Source Test Report

Continental Aluminum
29201 Milford Road
New Hudson, MI 48165

Source Tested: Reverberatory Furnace #2 (RV2)
Test Dates: October 29-30, 2019

AST Project No. 2019-1472

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

Regulatory Information

Permit No.	Michigan Department of Environmental Quality (MDEQ) Permit No. 504-96F
State Registration No.	N6013

Source Information

Source Name	*Source ID*	*Target Parameters*
Reverberatory Furnace #2 Flue Stack	SVHTRRVRB#2	PM, PM10, PM2.5
Reverberatory Furnace #2 Baghouse Stack	SVBHRVRB#2	PM, PM10, PM2.5

Contact Information

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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

Adam Robinson, QSTI
Alliance Source Testing, LLC

12/4/2019
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. The facility operates under the Michigan Department of Environmental Quality (MDEQ) Permit No. 504-96f. Testing was conducted to determine the emission rates of particulate matter (PM), particulate matter less than 10 microns (PM10) and particulate matter less than 2.5 microns (PM2.5) from the RV2 flue stack and baghouse stack. Testing will be conducted simultaneously at the furnace flue stack and the baghouse exhaust stack to demonstrate compliance with the combined permit limits.

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	Courtney Boc
Regulatory Personnel	Iranna Konanahalli Regina Angellotti
AST Personnel	Kenji Kinoshita Justin Bernard Tyler Branca Donald Burkey

1.3 Site Specific Test Plan & Notification

Testing was conducted in accordance with the Site-Specific Test Plan (SSTP) submitted to the MDEQ on September 25, 2019.

Summary of Results

2.0 Summary of Results

AST conducted compliance testing at the CA facility in New Hudson, Michigan on October 29-30, 2019. Testing consisted of determining the emission rates of PM, PM10 and PM2.5 from the RV2 flue stack and baghouse stack simultaneously.

Table 2-1 provides a summary of the emission testing results with comparisons to the applicable MDEQ 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 table and the detailed results contained in appendices is due to rounding for presentation.

Table 2-1
Summary of Results

Emissions Data				
Run Number	**Run 1**	**Run 2**	**Run 3**	**Average**
Date	**10/29/19**	**10/29/19**	**10/30/19**	**--**
Filterable Particulate Matter Data				
RV2 Flue Emission Factor, lb/ton	0.10	0.070	0.13	0.10
RV2 Baghouse Emission Factor, lb/ton	0.0085	0.010	0.018	0.012
Combined Emission Factor, lb/ton	0.11	0.080	0.15	0.11
Permit Limit, lb/ton	--	--	--	0.40
Percent of Limit, %	--	--	--	**28**
RV2 Flue Emission Rate, lb/hr	0.83	0.63	1.2	0.88
RV2 Baghouse Emission Rate, lb/hr	0.071	0.091	0.17	0.11
Condensable Particulate Matter Data				
RV2 Flue Emission Rate, lb/hr	0.049	0.019	0.022	0.030
RV2 Baghouse Emission Rate, lb/hr	0.46	0.96	0.61	0.68
Total Particulate Matter Data *				
RV2 Flue Emission Rate, lb/hr	0.88	0.65	1.20	0.91
RV2 Baghouse Emission Rate, lb/hr	0.53	1.1	0.78	0.79
PM10 Permit Limit, lb/hr	**--**	**--**	**--**	**2.0**
PM2.5 Permit Limit, lb/hr	**--**	**--**	**--**	**1.4**
Process Operating / Control System Data				
Run Number	**Run 1**	**Run 2**	**Run 3**	**Average**
Date	**10/29/19**	**10/29/19**	**10/30/19**	**--**
Feed Rate, lb/hr	16,729	18,092	18,202	17,674
Flux Feed, lb	4,990	5,550	7,500	5,983

* 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.

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

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 (O_2) and carbon dioxide (CO_2) 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 3.5.

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 stainless-steel or Teflon 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 ±25°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 Flue 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 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

Alliance SOURCE TESTING

Location: Continental Aluminum - New Hudson, MI
Source: RV2 Baghouse
Project No.: 2019-1472
Run No.: 1
Parameter: PM/CPM

Meter Pressure (Pm), in. Hg

$$Pm = Pb + \frac{\Delta H}{13.6}$$

where,

Pb	29.00	= barometric pressure, in. Hg
ΔH	0.771	= pressure differential of orifice, in H_2O
Pm	29.06	= in. Hg

Absolute Stack Gas Pressure (Ps), in. Hg

$$Ps = Pb + \frac{Pg}{13.6}$$

where,

Pb	29.00	= barometric pressure, in. Hg
Pg	0.12	= static pressure, in. H_2O
Ps	29.01	= in. Hg

Standard Meter Volume (Vmstd), dscf

$$Vmstd = \frac{17.647 \times Y \times Vm \times Pm}{Tm}$$

where,

Y	0.99	= meter correction factor
Vm	90.960	= meter volume, cf
Pm	29.06	= absolute meter pressure, in. Hg
Tm	536.2	= absolute meter temperature, °R
Vmstd	86.120	= dscf

Standard Wet Volume (Vwstd), scf

$$Vwstd = 0.04707 \times Vlc$$

where,

Vlc	63.6	= volume of H_2O collected, ml
Vwstd	2.999	= scf

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

$$BWSsat = \frac{10^{6.37 - \left(\frac{2,827}{Ts + 365}\right)}}{Ps}$$

where,

Ts	150.7	= stack temperature, °F
Ps	29.01	= absolute stack gas pressure, in. Hg
BWSsat	0.265	= dimensionless

Moisture Fraction (BWS), dimensionless (measured)

$$BWS = \frac{Vwstd}{(Vwstd + Vmstd)}$$

where,

Vwstd	2.999	= standard wet volume, scf
Vmstd	86.120	= standard meter volume, dscf
BWS	0.034	= dimensionless

Alliance SOURCE TESTING

Location: Continental Aluminum - New Hudson, MI
Source: RV2 Baghouse
Project No.: 2019-1472
Run No.: 1
Parameter: PM/CPM

Moisture Fraction (BWS), dimensionless

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

where,

BWSsat	0.265	= moisture fraction (theoretical at saturated conditions)
BWSmsd	0.034	= moisture fraction (measured)
BWS	0.034	

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,

CO_2	0.5	= carbon dioxide concentration, %
O_2	20.2	= oxygen concentration, %
Md	28.89	= lb/lb mol

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

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

where,

Md	28.89	= molecular weight (DRY), lb/lb mol
BWS	0.034	= moisture fraction, dimensionless
Ms	28.52	= 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	0.840	= pitot tube coefficient
$\Delta P^{1/2}$	0.917	= velocity head of stack gas, (in. H_2O)$^{1/2}$
Ts	610.7	= absolute stack temperature, °R
Ps	29.01	= absolute stack gas pressure, in. Hg
Ms	28.52	= molecular weight of stack gas, lb/lb mol
Vs	56.6	= ft/sec

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

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

where,

Vs	56.6	= stack gas velocity, ft/sec
As	10.56	= cross-sectional area of stack, ft^2
Qa	35,855	= acfm

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

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

where,

Qa	35,855	= average stack gas flow at stack conditions, acfm
BWS	0.034	= moisture fraction, dimensionless
Ps	29.01	= absolute stack gas pressure, in. Hg
Ts	610.7	= absolute stack temperature, °R
Qs	29,044	= dscfm

Alliance
SOURCE TESTING

Location: Continental Aluminum - New Hudson, MI
Source: RV2 Baghouse
Project No.: 2019-1472
Run No.: 1
Parameter: PM/CPM

Dry Gas Meter Calibration Check (Yqa), dimensionless

$$Yqa = \frac{Y - \left(\frac{\Theta}{Vm} \sqrt{\frac{0.0319 \times Tm \times 29}{\Delta H@ \times \left(Pb + \frac{\Delta H\ avg.}{13.6} \right) \times Md}} \sqrt{\Delta H}\ avg. \right)}{Y} \times 100$$

where,

Y	0.99	= meter correction factor, dimensionless
Θ	180	= run time, min.
Vm	90.96	= total meter volume, dcf
Tm	536.2	= absolute meter temperature, °R
ΔH@	1.778	= orifice meter calibration coefficient, in. H_2O
Pb	29.00	= barometric pressure, in. Hg
ΔH avg	0.771	= average pressure differential of orifice, in H_2O
Md	28.89	= molecular weight (DRY), lb/lb mol
$(\Delta H)^{1/2}$	0.873	= average squareroot pressure differential of orifice, (in. H2O)$^{1/2}$
Yqa	-0.6	= dimensionless

Volume of Nozzle (Vn), ft^3

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

where,

Ts	610.7	= absolute stack temperature, °R
Ps	29.01	= absolute stack gas pressure, in. Hg
Vlc	63.6	= volume of H_2O collected, ml
Vm	90.960	= meter volume, cf
Pm	29.06	= absolute meter pressure, in. Hg
Y	0.990	= meter correction factor, unitless
Tm	536.2	= absolute meter temperature, °R
Vn	106.313	= volume of nozzle, ft^3

Isokinetic Sampling Rate (I), %

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

where,

Vn	106.313	= nozzle volume, ft^3
θ	180.0	= run time, minutes
An	0.00017	= area of nozzle, ft^2
Vs	56.6	= average velocity, ft/sec
I	100.7	= %

Filterable PM Concentration (C_s), grain/dscf

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

where,

Mn	1.6	= filterable PM mass, mg
Vmstd	86.120	= standard meter volume, dscf
C_s	0.00029	= grain/dscf

Location: Continental Aluminum - New Hudson, MI
Source: RV2 Baghouse
Project No.: 2019-1472
Run No.: 1
Parameter: PM/CPM

Filterable PM Emission Rate (PMR), lb/hr

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

where,

C_s	0.00029	= filterable PM concentration, grain/dscf
Qs	29,044	= average stack gas flow at standard conditions, dscfm
PMR	0.071	= lb/hr

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

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

where,

PMR	0.071	= filterable PM emission rate, lb/hr
FR	16,729	= process feed rate, lb/hr
EF_{PM}	0.0085	= lb/ton

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

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

where,

M_{CPM}	10.2	= condensable PM mass, mg
Vmstd	86.120	= standard meter volume, dscf
C_{CPM}	0.0018	= grain/dscf

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

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

where,

C_{CPM}	0.0018	= condensable PM concentration, grain/dscf
Qs	29,044	= average stack gas flow at standard conditions, dscfm
ER_{CPM}	0.46	= lb/hr

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

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

where,

ER_{CPM}	0.46	= condensable PM emission rate, lb/hr
FR	16,729	= process feed rate, lb/hr
EF_{CPM}	0.054	= lb/ton

Alliance SOURCE TESTING

Location: Continental Aluminum - New Hudson, MI
Source: RV2 Baghouse
Project No.: 2019-1472
Run No.: 1
Parameter: PM/CPM

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

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

where,

C_s	0.00029	= filterable PM concentration, grain/dscf
C_{CPM}	0.0018	= condensable PM concentration, grain/dscf
C_{TPM}	0.0021	= grain/dscf

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

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

where,

PMR	0.071	= filterable PM emission rate, lb/hr
ER_{CPM}	0.46	= condensable PM emission rate, lb/hr
ER_{TPM}	0.53	= lb/hr

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

$$EF_{TPM} = \frac{ER_{TPM} \ x \ 2.0E+03}{FR}$$

where,

ER_{TPM}	0.53	= total PM emission rate, lb/hr
FR	16,729	= process feed rate, lb/hr
EF_{TPM}	0.063	= lb/ton

Appendix B

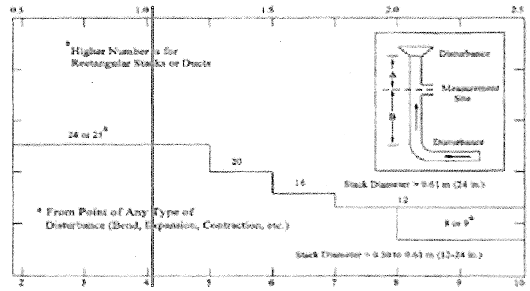
RV2 Baghouse Stack (SVBHRVRB#2)

Method 1 Data

Location: Continental Aluminum - New Hudson, MI
Source: RV2 Baghouse
Project No.: 2019-1472
Date: 10/29/19

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	ft^2
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	



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	1.00	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

Stack Diagram
A = 20.8 ft.
B = 15 ft.
Depth of Duct = 44 in.

Cross Sectional Area