SOURCE TEST REPORT
2019 MERCURY TESTING
GERDAU SPECIAL STEEL
MONROE MILL
EAST AND WEST EAF AND LMF
MONROE, MICHIGAN

Prepared For:

Gerdau Special Steel
3000 E. Front Street
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For Submittal To:

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STAC

ACCREDITED
TO ASTM D7036 ONLY
CERT #3925.01

MONTROSE
AIR QUALITY SERVICES

EXECUTIVE SUMMARY

Montrose Air Quality Services, LLC (MAQS) was retained by Gerdau Special Steel North America (GSS) to conduct an evaluation on two sources at the GSS facility in Monroe, Michigan. The emission test program included evaluation of mercury (Hg) from the Ladle Metallurgic Furnace (LMF) and the Electric Arc Furnace (EAF). The emissions test program was conducted on September 19-20, 2019.

Testing of the LMF (east and west) and EAF stacks consisted of triplicate 300-minute test runs conducted simultaneously for Hg. The emissions test program was required by MDEQ Air Quality Division ROP-MI-B7061-2016. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: September 19-20, 2019

Emission Unit	Pollutant	Permit Limit	Test Result
EAF+LMF Baghouse Stacks	Hg	0.033 lb/hr	0.004 lb/hr

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1. Introduction

Montrose Air Quality Services, LLC (MAQS) was retained by Gerdau Special Steel North America (GSS) to conduct an evaluation on two sources at the GSS facility in Monroe, Michigan. The emission test program included evaluation of mercury (Hg) from the Ladle Metallurgic Furnace (LMF) and the Electric Arc Furnace (EAF). The emissions test program was conducted on September 19-20, 2019.

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AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (March 2018). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on September 19-20, 2019 at the GSS facility located in Monroe, Michigan.

1.b Purpose of Testing

AQD issued ROP-MI-B7061-2016. The permit limits emissions from the sources as summarized by Table 1.

Table 1
Emission Limitations

Test Parameter	Combined FG Melt Shop Limits (EAF,LMF,VTD)
	Limit
Hg	0.033 lb/hr

1.c Source Description

The electric arc furnace (EAF) melts steel scrap in a batch operation. The EAF is a refractory lined cylindrical vessel with a bowl-shaped hearth and dome shaped roof. Electrodes are lowered and raised through the furnace roof for melting the steel scrap.

The LMF is a complete ladle metallurgy system which includes arc reheating, alloy additions, powder injections and stirring.

1.d Test Program Contacts

The contact for the source and test report is:

Mr. Craig Metzger
Environmental Manager
Gerdau Special Steel North America – Monroe Mill
3000 E. Front Street
Monroe, Michigan
(734) 818-7113

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

Table 2
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Steve Smith Project Manager	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Dave Koponen Field Technician	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Jake Young Field Technician	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Mike Nummer Field Technician	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Paul Diven Field Project Manager	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Mason Sakshaug Field Project Manager	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Ben Durham Field Technician	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Ms. Regina Angelotti	EGLE Air Quality Division	(313) 418-0895

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

EAF Baghouse
Temperature 149-232°F
Moisture Content ~4%

LMF Baghouse
Temperature 118-145°F
Moisture Content ~2%

2.b Applicable Permit

AQD ROP-MI-B7061-2016

2.c Results

See Table 3 in Section 5.a.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

LMF Baghouse
The LMF is controlled by a baghouse. Emissions from the LMF will be directed to the baghouse (DVLMFBAGHOUSE) via removable covers or decks, which are located over the ladle while the process is operating.

EAF Baghouse
The EAF is evacuated with a positive pressure baghouse (DVBAGHOUSE-01) with reverse air cleaning to control particulate emissions. The evacuation is by means of three main exhaust fans with a dual stack emission point. CO is combusted in a DEC combustion chamber. Dust disposal is accomplished by means of hopper screw conveyors to a pneumatic conveying system, which loads the dust into a storage silo.

3.b Process Flow Diagram

A process flow diagram is available upon request.

3.c Raw and Finished Materials

On average, approximately 134.6 tons of scrap steel is charged per heat into the EAF. During this same time frame an average of 9.9 tons of additives, alloys, and fluxes are added to each heat.

3.d Process Capacity

The rated capacity of the process is 850,000 liquid steel tons per year.

3.e Process Instrumentation

Section 3.d provides summary.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - *"Location of the Sampling Site and Sampling Points"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3 - *"Determination of Molecular Weight of Dry Stack Gas"(Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Method 1 and Method 2. S-type pitot tubes with thermocouple assemblies, calibrated in accordance with Method 2, Section 4.1.1, were used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. Calibrated s-type pitot tubes were used during this test (0.84).

Cyclonic flow checks were performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists.

Molecular weight determinations were evaluated according to USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." The equipment used for this evaluation consist of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Carbon dioxide and oxygen content were analyzed using the Fyrite® procedure.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the Hg sampling train. Exhaust gas moisture content is then determined gravimetrically.

Mercury (USEPA Method 29):

40 CFR 60, Appendix A, Method 29, *"Determination of Metals Emissions From Stationary Sources"* was used to measure predetermined metals concentrations and calculate appropriate emission rates (see Figure 1 for a schematic of the sampling train). Triplicate 300-minutes test runs were conducted.

MAQS's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a borosilicate glass nozzle, (2) a borosilicate glass probe, (3) a heated borosilicate or quartz glass filter holder containing a 90-mm diameter quartz filter with Teflon filter support; (4) a set of six Greenburg-Smith (GS) impingers with the first two with 100 ml of a 5% HNO_3 / 10% H_2O_2 solution (ii) an empty impinger, two with 100 ml of a 4% $KMnO_4$ / 10% $H2SO_4$ solution, (iii) and an impinger filled with approximately 300 grams of silica

gel. (5) a length of sample line, and (6) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

Upon completion of the final leak test for each test run, the filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with 100 ml of 0.1N HNO3. The rinses were collected in a pre-cleaned sample container and prepared for transport.

The back half of the filter housing and first two impingers were a triple rinsed with 100 ml of 0.1N HNO3. The third impinger (empty) was also rinsed with 100 ml of 0.1N HNO3. The fourth and fifth impingers were first triple rinsed with 100 ml of KMNO4, followed by a triple rinse with 100 ml of H20 and placed their respective sample containers. The impingers were then triple rinsed 25 ml of 8N HCL and placed in sample container with 200 ml H20.

MAQS labeled each container with the test number, test location, and test date, then marked the level of liquid on the outside of the container. In addition, blank samples of the filter, acetone, DI water, O.1N HNO_3, 5% HNO_3 / 10% H_2O_2, Acidified $KMnO_4$, and 8N HCL solutions, were collected. The samples were curried by Enthalpy personnel to First Analytical lab in Durham, NC.

4.b Recovery and Analytical Procedures

The samples were sent to First Analytical in Durham, North Carolina.

4.c Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figures 2 and 3.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figures 2 and 3.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 3. Detailed results for the emissions test program are summarized by Tables 4-6.

Table 3
Overall Emission Summary
Test Date: August 30-31, 2018

Emission Unit	Pollutant	Permit Limit	Test Result
EAF+LMF Baghouse Stacks	Hg	0.033 lb/hr	0.004 lb/hr

5.b Discussion of Results

All of the test results for each pollutant were well below the permit limits.

5.c Sampling Procedure Variations

There were no variations.

5.d Process or Control Device Upsets

The EAF process was interrupted during run 1. Both EAF and LMF testing was paused and resumed when the process restarted.

5.e Control Device Maintenance

The EAF baghouse fans must be cleaned at regular intervals. Testing at the EAF and LMF stacks was paused for the duration of this cleaning

5.f Re-Test

The emissions test program was not a re-test.

5.g Audit Sample Analyses

No audit samples were collected as part of the test program.

5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix B.

5.i Sample Calculations

Sample calculations are provided in Appendix C.

5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

5.k Laboratory Data

Laboratory analytical results for this test program are presented in Appendix D.

MEASUREMENT UNCERTAINTY STATEMENT

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, Montrose Air Quality Services, LLC, (MAQS) personnel reduce the impact of these uncertainty factors through the use of approved and validated test methods. In addition, MAQS personnel perform routine instrument and equipment calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

Limitations

All testing performed was done in conformance to the ASTM D7036-04 standard. The information and opinions rendered in this report are exclusively for use by Gerdau. MAQS will not distribute or publish this report without Gerdau's consent except as required by law or court order. MAQS accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by:_____
Jacob Young
Staff Engineer

This report was reviewed by:_____
Matthew Young
Client Project Manager

Table 4
Particulate Matter Emission Rates

Company	**Gerdau**			
Source Designation	**East EAF**			
Test Date	**9/19/2019**	**9/20/2019**	**9/20/2019**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	80.5	84.6	94.3	86.5
Meter Pressure - Pm (in. Hg)	29.7	29.6	29.6	29.7
Measured Sample Volume (Vm)	257.9	270.8	274.6	267.8
Sample Volume (Vm-Std ft3)	254.0	264.2	263.3	260.5
Sample Volume (Vm-Std m3)	7.19	7.48	7.46	7.38
Condensate Volume (Vw-std)	10.887	12.363	6.945	10.065
Gas Density (Ps(std) lbs/ft3) (wet)	0.0734	0.0733	0.0738	0.0735
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	19.44	20.27	19.95	19.88
Total weight of sampled gas (m g lbs) (dry)	18.93	19.69	19.62	19.42
Nozzle Size - An (sq. ft.)	0.000552	0.000552	0.000552	0.000552
Isokinetic Variation - I	100.6	100.4	98.5	99.8
Stack Data				
Average Stack Temperature - Ts (F)	183.0	178.6	126.9	162.8
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.4	28.4	28.6	28.4
Stack Gas Specific Gravity (Gs)	0.980	0.979	0.986	0.982
Percent Moisture (Bws)	4.11	4.47	2.57	3.72
Water Vapor Volume (fraction)	0.0411	0.0447	0.0257	0.0372
Pressure - Ps ("Hg)	29.5	29.4	29.4	29.5
Average Stack Velocity -Vs (ft/sec)	32.8	34.1	31.2	32.7
Area of Stack (ft2)	100.8	100.8	100.8	100.8
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	198,220	206,321	188,748	197,763
Flowrate ft^3 (Standard Wet)	160,516	167,867	167,102	165,162
Flowrate ft^3 (Standard Dry)	153,919	160,364	162,807	159,030
Flowrate m^3 (standard dry)	4,359	4,541	4,610	4,503
Total Metals Weights (ug)				
Mercury	38.9	25.0	2.2	22.0
Metals Concentrations				
lb/1000 lb (wet)	0.0000044	0.0000027	0.0000002	0.000002
lb/1000 lb (dry)	0.0000045	0.0000028	0.0000003	0.000003
mg/dscm (dry)	0.0054	0.0033	0.0003	0.003
gr/dscf	0.0000024	0.0000015	0.0000001	0.000001
Metals Emission Rate				
lb/ hr	0.0031	0.0020	0.0002	0.0018

Table 5
Mercury Emission Rates

Company	**Gerdau**			
Source Designation	**West EAF**			
Test Date	**9/19/2019**	**9/20/2019**	**9/20/2019**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	84.4	87.4	100.3	90.7
Meter Pressure - Pm (in. Hg)	29.7	29.7	29.6	29.7
Measured Sample Volume (Vm)	257.0	266.0	259.2	260.8
Sample Volume (Vm-Std ft3)	245.9	252.7	240.1	246.2
Sample Volume (Vm-Std m3)	6.96	7.16	6.80	6.97
Condensate Volume (Vw-std)	10.279	11.901	6.856	9.678
Gas Density (Ps(std) lbs/ft3) (wet)	0.0734	0.0733	0.0738	0.0735
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	18.81	19.39	18.22	18.80
Total weight of sampled gas (m g lbs) (dry)	18.33	18.83	17.90	18.35
Nozzle Size - An (sq. ft.)	0.000468	0.000468	0.000468	0.000468
Isokinetic Variation - I	99.6	100.4	99.7	99.9
Stack Data				
Average Stack Temperature - Ts (F)	187.9	181.3	130.4	166.6
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.4	28.3	28.5	28.4
Stack Gas Specific Gravity (Gs)	0.981	0.979	0.985	0.982
Percent Moisture (Bws)	4.01	4.50	2.78	3.76
Water Vapor Volume (fraction)	0.0401	0.0450	0.0278	0.0376
Pressure - Ps ("Hg)	29.5	29.4	29.4	29.4
Average Stack Velocity -Vs (ft/sec)	38.0	38.6	33.4	36.7
Area of Stack (ft2)	100.8	100.8	100.8	100.8
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	229,761	233,617	202,266	221,881
Flowrate ft^3 (Standard Wet)	184,604	189,243	177,800	183,882
Flowrate ft^3 (Standard Dry)	177,197	180,731	172,865	176,931
Flowrate m^3 (standard dry)	5,018	5,118	4,895	5,010
Total Metals Weights (ug)				
Mercury	37.8	23.7	2.1	21.2
Metals Concentrations				
lb/1000 lb (wet)	0.0000044	0.0000027	0.0000003	0.0000025
lb/1000 lb (dry)	0.0000046	0.0000028	0.0000003	0.0000025
mg/dscm (dry)	0.0054	0.0033	0.0003	0.0030
gr/dscf	0.0000024	0.0000014	0.0000001	0.0000013
Metals Emission Rate				
lb/ hr	0.0036	0.0023	0.0002	0.0020

Table 6
Particulate Matter Emission Rates

Company	**Gerdau**			
Source Designation	**LMF**			
Test Date	**9/19/2019**	**9/20/2019**	**9/20/2019**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	84.9	88.0	91.8	88.3
Meter Pressure - Pm (in. Hg)	29.7	29.6	29.6	29.6
Measured Sample Volume (Vm)	242.2	234.3	234.1	236.9
Sample Volume (Vm-Std ft3)	236.5	227.2	225.1	229.6
Sample Volume (Vm-Std m3)	6.70	6.43	6.37	6.50
Condensate Volume (Vw-std)	4.027	6.030	6.276	5.444
Gas Density (Ps(std) lbs/ft3) (wet)	0.0739	0.0738	0.0738	0.0738
Gas Density (Ps(std) lbs/ft3) (dry)	0.0744	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	17.78	17.21	17.07	17.35
Total weight of sampled gas (m g lbs) (dry)	17.59	16.93	16.78	17.10
Nozzle Size - An (sq. ft.)	0.000175	0.000175	0.000175	0.000175
Isokinetic Variation - I	99.7	100.7	100.5	100.3
Stack Data				
Average Stack Temperature - Ts (F)	124.6	132.3	128.6	128.5
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.6	28.6	28.5	28.6
Stack Gas Specific Gravity (Gs)	0.987	0.986	0.986	0.986
Percent Moisture (Bws)	1.67	2.59	2.71	2.32
Water Vapor Volume (fraction)	0.0167	0.0259	0.0271	0.0232
Pressure - Ps ("Hg)	29.4	29.3	29.3	29.3
Average Stack Velocity -Vs (ft/sec)	86.5	84.2	83.3	84.6
Area of Stack (ft2)	66.0	66.0	66.0	66.0
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	342,224	333,170	329,598	334,997
Flowrate ft^3 (Standard Wet)	303,544	291,284	289,684	294,837
Flowrate ft^3 (Standard Dry)	298,463	283,751	281,828	288,014
Flowrate m^3 (standard dry)	8,452	8,035	7,981	8,156
Total Metals Weights (ug)				
Mercury	1.5	1.1	0.8	1.1
Metals Concentrations				
lb/1000 lb (wet)	0.0000002	0.0000001	0.0000001	0.0000001
lb/1000 lb (dry)	0.0000002	0.0000001	0.0000001	0.0000001
mg/dscm (dry)	0.0002	0.0002	0.0001	0.0002
gr/dscf	0.0000001	0.0000001	0.0000001	0.0000001
Metals Emission Rate				
lb/ hr	0.0002	0.0002	0.0001	0.0002

MONTROSE
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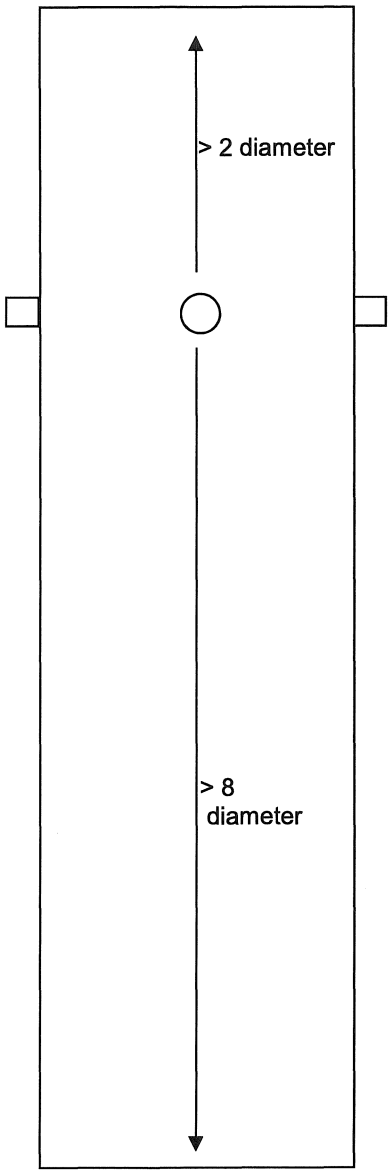
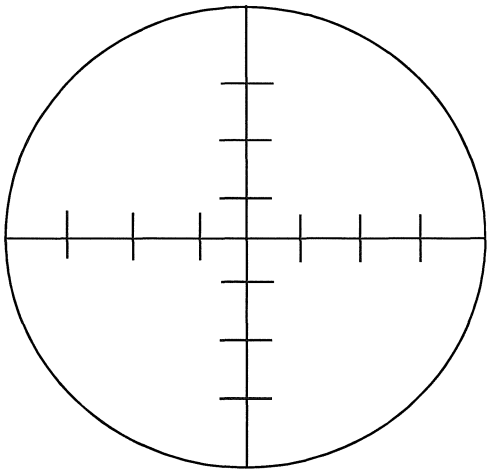
diameter = 110





Not to Scale

Points	Distance "
1	0.0
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0

Figure 3

Site: **Gerdau Special Steel** **Monroe, Michigan** **LMF Stack**	**Sampling Dates:** **September 19-20, 2019**	**Montrose Air Quality Services, LLC** **4949 Fernlee Ave** **Royal Oak, Michigan**