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AIR EMISSION TEST REPORT FOR THE VERIFICATION OF PARTICULATE MATTER EMISSIONS FROM ALUMNIMUM MELT FURNACES

Prepared for:

COSMA CASTINGS MICHIGAN

Battle Creek, MI

Test Dates: October 11-13, 2022

ICT Project No.: 2200097

December 12, 2022

IMPACT COMPLIANCE & TESTING

Report Certification

AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF PARTICULATE MATTER EMISSIONS
FROM
ALUMINUM MELT FURNACES

COSMA CASTINGS MICHIGAN
Battle Creek, MI

Report Certification

This report has been reviewed by Cosma Castings Michigan representatives and approved for submittal to the Michigan Department of Environment, Great Lakes, and Energy, Air Quality Division.

I certify that the testing was conducted in accordance with the reference 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.

Impact Compliance & Testing, Inc.

RL Harvey

Robert L. Harvey, P.E.
Services Director

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1.0 Introduction

Cosma Casting Michigan (CCMI) manufactures die cast aluminum parts and engine components for the automobile industry. The facility operates aluminum melting furnaces, high pressure die casters, heat treat furnaces, and other ancillary processes at its facility located in Battle Creek, Calhoun County, Michigan

This test report presents the results of particulate matter emission testing performed for two aluminum melt furnaces identified as EUMELTFURNACE1 and EUMELTFURNACE5. The field sampling and measurements presented in this report were performed by Impact Compliance & Testing (ICT) representatives Max Fierro, Clay Gaffey, Tyler Wilson, and Robert Harvey on October 11-13, 2022. Portions of the test event were observed by Michigan Department of Environment, Great Lakes, and Energy (EGLE) representatives Amanda Cross and Regina Angellotti.

The exhaust gas sampling and analysis was performed using procedures described in United States Environmental Protection Agency (USEPA) reference test methods as presented in a test protocol that was submitted to, and reviewed by, EGLE.

Attachment 1 provides a copy of the test plan approval letter issued by EGLE.

Questions regarding this air emission test report should be directed to:

Test Method and Procedures	Robert Harvey, P.E. Services Director Impact Compliance & Testing, Inc. 4180 Keller Rd, Suite B Holt, MI 48842 (517) 461-3170 Rob.Harvey@ImpactCandT.com
Facility Operations and Compliance	Mr. Mason Tinch HSE Manager Cosma Casting Michigan 10 Clark Rd Battle Creek MI 49037 (423) 470-0400 Mason.Tinch@magna.com

2.0 Summary of Test Results and Operating Conditions

2.1 Purpose and Objective of the Tests

Installation and operation of the CCMI melt furnaces is permitted by EGLE Air Quality Division (AQD) Permit to Install (PTI) No. 166-13F, issued to CCMI on May 11, 2022. PTI No. 166-13F identifies five (5) aluminum melting furnaces with natural gas fired burners that are grouped under flexible group FGFURNACES.

The TESTING / SAMPLING requirements of PTI 166-13F specify:

> *Within 180 days of permit issuance, the permittee shall verify PM, PM10, and PM2.5 emission rates in the SC V.I table from FGFURNACES by testing at owner's expense, in accordance with Department requirements. The testing can be performed in one representative furnace for each alloy or across multiple furnaces.*

Two representative furnaces were selected for this compliance demonstration;

- EUMELTFURNACE1 that typically melts A380 alloy. Results from the testing are used as representative for all A380 melting and fluxing that occurs in either EUMELTFURNACE1 or EUMELTFURNACE4.

- EUMELTFURNACE5, which has the largest capacity of the five furnaces and is used to melt alloys other than A380. This furnace has the highest allowable flux use rate per the conditions of PTI 166-13F. Results from the testing are used as representative for all non-A380 melting and fluxing that occurs in any of the furnaces.

Diagrams for the exhaust stack testing locations are presented in Attachment 2.

2.2 Operating Conditions During the Compliance Tests

During normal melting, aluminum ingots, customer returns and internal scrap are weighed and charged to the furnace in batches. Once melted, the molten aluminum is tapped (poured) from the furnace into portable ladles for degassing and transfer to the die casting processes.

For furnace fluxing and cleaning, a minimal amount of aluminum is charged to the furnace and melted. A measured amount of flux is added and stirred into the melt. The furnace doors are closed for 10-20 minutes. Afterwards, the walls of the furnace are scraped clean and residue (in the form of aluminum oxide) is manually raked from the melt. Normal melting resumes after the fluxing and cleaning process is complete.

For the emission test event, the furnaces were operated as described above as close to maximum capacity as could be achieved on the test dates.

Table 2.1 presents a summary of test times and furnace operating conditions.

Operational records provided by CCMI are presented in Attachment 3.

2.3 Summary of Air Pollutant Sampling Results

Emissions testing was performed on each furnace for three (3) test periods in each operating mode (melting and fluxing). No particulate sizing was performed; therefore, all filterable particulate matter was determined to be PM, PM10 and PM2.5 (worst-case scenario). Measured condensable emissions were added to the filterable emissions to calculate total PM10 and PM2.5 (worst-case scenario). The emission test results are less than (in compliance with) the permitted emission rates.

Table 2.2 presents the average measured emission rates for Furnace 1.

Table 2.3 presents the average measured emission rates for Furnace 5.

Test results for each sampling period are presented in Section 6.0 of this report.

Table 2.1 Test schedule and furnace operating conditions

Date	Furnace Test No.	Flux Added (lbs)	Total Charge (lbs)	Test Duration (hrs)	Melt Rate (ton/hr)
10/11/2022	5-1	4	882	1.1	
10/11/2022	1-1	3	2,000	1.1	
10/11/2022	1-2	None	1,567	1.2	0.67
10/11/2022	1-3	None	3,497	1.2	1.50
10/12/2022	1-4	3	0	1.1	
10/12/2022	5-2	3	0	1.1	
10/12/2022	5-3	None	7,958	1.6	2.54
10/12/2022	5-4	None	7,494	1.7	2.27
10/13/2022	5-5	6	0	1.1	
10/13/2022	1-5	3	0	1.1	
10/13/2022	1-6	None	1,439	1.1	0.66
10/13/2022	5-6	None	7,992	1.6	2.55

Table 2.2 Average measured emission rates for EUMELTFURNACE1

Melting Operation	Three-Test Average	Permit Limit
PM Emission Rate (lb/hr)	0.095	--
PM Emission Rate (lb/ton)	0.127	0.442
PM10 Emission Rate (lb/hr)	0.135	--
PM10 Emission Rate (lb/ton)	0.175	0.571
PM2.5 Emission Rate (lb/hr)	0.135	--
PM2.5 Emission Rate (lb/ton)	0.175	0.439
Fluxing Operation	**Three-Test Average**	**Permit Limit**
PM Emission Rate (lb/hr)	0.693	--
PM Emission Rate (lb/ton)	0.734	2.351
PM10 Emission Rate (lb/hr)	0.782	--
PM10 Emission Rate (lb/ton)	0.829	2.716
PM2.5 Emission Rate (lb/hr)	0.782	--
PM2.5 Emission Rate (lb/ton)	0.829	2.011

Table 2.3 Average measured emission rates the EUMELTFURNACE5

Melting Operation	Three-Test Average	Permit Limit
PM Emission Rate (lb/hr)	0.051	--
PM Emission Rate (lb/ton)	0.021	0.123
PM10 Emission Rate (lb/hr)	0.087	--
PM10 Emission Rate (lb/ton)	0.036	0.169
PM2.5 Emission Rate (lb/hr)	0.087	--
PM2.5 Emission Rate (lb/ton)	0.036	0.133
Fluxing Operation	**Three-Test Average**	**Permit Limit**
PM Emission Rate (lb/hr)	0.650	--
PM Emission Rate (lb/ton)	0.265	0.688
PM10 Emission Rate (lb/hr)	0.759	--
PM10 Emission Rate (lb/ton)	0.309	0.778
PM2.5 Emission Rate (lb/hr)	0.759	--
PM2.5 Emission Rate (lb/ton)	0.309	0.572

3.0 Source and Sampling Location Description

3.1 General Process Description / Capacities

CCMI operates five (5) aluminum melting furnaces at its facility located in Battle Creek, Calhoun County. Two of the furnaces were selected for this emission test event:

Emission Unit ID	Emission Unit Description	Flexible Group
EUMELTFURNACE1	Furnace ID # 3002 1.65 ton per hour (tph) aluminum melting furnace #1, with three natural gas-fired burners, and a total heat input of 4.3 MMBtu/hr. Emissions are uncontrolled and vented to atmosphere through SVMELT1.	FGFURNACES
EUMELTFURNACE5	Furnace ID # 6006 4,000 kg/hour (4.41 tph) aluminum melting furnace #5 with a total burner firing rate of 3,200 kW (10.9 MMBtu/hr). Emissions are uncontrolled and vented to atmosphere through SVMELT5.	FGFURNACES

3.2 Sampling Location

Exhaust gas from each furnace is directed through a vertical exhaust stack that exits through the roof of the facility. Furnace 1 exhausts to stack SVMELT that has a 24-inch diameter. Furnace 5 exhausts to stack SVMELT5 that has a 36-inch diameter.

Diagrams of the stacks and sampling locations are provided in Attachment 2.

4.0 Sampling and Analytical Procedures

This section provides a summary of the sampling and analytical procedures that were used during the testing periods.

4.1 Summary of Sampling Methods

The exhaust gases from the furnace exhaust stacks were sampled and analyzed to determine the concentration of particulate matter. The following USEPA Reference Test Methods were used.

Parameter / Analyte	Sampling Methodology	Analytical Method
Velocity traverses Volumetric flowrate	USEPA Method 1 USEPA Method 2	Selection of sample and velocity traverse locations by physical stack measurements. Type S Pitot tube and inclined manometer.
Molecular weight	USEPA Method 3A	Fyrite® combustion gas test kit for O_2 and CO_2 content
Moisture	USEPA Method 4	Moisture determination by gravimetric water gain in chilled impingers
Particulate Matter Filterable	USEPA Method 5	Isokinetic sample train for filterable particulate matter
Particulate Matter Condensable	USEPA Method 202	Isokinetic sample train, dry impinger method for condensable particulate matter

4.2 Exhaust Gas Velocity Determination (USEPA Method 2)

The exhaust stack gas velocities and volumetric flow rates were determined using USEPA Method 2 throughout each test run. 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 periodically throughout the test periods to verify the integrity of the measurement system.

4.3 Exhaust Gas Molecular Weight Determination (USEPA Method 3A)

Diluent gas content (O_2 and CO_2) measurements were performed with each of the sampling periods using a Fyrite® combustion test kit.

4.4 Exhaust Gas Moisture Content (USEPA Method 4)

Exhaust gas moisture was determined in accordance with USEPA Method 4 as part of the particulate sampling trains. At the conclusion of each sampling period the moisture gain in the impingers was determined gravimetrically by weighing each impinger to determine net weight gain.

4.5 Measurement of PM/PM10 (USEPA Method 5 / 202)

Testing was performed using a combined filterable and condensable particulate matter PM sampling train. The filterable and condensable fractions were added to calculate total PM10 and PM2.5 emissions (i.e., as a worst-case scenario, all filterable and condensable PM emissions were assumed to be in the PM10 and PM2.5 size range).

Filterable Particulate Matter Sample Train (USEPA Method 5)

Filterable PM was determined using USEPA Method 5. Exhaust gas was withdrawn from each exhaust stack at an isokinetic sampling rate using an appropriately-sized stainless steel 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. The back half of the filter housing was connected to the condensable PM impinger train.

Condensable Particulate Matter Sample Train (USEPA Method 202)

Condensable PM (CPM) content was measured in accordance with USEPA Method 202. Following the Method 5 filter assembly, the sample gas travelled through the impinger train which consisted of a condenser, a knock-out impinger, a standard Greenberg-Smith (G-S) impinger (dry), a Teflon-coated CPM filter (with exhaust thermocouple), a modified G-S impinger containing 100 milliliters of deionized water, and a modified G-S impinger containing a known amount of indicating silica gel.

The CPM components of the Method 202 sampling train (dry knockout impinger and dry GS impinger) were placed in a tempered water bath and a pump was used to circulate water through the condenser. The temperature of the bath was maintained such that the CPM filter outlet temperature remained between 65 and 85°F. Crushed ice was placed around the last two impingers to chill the gas to below 68°F.

Sample Recovery and Analysis (USEPA Method 5 / 202)

At the conclusion of each one-hour test period, the sample train was leak-checked and disassembled. The sample nozzle, probe liner, and filter holder were brushed and rinsed with acetone. The recovered particulate filter and acetone rinses were stored in sealed containers and transferred to Enthalpy Analytical, Inc. (Durham, North Carolina) for gravimetric measurements.

The impingers were transported to the recovery area where they were weighed. There was very little moisture catch in the Method 202 portion of the sample train. Therefore, the CPM portion of the sample train did not use the nitrogen purge step of Method 202. The glassware (between the particulate filter and CPM filter) was rinsed with DI water, acetone, and hexane in accordance with the Method 202 sample recovery procedures. The CPM filter and recovered rinses were clearly and uniquely labeled and transferred to Enthalpy Analytical, Inc. for analysis.

Attachment 4 provides printouts of the PM calculations and scans of the field data sheets for each test run.

Attachment 5 provides a copy of the laboratory analytical report.

5.0 QA/QC Activities

5.1 Flow Measurement Equipment

Prior to arriving onsite (or onsite prior to beginning compliance testing), the instruments used during the source test to measure exhaust gas properties and velocity (pyrometer, Pitot tube, and scale) were calibrated to specifications in the sampling methods.

The absence of cyclonic flow for each sampling location was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each of the velocity traverse points 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).

5.2 Isokinetic Sampling and Meter Box Calibrations

The dry gas meter sampling console used for moisture testing was calibrated prior to and after the testing program. This calibration uses the critical orifice calibration technique presented in USEPA Method 5. The metering console calibration exhibited no data outside the acceptable ranges presented in USEPA Method 5.

The digital pyrometer in the metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

The sampling rate for all test periods was within the allowable isokinetic variation (i.e. within 10% of the calculated isokinetic sampling rate required by USEPA Method 5).

Attachment 6 presents test equipment quality assurance data; meter box calibration records, and field equipment calibration records.

5.3 Particulate Matter Recovery and Analysis

All recovered particulate matter samples were stored and shipped in certified trace clean amber glass sample bottles with Teflon® lined caps. The liquid level on each bottle was marked with a permanent marker prior to pick-up and the caps were secured closed with tape. Samples of the reagents used in the test event (200 milliliters each of deionized high-purity water, acetone and hexane) were submitted with the samples for analysis to verify that the reagents used to recover the samples have low particulate matter residues.

The glassware used in the condensable PM impinger trains was washed and rinsed prior to use in accordance with the procedures of USEPA Method 202. The glassware was not baked prior to use; therefore, ICT used the field train proof blank option provided in USEPA Method 202. The laboratory reported 1.7 milligrams (mg) for the field train proof blank rinses (sample train rinse performed prior to use) and 3.3 mg for the field train recovery proof blank. The reported condensable PM test results were blank-corrected according to the method (USEPA Method 202 allows a blank correction of up to 2 mg).

5.4 Laboratory QA/AC Procedures

The particulate matter analyses were conducted by a qualified third-party laboratory according to the appropriate QA/QC procedures specified in the USEPA Methods 5 and 202 and are included in the final report in Attachment 5 provided by Enthalpy Analytical.

6.0 Results

The emission performance tests consisted of three (3) sampling periods per alloy class (A380 and non-A380) per operation condition (flux / cleaning and melting with no fluxing) for a total of twelve (12) test periods:

- Furnace 1; A380 melting
- Furnace 1; A380 fluxing / cleaning
- Furnace 5; Non-A380 melting
- Furnace 5; Non-A380 fluxing / cleaning

Each sampling period was planned for 60 minutes in duration, except for the Furnace 5 melt sampling periods, which were planned for 90 minutes. The melt furnaces were operated normally at maximum routine conditions during the test periods as close to maximum capacity as could be achieved on the test dates. For the fluxing test periods were coordinated to encompass flux addition and furnace cleaning.

Furnace operating data are presented in Attachment 3

6.1 Melting Test Results and Emission Factors

Material is charged to the furnace in batches, it is not a continuous process. The amount of material charged during the test period was recorded and used as the melt rate (tons/hr). The measured PM/PM10/PM2.5 emission rate (lb/hr) was divided by the average melt rate to calculate an emission factor (lb/ton) for use in the facility's monthly emission records.

6.2 Fluxing Test Results and Emission Factors

The entire fluxing and cleaning process requires approximately 40 minutes. The amount of flux used and the time it was added to the furnace was recorded by CCMI. PM/PM10/PM2.5 emissions were measured for a one-hour period that encompassed the entire fluxing and cleaning procedure. Aluminum is not charged to the furnace during the fluxing and cleaning process. Therefore, the average melt rate recorded for the melting test periods was used to calculate an emission factor (lb/ton) for the fluxing / cleaning test periods.

Tables 6.1 through 6.4 present test results for EUMELTFURNACE1 (melting and fluxing) and EUMELTFURNACE5 (melting and fluxing).

6.3 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with USEPA methods and the submitted Test Protocol except that diluent gases were determined using a Fyrite® combustion test kit as opposed to instrumental analyzers. This change was approved by Regina Angellotti (EGLE-AQD) prior to the test event.