

RECEIVED

FEB 14 2025

EGLE - Mailroom



Source Test Report

Hydro Aluminum Metals USA, LLC
Hydro Aluminum Cassopolis
1475 Follett Drive
Cassopolis, MI 49031

Sources Tested:
Stack SVEP-2 (FGMELT1),
Stack SVEP-3 (FGMELT2)

Test Dates:
October 29-November 1, 2024

Project No. AST-2024-3504

Prepared By
Alliance Technical Group, LLC
3000 Little Hills Expressway, Suite 102
St. Charles, MO 63301

Regulatory Information

Permit No. Michigan Department of Environment, Great Lakes, and Energy (EGLE)
Permit No. 70-22

Regulatory Citation 40 CFR 63, Subpart RRR – NESHAP for Secondary Aluminum Production

Source Information

<i>Source Name</i>	<i>Source ID</i>	<i>Target Parameters</i>
Stack SVEP-2	FGMELT1	PM/PM ₁₀ /PM _{2.5} , NO _x , D/F
Stack SVEP-3	FGMELT2	PM/PM ₁₀ /PM _{2.5} , NO _x , D/F, HCl, HF

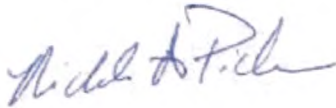
Contact Information

<i>Test Location</i>	<i>Test Company</i>	<i>Analytical Laboratories</i>
Hydro Aluminum Cassopolis 1475 Follett Drive Cassopolis, MI 49031	Alliance Technical Group, LLC 3000 Little Hills Expressway, Suite 102 St. Charles, MO 63301	Alliance Technical Group, LLC 214 Central Circle SW Decatur, AL 35603 John Lawrence john.lawrence@alliancetg.com (256) 351-0121 ext. 124
Consultant Contact Kathy Thomas kthomas@uscompliance.com (574) 674-8357	Project Manager Nick Pichee nick.pichee@alliancetg.com (314) 578-0668	Alliance Technical Group, LLC 5530 Marshall Street Arvada, CO 80002 Eric Grosjean eric.grosjean@alliancetg.com (303) 420-5949
	Field Team Leader Benjamin Murowchick ben.murowchick@alliancetg.com (913) 904-2841	Eurofins TestAmerica 5815 Middlebrook Pike Knoxville, TN 37921 Kevin Woodcock kevin.woodcock@testamericainc.com (865) 291-3000
	QA/QC Manager Kathleen Shonk katie.shonk@alliancetg.com (812) 452-4785	
	Report Coordinator Brendon Vyain brendon.vyain@alliancetg.com (765) 432-5129	
	Report Reviewer Erica Bolek erica.bolek@alliancetg.com (908) 323-5170	

Alliance Technical Group, LLC (Alliance) has completed the source testing as described in this report. Results apply only to the sources tested and operating conditions for the specific test dates and times identified within this report. All results are intended to be considered in their entirety, and Alliance 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 in the test report.

This report is only considered valid once an authorized representative of Alliance 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.



Nick Pichee – Project Manager
Alliance Technical Group, LLC

02/05/25

Date

TABLE OF CONTENTS

1.0	Introduction	1-1
1.1	Facility Description	1-1
1.2	Project Team	1-1
1.3	Site Specific Test Plan & Notification	1-1
1.4	Technical Discussion.....	1-1
2.0	Summary of Results	2-1
3.0	Testing Methodology	3-1
3.1	U.S. EPA Reference Test Methods 1 and 2 – Sampling/Traverse Points and Volumetric Flow Rate	3-1
3.2	U.S. EPA Reference Test Method 3A – Oxygen/Carbon Dioxide.....	3-1
3.3	U.S. EPA Reference Test Method 4 – Moisture Content	3-1
3.4	U.S. EPA Reference Test Methods 5 and 202 – Total Particulate Matter	3-2
3.5	U.S. EPA Reference Test Method 7E – Nitrogen Oxides	3-2
3.6	U.S. EPA Reference Test Method 23/Alternative Method 034 – Dioxins/Furans	3-3
3.7	U.S. EPA Reference Test Method 26 – Hydrogen Chloride and Hydrogen Fluoride	3-3
3.8	Quality Assurance/Quality Control – U.S. EPA Reference Test Methods 3A and 7E.....	3-4

LIST OF TABLES

Table 1-1: Project Team	1-1
Table 2-1: Summary of Results – Stack SVEP-2 (FGMELT1).....	2-1
Table 2-2: Summary of Results – Stack SVEP-3 (FGMELT2).....	2-2
Table 3-1: Source Testing Methodology	3-1

APPENDICES

Appendix A	Sample Calculations
Appendix B	Field Data
Appendix C	Laboratory Data
Appendix D	Quality Assurance/Quality Control Data
Appendix E	Process Operating/Control System Data
Appendix F	SSTP and Associated Documentation

Introduction

1.0 Introduction

Alliance Technical Group, LLC (Alliance) was retained by U.S. Compliance to conduct compliance testing at the Hydro Aluminum Metals USA, LLC (Hydro) facility in Cassopolis, Michigan. Portions of the facility are subject to provisions of 40 CFR 63, Subpart RRR – NESHAP for Secondary Aluminum Production, and the facility operates under Michigan Department of Environment, Great Lakes, and Energy (EGLE) Permit No. 70-22. Testing was conducted to determine the emission rates of particulate matter (PM), particulate matter no more than 10 microns in diameter (PM₁₀), particulate matter no more than 2.5 microns in diameter (PM_{2.5}), nitrogen oxides (NO_x), and dioxins and furans (D/F) at the exhaust of Stack SVEP-2 (FGMELT1); and the emission rates of PM, PM₁₀, PM_{2.5}, NO_x, D/F, hydrogen chloride (HCl), and hydrogen fluoride (HF) at the exhaust of Stack SVEP-3 (FGMELT2).

1.1 Facility Description

Hydro owns and operates this aluminum recycling facility in Cassopolis, Michigan. The facility began production in 2023 and will produce 120,000 tons/yr of aluminum extrusion ingot in support, especially of the automotive market.

1.2 Project Team

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

Table 1-1: Project Team

Facility Personnel	Kathy Thomas Suzanne Foster Shelia Bergen Justin Finger
Regulatory Agency	EGLE
Alliance Personnel	Benjamin Murowchick Carl Bender Ezzie Boyd Raushaud Dorsey

1.3 Site Specific Test Plan & Notification

Testing was conducted in accordance with the Site Specific Test Plan (SSTP) submitted to the EGLE.

1.4 Technical Discussion

During transit to the analytical laboratory, the inorganic rinse from the SVEP-2 (FGMELT1) Run 1 Method 202 sample leaked and the sample was not salvageable. The condensable PM results for this sample include the organic sample fraction only.

No other technical difficulties or protocol deviations occurred during this test program.

Summary of Results

2.0 Summary of Results

Alliance conducted compliance testing at the Hydro facility in Cassopolis, MI on October 29-November 1, 2024. Testing consisted of determining the emission rates of PM/PM₁₀/PM_{2.5}, NO_x, and D/F at the exhaust of FGMELT1, and the emission rates of PM/PM₁₀/PM_{2.5}, NO_x, D/F, HCl, and HF at the exhaust of FGMELT2.

Tables 2-1 and 2-2 provide a summary of the emission testing results with comparisons to the applicable NESHAP and EGLE permit limits. This table also provides a summary 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 – Stack SVEP-2 (FGMELT1)

Emissions Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	10/29/24	10/29/24	10/30/24	--
Total Particulate Matter Data ^{1, 2}				
Emission Rate, lb/hr	0.58	0.51	0.58	0.56
Permit Limit, lb/hr	--	--	--	3.29
Percent of Limit, %	--	--	--	17
Nitrogen Oxides Data				
Emission Rate, lb/hr	13.0	5.61	11.0	9.85
Permit Limit, lb/hr	--	--	--	5.59
Percent of Limit, %	--	--	--	>100
Dioxin/Furan Data ³				
Emission Factor, ug TEQ/MG	0.038	0.016	0.20	0.084
Permit Limit, ug TEQ/MG	--	--	--	0.25
Percent of Limit, %	--	--	--	34
Process Operating / Control System Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	10/29/24	10/29/24	10/30/24	--
Feed Rate, lb/hr	36,556	33,032	34,565	34,718
Baghouse Inlet Temperature, °F	265.3	239.8	239.5	248.2
Lime Injection Rate, lb/hr	35.8	32.6	32.2	33.5

¹ Total PM is the sum of filterable and condensable PM fractions and is a surrogate for PM₁₀ and PM_{2.5}.

² The inorganic rinse from the run 1 sample leaked during the shipping process; the condensable PM results for this sample include the organic sample fraction only.

³ D/F TEQ values were calculated using 1989 NATO TEFs.

Table 2-2: Summary of Results – Stack SVEP-3 (FGMELT2)

Emissions Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	10/31/24	10/31/24	11/1/24	--
Total Particulate Matter Data ^{1,2}				
Emission Rate, lb/hr	0.53	0.49	0.46	0.49
Permit Limit, lb/hr	--	--	--	1.37
Percent of Limit, %	--	--	--	36
Nitrogen Oxides Data				
Emission Rate, lb/hr	2.49	2.40	2.91	2.60
Permit Limit, lb/hr	--	--	--	4.89
Percent of Limit, %	--	--	--	53
Dioxin/Furan Data ³				
Emission Factor, ug TEQ/MG	0.15	0.13	0.034	0.10
Permit Limit, ug TEQ/MG	--	--	--	15.0
Percent of Limit, %	--	--	--	<1
Hydrogen Chloride Data				
Emission Rate, lb/hr	0.11	0.82	0.40	0.44
Permit Limit, lb/hr	--	--	--	0.57
Percent of Limit, %	--	--	--	77
Hydrogen Fluoride Data ⁴				
Emission Rate, lb/hr	0.0054	0.0051	0.0043	0.0049
Permit Limit, lb/hr	--	--	--	0.05
Percent of Limit, %	--	--	--	10
Process Operating / Control System Data				
Run Number	Run 1	Run 2	Run 3	Average
Date	10/31/24	10/31/24	11/1/24	--
Feed Rate, lb/hr	14,149	8,020	13,635	11,935
Baghouse Inlet Temperature, °F	195.9	211.6	189.6	199.0
Lime Injection Rate, lb/hr	52.7	53.7	55.8	54.1

¹ Total PM is the sum of filterable and condensable PM fractions and is considered all PM₁₀ and PM_{2.5}.

² Runs 1-3 filterable PM results were less than the minimum detection limit (MDL) and flagged as non-detect (ND). The MDL was used for calculation purposes.

³ D/F TEQ values were calculated using 1989 NATO TEFs.

⁴ Runs 1-3 HF results were less than the lowest standard and flagged as estimated. The estimated value 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	3A	Instrumental Analysis
Moisture Content	4	Gravimetric Analysis
Total Particulate Matter	5 & 202	Isokinetic Sampling
Nitrogen Oxides	7E	Instrumental Analysis
Dioxins/Furans	23/Alt-034	Isokinetic Sampling
Hydrogen Chloride/Hydrogen Fluoride	26	Isokinetic 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 (for isokinetic sampling) and/or Figure 1-2 (measuring velocity alone) 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.

Stack gas velocity pressure and temperature readings were recorded during each test run. The data collected was utilized to calculate the volumetric flow rate in accordance with U.S. EPA Reference Test Method 2.

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

The oxygen (O₂) and carbon dioxide (CO₂) testing was conducted in accordance with U.S. EPA Reference Test Method 3A. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. If an unheated Teflon sample line was used, then a portable non-contact condenser was placed in the system directly after the probe. Otherwise, a heated Teflon sample line was used. The quality control measures are described in Section 3.8.

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

The stack gas moisture content (BWS) 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 glass 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 four (4) chilled impingers. The first, and second impingers were initially empty, the third 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. Condensate was collected in the first dry impinger, therefore the front-half of the sample train (the nozzle, probe, and heated pre-weighed filter) was removed in order to purge the back-half of the sample train (coil condenser, first and second impingers and CPM filter). A glass bubbler was inserted into the first impinger. If needed, de-ionized ultra-filtered (DIUF) water was added to the first impinger to raise the water level above the bubbler, then the coil condenser was replaced. Zero nitrogen was connected to the condenser, and a 60-minute purge at 14 liters per minute was conducted. After the completion of the nitrogen purge 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 7E – Nitrogen Oxides

The nitrogen oxides (NO_x) testing was conducted in accordance with U.S. EPA Reference Test Method 7E. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. If an unheated Teflon sample line was used, then a portable non-contact condenser was placed in the system directly after the probe. Otherwise, a heated Teflon sample line was used. The quality control measures are described in Section 3.8.

3.6 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 glass 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 five (5) chilled impingers. The first impinger was empty. The next two (2) impingers each contained 100 mL of water. The fourth impinger was empty while the fifth 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.

Method 23 Section 6.1.7 requires the condenser to be oriented at an angle to cause moisture to flow down to the XAD adsorbent module to facilitate condensate drainage. Glassware with this configuration is not currently available from a national supplier utilizing a large enough condenser to meet the temperature specifications of the method. Alliance will continue to work with manufacturers, but until equipment is widely available, the horizontal or vertical condenser configuration from traditional Method 23 will be utilized.

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 then toluene, and these rinses were recovered in sample container 2. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for analysis.

Method 23 Section 8.2.9 has the impinger water and solvent rinses collected in a single container (No. 3). Due to analytical method development constraints of the subcontracted laboratory, it is necessary to split this recovery between two containers: condensate (Container No. 3a) and solvent rinses (Container No. 3b).

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.

3.7 U.S. EPA Reference Test Method 26 – Hydrogen Chloride and Hydrogen Fluoride

The hydrogen chloride (HCl) and hydrogen fluoride (HF) testing was conducted in accordance with U.S. EPA Reference Test Method 26. The complete sampling system consisted of a glass nozzle, 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 H_2SO_4 , 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.

3.8 Quality Assurance/Quality Control – U.S. EPA Reference Test Methods 3A and 7E

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.

High or Mid-Level gas (whichever was closer to the stack gas concentration) was introduced at the probe and the time required for the analyzer reading to reach 95 percent or 0.5 ppmv/% (whichever was less restrictive) of the gas concentration was recorded. The analyzer reading was observed until it reached a stable value, and this value was recorded. Next, Low Level gas was introduced at the probe and the time required for the analyzer reading to decrease to a value within 5.0 percent or 0.5 ppmv/% (whichever was less restrictive) was recorded. If the Low-Level gas was zero gas, the response was 0.5 ppmv/% or 5.0 percent of the upscale gas concentration (whichever was less restrictive). The analyzer reading was observed until it reached a stable value and this value was recorded. The measurement system response time and initial system bias were determined from these data. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference.

High or Mid-Level gas (whichever was closer to the stack gas concentration) was introduced at the probe. After the analyzer response was stable, the value was recorded. Next, Low Level gas was introduced at the probe, and the analyzer value recorded once it reached a stable response. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference or the data was invalidated and the Calibration Error Test and System Bias were repeated.

Drift between pre- and post-run System Bias was within 3 percent of the Calibration Span or 0.5 ppmv/% absolute difference. If the drift exceeded 3 percent or 0.5 ppmv/%, the Calibration Error Test and System Bias were repeated.

To determine the number of sampling points, a gas stratification check was conducted prior to initiating testing. The pollutant concentrations were measured at twelve traverse points (as described in Method 1). Each traverse point was sampled for a minimum of twice the system response time.

Because the pollutant concentration at each traverse point did not differ more than 5 percent or 0.5 ppmv/0.3% (whichever was less restrictive) of the average pollutant concentration, single point sampling was conducted during the test runs. Copies of stratification check data can be found in the Quality Assurance/Quality Control Appendix.

An NO₂ – NO converter check was performed on the analyzer prior to initiating testing and at the completion of testing. An approximately 50 ppm nitrogen dioxide cylinder gas was introduced directly to the NO_x analyzer and the instrument response was recorded in an electronic data sheet. The instrument response was within +/- 10 percent of the cylinder concentration.

A Data Acquisition System with battery backup was used to record the instrument response in one (1) minute averages. The data was continuously stored as a *.CSV file in Excel format on the hard drive of a computer. At the completion of testing, the data was also saved to the Alliance server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at Alliance'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: Hydro Aluminum - Cassopolis, Michigan
Source: Stack SVEP-2
Project No.: AST-2024-3504
Run No.: 1
Parameter: PM,CPM

Meter Pressure (Pm), in. Hg

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

where,

$$\begin{aligned} P_b &= \frac{29.06}{13.6} = \text{barometric pressure, in. Hg} \\ \Delta H &= \frac{1.183}{13.6} = \text{pressure differential of orifice, in. H}_2\text{O} \\ P_m &= \frac{29.15}{13.6} = \text{in. Hg} \end{aligned}$$

Absolute Stack Gas Pressure (Ps), in. Hg

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

where,

$$\begin{aligned} P_b &= \frac{29.06}{13.6} = \text{barometric pressure, in. Hg} \\ P_g &= \frac{-0.20}{13.6} = \text{static pressure, in. H}_2\text{O} \\ P_s &= \frac{29.05}{13.6} = \text{in. Hg} \end{aligned}$$

Standard Meter Volume (Vmstd), dscf

$$V_{mstd} = \frac{17.636 \times Y \times V_m \times P_m}{T_m}$$

where,

$$\begin{aligned} Y &= \frac{0.9853}{112.775} = \text{meter correction factor} \\ V_m &= \frac{112.775}{29.15} = \text{meter volume, cf} \\ P_m &= \frac{29.15}{539.3} = \text{absolute meter pressure, in. Hg} \\ T_m &= \frac{539.3}{105.921} = \text{absolute meter temperature, } ^\circ\text{R} \\ V_{mstd} &= \frac{105.921}{105.921} = \text{dscf} \end{aligned}$$

Standard Wet Volume (Vwstd), scf

$$V_{wstd} = 0.04716 \times V_{lc}$$

where,

$$\begin{aligned} V_{lc} &= \frac{71.4}{3.367} = \text{weight of H}_2\text{O collected, g} \\ V_{wstd} &= \frac{3.367}{3.367} = \text{scf} \end{aligned}$$

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,

$$\begin{aligned} T_s &= \frac{212.7}{29.05} = \text{stack temperature, } ^\circ\text{F} \\ P_s &= \frac{29.05}{1.000} = \text{absolute stack gas pressure, in. Hg} \\ BWS_{sat} &= \frac{1.000}{1.000} = \text{dimensionless} \end{aligned}$$

Moisture Fraction (BWS), dimensionless (measured)

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

where,

$$\begin{aligned} V_{wstd} &= \frac{3.367}{105.921} = \text{standard wet volume, scf} \\ V_{mstd} &= \frac{105.921}{0.031} = \text{standard meter volume, dscf} \\ BWS &= \frac{0.031}{0.031} = \text{dimensionless} \end{aligned}$$

Moisture Fraction (BWS), dimensionless

$$BWS = BWS_{msd} \text{ unless } BWS_{sat} < BWS_{msd}$$

Location: Hydro Aluminum - Cassopolis, Michigan
Source: Stack SVEP-2
Project No.: AST-2024-3504
Run No.: 1
Parameter: PM,CPM

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

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

where,

CO_2	<u>1.1</u>	= carbon dioxide concentration, %
O_2	<u>19.2</u>	= oxygen concentration, %
Md	<u>28.95</u>	= lb/lb mol

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

$$Ms = (Md \times [1 - BWS]) + (18.015 \times BWS)$$

where,

Md	<u>28.95</u>	= molecular weight (DRY), lb/lb mol
BWS	<u>0.031</u>	= moisture fraction, dimensionless
Ms	<u>28.61</u>	= 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	<u>0.840</u>	= pitot tube coefficient
$\Delta P^{1/2}$	<u>0.602</u>	= velocity head of stack gas, (in. H_2O) ^{1/2}
Ts	<u>672.4</u>	= absolute stack temperature, °R
Ps	<u>29.05</u>	= absolute stack gas pressure, in. Hg
Ms	<u>28.61</u>	= molecular weight of stack gas, lb/lb mol
Vs	<u>38.9</u>	= ft/sec

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

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

where,

Vs	<u>38.9</u>	= stack gas velocity, ft/sec
As	<u>36.67</u>	= cross-sectional area of stack, ft ²
Qa	<u>85,496</u>	= acfm

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

$$Qs = \frac{17.636 \times Qa \times (1 - BWS) \times Ps}{Ts}$$

where,

Qa	<u>85,496</u>	= average stack gas flow at stack conditions, acfm
BWS	<u>0.031</u>	= moisture fraction, dimensionless
Ps	<u>29.05</u>	= absolute stack gas pressure, in. Hg
Ts	<u>672.4</u>	= absolute stack temperature, °R
Qs	<u>63,127</u>	= dscfm

Location: Hydro Aluminum - Cassopolis, Michigan
Source: Stack SVEP-2
Project No.: AST-2024-3504
Run No.: 1
Parameter: PM,CPM

Dry Gas Meter Calibration Check (Yqa), dimensionless

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

where,

Y	0.9853	= meter correction factor, dimensionless
Θ	180	= run time, min.
V _m	112.8	= total meter volume, dcf
T _m	539	= absolute meter temperature, °R
ΔH@	1.87	= orifice meter calibration coefficient, in. H ₂ O
P _b	29.1	= barometric pressure, in. Hg
ΔH avg	1.18	= average pressure differential of orifice, in H ₂ O
M _d	28.95	= molecular weight (DRY), lb/lb mol
(Δ H) ^{1/2}	1.08	= average squareroot pressure differential of orifice, (in. H ₂ O) ^{1/2}
Yqa	1.3	= percent

Volume of Nozzle (Vn), ft³

$$V_n = \frac{T_s \times \left(0.002669 \times V_{lc} + \frac{V_m \times P_m \times Y}{T_m} \right)}{P_s}$$

where,

T _s	672	= absolute stack temperature, °R
P _s	29.05	= absolute stack gas pressure, in. Hg
V _{lc}	71.4	= volume of H ₂ O collected, ml
V _m	112.8	= meter volume, cf
P _m	29.15	= absolute meter pressure, in. Hg
Y	0.985	= meter correction factor, unitless
T _m	539.3	= absolute meter temperature, °R
V _n	143.4	= volume of nozzle, ft ³

Isokinetic Sampling Rate (I), %

$$I = \left(\frac{V_n}{\theta \times 60 \times A_n \times V_s} \right) \times 100$$

where,

V _n	143.445	= nozzle volume, ft ³
θ	180.0	= run time, minutes
A _n	0.00034	= area of nozzle, ft ²
V _s	38.9	= average velocity, ft/sec
I	101.1	= %

Location: Hydro Aluminum - Cassopolis, Michigan
Source: Stack SVEP-2
Project No.: AST-2024-3504
Run No.: 1
Parameter: PM,CPM

Filterable PM Concentration (C_s), grain/dscf

$$C_s = \frac{M_n \times 0.0154}{V_{mstd}}$$

where,

M_n	<u>4.10</u>	= filterable PM mass, mg
V_{mstd}	<u>105.9</u>	= standard meter volume, dscf
C_s	<u>0.00060</u>	= grain/dscf

Filterable PM Emission Rate (PMR), lb/hr

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

where,

C_s	<u>0.00060</u>	= filterable PM concentration, grain/dscf
Q_s	<u>63,127</u>	= average stack gas flow at standard conditions, dscfm
PMR	<u>0.32</u>	= lb/hr

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

$$C_{CPM} = \frac{M_{CPM} \times 0.0154}{V_{mstd}}$$

where,

M_{CPM}	<u>3.20</u>	= condensable PM mass, mg
V_{mstd}	<u>105.9</u>	= standard meter volume, dscf
C_{CPM}	<u>0.000466</u>	= grain/dscf

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

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

where,

C_{CPM}	<u>0.00047</u>	= condensable PM concentration, grain/dscf
Q_s	<u>63,127</u>	= average stack gas flow at standard conditions, dscfm
ER_{CPM}	<u>0.25</u>	= lb/hr

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

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

where,

C_s	<u>0.00060</u>	= filterable PM concentration, grain/dscf
C_{CPM}	<u>0.00047</u>	= condensable PM concentration, grain/dscf
C_{TPM}	<u>0.0011</u>	= grain/dscf

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

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

where,

PMR	<u>0.32</u>	= filterable PM emission rate, lb/hr
ER_{CPM}	<u>0.25</u>	= condensable PM emission rate, lb/hr
ER_{TPM}	<u>0.58</u>	= lb/hr

Location: Hydro Aluminum - Cassopolis, Michigan

Source: Stack SVEP-2

Project No.: AST-2024-3504

Run No. /Method Run 1 / Method 3A

O₂ - Outlet Concentration (C_{O₂}), % dry

$$C_{O_2} = (C_{obs} - C_0) \times \left(\frac{C_{MA}}{C_M - C_0} \right)$$

where,

C_{obs}	<u>19.19</u>	= average analyzer value during test, % dry
C_0	<u>0.0085</u>	= average of pretest & posttest zero responses, % dry
C_{MA}	<u>12.55</u>	= actual concentration of calibration gas, % dry
C_M	<u>12.58</u>	= average of pretest & posttest calibration responses, % dry
C_{O_2}	<u>19.15</u>	= O ₂ Concentration, % dry

CO₂ - Outlet Concentration (C_{CO₂}), % dry

$$C_{CO_2} = (C_{obs} - C_0) \times \left(\frac{C_{MA}}{C_M - C_0} \right)$$

where,

C_{obs}	<u>1.24</u>	= average analyzer value during test, % dry
C_0	<u>0.10</u>	= average of pretest & posttest zero responses, % dry
C_{MA}	<u>12.3</u>	= actual concentration of calibration gas, % dry
C_M	<u>12.5</u>	= average of pretest & posttest calibration responses, % dry
C_{CO_2}	<u>1.13</u>	= CO ₂ Concentration, % dry

Location: Hydro Aluminum - Cassopolis, Michigan

Source: Stack SVEP-2

Project No.: AST-2024-3504

Run No. /Method Run 1 / Method 7E

NOx - Outlet Concentration (C_{NOx}), ppmvd

$$C_{NOx} = (C_{obs} - C_0) \times \left(\frac{C_{MA}}{C_M - C_0} \right)$$

where,

C_{obs}	28.3	= average analyzer value during test, ppmvd
C_0	-0.3	= average of pretest & posttest zero responses, ppmvd
C_{MA}	56.4	= actual concentration of calibration gas, ppmvd
C_M	56.0	= average of pretest & posttest calibration responses, ppmvd
C_{NOx}	28.7	= NOx Concentration, ppmvd

NOx - Outlet Emission Rate (ER_{NOx}), lb/hr

$$ER_{NOx} = \frac{C_{NOx} \times MW \times Q_s \times 60 \frac{\text{min}}{\text{hr}} \times 28.32 \frac{\text{L}}{\text{ft}^3}}{24.04 \frac{\text{L}}{\text{g-mole}} \times 1.0E06 \times 453.592 \frac{\text{g}}{\text{lb}}}$$

where,

C_{NOx}	28.7	= NOx - Outlet Concentration, ppmvd
MW	46.0055	= NOx molecular weight, g/g-mole
Q_s	63,127	= stack gas volumetric flow rate at standard conditions, dscfm
ER_{NOx}	13.00	= lb/hr

Location Hydro Aluminum - Cassopolis, Michigan

Source Stack SVEP-3

Project No. AST-2024-3504

Run No. 1

Parameter(s) M26

Hydrogen Chloride Concentration, ppmvd

$$C_{\text{HCl}} = \frac{M_{\text{HCl}} \times 24.04}{\text{MW} \times V_{\text{mstd}} \times 28.32}$$

where,

M_{HCl}	<u>1,020</u>	= Hydrogen Chloride Mass, ug
MW	<u>36.5</u>	= molecular weight, g/g mol
V_{mstd}	<u>126.138</u>	= standard meter volume, dscf
C_{HCl}	<u>0.19</u>	= ppmvd

Hydrogen Chloride Emission Rate, lb/hr

$$\text{ER}_{\text{HCl}} = \frac{M_{\text{HCl}} \times Q_s \times 60}{V_{\text{mstd}} \times 4.54\text{E}+08}$$

where,

M_{HCl}	<u>1,020</u>	= Hydrogen Chloride Mass, ug
Q_s	<u>98,459</u>	= average stack gas flow at standard conditions, dscfm
V_{mstd}	<u>126.138</u>	= standard meter volume, dscf
ER_{HCl}	<u>0.11</u>	= lb/hr

Location: Hydro Aluminum - Cassopolis, Michigan
Source: Stack SVEP-2
Project No.: AST-2024-3504
Run No.: 1
Parameter: Dioxins/Furans

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

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

where,

$$\begin{array}{ll} M_{D/F} \frac{18}{109.272} & = \text{D/F TEQ mass, pg} \\ Vmstd & = \text{standard meter volume, dscf} \\ C_{D/F} \frac{2.5E-12}{2.5E-12} & = \text{grain TEQ/dscf} \end{array}$$

D/F TEQ Concentration ($C_{D/F}$), ng TEQ/ft³

$$C_{D/F} = \frac{M_{D/F}}{Vmstd \times 1.0E + 03}$$

where,

$$\begin{array}{ll} M_{D/F} \frac{18}{109.272} & = \text{D/F TEQ mass, pg} \\ Vmstd & = \text{standard meter volume, dscf} \\ C_{D/F} \frac{1.6E-04}{1.6E-04} & = \text{ng TEQ/ft}^3 \end{array}$$

D/F TEQ Concentration ($C_{D/F}$), ng TEQ/dscm

$$C_{D/F} = \frac{M_{D/F} \times 35.313}{Vmstd \times 1.0E + 03}$$

where,

$$\begin{array}{ll} M_{D/F} \frac{18}{109.272} & = \text{D/F TEQ mass, pg} \\ Vmstd & = \text{standard meter volume, dscf} \\ C_{D/F} \frac{0.01}{0.01} & = \text{ng TEQ/dscm} \end{array}$$

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,

$$\begin{array}{ll} C_{D/F} \frac{1.6E-04}{64.982} & = \text{D/F TEQ concentration, ng/ft}^3 \\ Q_s & = \text{average stack gas flow at standard conditions, dscfm} \\ ER_{DF} \frac{1.4E-09}{1.4E-09} & = \text{lb TEQ/hr} \end{array}$$

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

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

where,

$$\begin{array}{ll} ER_{DF} \frac{1.4E-09}{36.556} & = \text{D/F TEQ emission rate, lb TEQ /hr} \\ FR & = \text{process feed rate, lb/hr} \\ EF_{DF} \frac{0.04}{0.04} & = \text{ug TEQ/MG} \end{array}$$

Appendix B

SVEP-2

Location Hydro Aluminum - Cassopolis, Michigan

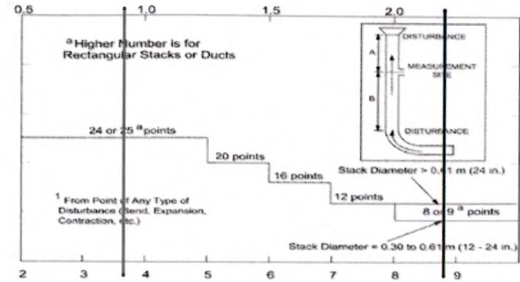
Source Stack SVEP-2

Project No. AST-2024-3504

Date: 10/28/24

Stack Parameters

Duct Orientation: Vertical
Duct Design: Circular
Distance from Far Wall to Outside of Port: 87.50 in
Nipple Length: 5.50 in
Depth of Duct: 82.00 in
No. of Test Ports: 2
Distance A: 15.0 ft
Distance A Duct Diameters: 2.2 (must be ≥ 0.5)
Distance B: 25.0 ft
Distance B Duct Diameters: 3.7 (must be ≥ 2)
Minimum Number of Traverse Points: 24
Actual Number of Traverse Points: 24
Number of Readings per Point: 1
Measurer (Initial and Date): MB 10/28/24
Reviewer (Initial and Date): MU 10/28/24



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

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

Traverse Point	% of Diameter	Distance from inside wall	Distance from outside of port
1	2.1	1.72	7 1/4
2	6.7	5.49	11
3	11.8	9.68	15 3/16
4	17.7	14.51	20
5	25.0	20.50	26
6	35.6	29.19	34 11/16
7	64.4	52.81	58 5/16
8	75.0	61.50	67
9	82.3	67.49	73
10	88.2	72.32	77 13/16
11	93.3	76.51	82
12	97.9	80.28	85 3/4

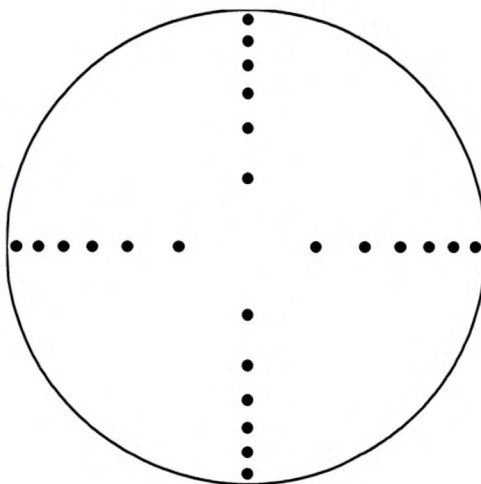
Stack Diagram

A = 15 ft.

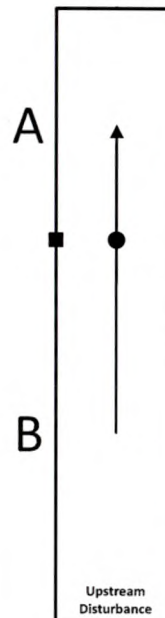
B = 25 ft.

Depth of Duct = 82 in.

Cross Sectional Area



Downstream Disturbance



Cyclonic Flow Check

Location Hydro Aluminum - Cassopolis, Michigan
 Source Stack SVEP-2
 Project No. AST-2024-3504
 Date 10/28/24

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

Location Hydro Aluminum - Cassopolis, Michigan

Source Stack SVEP-2

Project No. AST-2024-3504

Parameter PM,CPM

Run Number		Run 1	Run 2	Run 3	Average
Date		10/29/24	10/29/24	10/30/24	--
Start Time		9:14	14:36	13:32	--
Stop Time		12:25	17:48	16:46	--
Run Time, min	(θ)	180.0	180.0	180.0	180.0
INPUT DATA					
Barometric Pressure, in. Hg	(Pb)	29.06	29.15	29.20	29.14
Meter Correction Factor	(Y)	0.9853	0.9853	0.9853	--
Orifice Calibration Value	($\Delta H @$)	1.8689	1.8689	1.8689	--
Meter Volume, ft ³	(Vm)	112.775	116.775	113.825	114.458
Meter Temperature, °F	(Tm)	79.6	89.0	86.6	85.1
Meter Temperature, °R	(Tm)	539.3	548.7	546.3	544.7
Meter Orifice Pressure, in. WC	(ΔH)	1.183	1.252	1.216	1.217
Volume H ₂ O Collected, mL	(Vlc)	71.4	62.0	63.6	65.7
Nozzle Diameter, in	(Dn)	0.249	0.249	0.249	0.249
Area of Nozzle, ft ²	(An)	0.0003	0.0003	0.0003	0.0003
Filterable PM Mass, mg	(Mn)	<u>4.1</u>	<u>3.1</u>	1.7	3.0
Condensable PM Mass, mg	(M _{CPM})	3.2	3.4	5.7	4.1
ISOKINETIC DATA					
Standard Meter Volume, ft ³	(Vmstd)	105.921	108.147	106.045	106.704
Standard Water Volume, ft ³	(Vwstd)	3.367	2.924	2.999	3.097
Moisture Fraction Measured	(BWSmsd)	0.031	0.026	0.028	0.028
Moisture Fraction @ Saturation	(BWSsat)	1.000	0.837	0.822	0.886
Moisture Fraction	(BWS)	0.031	0.026	0.028	0.028
Meter Pressure, in Hg	(Pm)	29.15	29.24	29.29	29.23
Volume at Nozzle, ft ³	(Vn)	143.445	143.211	140.180	142.28
Isokinetic Sampling Rate, (%)	(I)	101.1	100.7	100.9	100.9
DGM Calibration Check Value, (+/- 5%)	(Y _{qa})	1.3	1.1	1.0	1.2
EMISSION CALCULATIONS					
Filterable PM Concentration, grain/dscf	(C _s)	6.0E-04	4.4E-04	2.5E-04	4.3E-04
Filterable PM Emission Rate, lb/hr	(PMR)	0.32	0.25	0.13	0.23
Condensable PM Concentration, grain/dscf	(C _{CPM})	4.7E-04	4.9E-04	8.3E-04	5.9E-04
Condensable PM Emission Rate, lb/hr	(ER _{CPM})	0.25	0.27	0.45	0.32
Total PM Concentration, grain/dscf	(C _{TPM})	1.1E-03	9.3E-04	1.1E-03	1.0E-03
Total PM Emission Rate, lb/hr	(ER _{TPM})	0.58	0.51	0.58	0.56

Underlined values total results that have been calculated based on MDL values for any sample fractions which were below the MDL.

Bold values were noted by the lab as follows: inorganic rinse run 1 sample leaked during the shipping process; results for this sample are only from organic rinses.

Location Hydro Aluminum - Cassopolis, Michigan
Source Stack SVEP-2
Project No. AST-2024-3504
Parameter PM,CPM

Run Number		Run 1	Run 2	Run 3	Average
Date		10/29/24	10/29/24	10/30/24	--
Start Time		9:14	14:36	13:32	--
Stop Time		12:25	17:48	16:46	--
Run Time, min		180.0	180.0	180.0	180.0
VELOCITY HEAD, in. WC					
Point 1		0.30	0.51	0.45	0.42
Point 2		0.31	0.50	0.43	0.41
Point 3		0.38	0.47	0.27	0.37
Point 4		0.25	0.50	0.27	0.34
Point 5		0.25	0.34	0.25	0.28
Point 6		0.30	0.30	0.25	0.28
Point 7		0.30	0.31	0.27	0.29
Point 8		0.23	0.31	0.27	0.27
Point 9		0.25	0.41	0.27	0.31
Point 10		0.33	0.39	0.25	0.32
Point 11		0.48	0.43	0.26	0.39
Point 12		0.48	0.51	0.26	0.42
Point 13		0.45	0.29	0.38	0.37
Point 14		0.43	0.40	0.40	0.41
Point 15		0.48	0.32	0.54	0.45
Point 16		0.43	0.25	0.49	0.39
Point 17		0.41	0.25	0.27	0.31
Point 18		0.36	0.40	0.30	0.35
Point 19		0.30	0.33	0.33	0.32
Point 20		0.39	0.31	0.36	0.35
Point 21		0.42	0.35	0.53	0.43
Point 22		0.42	0.35	0.55	0.44
Point 23		0.42	0.35	0.55	0.44
Point 24		0.42	0.39	0.50	0.44
CALCULATED DATA					
Square Root of ΔP , (in. WC) ^{1/2}	(ΔP)	0.602	0.608	0.595	0.602
Pitot Tube Coefficient	(Cp)	0.840	0.840	0.840	0.840
Barometric Pressure, in. Hg	(Pb)	29.06	29.15	29.20	29.14
Static Pressure, in. WC	(Pg)	-0.20	-0.20	-0.20	-0.20
Stack Pressure, in. Hg	(Ps)	29.05	29.14	29.19	29.12
Stack Cross-sectional Area, ft ²	(As)	36.67	36.67	36.67	36.67
Stack Temperature, °F	(Ts)	212.7	202.9	202.0	205.9
Stack Temperature, °R	(Ts)	672.4	662.5	661.7	665.5
Moisture Fraction Measured	(BWSmsd)	0.031	0.026	0.028	0.028
Moisture Fraction @ Saturation	(BWSsat)	1.000	0.837	0.822	0.886
Moisture Fraction	(BWS)	0.031	0.026	0.028	0.028
O ₂ Concentration, %	(O ₂)	19.15	20.01	19.58	19.58
CO ₂ Concentration, %	(CO ₂)	1.13	0.31	0.82	0.75
N ₂ Concentration, %	(N ₂)	79.72	79.68	79.6	79.67
Molecular Weight, lb/lb-mole (dry)	(Md)	28.95	28.85	28.91	28.90
Molecular Weight, lb/lb-mole (wet)	(Ms)	28.61	28.56	28.61	28.60
Velocity, ft/sec	(Vs)	38.9	39.0	38.1	38.6
VOLUMETRIC FLOW RATE					
At Stack Conditions, acfm	(Qa)	85,496	85,725	83,739	84,987
At Standard Conditions, scfm	(Qsw)	65,134	66,483	65,137	65,585
At Standard Conditions, dscfm	(Qs)	63,127	64,733	63,345	63,735

Location Hydro Aluminum - Cassopolis, Michigan
Source Stack SVEP-2
Project No. AST-2024-3504
Parameter PM,CPM
Analysis Gravimetric

Run 1	Date: 10/29/24				
Impinger No.	1	2	3	4	Total
Contents	Empty	Empty	H2O	Silica	--
Initial Mass, g	499.6	697.2	705.0	943.3	2845.1
Final Mass, g	506.2	697.2	741.1	972.0	2916.5
Gain	6.6	0.0	36.1	28.7	71.4
Run 2	Date: 10/29/24				
Impinger No.	1	2	3	4	Total
Contents	Empty	Empty	H2O	Silica	--
Initial Mass, g	517.0	655.4	731.3	925.8	2829.5
Final Mass, g	517.1	654.1	760.8	959.5	2891.5
Gain	0.1	-1.3	29.5	33.7	62.0
Run 3	Date: 10/30/24				
Impinger No.	1	2	3	4	Total
Contents	Empty	Empty	H2O	Silica	--
Initial Mass, g	499.2	696.2	741.2	995.7	2932.3
Final Mass, g	510.2	696.0	768.0	1021.7	2995.9
Gain	11.0	-0.2	26.8	26.0	63.6

Location: <u>Hydro Aluminum - Cassopolis, Michigan</u>				Start Time: <u>9:14</u>		Source: <u>Stack SVEP-2</u>					
Date: <u>10/29/24</u>		Run <u>1</u>		End Time: <u>12:25</u>		Project No.: <u>AST-2024-3504</u>		Parameter: <u>PM,CPM</u>			
STACK DATA (EST)		EQUIPMENT		STACK DATA (EST)		FILTER NO.		STACK DATA (FINAL)		MOIST. DATA	
Moisture: <u>3.0</u> % est.		Meter Box ID: <u>STL-12</u>		Est. Tm: <u>75</u> °F		<u>25913</u>		Pb: <u>29.06</u> in. Hg		Vlc (ml)	
Barometric: <u>29.15</u> in. Hg		Y: <u>0.9853</u>		Est. Ts: <u>208</u> °F				Pg: <u>-0.20</u> in. WC		71.4	
Static Press: <u>-0.20</u> in. WC		ΔH @ (in.WC): <u>1.8689</u>		Est. AP: <u>0.43</u> in. WC				O ₂ : <u>19.15</u> %		K-FACTOR	
Stack Press: <u>29.14</u> in. Hg		Probe ID: <u>SP-7-1</u>		Est. Dn: <u>0.265</u> in.				CO ₂ : <u>1.13</u> %		3.253	
CO ₂ : <u>1.0</u> %		Liner Material: <u>glass</u>		Target Rate: <u>0.75</u> scfm				Check Pt.		Initial Final Corr.	
O ₂ : <u>19.0</u> %		Pitot ID: <u>SP-7-1</u>		LEAK CHECK!		Pre Mid 1 Mid 2 Mid 3 Post		Mid 1 (cf)		-	
N ₂ /CO: <u>80.0</u> %		Pitot Cp/Type: <u>0.840</u> S-type		Leak Rate (cfm): <u>0.000</u>		-		Mid 2 (cf)		-	
Md: <u>28.92</u> lb/lb-mole		Nozzle ID: <u>.249</u> glass		Vacuum (in Hg): <u>15</u>		-		Mid 3 (cf)		-	
Ms: <u>28.59</u> lb/lb-mole		Nozzle Dn (in.): <u>0.249</u>		Pitot Tube: <u>Pass</u>		-		Mid-Point Leak Check Vol (cf):		-	

Sample Pt.	Sample Time (minutes)		Dry Gas Meter Reading (ft ³)	Pitot Tube ΔP (in WC)	Gas Temperatures (°F)		Orifice Press. ΔH (in. WC)		Pump Vac (in. Hg)	Gas Temperatures (°F)				% ISO	Vs (fps)
					DGM Average	Stack				Probe	Filter	Imp Exit	CPM		
					Amb.	Amb.				Amb.	Amb.	Amb.	Amb.		
		Begin			End			66		66	Ideal	Actual			
A1	0.00	7.50	245.900	0.30	69	166	1.03	1.00	4	250	247	62	68	101.1	34.09
2	7.50	15.00	250.250	0.31	71	173	1.06	1.10	4	250	251	58	68	99.7	34.84
3	15.00	22.50	254.600	0.38	74	190	1.27	1.30	5	250	250	58	68	100.1	39.09
4	22.50	30.00	259.400	0.25	75	169	0.87	0.87	4	250	249	59	70	100.9	31.19
5	30.00	37.50	263.400	0.25	76	174	0.86	0.86	4	250	250	59	70	101.1	31.32
6	37.50	45.00	267.400	0.30	76	187	1.01	1.00	4	250	251	60	70	101.5	34.65
7	45.00	52.50	271.750	0.30	77	202	0.99	1.00	4	250	251	60	73	102.4	35.05
8	52.50	60.00	276.100	0.23	78	198	0.77	0.77	4	250	252	61	74	101.6	30.60
9	60.00	67.50	279.900	0.25	78	203	0.83	0.83	4	250	250	62	75	101.7	32.02
10	67.50	75.00	283.850	0.33	79	226	1.06	1.10	5	250	248	63	74	101.4	37.43
11	75.00	82.50	288.300	0.48	79	235	1.51	1.50	5	250	247	63	74	102.7	45.43
12	82.50	90.00	293.700	0.48	80	247	1.49	1.50	5	250	248	63	75	102.5	45.82
B1	90.00	97.50	299.050	0.45	78	264	1.36	1.37	5	250	246	64	77	101.4	44.90
2	97.50	105.00	304.100	0.43	80	264	1.30	1.30	5	250	254	55	71	102.4	43.89
3	105.00	112.50	309.100	0.48	81	254	1.48	1.50	5	250	257	55	71	99.9	46.05
4	112.50	120.00	314.300	0.43	82	257	1.32	1.30	5	250	259	56	72	101.5	43.68
5	120.00	127.50	319.300	0.41	83	229	1.31	1.30	5	250	260	57	74	101.7	41.81
6	127.50	135.00	324.300	0.36	84	212	1.19	1.20	5	250	259	57	74	100.5	38.69
7	135.00	142.50	329.000	0.30	84	222	0.97	1.00	4	250	259	57	74	101.5	35.58
8	142.50	150.00	333.300	0.39	84	215	1.28	1.30	5	250	255	57	74	98.9	40.36
9	150.00	157.50	338.100	0.42	85	207	1.40	1.40	5	250	260	58	75	100.5	41.63
10	157.50	165.00	343.200	0.42	85	205	1.40	1.10	5	250	260	58	75	100.3	41.57
11	165.00	172.50	348.300	0.42	85	205	1.40	1.40	6	250	256	58	75	102.3	41.57
12	172.50	180.00	353.500	0.42	87	201	1.41	1.40	6	250	255	58	76	101.1	41.45
Final DGM:			358.675												

RESULTS	Run Time		Vm	ΔP	Tm		Ts		Max Vac	ΔH	%ISO	BWS	Y _{qs}
	min		ft ³	in. WC	°F		°F			in. WC			
	180.0		112.775	0.37	79.6		212.7		6	1.183	101.1	0.031	1.3

Location: Hydro Aluminum - Cassopolis, Michigan				Start Time: 14:36		Source: Stack SVEP-2			
Date: 10/29/24		Run 2		End Time: 17:48		Project No.: AST-2024-3504		Parameter: PM,CPM	

STACK DATA (EST)	EQUIPMENT	STACK DATA (EST)	FILTER NO.	STACK DATA (FINAL)	MOIST. DATA
Moisture: 3.0 % est.	Meter Box ID: STL-12	Est. Tm: 80 °F	25960	Pb: 29.15 in. Hg	Vlc (ml)
Barometric: 29.15 in. Hg	Y: 0.9853	Est. Ts: 213 °F		Pg: -0.20 in. WC	62.0
Static Press: -0.20 in. WC	ΔH @ (in.WC): 1.8689	Est. ΔP: 0.37 in. WC		O ₂ : 20.01 %	K-FACTOR
Stack Press: 29.14 in. Hg	Probe ID: SP-7-1	Est. Dn: 0.276 in.		CO ₂ : 0.31 %	3.26
CO ₂ : 1.0 %	Liner Material: glass	Target Rate: 0.75 scfm		Check Pt.	Initial Final Corr.
O ₂ : 19.0 %	Pitot ID: SP-7-1	LEAK CHECK: Pre Mid 1 Mid 2 Mid 3 Post		Mid 1 (cf)	—
N ₂ /CO: 80.0 %	Pitot Cp/Type: 0.840 S-type	Leak Rate (cfm): 0.000 — — — — 0.000		Mid 2 (cf)	—
Md: 28.92 lb/lb-mole	Nozzle ID: .249 glass	Vacuum (in Hg): 16 — — — — 7		Mid 3 (cf)	—
Ms: 28.59 lb/lb-mole	Nozzle Dn (in.): 0.249	Pitot Tube: Pass — — — — Pass		Mid-Point Leak Check Vol (cf):	—

Sample Pt.	Sample Time (minutes)		Dry Gas Meter Reading (ft ³)	Pitot Tube ΔP (in WC)	Gas Temperatures (°F)		Orifice Press. ΔH (in. WC)		Pump Vac (in. Hg)	Gas Temperatures (°F)				% ISO	Vs (fps)
					DGM Average	Stack				Probe	Filter	Imp Exit	CPM		
	Amb.	Amb.			Amb.	Amb.	Amb.	Amb.							
	—	—			Ideal	Actual	—	—		—	—				
A1	0.00	7.50	359.000	0.51	80	241	1.60	1.60	6	250	246	56	79	100.0	47.03
2	7.50	15.00	364.400	0.50	82	241	1.57	1.60	6	250	251	56	80	100.6	46.57
3	15.00	22.50	369.800	0.47	84	243	1.48	1.50	6	250	251	56	80	102.5	45.22
4	22.50	30.00	375.150	0.50	86	231	1.61	1.60	6	250	248	58	80	101.9	46.24
5	30.00	37.50	380.700	0.34	88	212	1.13	1.10	5	250	251	60	80	102.7	37.60
6	37.50	45.00	385.400	0.30	88	192	1.03	1.00	5	250	252	58	80	100.8	34.79
7	45.00	52.50	389.800	0.31	89	195	1.06	1.10	5	250	251	57	79	101.4	35.44
8	52.50	60.00	394.300	0.31	90	198	1.05	1.10	5	250	250	57	79	100.4	35.53
9	60.00	67.50	398.750	0.41	90	195	1.40	1.40	6	250	253	56	78	100.8	40.76
10	67.50	75.00	403.900	0.39	91	192	1.34	1.30	6	250	253	56	78	99.0	39.66
11	75.00	82.50	408.850	0.43	91	207	1.45	1.40	6	250	250	56	78	102.1	42.13
12	82.50	90.00	414.150	0.51	91	215	1.69	1.70	6	250	249	57	79	101.4	46.15
B1	90.00	97.50	419.845	0.29	89	201	0.98	1.00	6	250	241	60	80	101.9	34.44
2	97.50	105.00	424.200	0.40	90	215	1.33	1.30	6	250	251	59	79	100.6	40.87
3	105.00	112.50	429.200	0.32	91	200	1.09	1.10	6	250	254	58	79	102.1	36.15
4	112.50	120.00	433.800	0.25	91	180	0.88	0.88	5	250	256	58	79	102.5	31.46
5	120.00	127.50	437.950	0.25	91	189	0.86	0.87	5	250	254	58	79	100.8	31.68
6	127.50	135.00	442.000	0.40	91	191	1.38	1.40	6	250	253	59	80	101.6	40.14
7	135.00	142.50	447.150	0.33	91	193	1.13	1.10	6	250	252	60	80	100.0	36.51
8	142.50	150.00	451.750	0.31	91	176	1.09	1.10	6	250	251	61	80	102.9	34.93
9	150.00	157.50	456.400	0.35	91	187	1.21	1.20	6	250	252	61	80	100.9	37.43
10	157.50	165.00	461.200	0.35	90	190	1.21	1.20	6	250	254	62	80	101.3	37.52
11	165.00	172.50	466.000	0.35	90	193	1.20	1.20	6	250	252	62	80	101.5	37.60
12	172.50	180.00	470.800	0.39	90	192	1.34	1.30	6	250	249	63	80	99.6	39.66
Final DGM:			475.775												

RESULTS	Run Time		Vm	ΔP	Tm	Ts	Max Vac	ΔH	%ISO	BWS	Y _{qs}
	min		ft ³	in. WC	°F	°F		in. WC			
	180.0		116.775	0.37	89.0	202.9	6	1.252	100.7	0.026	1.1

Location: <u>Hydro Aluminum - Cassopolis, Michigan</u>				Start Time: <u>13:32</u>		Source: <u>Stack SVEP-2</u>			
Date: <u>10/30/24</u>		Run <u>3</u>		End Time: <u>16:46</u>		Project No.: <u>AST-2024-3504</u>		Parameter: <u>PM,CPM</u>	

STACK DATA (EST)	EQUIPMENT	STACK DATA (EST)	FILTER NO.	STACK DATA (FINAL)	MOIST. DATA
Moisture: <u>3.0</u> % est.	Meter Box ID: <u>STL-12</u>	Est. Tm: <u>89</u> °F	<u>25961</u>	Pb: <u>29.20</u> in. Hg	Vlc (ml)
Barometric: <u>29.15</u> in. Hg	Y: <u>0.9853</u>	Est. Ts: <u>203</u> °F		Pg: <u>-0.20</u> in. WC	<u>63.6</u>
Static Press: <u>-0.20</u> in. WC	ΔH @ (in.WC): <u>1.8689</u>	Est. ΔP: <u>0.37</u> in. WC		O ₂ : <u>19.58</u> %	K-FACTOR
Stack Press: <u>29.14</u> in. Hg	Probe ID: <u>SP-7-1</u>	Est. Dn: <u>0.271</u> in.		CO ₂ : <u>0.82</u> %	<u>3.365</u>
CO ₂ : <u>1.0</u> %	Liner Material: <u>glass</u>	Target Rate: <u>0.75</u> scfm		Check Pt. Initial Final Corr.	
O ₂ : <u>19.0</u> %	Pitot ID: <u>SP-7-1</u>	LEAK CHECK: Pre Mid 1 Mid 2 Mid 3 Post		Mid 1 (cf)	—
N ₂ /CO: <u>80.0</u> %	Pitot Cp/Type: <u>0.840</u> S-type	Leak Rate (cfm): <u>0.000</u> — — — — <u>0.000</u>		Mid 2 (cf)	—
Md: <u>28.92</u> lb/lb-mole	Nozzle ID: <u>.249</u> glass	Vacuum (in Hg): <u>15</u> — — — — <u>12</u>		Mid 3 (cf)	—
Ms: <u>28.59</u> lb/lb-mole	Nozzle Dn (in.): <u>0.249</u>	Pitot Tube: Pass — — — — Pass		Mid-Point Leak Check Vol (cf):	—

Sample Pt.	Sample Time (minutes)		Dry Gas Meter Reading (ft ³)	Pitot Tube ΔP (in WC)	Gas Temperatures (°F)		Orifice Press. ΔH (in. WC)		Pump Vac (in. Hg)	Gas Temperatures (°F)				% ISO	Vs (fps)
					DGM Average	Stack	Ideal	Actual		Probe	Filter	Imp Exit	CPM		
	Begin	End			Amb.	Amb.				Amb.	Amb.	Amb.	Amb.		
A1	0.00	7.50	475.900	0.45	79	215	1.46	1.50	5	250	246	62	76	102.6	43.35
2	7.50	15.00	481.200	0.43	80	205	1.42	1.40	5	250	250	60	74	100.1	42.06
3	15.00	22.50	486.300	0.27	81	198	0.90	0.90	4	250	251	58	73	103.1	33.15
4	22.50	30.00	490.500	0.27	82	181	0.93	0.93	4	250	252	58	72	101.6	32.72
5	30.00	37.50	494.700	0.25	83	194	0.85	0.85	4	250	255	56	72	101.4	31.81
6	37.50	45.00	498.700	0.25	84	175	0.87	0.87	4	250	251	56	72	99.7	31.34
7	45.00	52.50	502.700	0.27	85	178	0.94	0.94	4	250	252	57	72	100.8	32.65
8	52.50	60.00	506.900	0.27	86	179	0.94	0.94	4	250	251	57	72	100.7	32.67
9	60.00	67.50	511.100	0.27	86	194	0.92	0.92	4	250	253	58	72	101.9	33.05
10	67.50	75.00	515.300	0.25	86	196	0.85	0.85	4	250	252	58	72	101.0	31.85
11	75.00	82.50	519.300	0.26	87	198	0.88	0.88	4	250	251	58	73	101.5	32.53
12	82.50	90.00	523.400	0.26	87	200	0.88	0.88	4	250	251	59	73	100.4	32.58
B1	90.00	97.50	527.450	0.38	86	205	1.27	1.30	5	250	249	60	73	102.2	39.54
2	97.50	105.00	532.400	0.40	87	214	1.32	1.32	6	250	250	54	72	101.1	40.84
3	105.00	112.50	537.400	0.54	87	215	1.78	1.80	6	250	251	54	72	101.1	47.49
4	112.50	120.00	543.200	0.49	89	214	1.62	1.60	6	250	252	55	71	102.0	45.20
5	120.00	127.50	548.800	0.27	89	210	0.90	0.90	6	250	253	57	72	102.6	33.46
6	127.50	135.00	553.000	0.30	90	203	1.01	1.00	5	250	251	58	73	101.2	35.08
7	135.00	142.50	557.400	0.33	90	212	1.10	1.10	5	250	252	59	74	99.4	37.04
8	142.50	150.00	561.900	0.36	90	212	1.20	1.20	5	250	255	59	75	99.4	38.69
9	150.00	157.50	566.600	0.53	90	213	1.76	1.80	6	250	258	59	75	101.4	46.98
10	157.50	165.00	572.400	0.55	91	212	1.83	1.80	6	250	259	59	75	101.0	47.82
11	165.00	172.50	578.300	0.55	92	213	1.83	1.80	6	250	257	60	76	99.1	47.86
12	172.50	180.00	584.100	0.50	92	213	1.67	1.70	6	250	255	60	76	100.8	45.63
Final DGM:			589.725												

RESULTS	Run Time		Vm	ΔP	Tm	Ts	Max Vac	ΔH	%ISO	BWS	Y _{qs}
	min		ft ³	in. WC	°F	°F		in. WC			
	180.0		113.825	0.36	86.6	202.0	6	1.216	100.9	0.028	1.0

Location Hydro Aluminum - Cassopolis, Michigan

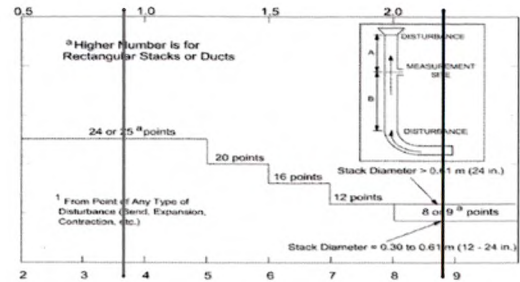
Source Stack SVEP-2

Project No. AST-2024-3504

Date: 10/28/24

Stack Parameters

Duct Orientation: Vertical
Duct Design: Circular
Distance from Far Wall to Outside of Port: 87.50 in
Nipple Length: 5.50 in
Depth of Duct: 82.00 in
No. of Test Ports: 2
Distance A: 15.0 ft
Distance A Duct Diameters: 2.2 (must be ≥ 0.5)
Distance B: 25.0 ft
Distance B Duct Diameters: 3.7 (must be ≥ 2)
Minimum Number of Traverse Points: 24
Actual Number of Traverse Points: 24
Number of Readings per Point: 1
Measurer (Initial and Date): JMB 10/28/24
Reviewer (Initial and Date): JMU 10/28/24

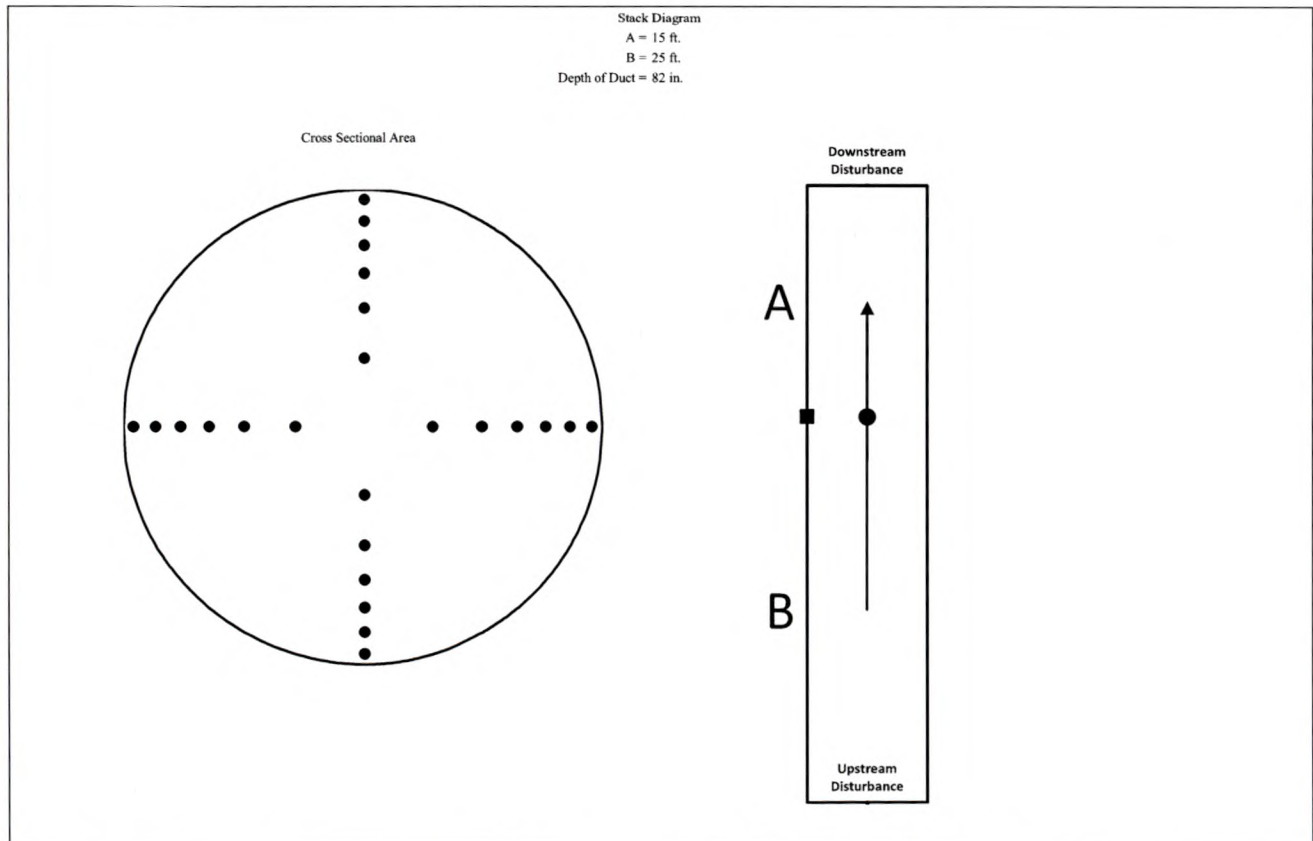


CIRCULAR DUCT

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	

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

Traverse Point	% of Diameter	Distance from inside wall	Distance from outside of port
1	2.1	1.72	7 1/4
2	6.7	5.49	11
3	11.8	9.68	15 3/16
4	17.7	14.51	20
5	25.0	20.50	26
6	35.6	29.19	34 11/16
7	64.4	52.81	58 5/16
8	75.0	61.50	67
9	82.3	67.49	73
10	88.2	72.32	77 13/16
11	93.3	76.51	82
12	97.9	80.28	85 3/4



Cyclonic Flow Check

Location Hydro Aluminum - Cassopolis, Michigan

Source Stack SVEP-2

Project No. AST-2024-3504

Date _____

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

Location Hydro Aluminum - Cassopolis, Michigan
Source Stack SVEP-2
Project No. AST-2024-3504
Parameter Dioxins/Furans

Run Number	Run 1	Run 2	Run 3	Average
Date	10/29/24	10/29/24	10/30/24	--
Start Time	9:14	14:36	13:32	--
Stop Time	12:25	17:48	16:46	--
Run Time, min	(0)	180.0	180.0	180.0
INPUT DATA				
2,3,7,8-TCDD Mass, pg	<i>1.61</i>	<i>0.239</i>	<i>5.75</i>	2.53
1,2,3,7,8 PeCDD Mass, pg	<i>3.19</i>	<i>1.44</i>	<i>5.35</i>	3.33
1,2,3,4,7,8 HxCDD Mass, pg	<i>3.78</i>	<i>0.871</i>	<i>1.51</i>	2.05
1,2,3,6,7,8 HxCDD Mass, pg	<i>3.46</i>	<i>0.794</i>	<i>0.00</i>	1.42
1,2,3,7,8,9 HxCDD Mass, pg	<i>7.68</i>	<i>0.980</i>	<i>2.69</i>	3.78
1,2,3,4,6,7,8 HpCDD Mass, pg	<i>21.3</i>	<i>6.40</i>	<i>5.86</i>	11.19
OCDD Mass, pg	<i>125</i>	<i>36.8</i>	<i>14.6</i>	58.80
Other TCDD Mass, pg	<i>80.5</i>	<i>36.3</i>	<i>581</i>	232.60
Other PeCDD Mass, pg	<i>109</i>	<i>56.4</i>	<i>213</i>	126.13
Other HxCDD Mass, pg	<i>55.4</i>	<i>23.3</i>	<i>48.2</i>	42.30
Other HpCDD Mass, pg	<i>45.9</i>	<i>14.7</i>	<i>15.5</i>	25.37
2,3,7,8-TCDF Mass, pg	<i>22.7</i>	<i>9.77</i>	<i>281</i>	104.49
1,2,3,7,8 PeCDF Mass, pg	<i>9.51</i>	<i>3.07</i>	<i>43.8</i>	18.79
2,3,4,7,8 PeCDF Mass, pg	<i>14.2</i>	<i>6.84</i>	<i>84.7</i>	35.25
1,2,3,4,7,8 HxCDF Mass, pg	<i>11.2</i>	<i>4.12</i>	<i>24.9</i>	13.41
1,2,3,6,7,8 HxCDF Mass, pg	<i>7.31</i>	<i>3.00</i>	<i>9.68</i>	6.66
2,3,4,6,7,8 HxCDF Mass, pg	<i>6.71</i>	<i>0.00</i>	<i>7.83</i>	4.85
1,2,3,7,8,9 HxCDF Mass, pg	<i>1.52</i>	<i>0.00</i>	<i>0.00</i>	0.51
1,2,3,4,6,7,8 HpCDF Mass, pg	<i>17.2</i>	<i>6.57</i>	<i>13.7</i>	12.49
1,2,3,4,7,8,9 HpCDF Mass, pg	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	0.00
OCDF Mass, pg	<i>25.5</i>	<i>1.63</i>	<i>3.53</i>	10.22
Other TCDF Mass, pg	<i>347</i>	<i>143</i>	<i>4,460</i>	1650.00
Other PeCDF Mass, pg	<i>135</i>	<i>60.2</i>	<i>1,030</i>	408.40
Other HxCDF Mass, pg	<i>57.6</i>	<i>22.6</i>	<i>139</i>	73.07
Other HpCDF Mass, pg	<i>25.3</i>	<i>6.57</i>	<i>13.7</i>	15.19

* Italicized values were flagged in the laboratory report. Results are calculated using the reported values. See the laboratory report in Appendix C for details

Location **Hydro Aluminum - Cassopolis, Michigan**
Source **Stack SVEP-2**
Project No. **AST-2024-3504**
Parameter **Dioxins/Furans**

Run Number		Run 1	Run 2	Run 3	Average
Date		10/29/24	10/29/24	10/30/24	--
Start Time		9:14	14:36	13:32	--
Stop Time		12:25	17:48	16:46	--
Run Time, min	(θ)	180.0	180.0	180.0	180.0
Run Duration, min		192.0	192.0	194.0	192.7
INPUT DATA					
Total Charge, lbs	(FR)	116,980	105,701	111,760	111,480
Charge Rate, lb/hr	(FR)	36,556	33,032	34,565	34,718
Barometric Pressure, in. Hg	(Pb)	29.06	29.15	29.20	29.14
Meter Correction Factor	(Y)	1.019	1.019	1.019	--
Orifice Calibration Value	($\Delta H @$)	1.815	1.815	1.815	--
Meter Volume, ft ³	(Vm)	111.698	125.692	122.840	120.077
Meter Temperature, °F	(Tm)	75.8	85.5	83.8	81.7
Meter Temperature, °R	(Tm)	535.5	545.2	543.5	541.4
Meter Orifice Pressure, in. WC	(ΔH)	1.235	1.529	1.479	1.414
Volume H ₂ O Collected, mL	(Vlc)	73.4	72.6	73.8	73.3
Nozzle Diameter, in	(Dn)	0.249	0.249	0.249	0.249
Area of Nozzle, ft ²	(An)	0.0003	0.0003	0.0003	0.0003
D/F TEQ TEQ Mass, pg	(M _{D/F}) (TEF)	17.8	6.7	85.9	36.8
2,3,7,8-TCDD TEQ Mass, pg	1	1.6	0.2	5.8	2.5
1,2,3,7,8 PeCDD TEQ Mass, pg	0.5	1.6	0.7	2.7	1.7
1,2,3,4,7,8 HxCDD TEQ Mass, pg	0.1	0.4	0.1	0.2	0.2
1,2,3,6,7,8 HxCDD TEQ Mass, pg	0.1	0.3	0.1	0.0	0.1
1,2,3,7,8,9 HxCDD TEQ Mass, pg	0.1	0.8	0.1	0.3	0.4
1,2,3,4,6,7,8 HpCDD TEQ Mass, pg	0.01	0.2	0.1	0.1	0.1
OCDD TEQ Mass, pg	0.001	0.1	0.0	0.0	0.1
2,3,7,8-TCDF TEQ Mass, pg	0.1	2.3	1.0	28.1	10.4
1,2,3,7,8 PeCDF TEQ Mass, pg	0.05	0.5	0.2	2.2	0.9
2,3,4,7,8 PeCDF TEQ Mass, pg	0.5	7.1	3.4	42.4	17.6
1,2,3,4,7,8 HxCDF TEQ Mass, pg	0.1	1.1	0.4	2.5	1.3
1,2,3,6,7,8 HxCDF TEQ Mass, pg	0.1	0.7	0.3	1.0	0.7
2,3,4,6,7,8 HxCDF TEQ Mass, pg	0.1	0.7	0.0	0.8	0.5
1,2,3,7,8,9 HxCDF TEQ Mass, pg	0.1	0.2	0.0	0.0	0.1
1,2,3,4,6,7,8 HpCDF TEQ Mass, pg	0.01	0.2	0.1	0.1	0.1
1,2,3,4,7,8,9 HpCDF TEQ Mass, pg	0.01	0.0	0.0	0.0	0.0
OCDF TEQ Mass, pg	0.001	0.0	0.0	0.0	0.0
ISOKINETIC DATA					
Standard Meter Volume, ft ³	(Vmstd)	109.272	121.235	119.054	116.520
Standard Water Volume, ft ³	(Vwstd)	3.462	3.424	3.480	3.455
Moisture Fraction Measured	(BWSmsd)	0.031	0.027	0.028	0.029
Moisture Fraction @ Saturation	(BWSsat)	1.000	0.843	0.806	0.883
Moisture Fraction	(BWS)	0.031	0.027	0.028	0.029
Meter Pressure, in Hg	(Pm)	29.15	29.26	29.31	29.24
Volume at Nozzle, ft ³	(Vn)	147.985	160.810	157.303	155.366
Isokinetic Sampling Rate, (%)	(I)	101.3	100.6	100.2	100.7
DGM Calibration Check Value, (+/- 5%)	(Y _{qa})	1.3	0.8	0.2	0.8
EMISSION CALCULATIONS					
D/F TEQ Concentration, grain/dscf	(C _{D/F})	2.5E-12	8.5E-13	1.1E-11	4.8E-12
D/F TEQ Concentration, ng/ft3	(C _{D/F})	1.6E-04	5.5E-05	7.2E-04	3.1E-04
D/F TEQ Emission Rate, lb/hr	(ER _{D/F})	1.4E-09	5.3E-10	6.8E-09	2.9E-09
D/F TEQ Emission Factor, ug/MG	(EF _{D/F})	0.038	0.016	0.20	0.084

Location Hydro Aluminum - Cassopolis, Michigan
Source Stack SVEP-2
Project No. AST-2024-3504
Parameter Dioxins/Furans

Run Number		Run 1	Run 2	Run 3	Average
Date		10/29/24	10/29/24	10/30/24	--
Start Time		9:14	14:36	13:32	--
Stop Time		12:25	17:48	16:46	--
Run Time, min		180.0	180.0	180.0	180.0
VELOCITY HEAD, in. WC					
Point 1		0.25	0.46	0.34	0.35
Point 2		0.25	0.49	0.41	0.38
Point 3		0.28	0.49	0.38	0.38
Point 4		0.28	0.45	0.46	0.40
Point 5		0.32	0.38	0.39	0.36
Point 6		0.28	0.35	0.45	0.36
Point 7		0.30	0.36	0.46	0.37
Point 8		0.30	0.35	0.50	0.38
Point 9		0.31	0.35	0.49	0.38
Point 10		0.35	0.35	0.47	0.39
Point 11		0.35	0.40	0.50	0.42
Point 12		0.38	0.44	0.50	0.44
Point 13		0.38	0.45	0.38	0.40
Point 14		0.39	0.61	0.49	0.50
Point 15		0.40	0.54	0.53	0.49
Point 16		0.33	0.51	0.47	0.44
Point 17		0.37	0.42	0.50	0.43
Point 18		0.33	0.62	0.45	0.47
Point 19		0.48	0.51	0.48	0.49
Point 20		0.51	0.53	0.45	0.50
Point 21		0.52	0.46	0.45	0.48
Point 22		0.62	0.72	0.40	0.58
Point 23		0.71	0.50	0.43	0.55
Point 24		0.75	0.57	0.51	0.61
CALCULATED DATA					
Square Root of ΔP , (in. WC) ^{1/2}	(ΔP)	0.619	0.683	0.673	0.658
Pitot Tube Coefficient	(Cp)	0.840	0.840	0.840	0.840
Barometric Pressure, in. Hg	(Pb)	29.06	29.15	29.20	29.14
Static Pressure, in. WC	(Pg)	-0.20	-0.20	-0.20	-0.20
Stack Pressure, in. Hg	(Ps)	29.05	29.14	29.19	29.12
Stack Cross-sectional Area, ft ²	(As)	36.67	36.67	36.67	36.67
Stack Temperature, °F	(Ts)	212.8	203.2	201.1	205.7
Stack Temperature, °R	(Ts)	672.5	662.9	660.8	665.4
Moisture Fraction Measured	(BWSmsd)	0.031	0.027	0.028	0.029
Moisture Fraction @ Saturation	(BWSsat)	1.000	0.843	0.806	0.883
Moisture Fraction	(BWS)	0.031	0.027	0.028	0.029
O ₂ Concentration, %	(O ₂)	19.15	20.01	19.58	19.58
CO ₂ Concentration, %	(CO ₂)	1.13	0.31	0.82	0.75
N ₂ Concentration, %	(N ₂)	79.72	79.68	79.6	79.67
Molecular Weight, lb/lb-mole (dry)	(Md)	28.95	28.85	28.91	28.90
Molecular Weight, lb/lb-mole (wet)	(Ms)	28.61	28.55	28.60	28.59
Velocity, ft/sec	(Vs)	40.0	43.8	43.0	42.3
VOLUMETRIC FLOW RATE					
At Stack Conditions, acfm	(Qa)	88,009	96,358	94,561	92,976
At Standard Conditions, scfm	(Qsw)	67,040	74,692	73,656	71,796
At Standard Conditions, dscfm	(Qs)	64,982	72,640	71,564	69,729

Location Hydro Aluminum - Cassopolis, Michigan

Source Stack SVEP-2

Project No. AST-2024-3504

Parameter Dioxins/Furans

Analysis Gravimetric

Run 1	Date: 10/29/24					
Impinger No.	1	2	3	4	5	Total
Contents	XAD Trap	Empty	H2O	H2O	Silica	--
Initial Mass, g	286.9	500.0	791.8	791.3	993.4	3363.4
Final Mass, g	289.4	506.3	791.9	822.8	1026.4	3436.8
Gain	2.5	6.3	0.1	31.5	33.0	73.4
Run 2	Date: 10/29/24					
Impinger No.	1	2	3	4	5	Total
Contents	XAD Trap	Empty	H2O	H2O	Silica	--
Initial Mass, g	295.3	498.6	802.4	844.2	989.8	3430.3
Final Mass, g	297.9	505.1	802.2	871.4	1026.3	3502.9
Gain	2.6	6.5	-0.2	27.2	36.5	72.6
Run 3	Date: 10/30/24					
Impinger No.	1	2	3	4	5	Total
Contents	XAD Trap	Empty	H2O	H2O	Silica	--
Initial Mass, g	301.5	502.4	798.3	792.8	1005.3	3400.3
Final Mass, g	303.9	509.1	800.1	820.3	1040.7	3474.1
Gain	2.4	6.7	1.8	27.5	35.4	73.8