1025099.9		ppb
	Ho	165	1927801		ppb
	Kr	83	-528.7		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-3 BH
Sample Da Monday, September 29, 2014 11:25:53
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	137368.4		ppb
|-	Sc	45	581323.9		ppb
|	Ni	60	26090.1	5.02109	ppb
|	Cu	63	73067.1	6.12939	ppb
|	Cu	65	36060	6.19115	ppb
|>	Rh	103	1030662.8		ppb
	Ho	165	1939720.6		ppb
	Kr	83	84.9		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-3 BH
Sample Da Monday, September 29, 2014 11:27:06
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	140347.1		ppb
|-	Sc	45	573503		ppb
|	Ni	60	276419	54.47475	ppb
|	Cu	63	628601.9	54.13763	ppb
|	Cu	65	310431.6	54.73786	ppb
|>	Rh	103	1009259.4		ppb
	Ho	165	1919661.3		ppb
	Kr	83	78.5		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: 23131-4 BH
Sample Da Monday, September 29, 2014 11:28:20
Sample De Derenzo
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	147136.6		ppb
|-	Sc	45	606221.4		ppb
|	Ni	60	18120.4	3.45723	ppb
|	Cu	63	11998.9	0.96832	ppb
|	Cu	65	5894.6	0.97105	ppb
|>	Rh	103	1038226.8		ppb
	Ho	165	1975487.1		ppb
	Kr	83	814.3		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 1
Sample Da Monday, September 29, 2014 11:29:35
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	132657.4		ppb
|-	Sc	45	486212.2		ppb
|	Ni	60	82	0.00169	ppb
|	Cu	63	407	0.00032	ppb
|	Cu	65	214	0.0001	ppb
|>	Rh	103	948470.6		ppb
	Ho	165	1786606.3		ppb
	Kr	83	1076.5		mg/L

Method 6020 & 200.8 Metals Summary Report
Sample ID: QC Std 4
Sample Da Monday, September 29, 2014 11:30:49
Sample Description:
Concentration Results

	Analyte	Mass	Meas. Intens	Conc. Mear	Report Unit
	Li	6	131543		ppb
|-	Sc	45	499712.1		ppb
|	Ni	60	463770.7	95.81318	ppb
|	Cu	63	1064984.3	96.16586	ppb
|	Cu	65	518610.2	95.88186	ppb
|>	Rh	103	962915.4		ppb
	Ho	165	1818278.8		ppb
	Kr	83	-34250.7		mg/L

APPENDIX F

FIELD SAMPLING DATA SHEETS AND COMPUTER GENERATED CALCULATION SHEETS

Isokinetic Field Sampling Data Sheet

Company	Eagle Mine			Leak Rate Initial	0.000 @ 12"
Source Designation	NWAR			Leak Rate Final	0.000 @ 7"
Test Date	9/16/14	Pitot Number	Probe 6F	Traverse points	24
Test Number	1	Meter Number	N-1	Pitot Cp	0.84
Operator	TW/JL	Kiso	1639.548	Meter Yd Factor	1.0138
Filter Numbers	022614 22	Delta H@	1.898	Molecular Weight (%)	
Bar. Press (Pb)	28.84	Assumed H2O	2.34%	O_2	20.9
Static Press (Ps)	-0.56	Cond.Vol. (Vlc-1)	10.3	CO_2	0.0
Stack Dia (in.)	126"	SG Gain (Vlc-2)	17.9		
		Nozzle Dia (in.)	0.219		

Initial

	Impinger	Final Wt (ml / g)	Initial Wt (ml / g)	Net Gain (ml / g)
700.5	1st	698.2	~~611.2~~ 685.6	-2.3
685.6	2nd	695.8	~~700.5~~	10.2
611.2	3rd	613.6	~~685.6~~ 611.2	2.4
845.6	Silica Gel	863.5	845.6	17.9

Traverse Point Number	Sampling Time (Min) ø	Time (24 hour)	Train Vacuum ("Hg)	Stack Temp (1) Ts (°F)	Velocity Pressure ("H2O) ΔP	Orifice Differential ("H2O) ΔH	Sample Vol (ft3) Vm	DGM Temp. Inlet (6) (°F) Tm	DGM Temp. Outlet (7) (°F) Tm	Probe Temp (2) (°F)	Filter Box Temp (3) (°F)	Last Imp Temp (4) (°F)
1	0	11:55	5.0	59	0.92	2.30	118.888	63	62	254	241	67
2	5	12:00	5.0	59	0.90	2.26	123.07	69	63	255	253	67
3	10	12:05	4.5	59	0.79	2.00	127.25	74	64	253	258	64
4	15	12:10	4.0	59	0.69	1.75	131.17	77	65	253	260	65
5	20	12:15	4.0	59	0.59	1.50	134.98	79	66	253	261	66
6	25	12:20	3.0	58	0.42	1.07	138.51	80	67	253	258	67
off	30	12:25	–	–	–	–	141.413	–	–	–	–	–
1	30	12:32	5.0	59	0.96	2.44	141.413	73	70	252	249	66
2	35	12:37	5.0	59	0.95	2.44	145.77	82	71	250	248	65
3	40	12:42	4.5	59	0.80	2.06	150.14	85	72	252	249	65
4	45	12:47	3.5	59	0.50	1.29	154.18	87	73	256	256	65
5	50	12:52	3.5	59	0.49	1.27	157.51	87	74	253	252	66
6	55	12:57	3.5	59	0.51	1.32	160.82	87	75	253	253	66
off	60	13:02	–	–	–	–	164.161	–	–	–	–	–
1	60	13:07	6.0	61	1.25	3.21	164.161	81	77	254	257	67
2	65	13:12	6.0	61	1.20	3.11	169.04	89	78	251	254	66
3	70	13:17	6.0	61	1.10	2.86	173.91	92	79	254	254	63
4	75	13:22	5.5	59	1.05	2.74	178.63	93	80	253	253	62
5	80	13:27	5.0	60	0.97	2.53	183.25	94	81	253	253	62
6	85	13:32	5.0	60	0.91	2.38	187.72	95	82	253	252	62
off	90	13:37	–	–	–	–	192.069	–	–	–	–	–
1	90	13:40	5.0	61	0.97	2.52	192.069	87	83	249	256	61
2	95	13:45	5.0	61	0.92	2.40	196.52	94	83	252	253	60
3	100	13:50	4.5	61	0.80	2.09	200.91	95	84	254	253	55
4	105	13:55	4.5	61	0.75	1.97	205.00	96	85	249	250	60
5	110	14:00	4.0	61	0.64	1.68	209.07	97	85	255	253	60
6	115	14:05	4.0	62	0.63	1.65	212.78	97	86	254	253	61
off	120	14:10	–	–	–	–	216.579	–	–	–	–	–

$\Delta H = Mf * (Tm/Ts) * (\Delta P)$

Note: All temperatures are °R (°F+460)

$Yc = (10/Vm)*((0.0319*(Tm))/Pb)^{0.5}$

Mf = 846.72 * (Dn^4) * (ΔH@) * (Cp^2) * ((1-(Bws/100))^2) * (Md/Ms) * (Ps/Pm)

Mf = 846.72 * (____) * (____) * (____) * (____) * (____) * (____)

Mf = _____

Nozzle Determination:

ΔH@ / Kiso*(Cp)^2*(1-(Bws/100))^2*(Md/Ms)*(Ps/Pm)*(Tm/Ts)* $\Delta P_{(average)}$ = $\sqrt[4]{Dn}$

(Recommend multiplying calculate nozzle size by 5%) Dn *1.05= _____

Pm = _____ Pbar + (ΔH@/13.6)

Ps = _____ Pbar + (Pstat/13.6)

Md = _____ $0.44(\%CO_2)+0.32(\%O_2)+0.28(\%N_2+\%CO)$

Ms = _____ (Md)(1-(Bws/100))+18(Bws/100)

Bws = _____ (Vwc+Vwsg)/(Vwc+Vwsg+Vm)

Vwc = _____ 0.04706(Vf-Vi)

Vwsg = _____ 0.04715(Wf-Wi)

Isokinetic Field Sampling Data Sheet

Company	Eagle Mine				
Source Designation	MVAR				
Test Date	9/16/14	Pitot Number	Probe 6F	Leak Rate Initial	0.000 @ 10"
Test Number	2	Meter Number	N-1	Leak Rate Final	0.000 @ 7"
Operator	TW/JL	Kiso	1639.548	Traverse points	24
Filter Numbers	022614 23	Delta H@	1.898	Pitot Cp	0.84
Bar. Press (Pb)	28.80	Assumed H2O	2.34%	Meter Yd Factor	1.0138
Static Press (Ps)	-0.56	Cond.Vol. (Vlc-1)	2.1	Molecular Weight (%)	
Stack Dia (in.)	126"	SG Gain (Vlc-2)	27.5	O_2	20.9
		Nozzle Dia (in.)	0.219	CO_2	0.0

Initial

	Impinger	Final Wt (ml / g)	Initial Wt (ml / g)	Net Gain (ml / g)
618.3	1st	609.4	~~600.7~~ 618.3	-8.9
687.5	2nd	695.7	~~687.5~~ 687.5	8.2
600.7	3rd	603.5	~~687.5~~ 600.7	2.8
907.7	Silica Gel	935.2	907.7	27.5

Traverse Point Number	Sampling Time (Min) ø	Time (24 hour)	Train Vacuum ("Hg)	Stack Temp Ts (°F)	Velocity Pressure ("H2O) ΔP	Orifice Differential ("H2O) ΔH	Sample Vol (ft3) Vm	DGM Temp. Inlet (°F) Tm	DGM Temp. Outlet (°F) Tm	Probe Temp (°F)	Filter Box Temp (°F)	Last Imp. Temp. (°F)
1	0	15:00	4.5	60	0.95	2.47	216.754	84	84	255	242	67
2	5	15:05	4.0	60	0.89	2.32	221.14	89	85	254	250	67
3	10	15:10	4.0	60	0.85	2.22	225.43	92	84	256	254	67
4	15	15:15	4.0	60	0.75	1.97	229.70	95	85	255	255	67
5	20	15:20	3.5	61	0.70	1.83	233.68	96	85	252	253	67
6	25	15:25	3.5	60	0.66	1.71	237.53	97	86	256	254	67
off	30	15:30	—	—	—	—	241.336	—	—	—	—	—
1	30	15:34	5.0	60	1.15	3.00	241.336	89	86	260	255	67
2	35	15:39	5.0	60	1.00	2.63	246.14	96	87	254	253	66
3	40	15:44	5.0	60	0.95	2.50	250.75	98	87	254	253	66
4	45	15:49	4.0	60	0.88	2.32	255.21	99	88	256	253	66
5	50	15:54	4.5	60	0.93	2.46	259.54	99	88	256	254	65
6	55	15:59	4.5	60	0.91	2.41	264.01	100	89	254	253	66
off	60	16:04	—	—	—	—	268.459	—	—	—	—	—
1	60	16:07	5.0	62	1.10	2.88	268.459	92	89	255	249	66
2	65	16:12	4.5	60	0.95	2.51	273.22	99	89	248	240	66
3	70	16:17	4.0	60	0.82	2.17	277.72	100	90	256	252	67
4	75	16:22	4.0	60	0.80	2.12	281.90	100	90	253	247	66
5	80	16:27	3.0	60	0.50	1.32	286.01	101	90	256	251	65
6	85	16:32	3.0	59	0.49	1.30	289.40	100	90	255	251	64
off	90	16:37	—	—	—	—	292.771	—	—	—	—	—
1	90	16:41	4.5	60	0.96	2.53	292.771	93	90	257	259	64
2	95	16:46	4.0	59	0.85	2.25	297.27	98	90	252	251	62
3	100	16:51	4.0	59	0.74	1.96	301.57	100	90	255	253	62
4	105	16:56	3.5	58	0.67	1.78	305.62	100	90	255	252	62
5	110	17:01	3.5	59	0.61	1.62	309.50	100	91	254	255	63
6	115	17:06	3.0	58	0.60	1.59	313.23	99	91	254	254	63
off	120	17:11	—	—	—	—	316.939	—	—	—	—	—

ΔH = Mf * (Tm/Ts) * (ΔP)

Note: All temperatures are °R (°F+460)

Yc= (10/Vm)*((0.0319*(Tm))/Pb)^0.5

Mf = 846.72 * (Dn^4) * (ΔH@) * (Cp^2) * ((1-(Bws/100))^2) * (Md/Ms) * (Ps/Pm)

Mf = 846.72 * (_____) * (_____) * (_____) * (_____) * (_____) * (_____)

Mf = _____

Nozzle Determination:

ΔH@ / Kiso*(Cp)^2*(1-(Bws/100))^2*(Md/Ms)*(Ps/Pm)*(Tm/Ts)* $\Delta P_{(average)}$ = $\sqrt[4]{Dn}$

(Recommend multiplying calculate nozzle size by 5%) Dn *1.05= _____

Pm = _____ Pbar + (ΔH@/13.6)

Ps = _____ Pbar + (Pstat/13.6)

Md = _____ 0.44(%CO_2)+0.32(%O_2)+0.28(%N_2+%CO)

Ms = _____ (Md)(1-(Bws/100))+18(Bws/100)

Bws = _____ (Vwc+Vwsg)/(Vwc+Vwsg+Vm)

Vwc = _____ 0.04706(Vf-Vi)

Vwsg = _____ 0.04715(Wf-Wi)

Isokinetic Field Sampling Data Sheet

Company	Eagle Mine			Leak Rate Initial	0.000 @10"
Source Designation	MYAR			Leak Rate Final	0.000@7"
Test Date	9/16/14	Pitot Number	Probe 6F	Traverse points	24
Test Number	3	Meter Number	N-1	Pitot Cp	0.84
Operator	TW/JL	Kiso	1639.548	Meter Yd Factor	1.0138
Filter Numbers	022614 24	Delta H@	1.898	Molecular Weight (%)	
Bar. Press (Pb)	28.80	Assumed H2O	2.34%	O_2	20.9
Static Press (Ps)	-0.56	Cond.Vol. (Vlc-1)	11.8	CO_2	0.0
Stack Dia (in.)	126"	SG Gain (Vlc-2)	20.0		
		Nozzle Dia (in.)	0.219		

Impinger	Final Wt (ml / g)	Initial Wt (ml / g)	Net Gain (ml / g)
1st	721.7	720.5	1.2
2nd	696.6	687.8	8.8
3rd	595.9	594.1	1.8
Silica Gel	883.5	863.5	20.0

Traverse Point Number	Sampling Time (Min) ø	Time (24 hour)	Train Vacuum ("Hg)	Stack Temp Ts (°F)	Velocity Pressure ("H2O) ΔP	Orifice Differential ("H2O) ΔH	Sample Vol (ft3) Vm	DGM Temp. Inlet (°F) Tm	DGM Temp. Outlet (°F) Tm	Probe Temp (°F)	Filter Box Temp (°F)	Last Imp. Temp. (°F)
1	0	17:59	5.0	58	0.88	2.30	317.123	85	85	256	254	62
2	5	18:04	4.5	58	0.77	2.02	321.43	89	85	253	254	62
3	10	18:09	4.5	58	0.80	2.10	325.50	91	85	254	254	60
4	15	18:14	4.5	58	0.75	1.97	329.58	94	85	256	253	62
5	20	18:19	4.0	58	0.71	1.87	333.63	95	85	255	253	65
6	25	18:24	4.5	58	0.74	1.95	337.58	96	86	255	255	67
off	30	18:29	—	—	—	—	341.623	—	—	—	—	—
1	30	18:32	5.5	58	1.05	2.75	341.623	88	85	258	254	62
2	35	18:37	5.0	58	0.92	2.43	346.27	95	86	254	253	66
3	40	18:42	5.0	58	0.86	2.27	350.75	96	86	254	252	67
4	45	18:47	4.0	58	0.69	1.82	355.06	96	86	254	254	65
5	50	18:52	4.5	58	0.75	1.98	358.99	96	86	254	252	61
6	55	18:57	4.0	58	0.67	1.77	363.03	96	87	255	252	59
off	60	19:02	—	—	—	—	366.901	—	—	—	—	—
1	60	19:06	6.0	57	1.20	3.15	366.901	89	86	256	256	57
2	65	19:11	5.5	57	1.10	2.91	371.89	95	87	253	252	57
3	70	19:16	6.0	57	1.15	3.04	376.70	97	86	254	252	55
4	75	19:21	5.5	57	1.05	2.78	381.60	97	87	254	253	55
5	80	19:26	5.5	57	1.00	2.65	386.30	97	86	254	253	56
6	85	19:31	5.0	57	0.99	2.62	390.89	97	86	254	253	56
off	90	19:36	—	—	—	—	395.508	—	—	—	—	—
1	90	19:40	5.0	58	0.90	2.36	395.508	89	86	254	254	54
2	95	19:45	5.0	57	0.87	2.29	399.93	93	86	252	252	55
3	100	19:50	4.5	57	0.83	2.19	404.25	94	85	253	253	53
4	105	19:55	4.5	57	0.77	2.03	408.48	95	85	253	252	53
5	110	20:00	4.0	57	0.65	1.71	412.53	94	85	253	252	54
6	115	20:05	4.0	58	0.65	1.71	416.35	94	85	254	253	54
off	120	20:10	—	—	—	—	420.164	—	—	—	—	—

ΔH = Mf * (Tm/Ts) * (ΔP)

Note: All temperatures are °R (°F+460)

Yc= (10/Vm)*((0.0319*(Tm))/Pb)^0.5

Mf = 846.72 * (Dn^4) * (ΔH@) * (Cp^2) * ((1-(Bws/100))^2) * (Md/Ms) * (Ps/Pm)

Mf = 846.72 * (_____) * (_____) * (_____) * (_____) * (_____) * (_____)

Mf = _____

Pm = _____ Pbar + (ΔH@/13.6)

Ps = _____ Pbar + (Pstat/13.6)

Md = _____ 0.44(%CO_2)+0.32(%O_2)+0.28(%N_2+%CO)

Ms = _____ (Md)(1-(Bws/100))+18(Bws/100)

Bws = _____ (Vwc+Vwsg)/(Vwc+Vwsg+Vm)

Vwc = _____ 0.04706(Vf-Vi)

Vwsg = _____ 0.04715(Wf-Wi)

Nozzle Determination:

ΔH@ / Kiso*(Cp)^2*(1-(Bws/100))^2*(Md/Ms)*(Ps/Pm)*(Tm/Ts)* $\Delta P_{(average)}$ = $\sqrt[4]{Dn}$

(Recommend multiplying calculate nozzle size by 5%) Dn *1.05= _____

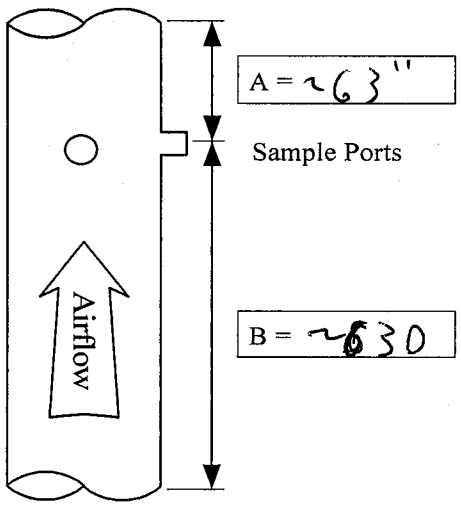
Derenzo and Associates, Inc.

USEPA Method 2
Gas Velocity Measurement Data Sheet

Company	~~Derenzo~~ Eagle Mine	No. of Points	24
Source Designation	MUAR	Operator(s)	JR, TW
Test Date	9/16/14	Pitot Type	(Type S) or Standard
Test Number	Prelim	Pitot Identification	6F-1
Time (24-hr clock)	9:45	O_2 Content (%)	Ambient
Barometric Press. (in. Hg)	28.98	CO_2 Content (%)	Ambient
Static Pressure (in. H_2O)	-0.56	Wet Bulb Temp.	63.5 °F

Inches from Stack Wall	Traverse Point Number	Stack Temperature (°F)	Velocity Head (in. H_2O)	Null Angel (zero angle)
2.65	1	62	0.99	3
8.44	2	61	0.98	0
14.87	3	60	0.91	0
22.30	4	60	0.80	0
31.50	5	59	0.70	0
44.86	6	59	0.60	10
81.14	7 1	58	0.88	5
94.50	8 2	58	0.88	2
103.70	9 3	57	0.85	0
111.13	10 4	58	0.81	0
117.56	11 5	57	0.74	5
123.35	12 6	57	0.65	5
	1	57	1.20	0
	2	56	1.20	5
	3	56	1.00	3
	4	56	0.99	2
	5	57	0.91	3
	6	57	0.80	3
	1	56	0.95	7
	2	56	0.99	0
	3	56	0.90	3
	4	56	0.82	5
	5	56	0.76	5
	6	56	0.70	0

Stack / Duct Measurements



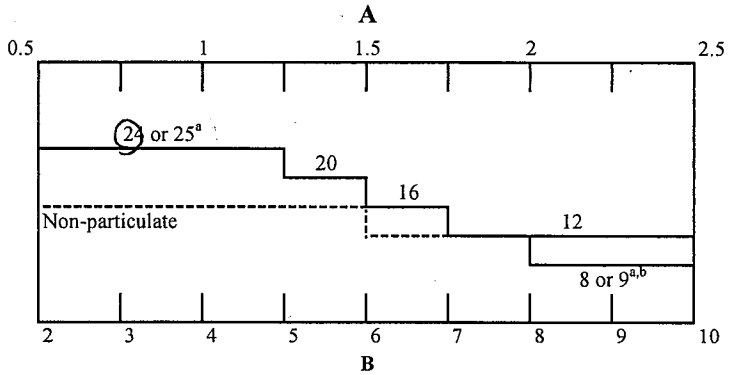
Round Duct Dia. (D): 126" (+5 3/4" nipple)

Square Duct (LxW): x

Square Duct Dia. (De): De = 2LW / (L+W)

Straight Length: (diameters) A / D: ~~0~~05

B / D: ~5



a- Higher No. for rectanguar stacks
b- For stacks between 12 and 24 in.

Traverse Point	No. of Traverse Points Per Dia. 6	8	10	12
1	4.4	3.2	2.6	2.1
2	14.6	10.5	8.2	6.7
3	29.6	19.4	14.6	11.8
4	70.4	32.2	22.6	17.7
5	85.4	67.7	34.2	25.0
6	95.6	80.6	65.8	35.6
7		89.5	77.4	64.4
8		96.8	85.4	75.0
9			91.8	82.3
10			97.4	88.2
11				93.3
12				97.9

Derenzo and Associates, Inc.

Company	Eagle Mine		
Source Designation	MVAR		
Test Date	9/16/2014	**Assumed Moisture (Bws)**	2.34
Test Number	T1	**Total Moisture Gan (Vlc)**	28.2
Operator	TW/JL		
Filter Number	022614 22	**Nozzle Diameter (in.)**	0.219
Barometric Pressure (Pb)	28.84	**Leak Rate Initial**	0.000 @ 12"
Stack Static Pressure (Ps)	-0.56	**Leak Rate Final**	0.000 @ 7"
Stack Dimensions (in.)	126	**Traverse points**	24
Pitot Tube Number	Probe 6F	**Pitot Corr. Factor (Cp)**	0.84
Meter Number	N-1	**Meter Corr. Factor (Y)**	1.0138
Meter Iso. Factor (Kiso)	1639.548	**Method 3A Results (%)**	
Delta H@	1.898	(Fyrite) **CO_2**	0.00
		(Fyrite) **O_2**	20.90

Traverse Point Number	Sampling Time (Minutes) ø	Clock Time (24 hour)	Sampling Train Vac. ("Hg)	Stack Temp. (^oF) Ts	Velocity Pres. ("H_2O) Delta P	Orifice Differential ("H_2O) Delta H	Sample Volume (cubic feet) Vm	Dry Gas Meter Temp. Inlet (^oF) Tm	Dry Gas Meter Temp. Outlet (^oF) Tm	Filter Box Temperature (^oF)	Last Impinger Temperature (^oF)
1	0	11:55:00	5.0	59	0.92	2.30	118.888	63	62	241	67
2	5	12:00:00	5.0	59	0.90	2.26	123.07	69	63	253	67
3	10	12:05:00	4.5	59	0.79	2.00	127.25	74	64	258	64
4	15	12:10:00	4.0	59	0.69	1.75	131.17	77	65	260	65
5	20	12:15:00	4.0	59	0.59	1.50	134.98	79	66	261	66
6	25	12:20:00	3.0	58	0.42	1.07	138.51	80	67	258	67
off	30	12:25:00	-	-	-	-	141.413	-	-	-	-
1	30	12:32:00	5.0	59	0.96	2.44	141.413	73	70	249	66
2	35	12:37:00	5.0	59	0.95	2.44	145.77	82	71	248	65
3	40	12:42:00	4.5	59	0.80	2.06	150.14	85	72	249	65
4	45	12:47:00	3.5	59	0.50	1.29	154.18	87	73	256	65
5	50	12:52:00	3.5	59	0.49	1.27	157.51	87	74	252	66
6	55	12:57:00	3.5	59	0.51	1.32	160.82	87	75	253	66
off	60	13:02:00	-	-	-	-	164.161	-	-	-	-
1	60	13:07:00	6.0	61	1.25	3.21	164.161	81	77	257	67
2	65	13:12:00	6.0	61	1.20	3.11	169.04	89	78	254	66
3	70	13:17:00	6.0	61	1.10	2.86	173.91	92	79	254	63
4	75	13:22:00	5.5	59	1.05	2.74	178.63	93	80	253	62
5	80	13:27:00	5.0	60	0.97	2.53	183.25	94	81	253	62
6	85	13:32:00	5.0	60	0.91	2.38	187.72	95	82	252	62
off	90	13:37:00	-	-	-	-	192.069	-	-	-	-
1	90	13:40:00	5.0	61	0.97	2.52	192.069	87	83	256	61
2	95	13:45:00	5.0	61	0.92	2.40	196.52	94	83	253	60
3	100	13:50:00	4.5	61	0.80	2.09	200.91	95	84	253	55
4	105	13:55:00	4.5	61	0.75	1.97	205.00	96	85	250	60
5	110	14:00:00	4.0	61	0.64	1.68	209.01	97	85	253	60
6	115	14:05:00	4.0	62	0.63	1.65	212.78	97	86	253	61
off	120	14:10:00	-	-	-	-	216.579	-	-	-	-
Average	120			59.8	0.8	2.1	97.691	85.5	75.2	253.3	63.7

Derenzo and Associates, Inc.

Company	Eagle Mine		
Source Designation	MVAR		
Test Date	9/16/2014	**Assumed Moisture (Bws)**	2.34
Test Number	2	**Total Moisture Gan (Vlc)**	29.6
Operator	TW/JL		
Filter Number	022614 23	**Nozzle Diameter (in.)**	0.219
Barometric Pressure (Pb)	28.80	**Leak Rate Initial**	0.000 @ 10"
Stack Static Pressure (Ps)	-0.56	**Leak Rate Final**	0.000 @ 7"
Stack Dimensions (in.)	126	**Traverse points**	24
Pitot Tube Number	Probe 6F	**Pitot Corr. Factor (Cp)**	0.84
Meter Number	N-1	**Meter Corr. Factor (Y)**	1.0138
Meter Iso. Factor (Kiso)	1639.548	**Method 3A Results (%)**	
Delta H@	1.898	(Fyrite) **CO_2**	0.00
		(Fyrite) **O_2**	20.90

Traverse Point Number	Sampling Time (Minutes) ø	Clock Time (24 hour)	Sampling Train Vac. ("Hg)	Stack Temp. (^oF) Ts	Velocity Pres. ("H_2O) Delta P	Orifice Differential ("H_2O) Delta H	Sample Volume (cubic feet) Vm	Dry Gas Meter Temp. Inlet (^oF) Tm	Dry Gas Meter Temp. Outlet (^oF) Tm	Filter Box Temperature (^oF)	Last Impinger Temperature (^oF)
1	0	15:00:00	4.5	60	0.95	2.47	216.754	84	84	242	67
2	5	15:05:00	4.0	60	0.89	2.32	221.14	89	85	250	67
3	10	15:10:00	4.0	60	0.85	2.22	225.43	92	84	254	67
4	15	15:15:00	4.0	60	0.75	1.97	229.70	95	85	255	67
5	20	15:20:00	3.5	61	0.70	1.83	233.68	96	85	253	67
6	25	15:25:00	3.5	60	0.66	1.71	237.53	97	86	254	67
off	30	15:30:00	-	-	-	-	241.336	-	-	-	-
1	30	15:34:00	5.0	60	1.15	3.00	241.336	89	86	255	67
2	35	15:39:00	5.0	60	1.00	2.63	246.14	96	87	253	66
3	40	15:44:00	5.0	60	0.95	2.50	250.75	98	87	253	66
4	45	15:49:00	4.0	60	0.88	2.32	255.21	99	88	253	66
5	50	15:54:00	4.5	60	0.93	2.46	259.54	99	88	254	65
6	55	15:59:00	4.5	60	0.91	2.41	264.01	100	89	253	66
off	60	16:04:00	-	-	-	-	268.459	-	-	-	-
1	60	16:07:00	5.0	62	1.10	2.88	268.459	92	89	249	66
2	65	16:12:00	4.5	60	0.95	2.51	273.22	99	89	240	66
3	70	16:17:00	4.0	60	0.82	2.17	277.72	100	90	252	67
4	75	16:22:00	4.0	60	0.80	2.12	281.90	100	90	247	66
5	80	16:27:00	3.0	60	0.50	1.32	286.01	101	90	251	65
6	85	16:32:00	3.0	59	0.49	1.30	289.40	100	90	251	64
off	90	16:37:00	-	-	-	-	292.771	-	-	-	-
1	90	16:41:00	4.5	60	0.96	2.53	292.771	93	90	259	64
2	95	16:46:00	4.0	59	0.85	2.25	297.27	98	90	251	62
3	100	16:51:00	4.0	59	0.74	1.96	301.57	100	90	253	62
4	105	16:56:00	3.5	58	0.67	1.78	305.62	100	90	252	62
5	110	17:01:00	3.5	59	0.61	1.62	309.50	100	91	255	63
6	115	17:06:00	3.0	58	0.60	1.59	313.23	99	91	254	63
off	120	17:11:00	-	-	-	-	316.939	-	-	-	-
Average	120			59.8	0.8	2.2	100.185	96.5	88.1	251.8	65.3

Derenzo and Associates, Inc.

Company	Eagle Mine		
Source Designation	MVAR		
Test Date	9/16/2014	**Assumed Moisture (Bws)**	2.34
Test Number	3	**Total Moisture Gan (Vlc)**	31.8
Operator	TW/JL		
Filter Number	022614 24	**Nozzle Diameter (in.)**	0.219
Barometric Pressure (Pb)	28.80	**Leak Rate Initial**	0.000 @ 10"
Stack Static Pressure (Ps)	-0.56	**Leak Rate Final**	0.000 @ 7"
Stack Dimensions (in.)	126	**Traverse points**	24
Pitot Tube Number	Probe 6F	**Pitot Corr. Factor (Cp)**	0.84
Meter Number	N-1	**Meter Corr. Factor (Y)**	1.0138
Meter Iso. Factor (Kiso)	1639.548	**Method 3A Results (%)**	
Delta H@	1.898	(Fyrite) **CO_2**	0.00
		(Fyrite) **O_2**	20.90

Traverse Point Number	Sampling Time (Minutes) ø	Clock Time (24 hour)	Sampling Train Vac. ("Hg)	Stack Temp. (^oF) Ts	Velocity Pres. ("H_2O) Delta P	Orifice Differential ("H_2O) Delta H	Sample Volume (cubic feet) Vm	Dry Gas Meter Temp. Inlet (^oF) Tm	Dry Gas Meter Temp. Outlet (^oF) Tm	Filter Box Temperature (^oF)	Last Impinger Temperature (^oF)
1	0	17:59:00	5.0	58	0.88	2.30	317.123	85	85	254	62
2	5	18:04:00	4.5	58	0.77	2.02	321.43	89	85	254	62
3	10	18:09:00	4.5	58	0.80	2.10	325.50	91	85	254	60
4	15	18:14:00	4.5	58	0.75	1.97	329.58	94	85	253	62
5	20	18:19:00	4.0	58	0.71	1.87	333.63	95	85	253	65
6	25	18:24:00	4.5	58	0.74	1.95	337.58	96	86	255	67
off	30	18:29:00	-	-	-	-	341.623	-	-	-	-
1	30	18:32:00	5.5	58	1.05	2.75	341.623	88	85	254	62
2	35	18:37:00	5.0	58	0.92	2.43	346.27	95	86	253	66
3	40	18:42:00	5.0	58	0.86	2.27	350.75	96	86	252	67
4	45	18:47:00	4.0	58	0.69	1.82	355.06	96	86	254	65
5	50	18:52:00	4.5	58	0.75	1.98	358.99	96	86	252	61
6	55	18:57:00	4.0	58	0.67	1.77	363.03	96	87	252	59
off	60	19:02:00	-	-	-	-	366.901	-	-	-	-
1	60	19:06:00	6.0	57	1.20	3.15	366.901	89	86	256	57
2	65	19:11:00	5.5	57	1.10	2.91	371.89	95	87	252	57
3	70	19:16:00	6.0	57	1.15	3.04	376.70	97	86	252	55
4	75	19:21:00	5.5	57	1.05	2.78	381.60	97	87	253	55
5	80	19:26:00	5.5	57	1.00	2.65	386.30	97	86	253	56
6	85	19:31:00	5.0	57	0.99	2.62	390.89	97	86	253	56
off	90	19:36:00	-	-	-	-	395.508	-	-	-	-
1	90	19:40:00	5.0	58	0.90	2.36	395.508	89	86	254	54
2	95	19:45:00	5.0	57	0.87	2.29	399.93	93	86	252	55
3	100	19:50:00	4.5	57	0.83	2.19	404.25	94	85	253	53
4	105	19:55:00	4.5	57	0.77	2.03	408.48	95	85	252	53
5	110	20:00:00	4.0	57	0.65	1.71	412.53	94	85	252	54
6	115	20:05:00	4.0	58	0.65	1.71	416.35	94	85	253	54
off	120	20:10:00	-	-	-	-	420.164	-	-	-	-
Average	120			57.6	0.9	2.3	103.041	93.7	85.7	253.1	59.0

Derenzo and Associates, Inc.

Company		**Eagle Mine**		
Source Designation		**MVAR**		
Test Date	**9/16/2014**	**9/16/2014**	**9/16/2014**	
Test Start Time	**11:55**	**15:00**	**17:59**	
Meter/Nozzle Information	MVAR-1	MVAR-2	MVAR-3	Average
Meter Temperature, Tm (°F)	80.38	92.29	89.69	87.45
Meter Pressure, Pm (in. Hg)	29.00	28.96	28.97	28.97
Measured Sample Volume, Vm (ft^3)	97.691	100.185	103.041	100.31
Meter Correction Factor, Y	1.0138	1.0138	1.0138	1.0138
Sample Volume at STP, Vm (Std ft^3) = (Vm*Y*17.64*Pm)/(Tm+460)	93.74	93.94	97.11	94.93
Sample Volume at STP, Vm (Std m^3) = (Vm(Std ft^3))*0.028317	2.65	2.66	2.75	2.69
Condensate Volume, Vw (std) = (0.04707 * Vwc) + (0.04715 * Vwsg)	1.33	1.39	1.50	1.41
Gas Density, ρs (std lbs/ft^3) = (Md(1-Bws) + 18(Bws))/385	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas, Ws (lbs) = (Vm + Vw) * ρs	7.083	7.101	7.343	7.176
Nozzle Size, An (sq. ft.) = ΠD/(4)^2, where D = Nozzle dia.	0.0002616	0.0002616	0.0002616	0.0002616
Isokinetic Variation, I	101.0	101.0	101.4	101.1
=100*Ts(0.002669(Vwc + Wsg)+((Vm*Y)/Tm)*Pm)/(60*C*vs*Ps*An)				
Stack Data				
Average Stack Temperature, Ts (°F)	59.8	59.8	57.6	59.1
Molecular Weight Stack Gas-dry, Md (lb/lb mole)	28.84	28.84	28.84	28.84
Molecular Weight Stack Gas-wet, Ms (lb/lb mole)	28.68	28.68	28.67	28.68
Stack Gas Specific Gravity, Gs	0.99	0.00	0.00	0.33
Percent Moisture, Bws = Vw/(Vw+Vm)*100	1.40	1.46	1.52	1.46
Water Vapor Volume (fraction) = Bws/100	0.014	0.015	0.015	0.015
Stack Pressure, Ps("Hg)	28.80	28.76	28.76	28.77
Average Stack Velocity, Vs (ft/s)	51.12	51.37	52.68	51.73
Area of Stack, As (ft^2)	86.59	86.59	86.59	86.59
Exhaust Gas Flowrate				
Actual flowrate, Qs (ACFM)= Vs*As*60	265,596	266,884	273,719	268,733
Standard wet flowrate, Qw (WSCFM) = 528*Qs*Ps/(Ts*29.92)	259,660	260,577	268,392	262,876
Dry standard flowrate, Qstd (DSCFM) = Qw *(1-Bws/100)	256,035	256,769	264,317	259,040
Dry standard flowrate, Qstd (DSCMM) = Qstd*0.028317	7,250.1	7,270.9	7,484.7	7,335.2
Standard Temperature and Pressure = 29.92 "Hg and 68°F				
Total Copper Weights				
Filter and Rinses (µg)	9.39	9.03	4.00	7.47
Total Copper Emission Rate				
Total Copper Emission Rate (lb/hr)	3.26E-03	3.06E-03	1.36E-03	2.56E-03
= ((total copper (µg)) / Vm) * Qstd * 60 min/hr * g/10.0E06 µg * lb/453.6 g				
Total Copper Emission Rate (lb/24 hour day)	7.81E-02	7.35E-02	3.26E-02	6.14E-02
= ((total copper (µg)) / Vm) * Qstd * 60 min/hr * g/10.0E06 µg * lb/453.6 g * 24 hours				
Total Nickel Weights				
Filter and Rinses (µg)	4.30	8.95	5.07	6.11
Total Nickel Emission Rate				
Total Nickel Emission Rate (lb/hr)	1.49E-03	3.03E-03	1.72E-03	2.08E-03
= ((total nickel (µg)) / Vm) * Qstd * 60 min/hr * g/10.0E06 µg * lb/453.6 g				
Total Nickel Emission Rate (lb/24 hour day)	3.57E-02	7.28E-02	4.13E-02	4.99E-02
= ((total nickel (µg)) / Vm) * Qstd * 60 min/hr * g/10.0E06 µg * lb/453.6 g * 24 hours				
Total Filterable Particulate Weights				
Primary Filter - Cont. 1 (mg)	0.2	0.1	0.1	0.13
Acetone rinse, Nozzle/Filter Holder - Cont. 2 (mg)	5.0	3.6	3.6	4.1
Total, (mg)	5.2	3.7	3.7	4.2
Total (lb)	1.15E-05	8.16E-06	8.16E-06	9.26E-06
Total Filterable Particulate Concentration				
lb PM/1000 lb gas (dry) = (Total (lb)/(Vm/ρs)*1000	0.0016	0.0012	0.0011	0.0013
Filterable Emission Rate (lb/hr) = filterable catch (lb) / Vm * Qstd * 60 min/hr	1.803	1.254	1.255	1.44E+00
Filterable Emission Rate (lb/24 hour day) = filterable catch (lb) / Vm * Qstd * 60 min/hr * 24 hours	43.3	30.1	30.1	34.5