

Source Test Report

Continental Aluminum
29201 Milford Road
New Hudson, MI 48165

Source Tested: Reverberatory Furnace #2 (RV2)
Test Dates: July 9-10, 2019

AST Project No. 2019-0342

Prepared By
Alliance Source Testing, LLC
1201 Parkway View Drive
Pittsburgh, PA 15205

MAIN OFFICE
255 Grant Street SE
Suite 600
Decatur, AL 35601
(256) 351-0121

stacktest.com

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Regulatory Information

<i>Permit No.</i>	Michigan Department of Environmental Quality (MDEQ) Permit No. 504-96F
<i>Regulatory Citation</i>	40 CFR 63, Subpart RRR
<i>State Registration No.</i>	N6013

Source Information

<i>Source Name</i>	<i>Source ID</i>	<i>Target Parameters</i>
Reverberatory Furnace #2 Flue Stack	SVHTRRVRB#2	PM, PM10, PM2.5, HCl, HF
Reverberatory Furnace #2 Baghouse Stack	SVBHRVRB#2	PM, PM10, PM2.5, HCl, HF, D/F

Contact Information

<i>Test Location</i>	<i>Test Company</i>	<i>Analytical Laboratories</i>
Continental Aluminum 29201 Milford Road New Hudson, MI 48165	Alliance Source Testing, LLC 1201 Parkway View Drive Pittsburgh, PA 15205	Alliance Source Testing, LLC 214 Central Circle SW Decatur, AL 35603 John Lawrence john.lawrence@stacktest.com (256) 351-0121 x 124
Courtney Boc cboc@contalum.com (248) 437-1001 ext 5120	Project Manager Adam Robinson adam.robinson@stacktest.com (501) 515-0903	Alliance Source Testing, LLC 5530 Marshall Street Arvada, CO 80002 James Davidson james.davidson@stacktest.com (720) 457-9504 ext. 802
	QA/QC Manager Heather Morgan heather.morgan@stacktest.com (256) 351-0121	SGS Analytical Perspectives 2714 Exchange Drive Wilmington, NC 28405 Amy Boehm amy.boehm@sgs.com (910) 794-1613, ext. 110
	Report Coordinator Alyssa Trujillo alyssa.trujillo@stacktest.com (801) 269-0550	ERA 16341 Table Mountain Parkway Golden, CO 80403 Claire Toon ctoon@waters.com (800) 372-0122

Alliance Source Testing, LLC (AST) has completed the source testing as described in this report. Results apply only to the source(s) tested and operating condition(s) for the specific test date(s) and time(s) identified within this report. All results are intended to be considered in their entirety, and AST is not responsible for use of less than the complete test report without written consent. This report shall not be reproduced in full or in part without written approval from the customer.

To the best of my knowledge and abilities, all information, facts and test data are correct. Data presented in this report has been checked for completeness and is accurate, error-free and legible. Onsite testing was conducted in accordance with approved internal Standard Operating Procedures. Any deviations or problems are detailed in the relevant sections on the test report.

This report is only considered valid once an authorized representative of AST has signed in the space provided below; any other version is considered draft. This document was prepared in portable document format (.pdf) and contains pages as identified in the bottom footer of this document.



Adam Robinson, QSTI
Alliance Source Testing, LLC

8/29/2019

Date

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Introduction

1.0 Introduction

Alliance Source Testing, LLC (AST) was retained by Continental Aluminum (CA) to conduct compliance testing at the New Hudson, Michigan facility. Portions of the facility are subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Secondary Aluminum facilities as detailed in 40 CFR 63, Subpart RRR. The facility operates under the Michigan Department of Environmental Quality (MDEQ) Permit No. 504-96f. Reverberatory Furnace #2 (RV2) is considered an area source under the Secondary Aluminum NESHAP.

Testing was conducted to determine the emission rates of particulate matter (PM), particulate matter less than 10 microns (PM10), particulate matter less than 2.5 microns (PM2.5), hydrogen chloride (HCl) and hydrogen fluoride (HF) from the RV2 flue stack and baghouse stack. Testing was conducted simultaneously at the furnace flue stack and the baghouse stack to demonstrate compliance with the facility permit limits. Testing also included determining the emission rate of dioxins and furans (D/F) from the baghouse stack to demonstrate compliance with the Secondary Aluminum NESHAP.

1.1 Source and Control System Descriptions

The facility consists of secondary aluminum melting operations. The secondary melting operation contains two (2) reverberatory furnace processing units and a rotary furnace. The secondary aluminum melting process is initiated by placing scrap into the sidewell of the furnace. The scrap is melted in the sidewell using natural gas-fired burners to heat the aluminum to its melting point (approximately 1,250 °F). The exhaust from the sidewell is vented through a hood into the lime-injected baghouse. The hearth (heating input only) is separated from the sidewell physically with underflow weirs and vented through a separate stack to the atmosphere. The molten metal is continuously transferred from the sidewell (via a pump) to the hearth of the furnace and then is cast into shaped products for sale.

FGRV2 consists of two natural gas-fired burners each with a heat input of 10 MMBtu (total 20 MMBtu capacity), raw material charging and melting, and a pouring operation. Combustion products from the burners and hearth chamber emissions are exhausted to the atmosphere through SVHTRRVRB#2. The pouring operation has one uncontrolled tapping line stack (SVTL3). Raw material charging and melting is hooded, and emissions are vented to a 45,000 SCFM high temp lime-injected baghouse (BH-1) and exit through SVBHRVRB#2.

1.2 Project Team

Personnel involved in this project are identified in the following table.

**Table 1-1
Project Team**

CA Personnel	Mitch Buchner Courtney Boc
MDEQ Personnel	Iranna Konanahalli Regina Angellotti
AST Personnel	Adam Robinson Justin Bernard Tyler Branca Brendan Price Mark Godman Donald Burkey Shane Boles

1.3 Site Specific Test Plan & Notification

Testing was conducted in accordance with the Site-Specific Test Plan (SSTP) submitted to MDEQ on April 25, 2019 and the MDEQ approval letter dated June 17, 2019.

Summary of Results

2.0 Summary of Results

AST conducted compliance testing at the CA facility in New Hudson, Michigan on July 9-10, 2019. Testing consisted of determining the emission rates of PM, PM10, PM2.5, HCl and HF from the RV2 flue stack and baghouse stack as well as the emission rates of D/F from the baghouse stack.

Tables 2-1 through 2-3 provide summaries of the emission testing results with comparisons to the applicable NESHAP and MDEQ permit limits. These tables also provide summaries of the process operating and control system data collected during testing. Any difference between the summary results listed in the following tables and the detailed results contained in appendices is due to rounding for presentation.

**Table 2-1
Summary of Results – Baghouse Exhaust D/F Data**

Emissions Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	7/9/19	7/9/19	7/10/19	--
Dioxin/Furan Data				
Emission Factor, ug TEQ/MG ¹	1.7	2.4	1.0	1.7
NESHAP Limit, ug TEQ/MG	--	--	--	15.0
Percent of Limit, %	--	--	--	11
Process Operating / Control System Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	7/9/19	7/9/19	7/10/19	--
Feed Rate, lb/hr	10,781	14,504	18,142	14,476
Baghouse Inlet Temperature, °F	139	196	164	166

¹ D/F TEQ values were calculated using 1989 NATO TEFs.

Table 2-2
Summary of Results – PM Data

Emissions Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	7/9/19	7/9/19	7/10/19	--
Filterable Particulate Matter Data				
RV2 Flue Emission Factor, lb/ton	0.12	0.067	0.072	0.085
RV2 Baghouse Emission Factor, lb/ton	0.19	0.020	0.17	0.13
Combined Emission Factor, lb/ton	0.31	0.087	0.24	0.21
Permit Limit, lb/ton	--	--	--	0.40
Percent of Limit, %	--	--	--	53
RV2 Flue Emission Rate, lb/hr	0.62	0.49	0.65	0.59
RV2 Baghouse Emission Rate, lb/hr	1.0	0.15	1.6	0.92
Combined Emission Rate, lb/hr	1.6	0.64	2.3	1.5
Condensable Particulate Matter Data				
RV2 Flue Emission Rate, lb/hr	0.014	0.041	0.013	0.023
RV2 Baghouse Emission Rate, lb/hr	1.4	2.5	0.25	1.4
Combined Emission Rate, lb/hr	1.4	2.5	0.26	1.4
Total Particulate Matter Data *				
RV2 Flue Emission Rate, lb/hr	0.64	0.53	0.66	0.61
RV2 Baghouse Emission Rate, lb/hr	2.5	2.7	1.8	2.3
Combined Emission Rate, lb/hr	3.1	3.2	2.5	2.9
PM10 Permit Limit	--	--	--	2.0
Percent of Limit, %	--	--	--	> 100
PM2.5 Permit Limit, lb/hr	--	--	--	1.4
Percent of Limit, %	--	--	--	> 100
Process Operating / Control System Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	7/9/19	7/9/19	7/10/19	--
Feed Rate, lb/hr	10,781	14,504	18,142	14,476
Flux Rate, lb	3,470	3,140	4,620	3,743
Lime Injection Rate, lb/hr	34	34	34	34

* Total PM is the summation of filterable and condensable PM fractions. All filterable PM is assumed to be equal to filterable PM10 and filterable PM2.5.

**Table 2-3
Summary of Results – HCl and HF Data**

Emissions Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	7/9/19	7/9/19	7/10/19	--
Hydrogen Chloride Data				
RV2 Flue Emission Factor, lb/hr	0.030	0.0067	0.028	0.022
RV2 Baghouse Emission Factor, lb/hr	0.070	1.4	0.77	0.73
Combined Emission Factor, lb/hr	0.10	1.4	0.79	0.77
Permit Limit, lb/hr	--	--	--	1.95
Percent of Limit, %	--	--	--	39
RV2 Flue Emission Factor, lb/ton	0.0055	0.00092	0.0031	0.0032
RV2 Baghouse Emission Factor, lb/ton	0.013	0.19	0.084	0.095
Combined Emission Factor, lb/ton	0.019	0.19	0.087	0.099
Permit Limit, lb/ton	--	--	--	0.40
Percent of Limit, %	--	--	--	25
Hydrogen Fluoride Data				
RV2 Flue Emission Factor, lb/hr	0.023	0.018	0.018	0.019
RV2 Baghouse Emission Factor, lb/hr *	0.0015	0.0013	0.0016	0.0015
Combined Emission Factor, lb/hr	0.025	0.019	0.020	0.021
RV2 Flue Emission Factor, lb/ton	0.0042	0.0024	0.0020	0.0029
RV2 Baghouse Emission Factor, lb/ton *	0.00029	0.00018	0.00017	0.00021
Combined Emission Factor, lb/ton	0.0045	0.0026	0.0022	0.0031
Process Operating / Control System Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	7/9/19	7/9/19	7/10/19	--
Feed Rate, lb/hr	10,781	14,504	18,142	14,476
Flux Rate, lb	3,470	3,140	4,620	3,743
Lime Injection Rate, lb/hr	34	34	34	34

* The laboratory results for HF for all runs were below the detection limit. The method detection limit (MDL) was used for calculation purposes.

Testing Methodology

3.0 Testing Methodology

The emission testing program was conducted in accordance with the test methods listed in Table 3-1. Method descriptions are provided below while quality assurance/quality control data is provided in Appendix D.

**Table 3-1
Source Testing Methodology**

Parameter	U.S. EPA Reference Test Methods	Notes/Remarks
Volumetric Flow Rate	1 & 2	Full Velocity Traverses
Oxygen / Carbon Dioxide	3 / 3A	Integrated Bag / Instrumental Analysis
Moisture Content	4	Gravimetric Analysis
Total Particulate Matter	5 / 202	Isokinetic Sampling
Dioxins and Furans	23 / ALT-034	Isokinetic Sampling
Hydrogen Chloride / Hydrogen Fluoride	26	Constant Rate Sampling

3.1 U.S. EPA Reference Test Methods 1 and 2 – Sampling/Traverse Points and Volumetric Flow Rate

The sampling location and number of traverse (sampling) points were selected in accordance with U.S. EPA Reference Test Method 1. To determine the minimum number of traverse points, the upstream and downstream distances were equated into equivalent diameters and compared to Figure 1-1 in U.S. EPA Reference Test Method 1.

Full velocity traverses were conducted in accordance with U.S. EPA Reference Test Method 2 to determine the average stack gas velocity pressure, static pressure and temperature. The velocity and static pressure measurement system consisted of a pitot tube and inclined manometer. The stack gas temperature was measured with a K-type thermocouple and pyrometer.

3.2 U.S. EPA Reference Test Method 3/3A – Oxygen/Carbon Dioxide

The oxygen (O₂) and carbon dioxide (CO₂) testing was conducted in accordance with U.S. EPA Reference Test Method 3/3A. One (1) integrated Tedlar bag sample was collected during each test run. The bag samples were analyzed on site with a gas analyzer. The remaining stack gas constituent was assumed to be nitrogen for the stack gas molecular weight determination. The quality control measures are described in Section 3.7.

3.3 U.S. EPA Reference Test Method 4 – Moisture Content

The stack gas moisture content was determined in accordance with U.S. EPA Reference Test Method 4. The gas conditioning train consisted of a series of chilled impingers. Prior to testing, each impinger was filled with a known quantity of water or silica gel. Each impinger was analyzed gravimetrically before and after each test run on the same balance to determine the amount of moisture condensed.

3.4 U.S. EPA Reference Test Methods 5 and 202 – Total Particulate Matter

The total particulate matter (filterable and condensable PM) testing was conducted in accordance with U.S. EPA Reference Test Methods 5 and 202. The complete sampling system consisted of a Teflon or stainless-steel nozzle, glass-lined probe, pre-weighed quartz filter, coil condenser, un-weighed Teflon filter, gas conditioning train, pump and calibrated dry gas meter. The gas conditioning train consisted of a coiled condenser and five (5) chilled

impingers. The first, second and third impingers were initially empty, the fourth contained 100 mL of de-ionized water and the last impinger contained 200-300 grams of silica gel. The un-weighed 90 mm Teflon filter was placed between the second and third impingers. The probe liner heating system was maintained at a temperature of $248 \pm 25^\circ\text{F}$, and the impinger temperature was maintained at 68°F or less throughout testing. The temperature of the Teflon filter was maintained greater than 65°F but less than or equal to 85°F .

Following the completion of each test run, the sampling train was leak checked at a vacuum pressure greater than or equal to the highest vacuum pressure observed during the run. The nitrogen purge was omitted due to minimal condensate collected in the dry impingers. After the leak check the impinger contents were measured for moisture gain.

The pre-weighed quartz filter was carefully removed and placed in container 1. The probe, nozzle and front half of the filter holder were rinsed three (3) times with acetone to remove any adhering particulate matter and these rinses were recovered in container 2. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for filterable particulate matter analysis.

The contents of impingers 1 and 2 were recovered in container CPM Cont. #1. The back half of the filterable PM filter holder, the coil condenser, impingers 1 and 2 and all connecting glassware were rinsed with DIUF water and then rinsed with acetone, followed by hexane. The water rinses were added to container CPM Cont. #1 while the solvent rinses were recovered in container CPM Cont. #2. The Teflon filter was removed from the filter holder and placed in container CPM Cont. #3. The front half of the condensable PM filter holder was rinsed with DIUF water and then with acetone, followed by hexane. The water rinse was added to container CPM Cont. #1 while the solvent rinses were added to container CPM Cont. #2. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for condensable particulate matter analysis.

3.5 U.S. EPA Reference Test Method 23/Alternative Method 034 – Dioxins/Furans

The dioxins and furans (D/F) testing was conducted in accordance with U.S. EPA Reference Test Method 23 with guidance from Alternative Method 034. The sampling system consisted of a Teflon nozzle, heated glass-lined probe, glass filter holder with pre-cleaned heated glass-fiber filter, condenser coil, XAD sorbent module, gas conditioning train, pump and calibrated dry gas meter. The gas conditioning system consisted of four (4) chilled impingers. The first impinger was empty. The second impinger contained 100 mL of water. The third impinger was empty while the last impinger was charged with 200-300 grams of silica gel. The probe liner and filter heating systems were maintained at a temperature of $120 \pm 14^\circ\text{C}$ ($248 \pm 25^\circ\text{F}$), and the impinger temperature was maintained at 20°C (68°F) or less throughout testing.

All glassware leading to the XAD adsorbing resin trap was cleaned and sealed before mobilizing to the site. Glassware cleaning consisted of washing with warm soapy water and rinsing with distilled water and acetone. The sampling train was assembled in the sample recovery area. The glass-fiber filter was placed in a glass filter holder with a Teflon filter support and connected to the condenser coil. All open ends of the sampling train were sealed with Teflon tape prior to complete assembly at the sampling location.

Following the completion of each test run, the sampling train was leak checked at vacuum pressure greater than or equal to the highest vacuum pressure observed during the run and the contents of the impingers were measured for moisture gain. The XAD sorbent module was sealed on both ends and placed on ice. The filter was removed from the filter holder and placed in sample container 1. The nozzle, probe liner, filter holder, condenser and all

connecting glassware were triple-rinsed and brushed with acetone, and these rinses were recovered in sample container 2. All glassware cleaned for sample container 2 was also triple-rinsed with toluene and recovered into sample container 3. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for analysis.

A field blank was collected after the first test run. A complete sampling system was placed at the sampling location and multiple leak checks were performed on the system similar to an actual testing scenario. The sample train was then moved to the mobile laboratory for recovery. A full set of reagent blanks including a filter and a trap were also submitted to the laboratory.

3.6 U.S. EPA Reference Test Method 26 – Hydrogen Chloride / Hydrogen Fluoride

The hydrogen chloride and hydrogen fluoride testing was conducted in accordance with U.S. EPA Reference Test Method 26. The complete sampling system consisted of a heated glass-lined probe, heated Teflon filter, gas conditioning train, pump and calibrated dry gas meter. The gas conditioning train consisted of four (4) chilled impingers. The first and second impingers contained 100 mL of 0.1 N H₂SO₄, the third was initially empty and the fourth contained 200-300 grams of silica gel. The probe liner and filter heating systems were maintained at 248-273°F, and the impinger temperature was maintained at 20°C (68°F) or less throughout the testing.

Following the completion of each test run, the sampling train was leak checked at a vacuum pressure greater than or equal to the highest vacuum pressure observed during the run and the contents of the impingers were measured for moisture gain. The absorbing solution (0.1 N H₂SO₄) from the first and second impingers was placed into sample container 3. The back-half of the filter holder, first, second and third impingers and all glassware leading to the outlet of the third impinger were rinsed with de-ionized (DI) water. These rinses were also placed in container 3. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for analysis.

3.7 Quality Assurance/Quality Control – U.S. EPA Reference Test Method 3/3A

Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Low-Level gas was introduced directly to the analyzer. After adjusting the analyzer to the Low-Level gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas. For the Calibration Error Test, Low, Mid, and High-Level calibration gases were sequentially introduced directly to the analyzer. All values were within 2.0 percent of the Calibration Span or 0.5 ppmv absolute difference.

At the completion of testing, the data was also saved to the AST server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at AST's office, all written and electronic data was relinquished to the report coordinator and then a final review was performed by the Project Manager.

Appendix A

Location: Continental Aluminum - New Hudson, MI
 Source: RV2 Baghouse
 Project No.: 2019-0342
 Run No.: 1
 Parameter: DF

Meter Pressure (Pm), in. Hg

$$P_m = P_b + \frac{\Delta H}{13.6}$$

where,

Pb $\frac{29.10}{}$ = barometric pressure, in. Hg
 ΔH $\frac{0.919}{}$ = pressure differential of orifice, in H₂O
 Pm $\frac{29.17}{}$ = in. Hg

Absolute Stack Gas Pressure (Ps), in. Hg

$$P_s = P_b + \frac{P_g}{13.6}$$

where,

Pb $\frac{29.10}{}$ = barometric pressure, in. Hg
 Pg $\frac{-0.15}{}$ = static pressure, in. H₂O
 Ps $\frac{29.09}{}$ = in. Hg

Standard Meter Volume (Vmstd), dscf

$$Vmstd = \frac{17.647 \times Y \times V_m \times P_m}{T_m}$$

where,

Y $\frac{0.98}{}$ = meter correction factor
 Vm $\frac{100.590}{}$ = meter volume, cf
 Pm $\frac{29.17}{}$ = absolute meter pressure, in. Hg
 Tm $\frac{546.6}{}$ = absolute meter temperature, °R
 Vmstd $\frac{92.832}{}$ = dscf

Standard Wet Volume (Vwstd), scf

$$V_{wstd} = 0.04707 \times V_{lc}$$

where,

Vlc $\frac{50.7}{}$ = volume of H₂O collected, ml
 Vwstd $\frac{2.391}{}$ = scf

Moisture Fraction (BWSsat), dimensionless (theoretical at saturated conditions)

$$BWS_{sat} = \frac{10^{6.37 - \left(\frac{2.827}{T_s + 365}\right)}}{P_s}$$

where,

Ts $\frac{148.4}{}$ = stack temperature, °F
 Ps $\frac{29.09}{}$ = absolute stack gas pressure, in. Hg
 BWSsat $\frac{0.250}{}$ = dimensionless

Moisture Fraction (BWS), dimensionless (measured)

$$BWS = \frac{V_{wstd}}{(V_{wstd} + V_{mstd})}$$

where,

Vwstd $\frac{2.391}{}$ = standard wet volume, scf
 Vmstd $\frac{92.832}{}$ = standard meter volume, dscf
 BWS $\frac{0.025}{}$ = dimensionless

Location: Continental Aluminum - New Hudson, MI
 Source: RV2 Baghouse
 Project No.: 2019-0342
 Run No.: 1
 Parameter: DF

Moisture Fraction (BWS), dimensionless

$$BWS = BWSmsd \text{ unless } BWSsat < BWSmsd$$

where,

BWSsat $\frac{0.250}{0.250}$ = moisture fraction (theoretical at saturated conditions)
 BWSmsd $\frac{0.025}{0.025}$ = moisture fraction (measured)
 BWS $\frac{0.025}{0.025}$

Molecular Weight (DRY) (Md), lb/lb-mole

$$Md = (0.44 \times \% CO_2) + (0.32 \times \% O_2) + (0.28 (100 - \% CO_2 - \% O_2))$$

where,

CO₂ $\frac{0.2}{0.2}$ = carbon dioxide concentration, %
 O₂ $\frac{20.4}{20.4}$ = oxygen concentration, %
 Md $\frac{28.84}{28.84}$ = lb/lb mol

Molecular Weight (WET) (Ms), lb/lb-mole

$$Ms = Md (1 - BWS) + 18 (BWS)$$

where,

Md $\frac{28.84}{28.84}$ = molecular weight (DRY), lb/lb mol
 BWS $\frac{0.025}{0.025}$ = moisture fraction, dimensionless
 Ms $\frac{28.57}{28.57}$ = lb/lb mol

Average Velocity (Vs), ft/sec

$$Vs = 85.49 \times Cp \times (\Delta P^{1/2})_{avg} \times \sqrt{\frac{Ts}{Ps \times Ms}}$$

where,

Cp $\frac{0.840}{0.840}$ = pitot tube coefficient
 $\Delta P^{1/2}$ $\frac{0.976}{0.976}$ = velocity head of stack gas, (in. H₂O)^{1/2}
 Ts $\frac{608.4}{608.4}$ = absolute stack temperature, °R
 Ps $\frac{29.09}{29.09}$ = absolute stack gas pressure, in. Hg
 Ms $\frac{28.57}{28.57}$ = molecular weight of stack gas, lb/lb mol
 Vs $\frac{60.0}{60.0}$ = ft/sec

Average Stack Gas Flow at Stack Conditions (Qa), acfm

$$Qa = 60 \times Vs \times As$$

where,

Vs $\frac{60.0}{60.0}$ = stack gas velocity, ft/sec
 As $\frac{10.56}{10.56}$ = cross-sectional area of stack, ft²
 Qa $\frac{37,988}{37,988}$ = acfm

Average Stack Gas Flow at Standard Conditions (Qs), dscfm

$$Qs = 17.647 \times Qa \times (1 - BWS) \times \frac{Ps}{Ts}$$

where,

Qa $\frac{37,988}{37,988}$ = average stack gas flow at stack conditions, acfm
 BWS $\frac{0.025}{0.025}$ = moisture fraction, dimensionless
 Ps $\frac{29.09}{29.09}$ = absolute stack gas pressure, in. Hg
 Ts $\frac{608.4}{608.4}$ = absolute stack temperature, °R
 Qs $\frac{31,246}{31,246}$ = dscfm

Location: Continental Aluminum - New Hudson, MI
 Source: RV2 Baghouse
 Project No.: 2019-0342
 Run No.: 1
 Parameter: DF

Dry Gas Meter Calibration Check (Yqa), dimensionless

$$Yqa = \frac{Y \cdot \left(\frac{\Theta}{V_m} \sqrt{\frac{0.0319 \times T_m \times 29}{\Delta H @ \times \left(P_b + \frac{\Delta H \text{ avg.}}{13.6} \right) \times M_d}} \sqrt{\Delta H \text{ avg.}} \right)}{Y} \times 100$$

where,

Y	<u>0.98</u>	= meter correction factor, dimensionless
Θ	<u>180</u>	= run time, min.
V _m	<u>100.59</u>	= total meter volume, dcf
T _m	<u>546.6</u>	= absolute meter temperature, °R
ΔH@	<u>1.832</u>	= orifice meter calibration coefficient, in. H ₂ O
P _b	<u>29.10</u>	= barometric pressure, in. Hg
ΔH avg	<u>0.919</u>	= average pressure differential of orifice, in H ₂ O
M _d	<u>28.84</u>	= molecular weight (DRY), lb/lb mol
(ΔH) ^{1/2}	<u>0.950</u>	= average squareroot pressure differential of orifice, (in. H ₂ O) ^{1/2}
Yqa	<u>0.7</u>	= dimensionless

Volume of Nozzle (Vn), ft³

$$Vn = \frac{Ts}{Ps} \left(0.002669 \times Vlc + \frac{Vm \times Pm \times Y}{Tm} \right)$$

where,

T _s	<u>608.4</u>	= absolute stack temperature, °R
P _s	<u>29.09</u>	= absolute stack gas pressure, in. Hg
V _{lc}	<u>50.7</u>	= volume of H ₂ O collected, ml
V _m	<u>100.590</u>	= meter volume, cf
P _m	<u>29.17</u>	= absolute meter pressure, in. Hg
Y	<u>0.980</u>	= meter correction factor, unitless
T _m	<u>546.6</u>	= absolute meter temperature, °R
V _n	<u>112.857</u>	= volume of nozzle, ft ³

Isokinetic Sampling Rate (I), %

$$I = \left(\frac{Vn}{\theta \times 60 \times An \times Vs} \right) \times 100$$

where,

V _n	<u>112.857</u>	= nozzle volume, ft ³
θ	<u>180.0</u>	= run time, minutes
A _n	<u>0.00017</u>	= area of nozzle, ft ²
V _s	<u>60.0</u>	= average velocity, ft/sec
I	<u>100.9</u>	= %

D/F TEQ Concentration (C_{D/F}), grain TEQ/dscf

$$C_{D/F} = \frac{M_{D/F}}{Vmstd \times 1.54E + 11}$$

where,

M _{D/F}	<u>411</u>	= D/F TEQ mass, pg
Vmstd	<u>92.832</u>	= standard meter volume, dscf
C _{D/F}	<u>6.8E-11</u>	= grain TEQ/dscf

Location: Continental Aluminum - New Hudson, MI
 Source: RV2 Baghouse
 Project No.: 2019-0342
 Run No.: 1
 Parameter: DF

D/F TEQ Emission Rate (ER_{DF}), lb TEQ/hr

$$ER_{DF} = \frac{C_{D/F} \times Q_s \times 60}{4.54 E + 11}$$

where,

$$C_{D/F} \frac{4.4E-03}{ng/\text{ft}^3} = \text{D/F TEQ concentration, ng/ft}^3$$

$$Q_s \frac{31,246}{\text{dscfm}} = \text{average stack gas flow at standard conditions, dscfm}$$

$$ER_{DF} \frac{1.8E-08}{lb \text{ TEQ/hr}} = \text{lb TEQ/hr}$$

D/F TEQ Emission Factor (EF_{DF}), ug TEQ/MG

$$EF_{DF} = \frac{ER_{DF} \times 1.0 E + 12}{FR}$$

where,

$$ER_{DF} \frac{1.8E-08}{lb \text{ TEQ/hr}} = \text{D/F TEQ emission rate, lb TEQ/hr}$$

$$FR \frac{10,781}{lb/hr} = \text{process feed rate, lb/hr}$$

$$EF_{DF} \frac{1.7}{ug \text{ TEQ/MG}} = \text{ug TEQ/MG}$$

Location: Continental Aluminum - New Hudson, MI
Source: RV2 Baghouse
Project No.: 2019-0342
Run No.: 1
Parameter: PM/CPM

Filterable PM Concentration (C_s), grain/dscf

$$C_s = \frac{M_n \times 0.0154}{Vmstd}$$

where,

M_n 23.3 = filterable PM mass, mg
 $Vmstd$ 91.686 = standard meter volume, dscf
 C_s 0.0039 = grain/dscf

Filterable PM Emission Rate (PMR), lb/hr

$$PMR = \frac{C_s \times Q_s \times 60}{7.0E + 03}$$

where,

C_s 0.0039 = filterable PM concentration, grain/dscf
 Q_s 30,976 = average stack gas flow at standard conditions, dscfm
 PMR 1.0 = lb/hr

Filterable PM Emission Factor (EF_{PM}), lb/ton

$$EF_{PM} = \frac{PMR \times 2.0E + 03}{FR}$$

where,

PMR 1.0 = filterable PM emission rate, lb/hr
 FR 10,781 = process feed rate, lb/hr
 EF_{PM} 0.19 = lb/ton

Condensable PM Concentration (C_{CPM}), grain/dscf

$$C_{CPM} = \frac{M_{CPM} \times 0.0154}{Vmstd}$$

where,

M_{CPM} 32.0 = condensable PM mass, mg
 $Vmstd$ 91.686 = standard meter volume, dscf
 C_{CPM} 0.0054 = grain/dscf

Condensable PM Emission Rate (ER_{CPM}), lb/hr

$$ER_{CPM} = \frac{C_{CPM} \times Q_s \times 60}{7.0E + 03}$$

where,

C_{CPM} 0.0054 = condensable PM concentration, grain/dscf
 Q_s 30,976 = average stack gas flow at standard conditions, dscfm
 ER_{CPM} 1.4 = lb/hr

Condensable PM Emission Factor (EF_{CPM}), lb/ton

$$EF_{CPM} = \frac{ER_{CPM} \times 2.0E + 03}{FR}$$

where,

ER_{CPM} 1.4 = condensable PM emission rate, lb/hr
 FR 10,781 = process feed rate, lb/hr
 EF_{CPM} 0.27 = lb/ton

Location: Continental Aluminum - New Hudson, MI
 Source: RV2 Baghouse
 Project No.: 2019-0342
 Run No.: 1
 Parameter: PM/CPM

Total PM Concentration (C_{TPM}), grain/dscf

$$C_{TPM} = C_s + C_{CPM}$$

where,

$$C_s \frac{0.0039}{\quad} = \text{filterable PM concentration, grain/dscf}$$

$$C_{CPM} \frac{0.0054}{\quad} = \text{condensable PM concentration, grain/dscf}$$

$$C_{TPM} \frac{0.0093}{\quad} = \text{grain/dscf}$$

Total PM Emission Rate (ER_{TPM}), lb/hr

$$ER_{TPM} = PMR + ER_{CPM}$$

where,

$$PMR \frac{1.0}{\quad} = \text{filterable PM emission rate, lb/hr}$$

$$ER_{CPM} \frac{1.4}{\quad} = \text{condensable PM emission rate, lb/hr}$$

$$ER_{TPM} \frac{2.5}{\quad} = \text{lb/hr}$$

Total PM Emission Factor (EF_{TPM}), lb/ton

$$EF_{TPM} = EF_{PM} + EF_{CPM}$$

where,

$$EF_{PM} \frac{4.6}{\quad} = \text{filterable PM emission rate, lb/ton}$$

$$EF_{CPM} \frac{6.3}{\quad} = \text{condensable PM emission rate, lb/ton}$$

$$EF_{TPM} \frac{10.8}{\quad} = \text{lb/ton}$$

Location Continental Aluminum - New Hudson, MI
 Source RV2 Baghouse
 Project No. 2019-0342
 Run No. 1
 Parameter(s) HCl and HF

Hydrogen Chloride Concentration, ppmvd

$$C_{HCl} = \frac{M_{HCl} \times 24.04}{MW \times Vmstd \times 28.32}$$

M(HCl) 1,686 = Hydrogen Chloride Mass, ug
 MW 36.5 = molecular weight, g/g mol
 Vmstd 98.012 = standard meter volume, dscf
 C(HCl) 0.40 = ppmvd

Hydrogen Chloride Emission Rate, lb/hr

$$ER_{HCl} = \frac{M_{HCl} \times Qs \times 60}{Vmstd \times 4.54E + 08}$$

where,

M(HCl) 1,686 = Hydrogen Chloride Mass, ug
 Qs 30,976 = average stack gas flow at standard conditions, dscfm
 Vmstd 98.012 = standard meter volume, dscf
 ER(HCl) 0.070 = lb/hr

Hydrogen Chloride Emission Factor, lb/ton

$$EF_{HCl} = \frac{ER_{HCl} \times 2.0E + 03}{FR}$$

where,

ER(HCl) 0.070 = Hydrogen Chloride Emission Rate, lb/hr
 FR 10,781 = process feed rate, lb/hr
 EF(HCl) 0.013 = lb/ton

Hydrogen Fluoride Concentration, ppmvd

$$C_{HF} = \frac{M_{HF} \times 24.04}{MW \times Vmstd \times 28.32}$$

where,

M(HF) 36.9 = Hydrogen Fluoride Mass, ug
 MW 20.0 = molecular weight, g/g mol
 Vmstd 98.012 = standard meter volume, dscf
 C(HF) 0.016 = ppmvd

Hydrogen Fluoride Emission Rate, lb/hr

$$ER_{HF} = \frac{M_{HF} \times Qs \times 60}{Vmstd \times 4.54E + 08}$$

where,

M(HF) 36.9 = Hydrogen Fluoride Mass, ug
 Qs 30,976 = average stack gas flow at standard conditions, dscfm
 Vmstd 98.012 = standard meter volume, dscf
 ER(HF) 0.0015 = lb/hr

Hydrogen Fluoride Emission Factor, lb/ton

$$EF_{HF} = \frac{ER_{HF} \times 2.0E + 03}{FR}$$

where,

ER(HF) 0.0015 = Hydrogen Fluoride Emission Rate, lb/hr
 FR 10,781 = process feed rate, lb/hr
 EF(HF) 0.00029 = lb/ton

Appendix B

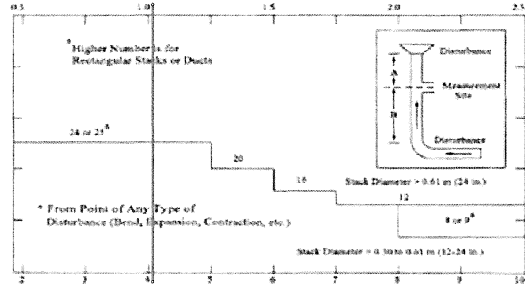
RV2 Baghouse Stack (SVBHRVRB#2)

Location Continental Aluminum - New Hudson, MI
 Source RV2 Baghouse
 Project No. 2019-0342
 Date: 07/08/19

Stack Parameters

Duct Orientation: Vertical
 Duct Design: Circular
 Distance from Far Wall to Outside of Port: 51.00 in
 Nipple Length: 7.00 in
 Depth of Duct: 44.00 in
 Cross Sectional Area of Duct: 10.56 ft²
 No. of Test Ports: 2
 Distance A: 20.8 ft
 Distance A Duct Diameters: 5.7 (must be > 0.5)
 Distance B: 15.0 ft
 Distance B Duct Diameters: 4.1 (must be > 2)
 Minimum Number of Traverse Points: 24
 Actual Number of Traverse Points: 24
 Number of Readings per Point: 1

15



CIRCULAR DUCT

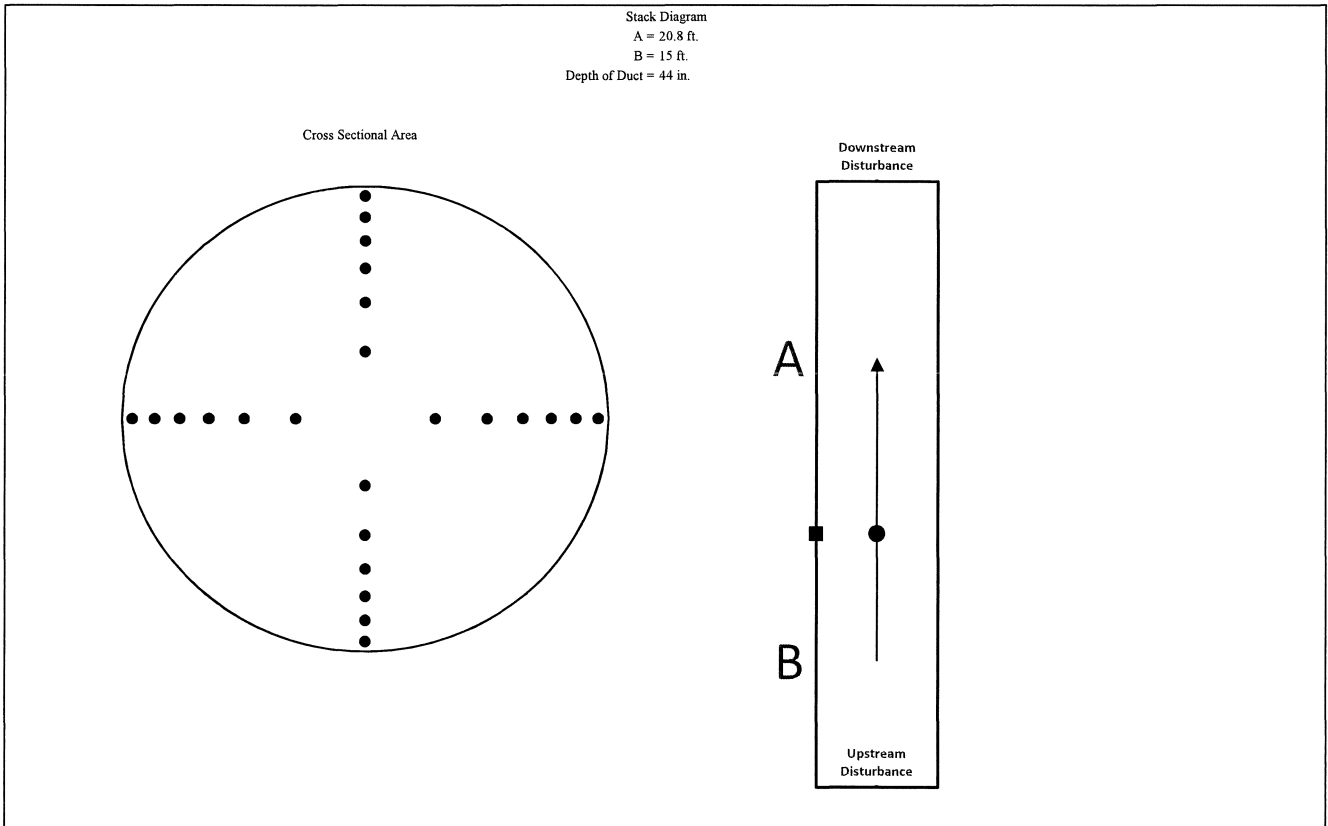
LOCATION OF TRAVERSE POINTS

Number of traverse points on a diameter

	2	3	4	5	6	7	8	9	10	11	12
1	14.6	--	6.7	--	4.4	--	3.2	--	2.6	--	2.1
2	85.4	--	25.0	--	14.6	--	10.5	--	8.2	--	6.7
3	--	--	75.0	--	29.6	--	19.4	--	14.6	--	11.8
4	--	--	93.3	--	70.4	--	32.3	--	22.6	--	17.7
5	--	--	--	--	85.4	--	67.7	--	34.2	--	25.0
6	--	--	--	--	95.6	--	80.6	--	65.8	--	35.6
7	--	--	--	--	--	--	89.5	--	77.4	--	64.4
8	--	--	--	--	--	--	96.8	--	85.4	--	75.0
9	--	--	--	--	--	--	--	--	91.8	--	82.3
10	--	--	--	--	--	--	--	--	97.4	--	88.2
11	--	--	--	--	--	--	--	--	--	--	93.3
12	--	--	--	--	--	--	--	--	--	--	97.9

Traverse Point	% of Diameter	Distance from inside wall	Distance from outside of port
1	2.1	1.00	8.00
2	6.7	2.95	9.95
3	11.8	5.19	12.19
4	17.7	7.79	14.79
5	25.0	11.00	18.00
6	35.6	15.66	22.66
7	64.4	28.34	35.34
8	75.0	33.00	40.00
9	82.3	36.21	43.21
10	88.2	38.81	45.81
11	93.3	41.05	48.05
12	97.9	43.00	50.00

**Percent of stack diameter from inside wall to traverse point.*



Location Continental Aluminum - New Hudson, MI
 Source RV2 Baghouse
 Project No. 2019-0342
 Date 07/08/19

Sample Point	Angle ($\Delta P=0$)
1	5
2	5
3	5
4	0
5	0
6	0
7	0
8	0
9	0
10	5
11	0
12	0
13	5
14	5
15	5
16	0
17	0
18	0
19	0
20	0
21	5
22	5
23	0
24	5
Average	2

Location Continental Aluminum - New Hudson, MI
Source RV2 Baghouse
Project No. 2019-0342
Parameter DF

Run Number		Run 1	Run 2	Run 3	Average
Date		7/9/19	7/9/19	7/10/19	--
Start Time		8:30	13:30	10:00	--
Stop Time		11:43	16:40	13:10	--
Run Time, min	(Θ)	180.0	180.0	180.0	180.0
INPUT DATA					
Feed Rate, lb/hr	(FR)	10,781	14,504	18,142	14,476
Barometric Pressure, in. Hg	(Pb)	29.10	29.10	29.00	29.07
Meter Correction Factor	(Y)	0.980	0.980	0.980	0.980
Orifice Calibration Value	($\Delta H @$)	1.832	1.832	1.832	1.832
Meter Volume, ft ³	(Vm)	100.590	96.323	92.835	96.583
Meter Temperature, °F	(Tm)	86.6	95.5	90.5	90.8
Meter Temperature, °R	(Tm)	546.6	555.5	550.5	550.8
Meter Orifice Pressure, in. WC	(ΔH)	0.919	0.834	0.777	0.843
Volume H ₂ O Collected, mL	(Vlc)	50.7	44.2	56.9	50.6
Nozzle Diameter, in	(Dn)	0.178	0.175	0.175	0.176
Area of Nozzle, ft ²	(An)	0.0002	0.0002	0.0002	0.0002
D/F TEQ Mass, pg	(M _{D/F})	411.0	735.0	408.0	518.0
ISOKINETIC DATA					
Standard Meter Volume, ft ³	(Vmstd)	92.832	87.455	84.743	88.343
Standard Water Volume, ft ³	(Vwstd)	2.391	2.084	2.683	2.386
Moisture Fraction Measured	(BWSmsd)	0.025	0.023	0.031	0.026
Moisture Fraction @ Saturation	(BWSsat)	0.250	0.519	0.341	0.370
Moisture Fraction	(BWS)	0.025	0.023	0.031	0.026
Meter Pressure, in Hg	(Pm)	29.17	29.16	29.06	29.13
Volume at Nozzle, ft ³	(Vn)	112.857	111.593	106.145	110.199
Isokinetic Sampling Rate, (%)	(I)	100.9	100.0	100.2	100.3
DGM Calibration Check Value, (+/- 5%)	(Y _{qa})	0.7	0.5	-0.1	0.4
EMISSION CALCULATIONS					
D/F TEQ Concentration, grain/dscf	(C _{DF})	6.8E-11	1.3E-10	7.4E-11	9.1E-11
D/F TEQ Concentration, ng/ft ³	(C _{D/F})	4.4E-03	8.4E-03	4.8E-03	5.9E-03
D/F TEQ Emission Rate, lb/hr	(ER _{D/F})	1.8E-08	3.4E-08	1.9E-08	2.4E-08
D/F TEQ Emission Factor, ug/MG	(EF _{D/F})	1.7	2.4	1.0	1.7