AIR EMISSION TEST REPORT

Title	Compliance Test Report for the Verification of Carbon Monoxide Emissions from an Electric Arc Furnace
Report Date	June 19, 2015
Test Dates	June 9, 2015

Facility Information	
Name	Ervin Industries, Amasteel Division
Street Address	915 Tabor St.
City, County	Adrian, Lenawee

Facility Permit Information	
SRN: B1754	ROP No. : MI-ROP-B1754-2013

Testing Contractor	
Company	Derenzo and Associates, Inc.
Mailing Address	39395 Schoolcraft Road Livonia, MI 48150
Phone	(734) 464-3880
Project No.	1503003

DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name Ervin Industries, Amasteel Division County Lenawee

Source Address 915 Tabor St City Adrian

AQD Source ID (SRN) B1754 ROP No. B1754-2013 ROP Section No. ______

Please check the appropriate box(es):

☐ Annual Compliance Certification (Pursuant to Rule 213(4)(c))

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, this source was in compliance with ALL terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, EXCEPT for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, ALL monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, EXCEPT for the deviations identified on the enclosed deviation report(s).

☒ Other Report Certification

Reporting period (provide inclusive dates): From ______ To ______

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Test Report for FG-0009 carbon monoxide emissions testing that occurred June 9-10, 2015

The testing was conducted in accordance with the approved Test Plan

and the facility operated in compliance with the permit conditions or at the

maximum routine operating conditions for the facility.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

~~James Lemon~~	Plant Manager	(517) 265-6118
Name of Responsible Official (print or type)	Title	Phone Number

[signature] 6/15/15

Signature of Responsible Official Date

* Photocopy this form as needed. EQP 5736 (Rev 11-04)

Derenzo and Associates, Inc.

Environmental Consultants

COMPLIANCE TEST REPORT
FOR THE
VERIFICATION OF CARBON MONOXIDE EMISSIONS FROM AN
ELECTRIC ARC FURNACE

ERVIN INDUSTRIES, AMASTEEL DIVISION
ADRIAN, LENAWEE COUNTY, MICHIGAN

1.0 INTRODUCTION

Ervin Amasteel, a division of Ervin Industries, Inc., State Registration Number (SRN) B1754 retained Derenzo and Associates, Inc. to conduct a testing program for the determination of carbon monoxide (CO) emissions from the exhaust of the Electric Arc Furnace (EAF) at the Ervin Amasteel Tabor Street facility located in Adrian, Michigan.

The testing was performed pursuant to the provisions in Michigan Department of Environmental Quality, Air Quality Division (MDEQ-AQD) Renewable Operating Permit (ROP) No. MI-ROP-B1754-2013. Section No. 5 for flexible emission group FG-0009 of the ROP requires Ervin Amasteel to verify carbon monoxide (CO) emission rates for the EAF annually.

The compliance testing was performed by Derenzo and Associates, Inc. (Derenzo and Associates), an environmental consulting and testing company founded in 1989. Derenzo and Associates representatives Daniel Wilson and Jason Logan performed the field sampling and measurements June 9-10, 2015.

The exhaust gas sampling and analysis was performed in accordance with the approved Test Plan dated March 30, 2015.

Questions regarding this emission test report should be directed to:

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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 Ervin Amasteel employees or representatives. This test report has been reviewed by Ervin Amasteel representatives and approved for submittal to the MDEQ-AQD. A signed ROP certification form (EQP 5736) is attached at the head of the report.

I certify that the testing was conducted in accordance with the specified test methods and submitted 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:

Jason Logan
Environmental Consultant
Derenzo and Associates, Inc.

Reviewed By:

Robert L. Harvey, P.E.
General Manager
Derenzo and Associates, Inc.

2.0 SOURCE DESCRIPTION

2.1 General Process Description

Ervin Amasteel manufactures cast steel abrasives using a 30-megawatt (MW) electric arc furnace and heat-treating furnaces. Steel scrap is charged into the furnace and the furnace roof is then closed. The scrap charges are weighed prior to charging into the furnace to assure charge consistency. Large electrodes are arced within the scrap bringing it to a molten state. The melt rate (scrap to molten metal) is controlled by regulation of amperage and voltage inputs to the EAF. When in a molten state, approximately one percent (%) by weight of carbon, manganese and silicon and a fraction of a percent of aluminum are added as alloys. The molten metal is then poured into a ladle and the melt process is repeated. The facility performs the melt cycles, or "heats," during the evening (off peak) hours.

2.2 Rated Capacities and Air Emission Controls

Each heat uses approximately 80,000 pounds (lbs) of scrap material, or 30 tons per hour (TpH), and is melted to a temperature of approximately 3,100°F prior to being poured into the ladle.

The furnace vessel itself is lined with a consumable refractory material, earthen in nature.

Emissions from melting the scrap metal are collected from various points using a system of hoods that are connected to an inline dirty air fan. The initial ducting is water-cooled; the temperature in downstream dry ducts is tempered by combining the furnace fume with collected air from furnace charging, tapping, and casting operations. The combined air stream is directed to a positive-pressure fabric-filter baghouse prior to discharge to the atmosphere.

2.3 Air Pollutant Emission Limits

The stationary source has been issued Renewable Operating Permit No. MI-ROP-B1754-2013. Conditions for flexible emission group FG-0009 specify CO emission limits of 3.0 lbs per ton of melted steel, 90 lbs per hour (3 hour average), and 322.5 tons per year.

3.0 SUMMARY OF TEST RESULTS AND OPERATING CONDITIONS

ROP No. MI-ROP-B1754-2013 requires Ervin Amasteel to perform annual testing to verify the CO emission rate from the EAF (FG-0009). The EAF exhaust gas flow and CO concentration measurements were performed in the horizontal duct prior to (or upstream) of the baghouse fan.

Appendix 1 provides diagrams of the emission test sampling location.

The gases exhausted from the EAF were sampled for three (3) test periods on June 9, 2015. Each test period was 81 minutes in duration and encompassed one full heat that charged approximately 40 tons of steel scrap.

Table 3.1 presents a summary of the average measured CO emission rate and operating conditions for the EAF (average of the three test periods).

The average measured CO emission rate, 9.88 pounds per hour (lb/hr) and 0.33 pounds per ton melted (lb/ton), are below the limits specified in MI-ROP-B1754-2013.

Appendix 2 provides operating records provided by Ervin Amasteel representatives for the test periods.

Test results for each one hour sampling period are presented in Table 6.1 at the end of this report.

Table 3.1 Average pollutant emissions and operating conditions during the test periods

Parameter	EAF	Permit Limit
Test Duration (hours)	1.4	-
Tons Scrap Melted (tons)	40.8	-
Exhaust Flowrate (dscfm)	179,380	-
CO Concentration (ppmvd)	12.7	-
CO Emission Rate (lb/hr)	9.88	90
CO Emission Factor (lb/ton)	0.33	3.00

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A test protocol for the air emission testing was reviewed and approved by the MDEQ-AQD. This section provides a summary of the sampling and analytical procedures that were used during the Ervin Amasteel EAF testing periods.

4.1 Summary of Sampling Methods

USEPA Method 1	Exhaust gas velocity measurement locations were determined based on the physical stack arrangement and requirements in USEPA Method 1
USEPA Method 2	Exhaust gas velocity pressure was determined using a Type-S Pitot tube connected to a red oil incline manometer; temperature was measured using a K-type thermocouple connected to the Pitot tube.
USEPA Method 3A	Exhaust gas O_2 and CO_2 content was determined using zirconia ion/paramagnetic and infrared instrumental analyzers, respectively.
USEPA Method 4	Wet bulb/dry bulb technique
USEPA Method 10	Exhaust gas CO concentration was measured using an NDIR instrumental analyzer

4.2 Sampling Locations (USEPA Method 1)

The EAF exhaust gas flow and CO concentration measurements were performed in the horizontal duct prior to (or upstream) of the baghouse fan. The location of the sample ports meets the USEPA Method 1 criteria for a representative sample location. The inner diameter of the duct is 113.5 inches. The duct is equipped with two (2) 4.75 inch sample ports, opposed 90°, that provided a sampling location 1,200 inches (10.57 duct diameters) downstream and 216 inches (1.90 duct diameters) upstream from any flow disturbance.

Velocity pressure traverse locations for the sampling points were determined in accordance with USEPA Method 1.

4.3 Exhaust Gas Velocity Determination (USEPA Method 2)

The EAF exhaust gas velocities and volumetric flow rates were determined using USEPA Method 2 prior to and after each test period. An S-type Pitot tube connected to a red-oil manometer was used to determine velocity pressure at each traverse point across the stack cross section. Gas temperature was measured using a K-type thermocouple mounted to the Pitot tube. The Pitot tube and connective tubing were leak-checked prior to each traverse to verify the integrity of the measurement system.

The absence of significant cyclonic flow for the exhaust configuration was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each velocity traverse point with the planes of the face openings of the Pitot tube perpendicular to the stack cross-sectional plane. The Pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

Appendix 3 provides exhaust gas flowrate calculations and field data sheets.

4.4 Exhaust Gas Molecular Weight Determination (USEPA Method 3A and 4)

CO_2 and O_2 content in the EAF exhaust gas stream was measured continuously throughout each test period in accordance with USEPA Method 3A. The CO_2 content of the exhaust was monitored using a Servomex 4900 single beam single wavelength (SBSW) infrared gas analyzer. The O_2 content of the exhaust was monitored using a Servomex 4900 gas analyzer that uses a paramagnetic sensor.

During each sampling period, a continuous sample of the EAF exhaust gas stream was extracted from the stack using a stainless steel probe connected to a Teflon® heated sample line. The sampled gas was conditioned by removing moisture prior to being introduced to the analyzers; therefore, measurement of O_2 and CO_2 concentrations correspond to standard dry gas conditions. Instrument response data were recorded using an ESC Model 8816 data acquisition system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages.

Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document). Sampling times were recorded on field data sheets.

The moisture content determination worksheet uses two equations to provide the percentage of moisture in an exhaust gas stream.

The following Equation was used to determine moisture content based on the wet bulb temperature and the dry bulb temperature.

$$\%H_2O = \frac{e'' - \frac{(P_a - e'')*(t_d - t_w)}{2{,}800 - 1.3*t_w}}{P_a} * 100$$

e"	vapor pressure of water at the wet bulb temperature (in. Hg)
P_a	absolute barometric pressure (in. Hg)
t_d	dry bulb temperature (°F)
t_w	wet bulb temperature (°F)

The vapor pressure (e") of water is required in the equation above, and can be determined using the following equation:

$$e'' = \left(6.07864 * 10^{-6}\right) * \left(t_w\right)^3 - \left(1.00431 * 10^{-3}\right)\left(t_w\right)^2 + \left(0.075602\right) * t_w - 1.69343$$

This equations are limited to use for stack temperatures between 50°F and 200°F. The stack temperatures during each flowrate were within this range.

Appendix 4 provides O_2 and CO_2 calculation sheets. Raw instrument response data are provided in Appendix 5.

4.5 CO Concentration Measurements (USEPA Method 10)

CO pollutant concentrations in the EAF exhaust gas streams were determined using a Fuji ZRF infrared CO analyzer.

Throughout each test period, a continuous sample of the EAF exhaust gas was extracted from the stack using the Teflon® heated sample line and gas conditioning system and delivered to the instrumental analyzers. Instrument response for each analyzer was recorded on an ESC Model 8816 data acquisition system that logged data as one-minute averages. Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias.

Appendix 4 provides CO and NO_X calculation sheets. Raw instrument response data are provided in Appendix 5.

5.0 <u>QA/QC ACTIVITIES</u>

5.1 Gas Divider Certification (USEPA Method 205)

A STEC Model SGD-710C 10-step gas divider was used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified (within the last 12 months) with a primary flow standard in accordance with Method 205. When cut with an appropriate zero gas, the ten-step STEC gas divider delivered calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas that was introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 were followed prior to use of gas divider. The field evaluation yielded no errors greater than 2% of the triplicate measured average and no errors greater than 2% from the expected values.

5.2 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure CO, O_2 and CO_2 have had an interference response test preformed prior to their use in the field, pursuant to the interference response test procedures specified in USEPA Method 7E. The appropriate interference test gases (i.e., gases that would be encountered in the exhaust gas stream) were introduced into each analyzer, separately and as a mixture with the analyte that each analyzer is designed to measure. All of analyzers exhibited a composite deviation of less than 3.0% of the span for all measured interferent gases. No major analytical components of the analyzers have been replaced since performing the original interference tests.

5.3 Instrument Calibration and System Bias Checks

At the beginning of each day of the testing program, initial three-point instrument calibrations were performed for the CO, CO_2 and O_2 analyzers by injecting calibration gas directly into the inlet sample port for each instrument. System bias checks were performed prior to and at the conclusion of each sampling period by introducing the upscale calibration gas and zero gas into the sampling system (at the base of the stainless steel sampling probe prior to the particulate filter and Teflon® heated sample line) and determining the instrument response against the initial instrument calibration readings.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO_2, O_2, and CO in nitrogen and zeroed using hydrocarbon free nitrogen. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

6.0 <u>RESULTS</u>

6.1 EAF Exhaust Test Results and Allowable Emission Limits

Operating data and air pollutant emission measurement results for each one hour test period are presented in Table 6.1. The average measured CO emissions were:

- 9.88 lb/hr; and
- 0.33 lb/ton.

Continuous operation at the average measured CO mass emission rate (9.88 lb/hr) would result in maximum annual emissions of less than 45 tons per year. Actual annual emissions are calculated by Ervin Amasteel using the measured process emission factor (0.33 lb/ton) and records of steel scrap throughput. These data are maintained at the facility and are available upon request.

The measured CO pollutant emission rates for the EAF are less than the allowable limits specified in MDEQ ROP No. MI-ROP-B1754-2013:

- 90 lb/hr;
- 3.0 lb/ton; and
- 322.5 ton/year.

6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with USEPA methods and the approved test protocol dated March 30, 2015. The facility was operated normally during the test periods.

Table 6.1 Measured exhaust gas conditions and CO air pollutant emissions for the EAF exhaust at Ervin Amasteel

Test No. Test Date Test Period (24-hr clock)	1 6/09/15 19:14-20:35	2 6/09/15 20:55-22:16	3 6/09/15 22:34-23:55	Three Test Average
Heat Melt Weight (tons)	41.1	40.6	40.8	40.8
Melt Cycle Time (hours)	1.4	1.4	1.4	1.4
Heat Melt Rate (tons/hour)	30.4	30.1	30.2	30.2
Exhaust Gas Composition				
CO_2 content (%)	0.18	0.12	0.14	0.15
O_2 (%)	19.88	19.97	19.91	19.92
Moisture (%)	1.4	1.1	0.8	1.1
Exhaust Gas Flowrate				
Dry basis (dscfm)	179,661	180,784	177,694	179,380
Carbon Monoxide Emissions				
CO conc. (ppmvd)*	7.7	7.4	23.0	12.7
CO emissions (lb/hr)	6.02	5.80	17.81	9.88
CO permit limit (lb/hr)				*90.0*
CO emission factor (lb/ton)	0.20	0.19	0.59	0.33
CO permit limit (lb/ton)				*3.00*

*Corrected for calibration bias