Derenzo Environmental Services
Consulting and Testing

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AIR EMISSION TEST REPORT

Report Title	TEST REPORT FOR THE VERIFICATION OF AIR POLLUTANT EMISSIONS FROM FOUNDRY OPERATIONS
Test Date(s)	October 19-20, 2016 November 10, 2016

Facility Information	
Name:	Brembo North America, Inc.
Street Address:	M60 and Van Wert Rd
City, County:	Albion Township, Calhoun
SRN:	N6226

Permit / Emission Unit Information	
Permit To Install No.:	PTI 199-14A
Emission Units:	EUSHAKEOUT, FGMELTING FGPOURCOOL, FGSANDHNDLG

Testing Contractor	
Company:	Derenzo Environmental Services
Mailing Address:	39395 Schoolcraft Rd. Livonia, MI 48150
Phone:	(734) 464-3880
Project No.	1608011

TEST REPORT
FOR THE VERIFICATION OF
AIR POLLUTANT EMISSIONS FROM FOUNDRY OPERATIONS

BREMBO NORTH AMERICA, INC.
HOMER, MICHIGAN

1.0 INTRODUCTION

Brembo North America, Inc. (Brembo) manufactures high-performance automobile brake system components at its facility located in Homer / Albion Township, Calhoun County (Facility State Registration No., SRN N6226). A Renewable Operating Permit (MI-ROP-N6226-2015) has been issued to the stationary source for existing brake finishing and assembly operations. Brembo recently completed the construction and startup of a grey iron foundry to cast and manufacture brake system components. The foundry operations were issued Permit to Install 199-14A, which has not, as of yet, been incorporated into the Renewable Operating Permit.

The facility is classified as a new foundry that is part of a major stationary source of hazardous air pollutant (HAP) emissions and is subject to the provisions of the National Emission Standards for Hazardous Air Pollutants from Iron and Steel Foundries (40 CFR Part 63 Subpart EEEEE, Iron and Steel Foundry MACT).

The conditions of Permit to Install 199-14A and the Iron and Steel Foundry MACT require that emission testing be performed to determine particulate matter (PM), carbon monoxide (CO) and volatile organic compound (VOC and/or VOHAP) emissions exhausted from several process exhaust stacks. In addition, visible emission (VE) observations were performed to determine the opacity of any fugitive emissions from the building that houses the foundry operations. A relative accuracy test audit (RATA) was performed for the VOHAP continuous emission monitoring system (CEMS) installed on the outlet of the FGPOURCOOL thermal oxidizer.

The emission testing was performed October 19-20, 2016 and November 10, 2016 by Derenzo Environmental Services, personnel Robert Harvey, Andrew Rusnak, (Qualified Stack Testing Individual, QSTI), Jason Logan, Daniel Wilson, Blake Beddow, and Clay Gaffey. Mr. David Patterson and Rex Lane from the MDEQ-AQD were on-site to observe 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 1 provides a copy of the MDEQ-AQD test plan approval letter.

2.0 CONTACT INFORMATION AND CERTIFICATION

Questions concerning this emission report should be directed to:

Testing Procedures	Robert L Harvey Derenzo Environmental Services 4180 Keller Rd, Suite B Holt MI 48842 rharvey@derenzo.com (517) 268-0043
Compliance Manager	Jessy L Conard Health, Safety & Environmental Manager Brembo North America 47765 Halyard Dr Plymouth MI 48170 jconard@us.brembo.com (734) 468-2092
Site Operations	Vivian Rowles HSE Manager Brembo North America 6259 30-Mile Rd Homer MI vrowles@us.brembo.com (517) 568-4398

This test report was prepared by Derenzo Environmental Services based on the field sampling data collected by Derenzo Environmental Services. Certain analyses were contracted to, and performed by third parties, and the results are presented in this report and its appendices. Facility process data were collected and provided by Brembo employees or representatives for inclusion in this report.

This report has been reviewed by appropriate Brembo North America, Inc. representatives and approved for submittal to the MDEQ-AQD.

Report Prepared By:

Robert L. Harvey, P.E.
General Manager

3.0 SUMMARY OF TEST RESULTS

Initial emission testing was performed for the Brembo foundry operations on October 19 and 20 and November 10, 2016.

Table 2.1 presents a summary of the particulate matter emission test results.

Table 2.2 presents a summary of measured CO, VOHAP and VOC emissions.

The test results in Tables 2.1 and 2.2 are based on the average of three test periods. More detailed information for each test period is presented in Section 7.0 and the tables at the end of this report.

Corresponding emission limits are presented in Tables 2.1 and 2.2 and in the tables in Section 7.0. Not all of the emission test results demonstrate compliance with the applicable emission limits. Emission exceedances are presented in more detail in Section 7.0.

The RATA compliance demonstration confirmed that the RTO VOHAP CEMS monitor operates in compliance with the relative accuracy criteria for VOC continuous emission monitoring systems (USEPA Performance Specification 8).

Observation of the facility by a certified observer of visible emissions verified that there are no visible fugitive emissions from the building housing iron and steel foundry emission sources (i.e., zero percent opacity for any fugitive emissions).

Production at the Brembo foundry is ramping up from its initial startup earlier this year. During the October/November test periods the processes were operated at normal operating conditions but are not yet at maximum capacity.

Tables 2.3 through 2.4 present a test matrix and production data for the test event.

Appendix 2 provides production and process operating data provided by Brembo for the test event.

Table 2.1 Summary of measured particulate matter emission rates (three-test average)

Emission Unit	Stack ID	Filterable PM Content[1] (gr/dscf)	Filterable PM Emission Rate (lb/hr)	Total $PM_{10}/PM_{2.5}$ Emission Rate (lb/hr)
FGPOURCOOL	SVRTO1	0.0005	0.34	0.92
Pouring only[2]	SVRTO1	0.0052	--	--
Applicable Limits		*0.002*	*0.24*	*0.75*
FGSANDHNDLG	SVSSBH	0.0005	0.67	2.1
Applicable Limits		--	*7.93*	*2.3 / 1.58*
FGMELTING	SVMELTBH	0.0005	0.37	0.93
Applicable Limits		*0.001*	*0.39*	*1.23*

1. PM emission standard (grains per dry standard cubic feet) specified in foundry MACT.
2. Assumes all measured PM emissions originate from pouring station. PM content calculated based on the ratio of measured pouring station and stack exhaust flowrates

Table 2.2 Summary of measured CO, VOHAP and VOC emissions (three-test average)

Emission Unit	CO Conc. (ppmvd)	CO Emissions (lb/hr)	VOHAP Conc[1] (ppmv C_6)	VOC Emissions (lb/hr)	VOC DE (% wt)
FGPOURCOOL	22.1	8.09	1.71	1.63	91.0%
Cooling only[2]	--	--	1.89	--	--
Applicable Limits	--	*10.44*	*20*	*1.44*	*>95%*
FGSANDHNDLG	2.93	1.92	3.24	6.86	NA
Shakeout only[3]	--	--	7.23	--	--
Applicable Limits	--	*11.6*	*20*	*3.19*	--

1. VOHAP emission standard (20 ppmv at hexane) specified in foundry MACT. Data for FGPOURCOOL based on three-hour average as recorded by CEMS in SVRTO1 stack.
2. Assumes all measured VOHAP emissions originate from cooling house. VOHAP concentration calculated based on the ratio of measured cooling house and stack exhaust flowrates
3. Assumes all measured VOHAP emissions originate from shakeout. VOHAP concentration calculated based on the ratio of measured shakeout and stack exhaust flowrates

Table 2.3 FGPOURCOOL stack test matrix and production data for October 19, 2016

10/19/16 Time	Steel Melted (lbs)	Discs Poured	RTO CEMS (ppmv C_6)	Emission Test Periods	
10:00 - 11:00	19,551	1,051	1.44	PM Test 1 1002-1206 ** PM Test 2 1245-1455 PM Test 3 1533-1740	RATA Test Periods 1000-1437
11:00 - 12:00	27,854	1,027	1.25		
12:00 - 13:00	21,551	1,113	1.15		
13:00 - 14:00	23,557	1,562	1.37		
14:00 - 15:00	23,884	1,287	1.39		
15:00 - 16:00	24,032	1,292	1.91		
16:00 - 17:00	24,851	1,374	1.60		CO/VOC DE Test Periods 1605-1940
17:00 - 18:00	25,474	1,549	1.63		
18:00 - 19:00	22,484	947	1.87		
19:00 - 20:00	17,845	1,185	1.42		

**Fugitive emission VE observations were performed during this time period from 1131 to 1431.

Table 2.4 FGSANDHNDLG and EUSHAKEOUT stack test matrix and production data for October 20, 2016

10/20/16 Time	Steel Melted (lbs)	Discs Poured	RTO CEMS (ppmv C_6)	Emission Test Periods	
15:00 - 16:00	33,581	1,291	1.55	PM Test Periods 1508-1918	CO/VOHAP Test Periods 1508-1918
16:00 - 17:00	33,542	1,361	1.61		
17:00 - 18:00	32,647	1,468	1.59		
18:00 - 19:00	29,856	1,346	1.99		
19:00 - 20:00	25,898	1,273	1.81		

Table 2.5 FGMELTING stack test matrix and production data for November 10, 2016

11/10/16 Time	Steel Melted (lbs)	Discs Poured	RTO CEMS (ppmv C_6)	Emission Test Periods
0500 - 0600	32,498	1,654	NA	PM Test 1 0540-0745 PM Test 2 0820-1025 PM Test 3 1106-1310
0600 - 0700	12,369	596	NA	
0700 - 0800	27,462	1,374	NA	
0800 - 0900	31,385	1,632	NA	
0900 - 1000	20,351	1,028	NA	
1000 - 1100	23,484	1,204	NA	
1100 - 1200	27,684	1,360	NA	
1200 - 1300	30,041	1,488	NA	
1300 - 1400	12,441	626	NA	

4.0 SOURCE DESCRIPTION

4.1 General Process Description

Brembo's grey iron foundry uses scrap iron and steel and produces castings for Brembo's existing brake disc plant located on the same property. Incoming raw material passes quality control checks, then is melted using one of the four main induction melting furnaces. Melted iron is then transferred to a pouring furnace which maintains the temperature of the molten iron until it is poured into the castings.

Molds are created using conventional green sand with urethane "coldbox" core. The greensand forms the exterior boundaries and shape of the casting while the sand cores form the void spaces within the interior of the mold.

The molten metal is poured from the pouring furnace into the molds. The molds are conveyed through the cooling house for in-mold cooling. After transfer through the cooling house molds are then conveyed to the shakeout system. This process involves removing the cooled grey iron casting from the mold using a rotating drum system to separate the metal part from the sand.

After the shakeout process is complete, the casting are then manually sorted off of a conveyor line and put into the appropriate containers for transport to the Brembo brake disc plant that is located on the same property.

4.2 Emission Control System Description

The shakeout (EUSHAKEOUT) and sand handling system (EUSANDHNDLG) are controlled by a common dust collector for particulate matter emission reduction and exhausted to a common stack SVSSBH.

Process air from four (4) induction melting furnaces (FGMELTING) is collected and exhausted to a dust collector for particulate matter emission reduction and exhausted to the stack SVMELTBH.

Emissions from the pouring and cooling operations (FGPOURCOOL) are controlled by a common baghouse and regenerative thermal oxidizer (RTO) and exhausted to a common stack SVRTO1

Appendix 3 provides drawings of the emission control device exhaust stacks and emission test sampling locations.

5.0 SUMMARY OF USEPA TEST METHODS

The following USEPA reference test methods and sampling trains were used to perform the emission compliance testing.

USEPA Method 1	Velocity and sampling locations were selected based on physical stack measurements in accordance with USEPA Method 1.
USEPA Method 2	Exhaust gas velocity pressure and temperature were measured using a Type-S Pitot tube connected to a red oil incline manometer and K-type thermocouple.
USEPA Method 3A	The RTO and sand system exhaust gas O_2 and CO_2 content was determined using instrumental analyzers.
USEPA Method 3	For all exhaust stacks and ducts other than the RTO and sand system exhaust stacks, O_2 and CO_2 content was consistent with ambient air and verified by Fyrite® combustion gas analyzer.
USEPA Method 4	Exhaust gas moisture was determined using the chilled impinger method (typically as part of the particulate sampling train).
USEPA Method 5	Filterable PM was determined using isokinetic sampling procedures and analysis of the front half of the particulate matter sampling train (filter and acetone rinse).
USEPA Method 202	Condensable PM was determined using isokinetic sampling procedures and analysis of the back half of the particulate matter sampling train.
USEPA Method 9	Building fugitive emission opacity was determined by a certified observer of visible emissions.
USEPA Method 10	Exhaust gas CO concentration was determined using an NDIR instrumental analyzer.
USEPA Method 25A	VOC / VOHAP concentration was measured as total hydrocarbons using a flame ionization analyzer.
USEPA PS8	The relative accuracy of the RTO VOHAP CEMS was verified using USEPA Method 25A and Performance Specification 8

6.0 SAMPLING AND ANALYSIS PROCEDURES

Detailed USEPA reference test method procedures were provided in the test protocol. This section provides a summary of the sampling and analysis procedures used for each emission unit. The test procedures are presented generally in the order in which they were performed.

6.1 FGPOURCOOL RTO Stack

6.1.1 VOHAP CEMS RATA (Cooling House)

Emissions from the pouring station and the cooling house are combined and vented to a baghouse and regenerative thermal oxidizer (RTO). A Horiba FIA-510 (flame ionization analyzer) continuously monitors THC/VOHAP emissions from the RTO emission control device as required by the Iron and Steel Foundry MACT §63.7732(f) to demonstrate compliance with the 20 ppmv VOHAP emission standard in §63.7690(a)(10) for pallet cooling lines.

USEPA PS 8, *Specifications for Volatile Organic Compound Continuous Emission Monitoring Systems in Stationary Sources,* was used to evaluate the relative accuracy (RA) of the CEMS.

A heated sampling probe was used to continuously sample RTO exhaust gas at three (3) positions along the stack diameter (0.4 m, 1.2 m and 2.0 m). The RTO exhaust gas sample was delivered to a TEI 51c heated FIA (reference analyzer) using a heated Teflon® line and heated 10-micron stainless steel filter. Both the CEMS and reference analyzer were calibrated using a hexane standard.

The CEMS RATA consisted of nine (9) individual 21-minute sampling periods.

6.1.2 Cooling House VOHAP Emission Standard Demonstration

Following completion of the VOC CEMS RATA, the cooling house VOHAP emission verification was performed based on 180 continuous minutes of VOHAP concentration data (parts per million as hexane, C_6) recorded using the permanently-installed CEMS. The data were reduced to hourly averages and three-hour averages as required by §63.7732(f)(1).

The MACT VOHAP emission standard is applicable to pallet cooling lines (i.e., cooling house). Since the pouring station and cooling house exhausts are combined before being vented to the dust collector and RTO, additional flowrate measurements were performed to determine the exhaust rate for the cooling house and a flow-weighted average VOHAP concentration was calculated assuming that all VOHAP emissions in the RTO exhaust originate from the cooling house.

The cooling house exhaust cannot be independently measured. Therefore, volumetric flowrate measurements of the pouring station exhaust (prior to being combined with the cooling house exhaust) were performed and subtracted from the RTO stack volumetric exhaust rate to estimate

the cooling house exhaust rate. These measurements were performed concurrent with the FGPOURCOOL PM test periods.

Cooling house VOHAP concentration was calculated using the following equation:

$C_{VOHAP} = C_{THC\ stack} \times Q_{Stack} / Q_{Cooling}$

Where: C_{VOHAP} = Flow-weighted average VOHAP for cooling house (ppmv as hexane)
Q_{Stack} = Volumetric flowrate, RTO stack (scfm)
$C_{THC\ stack}$ = Concentration THC measured at RTO stack (ppmv hexane)
$Q_{Cooling}$ = Volumetric flowrate, for cooling house exhaust (scfm)

6.1.3 FGPOURCOOL RTO VOC Destruction Efficiency Determination

PTI 199-14A specifies a minimum VOC destruction efficiency (DE) of 95% by weight for the FGPOURCOOL RTO. The VOC DE was determined based on simultaneous sampling of the oxidizer inlet and exhaust gas streams during three (3) one-hour sampling periods. THC concentration for the oxidizer inlet duct and exhaust stack were measured using independent TEI 51c heated FIA instruments according to USEPA Method 25A using propane as the calibration standard.

Air velocity measurements were performed near the beginning and conclusion of each one-hour test period using USEPA Method 2. Gas properties were determined using:

- USEPA Method 3 (Fyrite® gas analyzer) and Method 4 (wet bulb/dry bulb moisture approximation technique) for the RTO inlet gas.

- USEPA Method 3A (instrumental analyzers) and Method 4 (chilled impinger procedure) for the RTO exhaust gas.

Destruction efficiency for each test period was calculated using the following equation:

$DE_{VOC} = 1 - [(Q_{out} \times C_{THC,out}) / (Q_{in} \times C_{THC,in})] \times 100\%$

Where: DE_{VOC} = VOC destruction efficiency (% wt)
Q_{out} = Volumetric flowrate, oxidizer stack (scfm)
$C_{THC,out}$ = Concentration THC measured at oxidizer stack (ppmv propane)
Q_{in} = Volumetric flowrate, oxidizer inlet (scfm)
$C_{THC,in}$ = Concentration THC measured at oxidizer inlet (ppmv propane)

The inlet and outlet THC concentrations are reported relative to a propane calibration standard and the molecular weight of propane was used to calculate VOC mass emissions for each test period.

6.1.4 FGPOURCOOL CO Emission Testing

The CO concentration in the combined FGPOURCOOL exhaust was measured during the RTO VOC DE test periods using a TEI Model 48c infrared CO analyzer in accordance with USEPA Method 10. CO exhaust gas concentrations were monitored continuously throughout three (3) one-hour test periods and logged as 1-minute averages. The data were reduced to three (3) one-hour averages and used to calculate CO mass emission rate for each one-hour test period (pph).

6.1.5 FGPOURCOOL PM Emission Testing

PTI 199-14A specifies PM, PM_{10} and $PM_{2.5}$ emission limits for FGPOURCOOL. Filterable particulate matter emissions (PM) were measured using USEPA Method 5. The front half of the sample train (from the sampling nozzle to the heated filter) captured filterable PM for comparison to the PTI 199-14A PM emission limits. A USEPA Method 202 impinger train was added to the back half of the Method 5 sampling system to measure condensable particulate matter. The back half of the sampling train (from the exit of the heated filter, through the dry impingers, to the condensable PM filter) captured condensable PM. The filterable and condensable fractions were combined to determine total primary PM emissions ($PM_{10}/PM_{2.5}$) for comparison to the PTI 199-14A limits.

The testing consisted of three (3) two-hour isokinetic sampling periods. Diluent gas content (O_2 and CO_2) measurements were performed for each sampling period using instrumental analyzers (USEPA Method 3A).

6.1.6 Pouring PM Emission Calculation

The filterable particulate matter emissions (PM) measured using USEPA Method 5 at the RTO stack were used to for comparison to the Iron and Steel Foundry MACT emission standard for pouring stations in §63.7690(a)(6).

Since the cooling house is also vented to the dust collector and RTO, independent flowrate measurements were made for the pouring station exhaust prior to being combined with the cooling house exhaust and a flow-weighted average PM content was calculated assuming that all PM emissions in the RTO exhaust originate from the pouring station.

The volumetric flowrate of the pouring station exhaust was measured periodically (four times) throughout the PM test periods using USEPA Methods 1 through 4.

Pouring station PM content was calculated using the following equation:

$PM_{Pour} = PM_{Stack} \times Q_{Stack} / Q_{Pour}$

Where: PM_{Pour} = Flow-weighted average PM content for pouring (gr/dscf)
Q_{Stack} = Volumetric flowrate, dry basis, RTO stack (dscfm)
PM_{Stack} = PM content measured at RTO stack (gr/dscf)
Q_{Pour} = Volumetric flowrate, dry basis, for pouring exhaust (dscfm)

Appendix 4 provides instrumental analyzer data, isokinetic data sheets and emission calculations for the FGPOURCOOL emission test periods.

6.2 Fugitive Emissions

USEPA Method 9 procedures were used to evaluate the opacity of fugitive emissions being released from the Brembo building that houses iron and steel foundry emissions sources. All visible emissions determinations were performed by a qualified observer in accordance with USEPA Method 9, Section 3. The qualified observer was located at a distance sufficient to provide a clear view of the emission source(s) with the sun oriented in the 140° sector to his back. As much as possible, the line of vision was approximately perpendicular to the plume direction (though no plumes were observed).

Appendix 5 provides a building sketch, USEPA Method 9 field data sheets, and the certified observer certificate.

6.3 Sand Handling Exhaust Stack

6.3.1 Sand System (FGSANDHNDLG) PM Emission Testing

PTI 199-14A specifies PM, PM_{10} and $PM_{2.5}$ emission limits for FGSANDSYSTEM; the shakeout (EUSHAKEOUT) and sand handling system (EUSANDHNDLG) that are exhausted to a common baghouse (Sand System Baghouse).

Filterable particulate matter emissions (PM) were measured using USEPA Method 5. A USEPA Method 202 impinger train was added to the back half of the sampling system to measure condensable particulate matter. The filterable and condensable fractions were combined to determine total primary PM emissions ($PM_{10}/PM_{2.5}$).

The testing consisted of three (3) one-hour isokinetic sampling periods.

Diluent gas content (O_2 and CO_2) measurements were performed for each sampling period using instrumental analyzers (USEPA Method 3A).

6.3.2 EUSHAKEOUT CO and VOC Emission Testing

PTI 199-14A specifies emission limits that are specific to the shakeout process (EUSHAKEOUT). The CO and VOC mass emission limits (pph) specified in PTI 199-14A were measured at the Sand System Baghouse exhaust stack (SVSSBH). The sand handling system is also vented to the Sand System Baghouse. However, the sand handling system is assumed to be an insignificant source of CO and VOC emissions and all measured CO and VOC mass emissions at the Sand System Baghouse exhaust were reported as EUSHAKEOUT emissions (worst-case emissions assumption).

Exhaust gas CO concentration measurements were performed using a TEI Model 48c infrared CO analyzer in accordance with USEPA Method 10. The exhaust gas VOC concentration was measured as total hydrocarbons (THC) using a TEI Model 51c heated FIA that was calibrated using hexane (parts per million as hexane, C_6) in accordance with the foundry MACT and USEPA Method 25A.

CO and VOC exhaust gas concentrations were monitored continuously throughout three (3) one-hour test periods and logged as 1-minute averages. The data were reduced to three (3) one-hour averages and used to calculate CO and VOC mass emission rate for each one-hour test period (pph) using the molecular weights of CO and hexane.

Exhaust gas flowrate measurements for CO and VOC mass emission rate calculations were performed as part of the isokinetic sampling procedures described in the previous section.

6.3.3 EUSHAKEOUT VOHAP Concentration Determination

The Iron and Steel Foundry MACT specifies an emission standard of 20 ppmv VOHAP for automated sand mold shakeout lines, which is applicable to EUSHAKEOUT. The Iron and Steel Foundry MACT indicates that THC (measured as hexane) can be used as a surrogate for VOHAP.

The shakeout system is not currently equipped with a VOHAP CEMS. Therefore, the THC concentrations measured as part of the VOC emission testing specified in the previous section was used for comparison to the 20 ppmv VOHAP emission standard for EUSHAKEOUT. Since the sand handling system is also vented to the Sand System Baghouse, independent flowrate measurements were made for the shakeout exhaust prior to being combined with the sand handling system exhaust and a flow-weighted average VOHAP concentration was calculated assuming that all VOHAP emissions in the baghouse exhaust originate from the shakeout process.

The volumetric flowrate of the shakeout exhaust (prior to being combined with any other exhausts) was measured (four times) throughout the PM, VOC and CO test periods using USEPA Methods 1 through 4.

EUSHAKEOUT VOHAP concentration for each test period was calculated using the following equation:

$C_{VOHAP} = C_{THC\ stack} \times Q_{Stack} / Q_{Shakeout}$

Where: C_{VOHAP} = Flow-weighted average VOHAP for shakeout (ppmv as hexane)
Q_{Stack} = Volumetric flowrate, baghouse stack (scfm)
$C_{THC\ stack}$ = Concentration THC measured at baghouse stack (ppmv hexane)
$Q_{Shakeout}$ = Volumetric flowrate, for shakeout process exhaust (scfm)

Appendix 6 provides instrumental analyzer data, isokinetic data sheets and emission calculations for the FGSANDHNDLG emission test periods.

6.4 Melting Exhaust Stack PM Testing

Process air from four (4) induction melting furnaces is collected and exhausted to a dust collector for particulate matter emission reduction. Sampling for FGMELTING PM emissions was performed in the stack SVMELTBH.

Filterable particulate matter emissions (PM) were measured using USEPA Method 5 as specified in the Iron and Steel Foundry MACT §63.7732(b)(1). The front half of the sample train (from the sampling nozzle to the heated filter) captured filterable PM for comparison to the PTI 199-14A and Iron and Steel Foundry MACT PM emission limits.

A USEPA Method 202 impinger train was added to the back half of the Method 5 sampling system to measure condensable particulate matter. The filterable and condensable fractions were combined to determine total primary PM emissions ($PM_{10}/PM_{2.5}$) for comparison to the PTI 199-14A limits.

The testing consisted of three (3) two-hour isokinetic sampling periods.

Diluent gas content (O_2 and CO_2) was comparable to ambient air and was verified using a Fyrite® gas analyzer (USEPA Method 3).

Appendix 7 provides isokinetic data sheets and emission calculations for the FGMELTING emission test periods.

6.5 Quality Assurance/Quality Control Procedures

6.5.1 Exhaust Gas Flowrate

Prior to arriving onsite, the instruments used during the source test to measure exhaust gas properties and velocity (barometer, pyrometer, and Pitot tube) 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).

6.5.2 Instrumental Analyzer Calibration and 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.

At the beginning of each test day, appropriate high-range, mid-range, and low-range span gases followed by a zero gas were introduced to the THC analyzer, in series at a tee connection, which is installed between the sample probe and the particulate filter, through a poppet check valve. After each test period, mid-range and zero gases were re-introduced in series at the tee connection in the sampling system to check against the method's performance specifications for calibration drift and zero drift error.

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. The FIA instrument was calibrated with USEPA Protocol 1 certified concentrations of propane or hexane in air and zeroed using hydrocarbon-free air. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

The response time of the sampling system was determined prior to the compliance test program by introducing upscale gas and zero gas, in series, into the sampling system using a tee connection at the base of the sample probe. The elapsed time for the analyzer to display a reading of 95% of the expected concentration was determined using a stopwatch. Results of the response time determinations were recorded on field data sheets. For each test period, test data

were collected once the sample probe was in position for at least twice the maximum system response time.

6.5.3 Gas Divider Certification

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.

6.5.4 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 2.5% of the span for all measured interferent gases. No major analytical components of the analyzers have been replaced since performing the original interference tests.

6.5.5 Determination of Exhaust Gas Stratification

The RTO exhaust gas testing was performed using a 3-point probe. A stratification check was performed for the sand system exhaust stack. The stainless steel sample probe was positioned at sample points correlating to 16.7, 50.0 (centroid) and 83.3% of the stack diameter. Pollutant concentration data were recorded at each sample point for a minimum of twice the maximum system response time.

The recorded concentration data for each exhaust stack indicated that the measured O_2, CO_2, and CO concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the exhaust gas was considered to be unstratified and the compliance test sampling was performed at a single sampling location within each exhaust stack.

6.5.6 Meter Box Calibrations and Isokinetic Rate

The dry gas meter in the isokinetic sampling console, which was used for the particulate matter and exhaust gas moisture content sampling, was calibrated prior to and after the testing program. This calibration uses the critical orifice calibration technique 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 nozzle diameter was determined using the three-point calibration technique.

The sampling rate for all test periods was within 10% of the calculated isokinetic sampling rate required by USEPA Method 5.

6.5.7 Particulate Matter Recovery and Analysis

All recovered particulate matter samples were stored and shipped in 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 (200 milliliters each of deionized high-purity water, acetone and hexane) were sent to the laboratory 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, DES used the field train proof blank option provided in USEPA Method 202. In addition, a field train recovery proof blank was performed following the second PM test period. The reported condensable PM-10 test results were blank-corrected according to USEPA Method 202, which allows a blank correction of up to 2 mg (since greater than 2 mg was detected in the train proof blank).

6.5.8 Laboratory QA/QC Procedures

The laboratory particulate matter analyses were conducted by qualified third-party laboratory according to the appropriate QA/QC procedures of the associated USEPA test methods and are included in the final reports provided by Enthalpy Analytical.

Appendix 8 provides a copy of the Enthalpy Analytical laboratory analytical reports for gravimetric analysis of the filterable and condensable particulate matter samples.

Appendix 9 provides sampling equipment quality assurance and calibration data (equipment inspections, instrument calibration records, dry gas meter calibration records, calibration gas certificates).

7.0 TEST RESULTS AND DISCUSSION

7.1 FGPOURCOOL Emission Rates and RTO Performance

Table 7.1 presents a summary of the VOHAP CEMS RATA data. The RATA compliance demonstration confirmed that the RTO VOHAP CEMS instrument operates in compliance with the relative accuracy criteria specified in USEPA Performance Specification 8.

Table 7.2 presents a summary of recorded VOHAP CEMS data collected continuously for 10 hours on October 19, 2016. The data were reduced to one-hour and three-hour averages and adjusted to determine the VOHAP concentration for the cooling house exhaust (assuming all VOHAP emissions originate from the cooling house). The adjusted VOHAP concentration is less than the applicable MACT emission standard for pallet cooling lines (20 ppmv measured as hexane).

Table 7.3 presents measured FGPOURCOOL VOC and CO emissions and RTO VOC destruction efficiency test results. The measured CO emission rate was less than the pph limit specified in PTI 199-14A. The average outlet VOC concentration was relatively low, 2.8 ppmv measured as propane, however, the calculated VOC pph emission rate exceeds the corresponding mass emission limit in PTI 199-14A. The calculated destruction efficiency (DE) did not satisfy the minimum criteria specified in PTI 199-14A (95%) due to the relatively low inlet loading, which is only 33 ppmv as propane (C_3).

Table 7.4 presents FGPOURCOOL particulate matter emission test results. The measured PM content at the RTO stack is relatively low; approximately 0.0005 gr/dscf. However, this has to be flow-adjusted for the pouring station since the MACT PM emission standard applies only to the pouring station. The pouring station flow is less than 10% of the total stack flow where the PM measurements are performed. Therefore, the measured PM content increases by a factor of 10 to 0.0052 gr/dscf, which then exceeds the MACT limit of 0.002 gr/dscf. The measured PM mass emission rates are slightly above (exceed) the PM, PM10 and PM2.5 emission limits specified in PTI 199-14A.

7.2 Fugitive Emissions

USEPA Method 9 procedures were used to evaluate the opacity of fugitive emissions being released from the Brembo building housing iron and steel foundry emissions sources. The observer chose two locations in the east parking lot with clear views of the north dock doors, sand handling truck door, and east facility doors (no openings were identified for the west side of the facility).

Observations were recorded at 15-second intervals. The fugitive VE opacity observations were performed for three (3) continuous hours (30, 6-minute averages) on October 19, 2016 coinciding with the FGPOURCOOL PM emission test periods.

No visible emissions were observed (all recorded values are 0%). The facility is in compliance with the opacity limit in §63.7690(a)(7) for fugitive emissions from buildings or structures housing iron and steel foundry emission sources.

7.3 FGSANDHNDLG / EUSHAKEOUT Emission Rates

Table 7.5 presents measured EUSHAKEOUT VOHAP, VOC and CO emission rates. The measured CO emission rate is less than the pph limit specified in PTI 199-14A. The measured exhaust gas VOHAP concentration is low (2-4 ppm as hexane) and well below 20 ppm MACT limit even when flow-adjusted for the shakeout exhaust only. However, the calculated VOC mass emission rate exceeds the 3.19 pph limit in PTI 199-14A.

Table 7.6 presents FGSANDHNDLG particulate matter emission test results. The test results demonstrate compliance with the PM and PM_{10} pph permit limits but exceed the $PM_{2.5}$ pph permit limit.

7.4 FGMELTING PM Emission Rates

Table 7.7 presents FGMELTING particulate matter emission test results. The test results demonstrate compliance with the MACT PM emission standard and PM, PM_{10} and $PM_{2.5}$ pph limits specified in PTI 199-14A.

7.5 Variations from Normal Sampling Procedures or Operating Conditions

The testing was performed as described in the approved test plan and associated USEPA test methods unless noted in this section.

Production at the Brembo foundry is ramping up from its initial startup earlier this year. During the October/November test periods the processes were operated at normal operating conditions but are not yet at maximum capacity.

The submitted test plan indicates that independent flowrate measurements would be performed for the pouring station and cooling house exhausts in order to perform flow-weighted calculations for pouring station PM emissions and pallet cooling VOHAP emissions as specified in the foundry MACT. However, based on the configuration of the ductwork, the cooling house exhaust flowrate cannot be independently measured before it's combined with the pouring station exhaust. Therefore, the measured pouring station flowrate was subtracted from the combined flowrate measured at the RTO stack to estimate the cooling house volumetric flowrate.

The test plan approval letter in Appendix 1 specifies that *The 20 ppm VOHAP limit for EUSHAKEOUT and FGPOURCOOL is a combined limit. Therefore, it will be necessary to test these processes simultaneously.* Emission test results for the shakeout and FGPOURCOOL

(cooling house) exhausts demonstrate that each exhaust emits less than 20 ppmv VOHAP (measured as hexane). The combination of the two gas stream would inherently contain less than 20 ppmv VOHAP since each has a concentration less than 20 ppmv (the VOHAP concentrations would be flow-averaged as opposed to accumulated). Table 2.4 presents recorded VOHAP CEMS data for October 20 when the shakeout VOHAP testing took place. However, a combined concentration is not presented in this report.

Table 7.1 RATA summary, VOHAP concentration measured at the RTO exhaust

Run Number	Test Date	Begin	End	Ref. Method Result (ppmv as hexane)	CEMS Data	Difference [d]
1	10/19/16	10:00	10:21	0.81	1.43	-0.62
2	10/19/16	10:27	10:48	0.61	1.39	-0.78
3	10/19/16	11:07	11:28	1.19	1.42	-0.23
4	10/19/16	11:35	11:56	0.86	1.05	-0.19
5	10/19/16	12:08	12:29	1.19	1.19	0.00
6	10/19/16	12:36	12:57	0.90	1.10	-0.20
7	10/19/16	13:04	13:25	0.82	1.41	-0.59
8	10/19/16	13:31	13:52	1.26	1.41	-0.15
9	10/19/16	14:16	14:37	1.53	1.34	0.19

Number of tests periods:	$[n]$	9
Arithmetic Mean Difference:	$[\bar{d}]$	-0.29
Standard Deviation:	$[S_d]$	0.316
97.5% Confidence T-Value:	$[t_{0.975}]$	2.306
Confidence Coefficient:	$[CC]$	0.24
Arithmetic Mean RM Values*:	$[\bar{RM}]$	20.0
Relative Accuracy**:	$[RA]$	**2.6%**
Allowable Limit:		**10%**

* Measured concentration is less than 50% of emission standard. Therefore 20 ppm standard was used as RM'.
** Relative accuracy for the CEMS must be no greater than 10% when emission standard is used for RM'.

Table 7.2 VOHAP CEMS data, three-hour averages adjusted for cooling house

10/19/16 Begin	10/19/16 End	Avg RTO Temp (°F)	Avg CEM VOHAP (ppm C_6)	3-hr Avg VOHAP (ppm C_6)	Adjusted 3-hr Avg[1] (ppm C_6)
10:00:00	10:59:59	1618	1.44	--	--
11:00:00	11:59:59	1617	1.25	--	--
12:00:00	12:59:59	1617	1.15	1.28	1.41
13:00:00	13:59:59	1617	1.37	1.26	1.39
14:00:00	14:59:59	1616	1.39	1.30	1.44
15:00:00	15:59:59	1620	1.91	1.56	1.72
16:00:00	16:59:59	1619	1.60	1.63	1.80
17:00:00	17:59:59	1620	1.63	1.71	1.89
18:00:00	18:59:59	1621	1.87	1.70	1.88
19:00:00	19:59:59	1619	1.42	1.64	1.81
				MACT Limit	*20*

1. The CEMS (in RTO stack) three-hour average concentration data were adjusted assuming all measured VOHAP emissions originate from the cooling house. The measured RTO stack flowrate (83,294 scfm) and the measured pouring station flowrate (7,812 scfm) were used with the following equations:

   Calculated cooling house flow = (Stack flowrate) – (pouring station flowrate)
   Calculated cooling house flow = (83,294 scfm) – (7,812 scfm) = 75,483 scfm

   Adjusted VOHAP concentration = (VOHAP ppm) x (Stack flowrate) / (cooling house flowrate)

Table 7.3 Measured FGPOURCOOL VOC and CO emissions and RTO VOC destruction efficiency test results

Date Test Times	Test 1 10/19/16 1605-1705	Test 2 10/19/16 1722-1822	Test 3 10/19/16 1840-1940	Three Test Avg
RTO Operating Data				
Average Temperature (°F)	1,619	1,620	1,620	1,620
Minimum Temperature (°F)	1,559	1,562	1,564	1,559
RTO Inlet Gas				
Temperature (°F)	94	95	95	95
Flowrate (scfm)	81,093	80,442	79,981	80,505
Average THC conc. (ppmv C_3)	32.6	37.3	29.1	33.0
Calculated VOC mass flow (lb/hr)	18.2	20.6	16.0	18.3
RTO Exhaust Gas				
Temperature (°F)	196	185	179	187
Flowrate (scfm)	82,724	86,233	87,139	85,365
Flowrate (dscfm)	81,475	84,691	85,352	83,839
Average THC conc. (ppmv C_3)	2.81	2.99	2.54	2.78
Calculated VOC mass flow (lb/hr)	1.60	1.77	1.52	1.63
			VOC Limit (lb/hr)	*1.44*
Average CO conc. (ppmvd CO)	21.6	22.4	22.3	22.1
Calculated CO mass flow (lb/hr)	7.69	8.28	8.29	8.09
			CO Limit (lb/hr)	*10.44*
Calculated VOC Destruction Efficiency				
1 - [RTOout / RTO in] x 100%	91.2%	91.4%	90.5%	91.0%
			DE Requirement	> 95%

Table 7.4 FGPOURCOOL particulate matter emission test results

Date Test Times	Test 1 10/19/16 1002-1206	Test 2 10/19/16 1245-1455	Test 3 10/19/16 1533-1740	Three Test Avg
Stack Exhaust Gas Properties				
Temperature (°F)	186	206	198	197
Moisture (% vol)	1.8	1.7	1.5	1.7
Flowrate (scfm)	83,034	82,976	83,873	83,294
Flowrate (dscfm)	81,526	81,571	82,608	81,902
Pouring Station Exhaust Flow				
Temperature (°F)	81	77	73	77
Moisture (% vol)	1.7	1.9	1.9	1.8
Flowrate (scfm)	7,810	7,821	7,814	7,815
Flowrate (dscfm)	7,679	7,674	7,663	7,672
Particulate Matter				
Sample volume (dscf)	104	107	108	106
PM catch primary filter (mg)	0.2	0.0	0.0	0.1
PM catch acetone rinse (mg)	2.7	3.4	3.7	3.3
PM content (gr/dscf)	0.0004	0.0005	0.0005	0.0005
Adjusted Pouring PM (gr/dscf)[1]	0.0046	0.0052	0.0057	0.0052
			PM Limit[2] (gr/dscf)	*0.002*
PM (filterable) emission rate (lb/hr)	0.30	0.34	0.37	0.34
			PM Limit (lb/hr)	*0.24*
Condensables and Total PM				
CPM catch organic (mg)	2.0	3.5	8.2	4.6
CPM catch inorganic (mg)	4.0	2.1	3.3	3.1
CPM emission rate (lb/hr)	0.42	0.36	0.96	0.58
Total PM emission rate (lb/hr)	0.72	0.71	1.34	0.92
			PM10/PM2.5 Limit (lb/hr)	*0.75*

1. Assumes all measured PM emissions originate from pouring station. PM content calculated based on the ratio of measured pouring station and stack exhaust flowrates
   Adjusted PM = (Measured PM content) x (Stack flowrate, dscfm) / (Pouring station flowrate, dscfm)

2. PM emission standard (grains per dry standard cubic feet) specified in foundry MACT.

Table 7.5 Measured EUSHAKEOUT VOHAP, VOC and CO emission rates

Date Test Times	Test 1 10/20/16 1508-1610	Test 2 10/20/16 1653-1754	Test 3 10/20/16 1817-1918	Three Test Avg
Stack Exhaust Gas Properties				
Temperature (°F)	120	122	120	120
Moisture (% vol)	4.1	5.1	4.6	4.6
Flowrate (scfm)	157,512	157,719	157,498	157,576
Flowrate (dscfm)	151,039	149,717	150,270	150,342
Shakeout Exhaust Flow				
Temperature (°F)	137	139	137	138
Moisture (% vol)	4.4	4.5	5.2	4.7
Flowrate (scfm)	71,273	71,180	69,490	70,648
Gaseous Pollutants				
Average THC conc. (ppmv C_6)	2.16	3.71	3.85	3.24
Shakeout VOHAP[1] (ppmv C_6)	4.78	8.22	8.73	7.23
			VOHAP Limit[2] (ppmv)	*20*
Calculated VOC mass flow (lb/hr)	4.58	7.86	8.15	6.86
			VOC Limit (lb/hr)	*3.19*
Average CO conc. (ppmvd CO)	2.35	3.23	3.22	2.93
Calculated CO mass flow (lb/hr)	1.55	2.11	2.11	1.92
			CO Limit (lb/hr)	*11.6*

1. Assumes all measured VOHAP emissions originate from shakeout. VOHAP content calculated based on the ratio of measured shakeout and stack exhaust flowrates
   Adjusted VOHAP = (Measured VOHAP conc) x (Stack flowrate, scfm) / (Shakeout flowrate, scfm)

2. VOHAP emission standard specified in foundry MACT.

Table 7.6 FGSANDHNDLG particulate matter emission test results

Date Test Times	Test 1 10/20/16 1508-1610	Test 2 10/20/16 1653-1754	Test 3 10/20/16 1817-1918	Three Test Avg
Stack Exhaust Gas Properties				
Temperature (°F)	120	122	120	120
Moisture (% vol)	4.1	5.1	4.6	4.6
Flowrate (scfm)	157,512	157,719	157,498	157,576
Flowrate (dscfm)	151,039	149,717	150,270	150,342
Particulate Matter				
Sample volume (dscf)	63.1	63.3	63.5	63.3
PM catch primary filter (mg)	0.7	0.8	0.3	0.6
PM catch acetone rinse (mg)	2.5	1.8	0.3	1.5
PM content (gr/dscf)	0.0008	0.0006	0.0001	0.0005
PM (filterable) emission rate (lb/hr)	1.0	0.81	0.19	0.67
			PM Limit (lb/hr)	*7.93*
Condensables and Total PM				
CPM catch organic (mg)	2.2	2.2	2.2	2.2
CPM catch inorganic (mg)	2.9	7.1	3.4	4.5
CPM emission rate (lb/hr)	1.0	2.3	1.1	1.5
Total PM emission rate (lb/hr)	2.0	3.1	1.3	2.1
			PM10 Limit (lb/hr)	*2.3*
			PM2.5 Limit (lb/hr)	*1.58*

Table 7.7 FGMELTING particulate matter emission test results

Date Test Times	Test 1 11/10/16 0540-0745	Test 2 11/10/16 0820-1025	Test 3 11/10/16 1106-1310	Three Test Avg
Stack Exhaust Gas Properties				
Temperature (°F)	98	99	104	100
Moisture (% vol)	1.0	1.0	0.9	0.9
Flowrate (scfm)	87,361	90,744	87,728	88,611
Flowrate (dscfm)	86,518	89,877	86,972	87,789
Particulate Matter				
Sample volume (dscf)	105	110	109	108
PM catch primary filter (mg)	2.8	3.0	2.4	2.7
PM catch acetone rinse (mg)	0.6	1.1	0.5	0.7
PM content (gr/dscf)	0.0005	0.0006	0.0004	0.0005
			PM Limit[1] (gr/dscf)	*0.001*
PM (filterable) emission rate (lb/hr)	0.37	0.43	0.31	0.37
			PM Limit (lb/hr)	*0.39*
Condensables and Total PM				
CPM catch organic (mg)	3.4	3.3	4.2	3.6
CPM catch inorganic (mg)	3.9	3.6	3.4	3.6
CPM emission rate (lb/hr)	0.57	0.52	0.60	0.56
Total PM emission rate (lb/hr)	0.94	0.95	0.91	0.93
			PM10 / PM2.5 Limit (lb/hr)	*1.23*

1. PM emission standard (grains per dry standard cubic feet) specified in foundry MACT.