Non-Confidential Business Information (Non-CBI)

Certification Test Report

RAIS A/S

Freestanding Wood Stove

Viva L Series

Models: Viva 100 L (CA) USA, Viva 100 L G (CA) USA, Viva 100 L Classic (CA) USA, Viva 100 L G Classic (CA) USA, Viva 120 L (CA) USA, Viva 120 L G (CA) USA, Viva 120 L Classic (CA) USA, Viva 120 L G Classic (CA) USA, Viva 160 L (CA) USA, Viva 160 L G (CA) USA, Viva 160 L Classic (CA) USA, Viva 160 L G Classic (CA) USA

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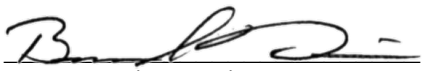

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Section 1

Sampling Procedures and Test Results

INTRODUCTION

RAIS A/S retained *OMNI* to perform U.S. Environmental Protection Agency (EPA) certification testing on the Viva L Series wood stove. The Viva L Series wood stove is a radiant-type room heater. The firebox is constructed of mild steel. Usable firebox volume was measured to be 1.29 cubic feet and the stove is vented through a 6" flue collar located at the top of the unit.

The testing was performed at *OMNI*'s facilities in Portland, OR. The altitude of the laboratory is 30 feet above sea level. The unit was received in good condition and logged in on 1/30/2017, then assigned and labeled with *OMNI* ID #2223. *OMNI* representatives Aaron Kravitz and Sebastian Button conducted the certification testing and completed all testing by 2/13/2017.

This report is organized in accordance with the EPA-recommended outline and is summarized in the Table of Contents immediately preceding this section. The results in this report are limited to the item submitted.

SAMPLING PROCEDURE

The Viva L Series wood stove was tested in accordance with the U.S. EPA 40 CFR Part 60, Subpart AAA – Standards of Performance for New Residential Wood Heaters using EPA Method 28R, ASTM E2515 and ASTM E2780. Particulate emissions were measured using sampling trains consisting of two filters (front and back).

The model Viva L Series was tested for thermal efficiency and carbon monoxide (CO) emissions in accordance with CSA B415.1-10 using dimensional Douglas Fir lumber.

Efficiency results were calculated using spread sheet Version 2.2 created 12/14/2009 and distributed by CSA. Example calculations for CSA B415.1 were not provided by CSA; spreadsheet is protected from modifications by means of a password.

An ambient filter (Background) was not operated during this series, there were no operations in the area that would have generated additional particulate into the ambient air. Running an ambient filter can only reduce emissions by backing out any particulate not generated by fuel in the appliance, it can never increase emissions. Tests conducted without an ambient filter are considered worse case.

SUMMARY OF RESULTS

The weighted average emissions of the four test runs included in the results indicate a particulate emission rate of 1.13 grams per hour.

Five additional test runs were conducted in Category II. ASTM E278 section 9.5.13 states:

If more than one test run is conducted at a specified burn rate, the results from at least two thirds of the test runs in that burn rate category shall be used in calculating the weighted average emission rate.

In accordance with this requirement, only four of the six (runs 3, 4, 5, and 6) Category II tests are included in the weighted average. All measurement data and results from the other two runs (runs 1 and 2) are included in this report.

The Viva L Series results are within the emission limit of 2.0 g/hr for affected facilities manufactured on or after May 15, 2020.

The proportionality results for all eight test runs were acceptable. Quality check results for each test run are presented in Section 4 of this report.

TESTING NARRATIVE

Run 1 - To achieve a fuel loading density in accordance with the requirements of ASTM E2780, using two different lengths of fuel piece was required. The fuel pieces in the rear of the firebox were 10.5" in length and the front pieces were 12.5". Targeted category I burn rate at an air setting on 14mm open. Result of 1.04 kg/hr (category II).

Run 2 - Due to poor emissions performance in run 1, run 2 was performed with the same settings and fuel sizes as a potential replacement run. Result of 0.86 kg/hr (category II). Tests 1 and 2 were omitted from weighted average on a two for 1 basis replaced by tests 3 – 6.

Run 3 - During run 2 the size of the front fuel pieces, which spanned nearly 100% of the firebox length, was observed impeding combustion airflow. It was then determined that if fuel pieces very near to the 35 lb/ft^3 density limit were used, loading density requirements could be met with all five fuel pieces cut to the appropriate length of 10.5". Run 3 and all subsequent runs used this test fuel piece length. Negative filter weights were found on train B, transfer of material can be seen as positive weight on the O-ring. There is no evidence of actual filter loss.

Targeted category I at air setting of 15mm open. Result of 1.11 kg/hr (category II).

Run 4 - Negative filter weights were found on train A; transfer of material can be seen as positive weight on the O-ring. There is no evidence of actual filter loss.

Targeted category I at an air setting of 13mm open. Result of 0.99 kg/hr (category II).

Run 5 - Repeat of run 4. Targeted category I at an air setting of 13mm open. Result of 0.93 kg/hr (category II).

Run 6 - Repeat of run 3. Targeted category II at an air setting of 15mm open. Result of 1.06 kg/hr (category II).

Run 7 - Negative filter weights were found on train A; transfer of material can be seen as positive weight on the O-ring. There is no evidence of actual filter loss.

Targeted category III at an air setting of 22mm open. Result of 1.29 kg/hr (category III).

Run 8 - Targeted category IV at primary air setting of fully open. Result of 1.73 kg/hr (category III). Since no higher air adjustment is possible, this run is considered a category IV for the purposes of reporting.

No sampling anomalies occurred during the 6 useable tests, and all proportionality results are acceptable, so all test runs are valid and appropriate for inclusion in the weighted average.

Since the lowest air setting used was 13mm open, a fixed stop at this setting will be included in all production units.

CATEGORY I BURN RATE RATIONALE

EPA Method 28 section 8.1.1.3.2 states the following:

> *Evidence that a wood heater cannot be operated at a burn rate less than 0.80 kg/hr shall include documentation of two or more attempts to operate the wood heater in burn rate Category I and fuel combustion has stopped, or results of two or more test runs demonstrating that the burn rates were greater than 0.80 kg/hr when the air supply controls were adjusted to the lowest possible position or settings… NOTE: After July 1, 1990, if a wood heater cannot be operated at a burn rate less than 0.80 kg/hr, at least one test run with an average burn rate of 1.00 kg/hr or less shall be conducted.*

The U.S. Environmental Protection Agency Applicability Determination Index, under Control Number WDS-109, states the following regarding this requirement of Method 28:

> *The purpose of this requirement is to ensure that a good-faith effort has been made to achieve a Category I burn rate. However, if the air supply control is tamper-proof, EPA will accept one test as adequate documentation that the stove cannot achieve a Category I burn rate. Note that this applies only to stoves which do not reach the low burn rate because of limits on the air supply; manufacturers of stoves which cannot sustain a burn rate at lower air settings will still be required to submit documentation of two or more attempts. In all cases, a test series consisting of at least four runs is required.*

As the Run Notes in Section 3 and Table 10 in Section 1 of this report show, Tests 4 and 5 were operated at a burn-rate of less than 1.0 kg/hr with the combustion air inlet open an area of 126.5 mm^2. The primary air control is designed and manufactured with a stop that provides an area of 126.5 mm^2 when the control is set to the minimum position. See attached drawings of the primary air control system. The air controls for this heater are tamper-proof. When tested in accordance with EPA Method 28 the heater cannot be induced to operate at a burn rate less than 0.80 kg/hr therefore Runs 4 and 5 fulfill the requirements of the standard.

Table 1 – Particulate Emissions

Run	**Burn Rate** (kg/hr dry)	**EPA 28R Category**	**ASTM E2515 Emissions** (g/hr)	**ASTM E2780 Weighting**
1	1.04	II	17.79	0.0%*
2	0.86	II	50.60	0.0%*
3	1.11	II	1.29	12.6%
4	0.99	II	0.79	5.9%
5	0.93	II	0.99	24.1%
6	1.06	II	0.90	5.9%
7	1.29	III	0.94	25.4%
8	1.73	IV	1.51	26.0%
Weighted Average of 6 test runs:			**1.13**	**g/hr**

*Runs 1 & 2 excluded from the weighted average per the requirements of EPA Method 28R/ ASTM E2780

Table 2 – Particulate Emissions (First Hour)

Run	**ASTM E2515 Emissions – First Hour** (g/hr)
1	46.19
2	60.91
3	3.12
4	1.08
5	1.58
6	0.70
7	0.59
8	1.02

Table 3 – B415.1 Efficiency and CO Emissions

Run	Heat Output (BTU/hr)	HHV Efficiency (%)	LHV Efficiency (%)	CO Emissions (g/MJ Output)	CO Emissions (g/kg Dry Fuel)	CO Emissions (g/hr)
1	12,285	63.0%	68.1%	21.16	264.21	274.00
2	9,150	57.2%	61.9%	31.59	358.23	304.74
3	14,587	70.8%	76.6%	9.97	139.86	153.27
4	13,175	72.2%	78.0%	8.54	122.08	118.59
5	12,490	72.6%	78.4%	8.68	124.84	114.32
6	13,820	71.9%	77.7%	8.14	115.93	118.61
7	17,028	73.0%	78.9%	4.99	72.19	89.63
8	22,857	71.7%	77.5%	4.51	64.12	108.79
Weighted average HHV efficiency of 6 test runs: 72.2%						

Table 4 – Test Facility Conditions

Run	Room Temperature (°F)		Barometric Pressure (in. Hg)		Air Velocity (ft/min)	
	Before	After	Before	After	Before	After
1	70	71	29.72	29.79	<50	<50
2	71	71	29.89	29.89	<50	<50
3	69	67	29.83	29.77	<50	<50
4	70	70	29.51	29.50	<50	<50
5	72	71	29.53	29.61	<50	<50
6	69	72	29.96	29.99	<50	<50
7	71	71	30.02	30.09	<50	<50
8	72	71	30.29	30.24	<50	<50

Table 5 – Fuel Measurement and Crib Description Summary – PRETEST

Run	Pretest Fuel Weight (Starting weight in lbs)	Pretest Moisture (Dry basis - %)	Coal Bed Weight (lbs)
1	9.2	22.91	2.1
2	9.3	20.89	2.1
3	8.8	19.72	2.1
4	8.3	20.81	2.0
5	8.3	21.45	2.1
6	8.3	20.92	1.7
7	8.7	20.75	2.1
8	9.5	21.11	1.7

Table 6 – Fuel Measurement and Crib Description Summary – TEST

Run	Test Fuel Wet Basis (lbs)	Test Fuel Moisture (Dry basis %)	Test Fuel Dry Basis (lbs)	Fuel Loading Density (Wet Basis lbs/ft^3)	Piece Length (in)	2x4s (count)	4x4s (count)
1	8.4	22.50	6.88	6.51	10.5 & 12.5	5	0
2	8.4	22.19	6.95	6.51	10.5 & 12.5	5	0
3	8.2	19.83	6.92	6.36	10.5	5	0
4	8.2	20.95	6.92	6.36	10.5	5	0
5	8.2	21.89	6.84	6.36	10.5	5	0
6	8.3	22.69	7.01	6.43	10.5	5	0
7	8.4	22.79	7.10	6.51	10.5	5	0
8	8.3	21.07	7.00	6.43	10.5	5	0

Table 7 – Average Dilution Tunnel Gas Measurements

Run	Static Pressure (in. H_2O)	Flow Rate (dscf/min)	Temperature (°F)
1	-0.28	196.14	85.6
2	-0.26	200.58	82.6
3	-0.26	196.16	87.1
4	-0.27	192.06	89.9
5	-0.27	194.13	89.4
6	-0.27	190.76	91.7
7	-0.27	192.84	96.4
8	-0.27	184.87	106.7

Table 8 - Average Temperature Data

Run	Surface Delta T (F)*
1	8.2
2	64.6
3	44.0
4	56.2
5	64.6
6	56.6
7	80.2
8	42.0

*Represents the difference between beginning and ending average surface temperatures.

Table 9 – Pretest Configuration

Run	Combustion Air	Fuel Added	Fuel Removed	**Time** (min)
1	14 mm Open	None	None	73
2	14 mm Open	None	None	67
3	15 mm Open	None	None	83
4	13 mm Open	None	None	72
5	13 mm Open	None	None	83
6	15 mm Open	None	None	74
7	22 mm Open	None	None	68
8	Fully Open	None	None	60

Table 10 – Test Configurations

Run	Five-Minute Startup Procedures	Combustion Air Setting
1	Fuel Loading: Completed by 0:40 Door: Closed at 0:50 Startup Air: Closed at 4:00 Primary Air: Closed from fully open to test setting from 4:30 – 5:00	14 mm Open
2	Fuel Loading: Completed by 0:25 Door: Closed at 0:30 Startup Air: Closed at 4:30 Primary Air: Closed from fully open to test setting from 4:50 – 5:00	14 mm Open
3	Fuel Loading: Completed by 0:35 Door: Closed at 0:45 Startup Air: Closed at 4:30 Primary Air: Closed from fully open to test setting from 4:50 – 5:00	15 mm Open
4	Fuel Loading: Completed by 0:20 Door: Closed at 0:25 Startup Air: Closed at 4:30 Primary Air: Closed from fully open to test setting from 4:50 – 5:00	13 mm Open
5	Fuel Loading: Completed by 0:25 Door: Closed at 0:35 Startup Air: Closed at 4:30 Primary Air: Closed from fully open to test setting from 4:50 – 5:00	13 mm Open
6	Fuel Loading: Completed by 0:30 Door: Closed at 0:35 Startup Air: Closed at 4:30 Primary Air: Closed from fully open to test setting from 4:50 – 5:00	15 mm Open
7	Fuel Loading: Completed by 0:25 Door: Closed at 0:35 Startup Air: Closed at 4:00 Primary Air: Closed from fully open to test setting from 4:50 – 5:00	22 mm Open
8	Fuel Loading: Completed by 0:30 Door: Closed at 0:40 Startup Air: Closed at 4:00 Primary Air: At test setting by 4:00	Fully Open

Section 2

Photographs/Appliance Description/Drawings

RAIS A/S

Viva L Series

Test Dates: 2/6/2017 - 2/13/2017

RAIS A/S
Viva L Series

Run 1 – Fuel

Run 1 – Newly Loaded Stove

Run 2 – Fuel

Run 2 – Newly Loaded Stove

RAIS A/S
Viva L Series

Run 3 – Fuel

Run 3 – Newly Loaded Stove

Run 4 – Fuel

Run 4 – Newly Loaded Stove

RAIS A/S
Viva L Series

Run 5 – Fuel

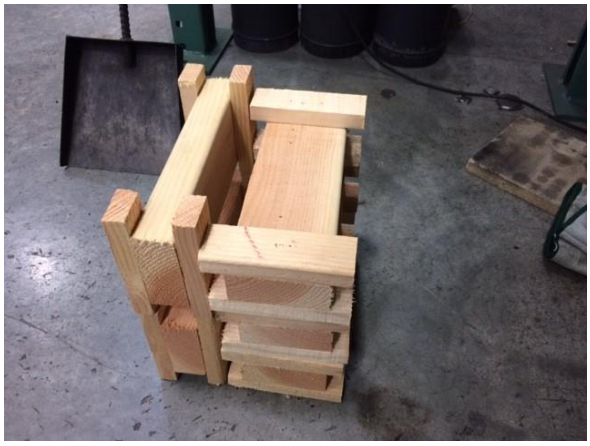
Run 5 – Newly Loaded Stove

Run 6 – Fuel

Run 6 – Newly Loaded Stove

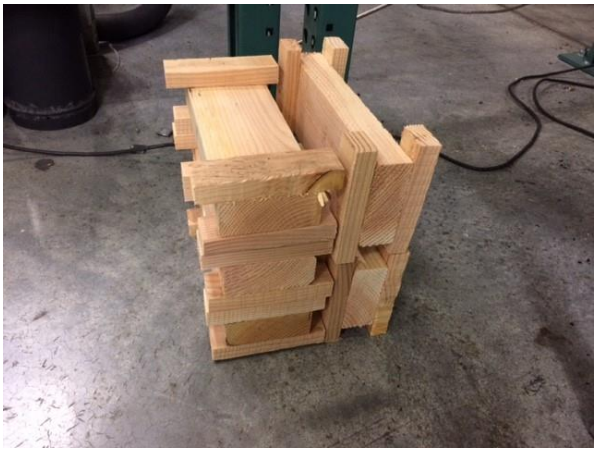
RAIS A/S
Viva L Series

Run 7 – Fuel



Run 7 – Newly Loaded Stove

Run 8 – Fuel



Run 8 – Newly Loaded Stove

WOOD HEATER DESCRIPTION

Appliance Manufacturer: RAIS A/S
Wood Stove Model: Viva L Series
Type: Freestanding, radiant-type non-catalytic woodstove

WOOD HEATER INFORMATION

Materials of Construction: The unit is constructed primarily of mild steel. The firebox is lined with formed vermiculite conforming to the unit's cylindrical shape. The feed door has a 17"x16" curved inner glass panel sealed with a ½" fiberglass rope gasket.

Air Introduction System: The wood heater has four air introduction systems: primary, secondary, pilot, and auxiliary startup. The secondary and pilot systems are fixed and non-adjustable, while the primary and auxiliary are user-adjustable via a single adjustment handle.

The primary air system draws air through the bottom of the unit and into the firebox via an opening across the top of the loading door. The primary air control's minimum setting corresponds to an intake area of 0.06 cm^2, and the area for the maximum setting is 7.84 cm^2.

The secondary air system draws air through the bottom of the unit to intake holes in the back of the firebox. Air is routed from these holes through the vermiculite firebox lining, with exit holes into the firebox chamber in the rear of the firebox and in the front of the main baffle.

The pilot introduces air supplied by the secondary system to the firebox through a ¼" diameter tube located in the lower rear of the firebox.

The auxiliary startup air draws air through the bottom of the firebox, and routes it into the firebox through the ash grate. When the startup air system is open, the primary air intake area is 13.68 cm^2.

Combustion Control Mechanisms: A single air slide handle controls both the auxiliary air and primary air adjustment. Users are alerted to the point at which auxiliary air is fully closed and primary air fully open by a positive-engagement point midway through the full range of adjustment.

Internal Baffles: The unit features two vermiculite baffles to route flue gas. The main, lower baffle contains secondary air holes, while the upper baffle is solid.

Other Features: The unit features an ash cleanout grate which empties into a removable cleanout drawer located beneath the firebox. The grate includes a lower "shaker" grate which is operated by a handle that can be accessed only while the loading door is open

Flue Outlet: The 6" diameter flue outlet is located at the top of the unit.

Model Variants: The Viva L series comes with several different options, for a total of 24 distinct variations. A full list of models can be found in the Engineering Drawings section. Each option, and its effect on emissions performance, is summarized below:

***Bi-metallic Air Control*:**

The Viva L models designated "CA" are specified with the "CleverAir" system, a thermostatic control for the air damper that replaces the manual air control slide. A bi-metallic spring mounted above the airbox, enclosed within the flue gas baffle, is permanently attached to the linkage that actuates the air slide.

The fixed stops for minimum and maximum air settings remain in place, though the division between primary and startup air is eliminated. However, the spring mimics the action of the manual startup system by limiting air as the unit warms.

Models incorporating the CleverAir system have no user adjustment whatsoever. There is no air slide, and owners are instructed to build and maintain the fire in accordance with flue draft and coal bed conditions. The system is tamper-proof and located behind the firebox vermiculite, preventing any unauthorized user interference with airflow.

Due to these design features of the system, no effect on emissions performance is anticipated. Therefore Viva L "CA" models are included in this certification.

***Side Glass Panels*:**

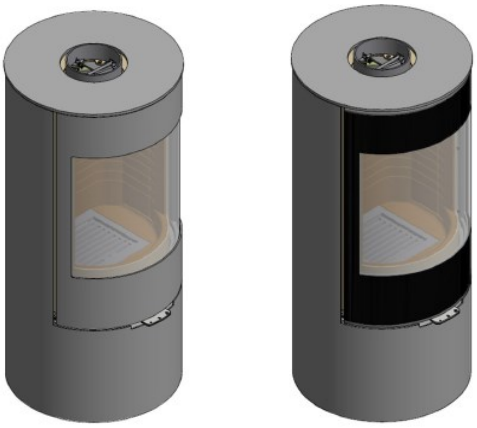
The Viva L models designated "G" can be specified with two fixed glass panels that flank the feed door. In models without these panels, the firebox weldment and vermiculite extends all the way to the feed door. Models with these panels feature an additional inner glass panel on the loading door to compensate for the reduced heat capacity and increased radiant heat loss.

Viva L G *Viva L* *Double Glass Door* *Single Glass Door*

This option does not affect firebox volume or airflow, and the effects on emissions performance by any variance in heat retention was carefully considered. The heat capacity and insulation value of the additional steel and vermiculite are far greater than those of additional glass panel. Therefore, the model with the side glass option was tested, and all variants are included in certification.

Full Length Glass:

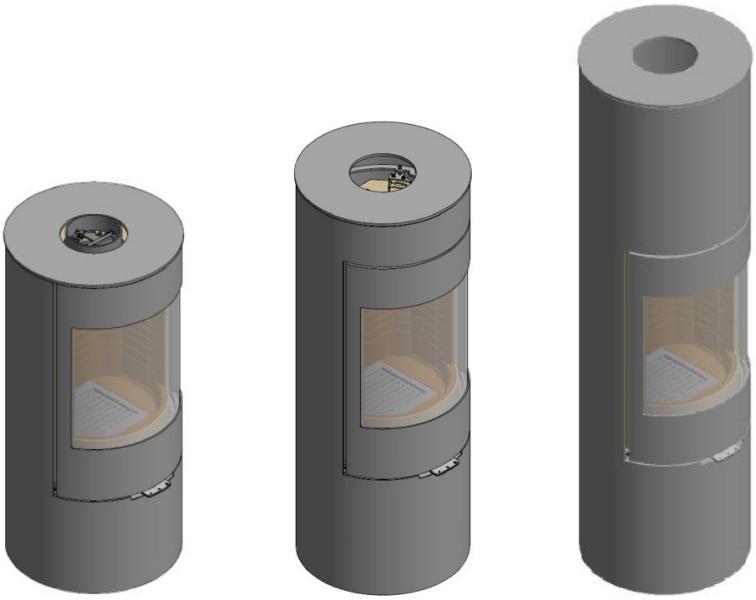
The loading door is available either with a front glass panel that extends the entire height of the door, or a "Classic" version with a smaller glass panel enclosed in a steel door. This variation does not affect the viewing (or volumetric) area of the firebox, nor does it impact heat capacity or radiation. Therefore, both versions are included in certification as this option will not affect emissions performance.



Viva L Classic *Viva L*

Taller Pedestal and Header:

The tested model, designated Viva "100" L, is 100cm tall. Two additional options, designated "120" L and "160" L, are 120cm and 160 cm tall, respectively. These height increases are achieved simply by extending the cylindrical body of the unit above and below the firebox. None of the emissions control features of the design, such as air controls, baffles, or insulation, are extended or raised. The dimensions of the firebox and airflow through the unit are not affected, so these options have no impact on emissions performance. All variants are included in certification.



Viva 100 L *Viva 120 L* *Viva 160 L*

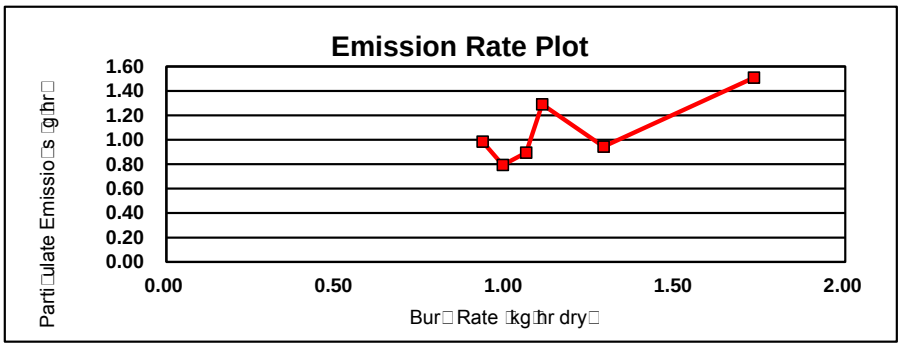
Section 3

Test Data by Run

EPA Weighted Average Emissions
EPA Method 28R

Client:	RAIS	Status:	Final
Stove Model:	Viva L	Stove Type:	Non-Catalytic Stove
Test Dates:	2/6/2017 - 2/13/207		
Project Number:	0138WS017E		
Tracking Number:	2233		

Weighted Averages	**Emissions (g/hr):**	**1.1**
	HHV Efficeincy (%):	**72.2%**
	LHV Efficeincy (%):	**78.0%**



Run #	5	
Burn Rate (dry kg/hr)	0.93	
Category	2	
LHV Efficiency (%)	0.784525057	
HHV Efficiency (%)	0.725861482	
Emissions (g/hr)	0.986120153	
Weighting Factor	0.370	24.10%

Run #	7	
Burn Rate (dry kg/hr)	1.29	
Category	3	
LHV Efficiency (%)	0.774869834	
HHV Efficiency (%)	0.729867802	
Emissions (g/hr)	0.943246237	
Weighting Factor	0.390	25.45%

Run #	4	
Burn Rate (dry kg/hr)	0.99	
Category	2	
LHV Efficiency (%)	0.78007925	
HHV Efficiency (%)	0.721748114	
Emissions (g/hr)	0.793146295	
Weighting Factor	0.090	5.88%

Run #	8	
Burn Rate (dry kg/hr)	1.73	
Category	3	
LHV Efficiency (%)	0.784525057	
HHV Efficiency (%)	0.716928238	
Emissions (g/hr)	1.508187561	
Weighting Factor	0.399	26.03%

Run #	6	
Burn Rate (dry kg/hr)	1.06	
Category	2	
LHV Efficiency (%)	0.765591654	
HHV Efficiency (%)	0.718823009	
Emissions (g/hr)	0.895296048	
Weighting Factor	0.090	5.90%

Run #	3	
Burn Rate (dry kg/hr)	1.11	
Category	2	
LHV Efficiency (%)	0.77691774	
HHV Efficiency (%)	0.708343841	
Emissions (g/hr)	1.290780152	
Weighting Factor	0.194	12.64%

Wood Heater Conditioning Data - ASTM E2780/ ASTM E2515

Manufacturer:	RAIS
Model:	Viva L
Tracking No.:	2233
Project No.:	0138WS017E
Test Date:	12/21/16 - 1/6/17
Technician:	Villy Jacobsen
Operation Category:	II-III

Fuel used contained moisture between 18 and 28%, appliance operated on medium.

Elapsed Time (hr)	Flue Gas Temp (° F)	Fuel Weight (lbs)
0	539	7.3
1	663	
2	508	7.6
3	614	
4	387	
5	520	7.7
6	990	
7	426	
8	592	7.4
9	610	
10	599	7.4
11	612	
12	447	
13	602	7.3
14	1001	
15	445	
16	504	7.5
17	600	
18	528	7.3
19	644	
20	541	7.4
21	645	
22	516	7.0
23	1103	
24	400	
25	440	6.9

Elapsed Time (hr)	Flue Gas Temp (° F)	Fuel Weight (lbs)
26	486	
27	390	
28	546	7.4
29	1215	
30	389	
31	465	7.4
32	578	
33	404	
34	681	7.2
35	566	
36	508	
37	347	
38	669	7.5
39	666	
40	418	
41	561	7.2
42	831	
43	418	
44	582	7.5
45	826	
46	423	
47	571	7.5
48	800	
49	405	
50	358	

Technician Signature:_____

Kindling the fire

- Step one. Use 1,5-1,6 kg wood
- Step two. Full start up air in ten minutes, then push the air handle to click position
- Step tree, burn down to charcoal

Pre testing

- Adjust the charcoals by a Poker
- Load 3, 99 kg/8.8 lbs. wood, 11 pieces, placed as shown on pictures.
- Full start up air in 10 minutes,
- Then adjust the air control handle to click position
- After 5 minutes adjust the air control handle slowly to 13 mm
- As soon as possible start the main test (stack temperature about 220 C/428 F)

Test, burn rate one

- Adjust the charcoal by a Poker
- Load with 3.8 kg/8.4 lbs. wood logs, as shown on pictures.
- Full start up air in 4,5 minutes
- Then adjust the air control handle to click position.
- Adjust the air control handle slowly to 13 mm

Testing Viva L February the 8th. 2017, burn rate two

Kindling the fire

- Step one. Use 1,5-1,6 kg wood
- Step two. Full start up air in ten minutes, then push the air handle to click position
- Step tree, burn down to charcoal

Pre testing

- Adjust the charcoals by a Poker
- Load 3, 99 kg/8.8 lbs. wood, 11 pieces, placed as shown on pictures.
- Full start up air in 10 minutes,
- Then adjust the air control handle to click position
- After 5 minutes adjust the air control handle slowly to 14 mm
- As soon as possible start the main test, (stack temperature about 220 C/428 F)

Test, burn rate two

- Adjust the charcoal by a Poker
- Load with 3.8 kg/8.4 lbs. wood logs, as shown on pictures.
- Full start up air in 4,5 minutes
- Then adjust the air control handle to click position.
- Adjust the air control handle slowly to 14 mm

Kindling the fire

- Step one. Use 1,5-1,6 kg wood
- Step two. Full start up air in ten minutes, then push the air handle to click position
- Step tree, burn down to charcoal

Pre testing

- Adjust the charcoals by a Poker
- Load 3, 99 kg/8.8 lbs. wood, 11 pieces, placed as shown on pictures.
- Full start up air in 10 minutes,
- Then adjust the air control handle to click position
- After 5 minutes adjust the air control handle slowly to 16 mm
- As soon as possible start the main test

Test, burn rate three

- Adjust the charcoal by a Poker
- Load with 3.8 kg/8.4 lbs. wood logs, as shown on pictures.
- Full start up air in 4,5 minutes
- Then adjust the air control handle to click position.
- Adjust the air control handle slowly to 16 mm

Kindling the fire

- Step one. Use 1,5-1,6 kg wood
- Step two. Full start up air in ten minutes, then push the air handle to click position
- Step tree, burn down to charcoal

Pre testing

- Adjust the charcoals by a Poker
- Load 4, 5kg/9.92 lbs. wood, 11 pieces, placed as shown on pictures.
- Full start up air in 10 minutes,
- Then adjust the air control handle to click position

Test, burn rate four

- Adjust the charcoal by a Poker
- Load with 3.8 kg/8.4 lbs. wood logs, as shown on pictures.
- Full start up air in 4,5 minutes
- Then adjust the air control handle to click position.

Run 1

Wood Heater Preburn Data - ASTM E2780

Run:	1

Technician Signature:

Manufacturer:	RAIS
Model:	Viva L
Tracking No.:	2233
Project No.:	0138WS017E
Test Date:	2/6/2017
Beginning Clock Time:	12:53

Coal Bed Range (lb):	1.7 (min)	2.1 (max)

Preburn Fuel Data

Fuel Piece Lengths (in.):	9		
Total Preburn Weight (lb):	9.2		
Fuel Moisture Readings (% DB):	23.9	24.8	24.5
	23.9	24.5	19.2
	24.9	24.5	22.6
	20.1	19.1	
Avg Preburn Moisture (% DB):	22.91		

			Temperatures (°F)							
Elapsed Time (min)	Scale (lb)	Stack Draft (in H_2O)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Avg. Firebox Surface	Stack	Ambient
0	6.3	-0.038	491	285	281	266	306	325.7	306	68
10	5.6	-0.035	563	285	287	277	301	342.8	266	69
20	5.0	-0.036	596	277	291	288	308	351.8	280	69
30	4.1	-0.040	632	267	294	300	317	362.1	318	69
40	3.3	-0.041	669	257	303	310	327	373.3	344	69
50	2.6	-0.039	708	251	314	321	336	385.9	331	70
60	2.3	-0.030	681	249	326	332	347	387.1	256	70
70	2.2	-0.025	584	252	326	321	334	363.3	215	70
73	2.1	-0.023	556	253	323	312	327	354.0	207	70

Wood Heater Test Fuel Data - ASTM E2780

Manufacturer:	**RAIS**
Model:	**Viva L**
Tracking No.:	**2233**
Project No.:	**0138WS017E**
Test Date:	**2/6/2017**
Run No.:	**1**

Firebox Volume (ft^3):	**1.29**
Fuel Piece Length (in):	**11.7**
2x4 Crib Weight (lb):	**8.4**
4x4 Crib Weight (lb):	**0**

Total Fuel Weight (Dry Basis, lb):	**6.9**	
Fuel Density (lb/ft^3, Dry Basis):	**29.40**	**OK**
Loading Density (lb/ft^3, Wet Basis):	**6.51**	**OK**
2x4 Percentage:	**N/A**	**N/A**

Coal Bed Range (20-25%): 1.68 - 2.1

Test Fuel Piece	Weight (lb)	Size	Readings (Dry Basis %)			Dry Weight (lb)
1	1	2"x 4"	22.5	23.2	22.9	0.81
2	1.2	2"x 4"	23.1	22.5	22.9	0.98
3	1.2	2"x 4"	21.6	22.5	19.1	0.99
4	1.6	2"x 4"	24.2	22.1	19.9	1.31
5	1.4	2"x 4"	24.5	22.8	23.7	1.13

Spacer Readings (Dry Basis %)			
22.7	23.4		
22.7	20.4		
23.6	13.8		
23.2	22.1		
21.2	19.4		
23.1	22.3		
21.1	21.9		
14.3			
13.5			
23.7			
22.5			
23.6			
19.3			

Technician Signature:

Wood Heater Test Data - ASTM E2780 / ASTM E2515

Run: 1

Manufacturer: RAIS
Model: Viva L
Tracking No.: 2233
Project No.: 0138WS017E
Test Date: 06-Feb-17
Beginning Clock Time: 14:07

Total Sampling Time: 180 min
Recording Interval: 10 min
Background Sample Volume: 0 cubic feet

Meter Box Y Factor: 0.984 (1) 0.99 (2) 1 (Amb)

Barometric Pressure:

Begin	Middle	End	Average
29.72	29.75	29.79	29.75 "Hg

OMNI Equipment Numbers: 296-T55, 185, 340, 431, 335, 336, 594, 410, 559, 209, 132, 23, 592, 283A

PM Control Modules: 335/336
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.280 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 17.67 ft/sec.
Initial Tunnel Flow: 191.7 scfm
Average Tunnel Flow: 196.1 scfm
Post-Test Leak Check (1): 0.000 cfm @ -5 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ -5 in. Hg
Average Test Piece Fuel Moisture: 22.50 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.052	0.070	0.080	0.060	0.052	0.076	0.080	0.062	0.088	"H2O
Temp:	92	92	92	92	92	92	92	92	92	°F

V_{strav} 17.78 ft/sec V_{scent} 20.18 ft/sec F_p 0.881

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface Temp	Catalyst Exit Temp	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			0.85	73	1.84	0.68	74	1.2	97	0.088			8.4		545	253	322	310	329	352	N/A	266	68	68	68	68	70	-0.032	1.72	0.54
10	1.666	1.688	0.17	0.17	1.35	74	2.14	1.21	74	1.3	85	0.088	102	101	7.7	-0.7	484	275	300	271	282	322	N/A	225	70	70	70	70	69	-0.027	2.47	1.45
20	3.312	3.389	0.16	0.17	1.35	75	2.15	1.20	76	1.3	82	0.088	100	101	7.3	-0.4	418	296	293	244	256	301	N/A	189	70	70	70	70	69	-0.022	2.88	1.78
30	4.959	5.089	0.16	0.17	1.33	77	2.15	1.19	77	1.3	80	0.088	100	100	6.8	-0.5	374	298	285	232	246	287	N/A	183	70	70	70	70	69	-0.021	4.18	1.86
40	6.605	6.788	0.16	0.17	1.34	78	2.17	1.19	78	1.4	80	0.088	99	100	6.3	-0.5	359	293	282	230	246	282	N/A	187	70	70	70	70	69	-0.021	3.79	2.53
50	8.249	8.483	0.16	0.17	1.33	79	2.2	1.18	79	1.4	83	0.088	99	100	5.3	-1	401	286	283	239	255	293	N/A	260	71	71	71	71	69	-0.034	8.53	2.73
60	9.891	10.175	0.16	0.17	1.32	80	2.22	1.18	80	1.4	86	0.088	99	100	4.3	-1	506	278	292	265	279	324	N/A	287	71	71	71	71	70	-0.035	10.33	2.83
70	11.546	11.865	0.17	0.17	1.33	81	2.17	1.17	81	1.4	89	0.088	100	100	3.3	-1	585	270	302	286	305	350	N/A	309	72	72	72	72	70	-0.038	11.64	1.74
80	13.200	13.557	0.17	0.17	1.33	81	2.18	1.17	81	1.4	91	0.088	100	100	2.5	-0.8	638	262	314	304	322	368	N/A	304	73	73	73	73	70	-0.036	10.25	2.25
90	14.854	15.248	0.17	0.17	1.33	82	2.18	1.18	82	1.4	90	0.088	100	100	1.9	-0.6	677	255	323	318	335	382	N/A	284	73	73	73	73	71	-0.033	9.12	0.81
100	16.508	16.941	0.17	0.17	1.34	83	2.19	1.18	83	1.4	89	0.088	100	100	1.5	-0.4	616	251	328	321	340	371	N/A	242	73	73	73	73	71	-0.028	5.93	3.25
110	18.165	18.635	0.17	0.17	1.34	83	2.19	1.18	83	1.4	87	0.088	100	100	1.3	-0.2	578	250	334	323	338	365	N/A	242	73	73	73	73	72	-0.026	7.57	0.82
120	19.824	20.332	0.17	0.17	1.35	83	2.19	1.18	84	1.4	86	0.088	100	100	1.1	-0.2	553	253	346	328	351	366	N/A	228	73	73	73	73	71	-0.024	7.41	0.76
130	21.484	22.029	0.17	0.17	1.34	84	2.2	1.19	84	1.4	85	0.088	100	99	0.9	-0.2	527	260	352	334	350	365	N/A	218	73	73	73	73	72	-0.022	7.11	0.95
140	23.145	23.728	0.17	0.17	1.34	84	2.19	1.19	84	1.4	84	0.088	100	99	0.8	-0.1	507	268	354	333	349	362	N/A	215	73	73	73	73	71	-0.022	7	1.08
150	24.806	25.427	0.17	0.17	1.34	84	2.19	1.18	84	1.4	84	0.088	100	99	0.6	-0.2	493	275	358	333	348	361	N/A	212	72	72	72	72	71	-0.021	6.72	1.31
160	26.468	27.126	0.17	0.17	1.35	84	2.19	1.18	84	1.4	83	0.088	100	99	0.5	-0.1	481	282	361	335	346	361	N/A	210	72	72	72	72	71	-0.021	6.71	1.45
170	28.130	28.825	0.17	0.17	1.35	84	2.2	1.19	84	1.4	83	0.088	100	99	0.3	-0.2	472	288	363	335	346	361	N/A	205	72	72	72	72	71	-0.020	6.52	1.27
180	29.793	30.524	0.17	0.17	1.35	84	2.19	1.19	84	1.4	83	0.088	100	99	0.0	-0.3	466	293	363	331	347	360	N/A	204	72	72	72	72	71	-0.020	7.39	0.91
Avg/Tot	29.793	30.524	0.17	0.17	1.31	81		1.16	81		86	0.088	100	100								8.2				72	72	72	70	-0.026		

Wood Heater Test Results - ASTM E2780 / ASTM E2515

Manufacturer: RAIS
Model: Viva L
Project No.: 0138WS017E
Tracking No.: 2233
Run: 1
Test Date: 02/06/17

Burn Rate	**1.04 kg/hr dry**
Average Tunnel Temperature	86 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	17.67 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11768.2 dscf/hour
Average Delta p	0.088 inches H20
Total Time of Test	180 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	29.793 cubic feet	30.524 cubic feet	9.891 cubic feet
Average Gas Meter Temperature	70 degrees Fahrenheit	81 degrees Fahrenheit	81 degrees Fahrenheit	81 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	28.550 dscf	29.409 dscf	9.478 dscf
Total Particulates - m_n	0 mg	43.5 mg	44.1 mg	37.2 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000000 grams/dscf	0.00152 grams/dscf	0.00150 grams/dscf	0.00392 grams/dscf
Total Particulate Emissions - E_T	0.00 grams	53.79 grams	52.94 grams	46.19 grams
Particulate Emission Rate	0.00 grams/hour	17.93 grams/hour	17.65 grams/hour	46.19 grams/hour
Emissions Factor		17.24 g/kg	16.97 g/kg	30.42 g/kg
Difference from Average Total Particulate Emissions		0.43 grams	0.43 grams	
	Dual Train Comparison Results Are Acceptable			

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	53.37 grams
Particulate Emission Rate	**17.79 grams/hour**
Emissions Factor	17.10 grams/kg
Train Precision g/kg ≤ 0.5	0.27 grams/kg
Train Precision ≤ 7.5%	0.80 %
First Hour Emissions	
Total Particulate Emissions - E_T	46.19 grams
Particulate Emission Rate	46.19 grams/hour
Emissions Factor	30.42 grams/kg

QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Stove Surface ΔT	OK

Technician Signature:_____

OMNI-Test Laboratories

Manufacturer:	**RAIS**
Model:	**Viva L**
Date:	**02/06/17**
Run:	**1**
Control #:	**0138WS017E**
Test Duration:	**180**
Output Category:	**II**

Technicians: _____

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	**63.0%**	**68.1%**
Combustion Efficiency	**80.8%**	**80.8%**
Heat Transfer Efficiency	**78%**	**84.3%**

Output Rate (kJ/h)	**12,950**	**12,285**	**(Btu/h)**
Burn Rate (kg/h)	**1.04**	**2.29**	**(lb/h)**
Input (kJ/h)	**20,544**	**19,489**	**(Btu/h)**

Test Load Weight (dry kg)	**3.11**	**6.86**	**dry lb**
MC wet (%)	**18.37**		
MC dry (%)	**22.50**		
Particulate (g)	**N/A**		
CO (g)	**822**		
Test Duration (h)	**3.00**		

Emissions	Particulate	CO
g/MJ Output	**N/A**	**21.16**
g/kg Dry Fuel	**N/A**	**264.21**
g/h	**N/A**	**274.00**
lb/MM Btu Output	**N/A**	**49.17**

Air/Fuel Ratio (A/F)	**14.65**

VERSION: **2.2** **12/14/2009**

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 1
Model: VIVA L Tracking Number: 2233 Date: 2/6/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Run Notes

Air Control Settings

Primary: 14 mm open from fully closed*

* upon completion of testing a fixed stop will be installed to correspond to low burn test setting, the setting above represents distance without fixed stop in place.

Secondary: Fixed

Tertiary/Pilot: Fixed

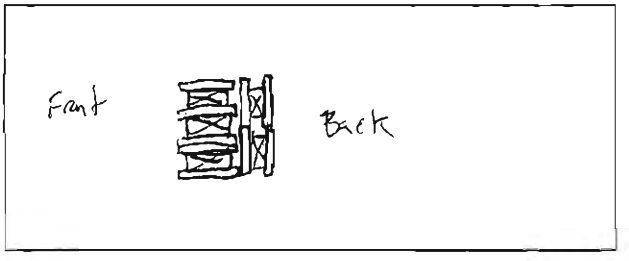
Fan: N/A

Preburn Notes

Time	Notes
	N/A

Test Notes

Sketch test fuel configuration:



Start up procedures & Timeline:

Bypass: N/A
Fuel loaded by: 40 sec
Door closed at: 50 sec
Primary air: Air @ max for 4 min, then turned to click @ 4.5 mm slowly turned low to test setting.
Notes:

Time	Notes
	N/A

Technician Signature: _____ Date: 2/6/17

OMNI-Test Laboratories, Inc. **ASTM E2780 Wood Heater Run Sheets**

Client: RAIS Project Number: 0138WS017E Run Number: 1

Model: VIVA L Tracking Number: 2233 Date: 2/6/2017

Test Crew: S. Button, A. Kravitz

OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Supplemental Data

Start Time: 14:07 Booth #: E1

Stop Time: 17:13

Stack Gas Leak Check:

Initial: Ø Final: Ø

Sample Train Leak Check:

A: 0.000 @ -5 "Hg

B: 0.000 @ -5 "Hg

Calibrations: Span Gas CO_2: 16.74 CO: 4.20 CO (ppm): 500

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	9:25	9:31	N/A	
CO_2	0.00	16.74		
CO (%)	0.00	4.20		
CO (ppm)	0	505		

Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs): Initial: 10 Final: 10

Pitot Tube Leak Test: Initial: Ø Final: Ø

Stack Diameter (in): 6"

Induced Draft: Ø

% Smoke Capture: 100%

Flue Pipe Cleaned Prior to First Test in Series:

Date: 2/2/17 Initials: AK

	Initial	Middle	Ending
P_b (in/Hg)	29.72	29.75	29.79
RH (%)	18.5	22.1	25.3
Ambient (°F)	70	71	71

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
0.026	0.052	92
0.035	0.070	92
0.040	0.080	92
0.030	0.060	92
0.026	0.052	92
0.038	0.076	92
0.040	0.080	92
0.031	0.062	92
Center:		
0.044	0.088	92

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-0.27	-0.28

Background Filter Volume: N/A

Technician Signature: _____ Date: 2/6/17

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 1
Model: VIVA L Tracking Number: 2233 Date: 2/6/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Fuel Data

Fuel: Douglas fir, untreated and air dried, standard grade or better dimensional lumber

Pre-Burn Fuel

Calibration: Cal Value (1) = 12% Actual Reading 12%
Cal Value (2) = 22% Actual Reading 22%

Piece:	Length:	Reading:	Piece:	Length:	Reading:
1	9" in	23.9	7	~~9~~ 9 in	24.9
2	9" in	24.8	8	~~9~~ 9 in	24.5
3	9 in	24.5	9	9 in	22.6
4	9 in	23.9	10	9 in	20.1
5	9 in	24.5	11	9 in	19.1
6	9 in	19.2	12	in	

Total Pre-Burn Fuel Weight: 9.2 Pre-Burn Fuel Average Moisture: 22.9%

Time (clock): 11:30 Room Temperature (F): 65° Initials: SB

Test Fuel

Firebox Volume (ft³): 1.294 ft³ Test Fuel Piece Length (in): 2@ 10.5" 3@ 12.5"
Load Weight Range (lb): 8.2 - 9.9 Total Wet Fuel Load Weight (lb): 8.4

Fuel Type & Amount: 2 x 4: 5 4 x 4: ∅
Weight (with spacers): 8.4 Weight (with spacers): ∅

Piece:	Weight (lbs):	Moisture Readings (%DB):			Fuel Type:
1	1.6	22.5	23.2	22.9	2x4
2	1.2	23.1	22.5	22.9	2x4
3	1.2	21.6	22.5	19.1	2x4
4	1.6	24.2	22.1	19.9	2x4
5	1.4	24.5	22.8	23.7	2x4
6					
7					

Spacer Moisture Readings (%DB)

22.7	21.2	13.5	19.3	~~13.8~~ DQ	22.1		
22.7	23.1	23.7	23.4		19.4		
23.6	21.1	22.5	26.4		22.3		
23.2	14.3	23.6	13.8		21.6		

Time (clock): 11:00 Room Temperature (F): 65 Initials: SB

Technician Signature: Date: 2/6/2017

Run 2

Wood Heater Preburn Data - ASTM E2780

Run:	2

Technician Signature:

Manufacturer:	RAIS
Model:	Viva L
Tracking No.:	2233
Project No.:	0138WS017E
Test Date:	2/7/2017
Beginning Clock Time:	11:19

Coal Bed Range (lb):	1.7 (min)	2.1 (max)

Preburn Fuel Data

Fuel Piece Lengths (in.):	8		
Total Preburn Weight (lb):	9.3		
Fuel Moisture Readings (% DB):	19.7	20.9	19.2
	18.9	20.6	19.1
	22.2	24.3	19.2
	22.9	22.8	
Avg Preburn Moisture (% DB):	20.89		

			Temperatures (°F)							
Elapsed Time (min)	Scale (lb)	Stack Draft (in H_2O)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Avg. Firebox Surface	Stack	Ambient
0	7.2	-0.052	609	359	333	343	318	392.5	454	70
10	5.8	-0.047	664	371	353	344	333	413	399	72
20	4.9	-0.040	680	361	367	345	346	419.6	329	71
30	3.9	-0.046	708	342	372	348	352	424.4	396	72
40	3.1	-0.044	743	323	369	346	351	426.5	387	71
50	2.6	-0.039	725	308	371	358	355	423.3	319	71
60	2.2	-0.033	675	300	374	362	366	415.3	275	72
67	2.1	-0.030	637	300	374	360	368	408.1	257	72

Wood Heater Test Fuel Data - ASTM E2780

Manufacturer:	**RAIS**
Model:	**Viva L**
Tracking No.:	**2233**
Project No.:	**0138WS017E**
Test Date:	**2/7/2017**
Run No.:	**2**

Firebox Volume (ft^3):	**1.29**
Fuel Piece Length (in):	**11.7**
2x4 Crib Weight (lb):	**8.4**
4x4 Crib Weight (lb):	**0**

Total Fuel Weight (Dry Basis, lb):	**7.0**	
Fuel Density (lb/ft^3, Dry Basis):	**28.98**	**OK**
Loading Density (lb/ft^3, Wet Basis):	**6.51**	**OK**
2x4 Percentage:	**N/A**	**N/A**

Coal Bed Range (20-25%): 1.68 - 2.1

Test Fuel Piece	Weight (lb)	Size	Readings (Dry Basis %)			Dry Weight (lb)
1	0.9	2"x 4"	20.1	20.2	19.7	0.75
2	1.2	2"x 4"	23.2	22.6	22.6	0.98
3	1.3	2"x 4"	23.8	23.4	23.2	1.05
4	1.4	2"x 4"	23.9	22.1	22.7	1.14
5	1.5	2"x 4"	22.3	22.8	20.2	1.23

Spacer Readings (Dry Basis %)			
20.2	12.6		
19.7	19.2		
15.1	17.0		
16.7	18.9		
19.9	19.8		
13.9	13.0		
18.5	15.0		
17.0			
12.2			
17.3			
16.8			
16.7			
12.6			

Technician Signature:

Wood Heater Test Data - ASTM E2780 / ASTM E2515

Run: 2

Manufacturer: RAIS
Model: Viva L
Tracking No.: 2233
Project No.: 0138WS017E
Test Date: 07-Feb-17
Beginning Clock Time: 12:33

Total Sampling Time: 220 min
Recording Interval: 10 min
Background Sample Volume: 0 cubic feet

Meter Box Y Factor: 0.984 (1) 0.99 (2) 1 (Amb)

Barometric Pressure:

Begin	Middle	End	Average
29.89	29.89	29.89	29.89 "Hg

OMNI Equipment Numbers: 296-T55, 185, 340, 431, 335, 336, 594, 410, 559, 209, 132, 23, 592, 283A

PM Control Modules: 335/336
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.260 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 17.88 ft/sec.
Initial Tunnel Flow: 192.2 scfm
Average Tunnel Flow: 200.6 scfm
Post-Test Leak Check (1): 0.000 cfm @ 12 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 11 in. Hg
Average Test Piece Fuel Moisture: 22.19 Dry Basis %

Technician Signature: _____

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.048	0.080	0.082	0.068	0.044	0.070	0.080	0.060	0.095	"H2O
Temp:	89	89	89	89	89	89	89	89	89	°F

V_{strav} 17.73 ft/sec V_{scent} 20.85 ft/sec F_p 0.851

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface Temp	Catalyst Exit Temp	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			0.03	75	1.85	0.67	76	1.3	105	0.090			8.4		631	299	375	359	370	407	N/A	327	71	71	70	70	71	-0.038	2.81	0.23
10	1.699	1.698	0.17	0.17	1.44	76	2.29	1.22	77	1.3	90	0.090	106	107	7.6	-0.8	590	331	358	318	326	385	N/A	270	73	73	73	73	71	-0.034	3.17	0.91
20	3.399	3.403	0.17	0.17	1.43	77	2.29	1.20	78	1.3	86	0.090	106	107	7.1	-0.5	502	349	337	287	295	354	N/A	215	73	73	73	73	71	-0.027	3.41	1.41
30	5.097	5.108	0.17	0.17	1.42	79	2.29	1.20	79	1.3	84	0.100	100	101	6.7	-0.4	438	344	318	268	276	329	N/A	198	72	72	73	73	71	-0.024	4.28	1.85
40	6.796	6.810	0.17	0.17	1.41	80	2.31	1.19	80	1.4	82	0.100	99	101	6.2	-0.5	402	336	307	257	264	313	N/A	191	72	72	72	72	70	-0.022	4.78	2.26
50	8.492	8.508	0.17	0.17	1.41	81	2.33	1.18	81	1.4	82	0.100	99	100	5.7	-0.5	390	329	305	255	264	309	N/A	195	72	72	72	72	70	-0.022	5.99	1.73
60	10.186	10.195	0.17	0.17	1.43	81	2.28	1.15	81	1.5	82	0.100	99	100	5.0	-0.7	388	324	307	258	264	308	N/A	196	72	72	72	72	70	-0.021	5.04	3.23
70	11.894	11.861	0.17	0.17	1.42	82	2.31	1.13	82	1.6	81	0.100	99	98	4.3	-0.7	377	319	312	261	266	307	N/A	197	72	72	72	72	70	-0.021	5.50	3.78
80	13.596	13.512	0.17	0.17	1.41	82	2.34	1.17	82	1.7	82	0.100	99	97	3.5	-0.8	378	315	320	270	273	311	N/A	201	72	72	72	72	70	-0.021	5.80	4.23
90	15.291	15.193	0.17	0.17	1.40	82	2.37	1.15	82	1.8	82	0.100	99	99	2.8	-0.7	387	311	333	286	292	322	N/A	198	72	72	72	72	70	-0.021	5.78	4.34
100	16.979	16.860	0.17	0.17	1.39	82	2.4	1.13	82	1.9	81	0.100	98	98	2.2	-0.6	396	309	344	299	306	331	N/A	193	72	72	72	72	71	-0.020	5.59	4.22
110	18.664	18.518	0.17	0.17	1.39	82	2.41	1.13	82	1.9	81	0.100	98	98	1.8	-0.4	403	308	348	304	314	335	N/A	185	72	72	72	72	70	-0.019	4.95	3.95
120	20.350	20.178	0.17	0.17	1.39	82	2.4	1.13	82	1.9	80	0.100	98	98	1.7	-0.1	404	307	347	308	314	336	N/A	174	71	71	71	71	70	-0.018	4.52	3.69
130	22.037	21.840	0.17	0.17	1.40	82	2.4	1.14	82	1.9	80	0.100	98	98	1.5	-0.2	400	306	346	307	312	334	N/A	170	70	70	71	71	69	-0.017	4.65	3.71
140	23.726	23.505	0.17	0.17	1.40	82	2.4	1.14	82	1.9	80	0.100	98	98	1.4	-0.1	398	305	344	305	311	333	N/A	170	70	70	71	71	70	-0.016	4.78	3.84
150	25.413	25.169	0.17	0.17	1.40	82	2.4	1.14	82	1.9	80	0.090	103	103	1.2	-0.2	398	303	342	302	308	331	N/A	173	71	71	71	71	70	-0.017	4.65	3.98
160	27.101	26.833	0.17	0.17	1.40	82	2.4	1.14	82	1.8	80	0.100	98	98	1.0	-0.2	408	302	332	297	303	328	N/A	177	71	71	71	71	69	-0.017	6.83	1.17
170	28.789	28.500	0.17	0.17	1.39	82	2.4	1.14	82	1.9	80	0.100	98	98	0.9	-0.1	421	300	328	294	304	329	N/A	179	70	70	71	71	70	-0.017	6.82	1.15
180	30.477	30.163	0.17	0.17	1.39	82	2.4	1.14	82	1.8	80	0.090	104	103	0.7	-0.2	427	300	327	296	306	331	N/A	178	71	71	71	71	70	-0.016	7.00	1.08
190	32.164	31.828	0.17	0.17	1.40	82	2.4	1.14	82	1.8	81	0.100	98	98	0.6	-0.1	435	301	329	299	311	335	N/A	182	71	71	71	71	70	-0.017	7.30	1.03
200	33.851	33.493	0.17	0.17	1.39	82	2.41	1.14	82	1.8	81	0.100	98	98	0.4	-0.2	439	303	334	304	315	339	N/A	183	71	71	71	71	70	-0.017	7.13	1.23
210	35.538	35.159	0.17	0.17	1.38	83	2.41	1.14	82	1.9	80	0.100	98	98	0.2	-0.2	440	305	338	307	318	342	N/A	182	71	71	71	71	71	-0.017	6.98	1.25
220	37.226	36.825	0.17	0.17	1.40	83	2.41	1.14	83	1.8	80	0.100	98	98	0.0	-0.2	439	308	338	307	319	342	N/A	182	71	71	71	71	71	-0.018	6.99	1.38
Avg/Tot	37.226	36.825	0.17	0.17	1.34	81		1.13	81		83	0.098	100	100								64.6				71	72	72	70	-0.021		

Wood Heater Test Results - ASTM E2780 / ASTM E2515

Manufacturer: RAIS
Model: Viva L
Project No.: 0138WS017E
Tracking No.: 2233
Run: 2
Test Date: 02/07/17

Burn Rate	**0.86 kg/hr dry**
Average Tunnel Temperature	83 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	17.88 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	12034.9 dscf/hour
Average Delta p	0.098 inches H20
Total Time of Test	220 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	37.226 cubic feet	36.825 cubic feet	10.186 cubic feet
Average Gas Meter Temperature	70 degrees Fahrenheit	81 degrees Fahrenheit	81 degrees Fahrenheit	81 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	35.818 dscf	35.624 dscf	9.801 dscf
Total Particulates - m_n	0 mg	150 mg	150.4 mg	49.6 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000000 grams/dscf	0.00419 grams/dscf	0.00422 grams/dscf	0.00506 grams/dscf
Total Particulate Emissions - E_T	0.00 grams	184.80 grams	186.30 grams	60.91 grams
Particulate Emission Rate	0.00 grams/hour	50.40 grams/hour	50.81 grams/hour	60.91 grams/hour
Emissions Factor		58.60 g/kg	59.08 g/kg	48.26 g/kg
Difference from Average Total Particulate Emissions		0.75 grams	0.75 grams	

Dual Train Comparison Results Are Acceptable

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	185.55 grams
Particulate Emission Rate	**50.60 grams/hour**
Emissions Factor	58.84 grams/kg
Train Precision g/kg ≤ 0.5	0.48 grams/kg
Train Precision ≤ 7.5%	0.40 %
First Hour Emissions	
Total Particulate Emissions - E_T	60.91 grams
Particulate Emission Rate	60.91 grams/hour
Emissions Factor	48.26 grams/kg

QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Stove Surface ΔT	OK

Technician Signature:_____

OMNI-Test Laboratories

Manufacturer:	**RAIS**
Model:	**Viva L**
Date:	**02/07/17**
Run:	**2**
Control #:	**0138WS017E**
Test Duration:	**220**
Output Category:	**II**

Technicians: _____

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	**57.2%**	**61.9%**
Combustion Efficiency	**73.9%**	**73.9%**
Heat Transfer Efficiency	**77%**	**83.7%**

Output Rate (kJ/h)	**9,646**	**9,150**	**(Btu/h)**
Burn Rate (kg/h)	**0.85**	**1.87**	**(lb/h)**
Input (kJ/h)	**16,852**	**15,986**	**(Btu/h)**

Test Load Weight (dry kg)	**3.12**	**6.87**	**dry lb**
MC wet (%)	**18.16**		
MC dry (%)	**22.19**		
Particulate (g)	**n/a**		
CO (g)	**1,117**		
Test Duration (h)	**3.67**		

Emissions	**Particulate**	**CO**
g/MJ Output	**N/A**	**31.59**
g/kg Dry Fuel	**N/A**	**358.23**
g/h	**N/A**	**304.74**
lb/MM Btu Output	**N/A**	**73.43**

Air/Fuel Ratio (A/F)	**15.43**

VERSION: **2.2** **12/14/2009**

OMNI-Test Laboratories, Inc. **ASTM E2780 Wood Heater Run Sheets**

Client: RAIS Project Number: 0138WS017E Run Number: 2

Model: VIVA L Tracking Number: 2233 Date: ~~2/6/2017~~ 2/7/17

Test Crew: S. Button, A. Kravitz

OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Run Notes

Air Control Settings

Primary: 0 pm 4 mm

Secondary: Fixed

Tertiary/Pilot: Fixed

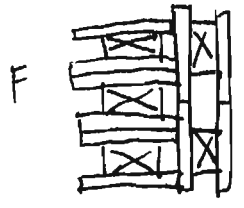
Fan: NA

Preburn Notes

Time	Notes
	None

Test Notes

Sketch test fuel configuration:



Start up procedures & Timeline:

Bypass: NA
Fuel loaded by: 0:25
Door closed at: 0:30
Primary air: Startup until 4:30
SeA from 4:50- 5:00

Notes:

Time	Notes
	None

Technician Signature: _____ Date: 2/7/17

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 2
Model: VIVA L Tracking Number: 2233 Date: 2/6/2017
Test Crew: S. Button, A. Kravitz 7
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Supplemental Data

Start Time: 12:33 Booth #: E1
Stop Time: 16:16

Stack Gas Leak Check:
Initial: Ø Final: Ø

Sample Train Leak Check:
A: Ø @ 12 "Hg
B: Ø @ 12 "Hg

Calibrations: Span Gas CO_2: 16.74 CO(%): 4.20 CO(ppm): 500

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	1:11	9:15		
CO_2	0.00	16.74		
CO(%)	0.060	4.196		
CO(ppm)	0			

Air Velocity (ft/min): Initial: <50 Final: <50
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: Ø Final: Ø
Stack Diameter (in): 6
Induced Draft: Ø
% Smoke Capture: 100
Flue Pipe Cleaned Prior to First Test in Series:
Date: 2/2 Initials: A

	Initial	Middle	Ending
P_b (in/Hg)	28.89	28.89	29.89
RH (%)	24.4	24.4	24.5
Ambient (°F)	71.9	70	70

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
0.024	0.048	89
0.040	0.080	
0.041	0.082	
0.034	0.068	
0.022	0.044	
0.035	0.070	
0.040	0.080	
0.030	0.060	
~~0.045~~	Center:	
~~0.047~~	0.095	89

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
~0.26	

Background Filter Volume: Ø

Technician Signature: A

Date: 2/16/17

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 2
Model: VIVA L Tracking Number: 2233 Date: 2/8/2017
Test Crew: S. Button, A. Kravitz 7
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Fuel Data

Fuel: Douglas fir, untreated and air dried, standard grade or better dimensional lumber

Pre-Burn Fuel

Calibration: Cal Value (1) = 12% Actual Reading 12.6
Cal Value (2) = 22% Actual Reading 22.0

Piece:	Length:	Reading:	Piece:	Length:	Reading:
1	8 in	19.7	7	6 in	20.6
2		18.9	8		20.0
3		22.2	9		19.2
4		22.9	10		18.1
5		22.8	11		18.2
6		24.3	12	in	

Total Pre-Burn Fuel Weight: 9.3 Pre-Burn Fuel Average Moisture: 22.91

Time (clock): 10:00 Room Temperature (F): 71 Initials: [illegible]

Test Fuel

Firebox Volume (ft³): 1.24 Test Fuel Piece Length (in): 2@10.5", 3@12.5"
Load Weight Range (lb): 8.2-9.4 Total Wet Fuel Load Weight (lb): _____

Fuel Type & Amount: 2 x 4: 5 4 x 4: _____
Weight (with spacers): 8.4 Weight (with spacers): _____

Piece:	Weight (lbs):	Moisture Readings (%DB):				Fuel Type:
1	0.9	20.1	20.2	19.7		DF
2	1.2	23.2	22.6	22.6		
3	1.3	23.8	23.4	23.2		
4	1.4	23.4	22.1	22.7		
5	1.5	22.3	22.8	20.2		
6						
7						

Spacer Moisture Readings (%DB)

20.2	18.9	12.2	12.6	18.9			
19.7	13.9	17.3	12.6	18.8			
15.1	16.5	16.8	18.2	13.0			
16.7	17.0	16.7	17.0	15.0			

Time (clock): 10:00 Room Temperature (F): 71 Initials: [illegible]

Technician Signature: _____ Date: 2/8/17

Run 3

Wood Heater Preburn Data - ASTM E2780

Run:	3

Technician Signature:

Manufacturer:	RAIS
Model:	Viva L
Tracking No.:	2233
Project No.:	0138WS017E
Test Date:	2/8/2017
ginning Clock Time:	12:57

Coal Bed Range (lb):	1.6 (min)	2.1 (max)

Preburn Fuel Data

Fuel Piece Lengths (in.):	8		
Total Preburn Weight (lb):	8.8		
Fuel Moisture Readings (% DB):	21.7	20.2	20.2
	18.6	19.5	20.1
	19.6	18.9	19.3
	19.7	19.1	
Avg Preburn Moisture (% DB):	19.72		

			Temperatures (°F)							
Elapsed Time (min)	Scale (lb)	Stack Draft (in H_2O)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Avg. Firebox Surface	Stack	Ambient
0	8.4	-0.062	573	325	331	341	332	325.7	479	69
10	7.4	-0.05	581	355	329	313	311	342.8	322	69
20	6.4	-0.05	617	341	329	310	305	351.8	346	68
30	5.5	-0.05	660	317	333	320	311	362.1	353	69
40	4.6	-0.048	681	294	338	331	320	373.3	340	69
50	3.7	-0.047	685	277	340	342	327	385.9	332	68
60	3	-0.047	692	270	345	350	334	387.1	331	69
70	2.5	-0.043	687	269	348	355	337	363.3	306	68
80	2.2	-0.037	639	272	354	350	345	392	265	69
83	2.1	-0.034	625	274	357	351	347	390.8	259	68

Wood Heater Test Fuel Data - ASTM E2780

Manufacturer:	**RAIS**
Model:	**Viva L**
Tracking No.:	**2233**
Project No.:	**0138WS017E**
Test Date:	**2/8/2017**
Run No.:	**3**

Firebox Volume (ft^3):	**1.29**
Fuel Piece Length (in):	**10.5**
2x4 Crib Weight (lb):	**8.2**
4x4 Crib Weight (lb):	**0**

Total Fuel Weight (Dry Basis, lb):	**6.9**	
Fuel Density (lb/ft^3, Dry Basis):	**29.82**	**OK**
Loading Density (lb/ft^3, Wet Basis):	**6.36**	**OK**
2x4 Percentage:	**N/A**	**N/A**

Coal Bed Range (20-25%): 1.64 - 2.05

Test Fuel Piece	Weight (lb)	Size	Readings (Dry Basis %)			Dry Weight (lb)
1	1.1	2"x 4"	19.4	19.1	19.5	0.92
2	1.1	2"x 4"	19.4	19.0	19.1	0.92
3	1.2	2"x 4"	20.3	19.4	19.1	1.00
4	1.2	2"x 4"	20.5	19.7	20.2	1.00
5	1.1	2"x 4"	19.8	21.6	21.3	0.91

Spacer Readings (Dry Basis %)			
17.8			
12.2			
14.6			
8.8			
19.1			
17.6			
17.7			
19.9			
14.3			
16.1			

Technician Signature:

Wood Heater Test Data - ASTM E2780 / ASTM E2515

Run: 3

Manufacturer: RAIS
Model: Viva L
Tracking No.: 2233
Project No.: 0138WS017E
Test Date: 08-Feb-17
Beginning Clock Time: 14:42

Total Sampling Time: 170 min
Recording Interval: 10 min
Background Sample Volume: 0 cubic feet

Meter Box Y Factor: 0.984 (1) 0.99 (2) 1 (Amb)

Barometric Pressure: Begin 29.83 Middle 29.8 End 29.77 Average 29.80 "Hg

OMNI Equipment Numbers: 296-T55, 185, 340, 431, 335, 336, 594, 410, 559, 209, 132, 23, 592, 283A

PM Control Modules: 335/336
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.260 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 17.69 ft/sec.
Initial Tunnel Flow: 187.2 scfm
Average Tunnel Flow: 196.2 scfm
Post-Test Leak Check (1): 0.000 cfm @ -12 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ -11 in. Hg
Average Test Piece Fuel Moisture: 19.83 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.052	0.074	0.078	0.052	0.044	0.070	0.074	0.062	0.097	"H2O
Temp:	90	90	90	90	90	90	90	90	90	°F

V_{strav} 17.42 ft/sec V_{scent} 21.10 ft/sec F_p 0.826

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface Temp	Catalyst Exit Temp	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			0.41	73	0.61	0.11	74	-0.4	100	0.095			8.2		619	274	358	351	350	390	N/A	313	67	68	67	68	69	-0.045	4.02	0.37
10	1.697	1.670	0.17	0.17	1.44	73	2.29	1.18	74	1.3	92	0.102	100	100	7.0	-1.2	620	313	342	320	316	382	N/A	343	70	70	71	70	68	-0.049	9.82	1.15
20	3.393	3.341	0.17	0.17	1.44	75	2.28	1.16	76	1.3	92	0.102	100	100	6.0	-1	648	336	333	305	301	385	N/A	348	71	70	72	70	68	-0.050	10.03	1.74
30	5.091	5.011	0.17	0.17	1.43	76	2.28	1.16	77	1.3	92	0.100	101	101	4.9	-1.1	672	334	326	312	305	390	N/A	344	71	70	73	70	68	-0.050	11.11	1.99
40	6.789	6.682	0.17	0.17	1.43	78	2.29	1.16	78	1.3	94	0.101	100	100	3.8	-1.1	707	323	326	324	312	398	N/A	389	71	70	73	70	69	-0.054	12.37	2.39
50	8.490	8.355	0.17	0.17	1.43	79	2.29	1.16	79	1.3	97	0.101	100	100	2.7	-1.1	752	310	331	338	323	411	N/A	416	72	71	74	71	69	-0.055	12.86	0.42
60	10.194	10.029	0.17	0.17	1.43	80	2.27	1.16	80	1.3	95	0.100	100	101	2.0	-0.7	768	300	341	352	335	419	N/A	364	72	71	74	71	69	-0.049	9.79	0.45
70	11.901	11.706	0.17	0.17	1.43	80	2.27	1.16	81	1.3	91	0.099	101	101	1.7	-0.3	714	293	354	365	343	414	N/A	290	72	72	73	72	68	-0.040	8.54	0.42
80	13.611	13.385	0.17	0.17	1.43	81	2.27	1.17	81	1.3	87	0.099	100	100	1.4	-0.3	645	292	359	365	347	402	N/A	261	71	73	73	73	68	-0.035	7.51	0.88
90	15.323	15.065	0.17	0.17	1.44	81	2.26	1.16	82	1.3	85	0.103	98	98	1.3	-0.1	585	300	357	360	343	389	N/A	240	71	73	72	73	69	-0.032	7.18	1.18
100	17.037	16.747	0.17	0.17	1.44	81	2.27	1.16	81	1.3	83	0.102	99	99	1.1	-0.2	540	310	354	354	336	379	N/A	225	70	73	71	73	69	-0.030	6.93	1.44
110	18.750	18.428	0.17	0.17	1.44	81	2.26	1.17	81	1.3	82	0.099	100	100	1.0	-0.1	510	320	349	348	329	371	N/A	216	70	73	71	73	69	-0.027	6.65	1.47
120	20.465	20.111	0.17	0.17	1.45	81	2.27	1.17	81	1.3	81	0.102	99	99	0.8	-0.2	486	329	346	338	322	364	N/A	211	69	73	71	73	68	-0.027	6.4	1.58
130	22.181	21.795	0.17	0.17	1.44	81	2.27	1.17	81	1.3	80	0.099	100	100	0.7	-0.1	467	336	343	329	316	358	N/A	207	69	73	70	73	68	-0.026	6.23	1.3
140	23.897	23.479	0.17	0.17	1.44	81	2.27	1.17	81	1.3	80	0.099	100	100	0.5	-0.2	454	339	340	325	313	354	N/A	204	69	73	70	73	67	-0.025	6.43	1.26
150	25.611	25.163	0.17	0.17	1.44	80	2.26	1.17	81	1.3	79	0.101	99	99	0.4	-0.1	447	339	337	324	310	351	N/A	202	69	72	70	72	67	-0.025	6.24	1.45
160	27.327	26.845	0.17	0.17	1.44	80	2.26	1.17	81	1.3	79	0.101	99	99	0.2	-0.2	441	338	336	319	309	349	N/A	201	69	72	70	72	68	-0.025	6.17	1.49
170	29.043	28.528	0.17	0.17	1.44	80	2.26	1.17	80	1.3	79	0.102	99	99	0.0	-0.2	439	335	334	317	307	346	N/A	201	69	72	69	72	67	-0.025	6.38	1.4
Avg/Tot	29.043	28.528	0.17	0.17	1.38	79		1.11	79		87	0.100	100	100								44.0				72	71	72	68	-0.037		

Wood Heater Test Results - ASTM E2780 / ASTM E2515

Manufacturer: RAIS
Model: Viva L
Project No.: 0138WS017E
Tracking No.: 2233
Run: 3
Test Date: 02/08/17

Burn Rate	**1.107 kg/hr dry**
Average Tunnel Temperature	87 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	17.69 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11769.6 dscf/hour
Average Delta p	0.100 inches H20
Total Time of Test	170 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	29.043 cubic feet	28.528 cubic feet	10.194 cubic feet
Average Gas Meter Temperature	68 degrees Fahrenheit	79 degrees Fahrenheit	79 degrees Fahrenheit	79 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	27.969 dscf	27.600 dscf	9.817 dscf
Total Particulates - m_n	0 mg	3.5 mg	2.6 mg	2.6 mg
Particulate Concentration (dry-standard) - C_r/C_s	0.000000 grams/dscf	0.00013 grams/dscf	0.00009 grams/dscf	0.00026 grams/dscf
Total Particulate Emissions - E_T	0.00 grams	4.17 grams	3.14 grams	3.12 grams
Particulate Emission Rate	0.00 grams/hour	1.47 grams/hour	1.11 grams/hour	3.12 grams/hour
Emissions Factor		1.33 g/kg	1.00 g/kg	1.33 g/kg
Difference from Average Total Particulate Emissions		0.52 grams	0.52 grams	
	Dual Train Comparison Results Are Acceptable			

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	3.66 grams
Particulate Emission Rate	1.29 **grams/hour**
Emissions Factor	1.17 grams/kg
Train Precision g/kg ≤ 0.5	0.33 grams/kg
Train Precision ≤ 7.5%	14.1 %
First Hour Emissions	
Total Particulate Emissions - E_T	3.12 grams
Particulate Emission Rate	3.12 grams/hour
Emissions Factor	1.33 grams/kg
7.5% of Average Total Particulate Emissions	0.27 grams

QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Stove Surface ΔT	OK

Technician Signature:_____

OMNI-Test Laboratories

Manufacturer:	**RAIS**
Model:	**Viva L**
Date:	**02/08/17**
Run:	**3**
Control #:	**0138WS017E**
Test Duration:	**170**
Output Category:	**II**

Technicians:

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	**70.8%**	**76.6%**
Combustion Efficiency	**89.9%**	**89.9%**
Heat Transfer Efficiency	**79%**	**85.2%**

Output Rate (kJ/h)	**15,377**	**14,587**	**(Btu/h)**
Burn Rate (kg/h)	**1.10**	**2.42**	**(lb/h)**
Input (kJ/h)	**21,709**	**20,593**	**(Btu/h)**

Test Load Weight (dry kg)	**3.10**	**6.84**	**dry lb**
MC wet (%)	**16.55**		
MC dry (%)	**19.83**		
Particulate (g)	**N/A**		
CO (g)	**434**		
Test Duration (h)	**2.83**		

Emissions	Particulate	CO
g/MJ Output	**N/A**	**9.97**
g/kg Dry Fuel	**N/A**	**139.86**
g/h	**N/A**	**153.27**
lb/MM Btu Output	**N/A**	**23.16**

Air/Fuel Ratio (A/F)	**13.12**

VERSION: **2.2** **12/14/2009**

OMNI-Test Laboratories, Inc. **ASTM E2780 Wood Heater Run Sheets**

Client: RAIS Project Number: 0138WS017E Run Number: 3

Model: VIVA L Tracking Number: 2233 Date: ~~2/8/2017~~ 2/8/17

Test Crew: S. Button, A. Kravitz

OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Run Notes

Air Control Settings

Primary: 15mn Open

Secondary: Fixed

Tertiary/Pilot: Fixed

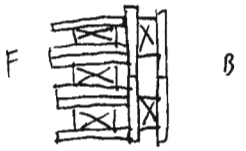
Fan: NA

Preburn Notes

Time	Notes
15 min	set air to test setting
55min	knocked down preburn load, added 0.7 lbs of wood

Test Notes

Sketch test fuel configuration:



Start up procedures & Timeline:

Bypass: NA
Fuel loaded by: 35 sec
Door closed at: 45 sec
Primary air: startup VA:1 4:30
Set from 4:50-5:60

Notes:

Time	Notes
	None

Technician Signature: _____ Date: 2/5/17

OMNI-Test Laboratories, Inc. **ASTM E2780 Wood Heater Run Sheets**

Client: RAIS Project Number: 0138WS017E Run Number: 3

Model: VIVA L Tracking Number: 2233 Date: 2/8/2017

Test Crew: S. Button, A. Kravitz

OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Supplemental Data

Start Time: 14:42 Booth #: E1

Stop Time: 17:32

Stack Gas Leak Check:

Initial: Ø Final: Ø

Sample Train Leak Check:

A: Ø @ -12 "Hg

B: Ø @ -11 "Hg

Calibrations: Span Gas CO_2: 16.74 CO(%): 4.20 CO(ppm): 500

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	9:07	9:09	17:41	17:43
CO_2	0.00	16.75	0.06	16.81
CO(%)	0.000	4.206	0.021	4.261
CO(ppm)	1	N/A	3	NM

Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs): Initial: 10.0 Final: 10.0

Pitot Tube Leak Test: Initial: Ø Final: Ø

Stack Diameter (in): 6

Induced Draft: Ø

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in Series:

Date: 2/2 Initials: A

	Initial	Middle	Ending
P_b (in/Hg)	29.83	29.80	29.77
RH (%)	25.6	24.8	23.8
Ambient (°F)	70.1	70.3	69.9

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
0.026	0.052	90
0.037	0.074	
0.039	0.078	
0.026	0.052	
0.022	0.044	
0.035	0.070	
0.037	0.074	
0.031	0.062	
Center:		
—	0.047	90

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-0.26	-0.26

Background Filter Volume: NA

Technician Signature: Date: 3/8/17

OMNI-Test Laboratories, Inc. **ASTM E2780 Wood Heater Run Sheets**

Client: RAIS Project Number: 0138WS017E Run Number: 3

Model: VIVA L Tracking Number: 2233 Date: 2/8/2017

Test Crew: S. Button, A. Kravitz

OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Fuel Data

Fuel: Douglas fir, untreated and air dried, standard grade or better dimensional lumber

Pre-Burn Fuel

Calibration: Cal Value (1) = 12% Actual Reading 12.0

Cal Value (2) = 22% Actual Reading 22.0

Piece:	Length:	Reading:	Piece:	Length:	Reading:
1	8 in	21.7	7	8 in	18.9
2		18.6	8		19.1
3		19.6	9		20.2
4		19.7	10		20.1
5		20.2	11		19.3
6		19.5	12		

Total Pre-Burn Fuel Weight: 8.8 Pre-Burn Fuel Average Moisture: 19.72

Time (clock): 12:30 Room Temperature (F): 76 Initials: [illegible]

Test Fuel

Firebox Volume (ft³): 1.29 Test Fuel Piece Length (in): 16.5

Load Weight Range (lb): 8.2-9.9 Total Wet Fuel Load Weight (lb): 8.2

Fuel Type & Amount: 2 x 4: 5 4 x 4:

Weight (with spacers): 8.2 Weight (with spacers):

Piece:	Weight (lbs):	Moisture Readings (%DB):				Fuel Type:
1	1.1	19.4	19.1	19.5		2x4
2	1.1	19.4	19.6	19.1		
3	1.2	20.3	19.4	19.1		
4	1.2	20.5	19.7	20.2		
5	1.1	19.8	21.6	21.3		
6						
7						

Spacer Moisture Readings (%DB) (All spacers cut from single 2x4)

17.8	19.1	19.3					
12.2	17.6	16.1					
19.6	17.7						
8.8	19.9						

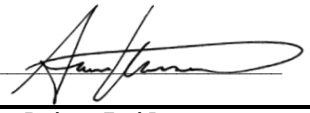
Time (clock): 12:30 Room Temperature (F): 76 Initials: [illegible]

Technician Signature: [signature] Date: 2/8/17

Run 4

Wood Heater Preburn Data - ASTM E2780

Run:	4

Technician Signature: 

Manufacturer:	RAIS
Model:	Viva L
Tracking No.:	2233
Project No.:	0138WS017E
Test Date:	2/9/2017
Beginning Clock Time:	9:15

Preburn Fuel Data

Fuel Piece Lengths (in.):	8.0		
Total Preburn Weight (lb):	8.3		
Fuel Moisture Readings (% DB):	21.7	20.2	19.1
	22.4	19.4	19.6
	21.9	22.6	21.7
	19.9	20.4	
Avg Preburn Moisture (% DB):	20.81		

Coal Bed Range (lb):	1.6 (min)	2.1 (max)

			Temperatures (°F)							
Elapsed Time (min)	Scale (lb)	Stack Draft (in H_2O)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Avg. Firebox Surface	Stack	Ambient
0	8.8	-0.041	440	155	232	268	251	269.2	315	68
0	7.6	-0.052	462	258	271	259	251	300.3	381	68
10	6.6	-0.048	530	304	297	270	258	331.9	325	68
20	5.6	-0.05	598	306	299	293	281	355.3	349	69
30	4.7	-0.045	653	297	306	316	300	374.4	322	69
40	4.0	-0.045	676	289	313	327	314	383.7	313	68
50	3.1	-0.047	695	283	324	337	322	392.1	340	69
60	2.5	-0.041	707	280	339	350	333	401.6	306	70
70	2.0	-0.036	687	278	345	361	341	402.5	271	70
72	2.0	-0.035	678	277	345	358	341	399.9	263	70

Wood Heater Test Fuel Data - ASTM E2780

Manufacturer:	**RAIS**
Model:	**Viva L**
Tracking No.:	**2233**
Project No.:	**0138WS017E**
Test Date:	**2/9/2017**
Run No.:	**4**

Firebox Volume (ft^3):	**1.29**
Fuel Piece Length (in):	**10.5**
2x4 Crib Weight (lb):	**8.2**
4x4 Crib Weight (lb):	**0**

Total Fuel Weight (Dry Basis, lb):	**6.922**	
Fuel Density (lb/ft^3, Dry Basis):	**29.56**	**OK**
Loading Density (lb/ft^3, Wet Basis):	**6.36**	**OK**
2x4 Percentage:	**N/A**	**N/A**

Coal Bed Range (20-25%): 1.64 - 2.05

Test Fuel Piece	Weight (lb)	Size	Readings (Dry Basis %)			Dry Weight (lb)
1	1.1	2"x 4"	23.6	23.0	21.5	0.90
2	1.1	2"x 4"	19.9	22.7	24.5	0.90
3	1.2	2"x 4"	19.2	19.0	19.1	1.01
4	1.2	2"x 4"	19.9	22.4	21.0	0.99
5	1.1	2"x 4"	19.7	19.6	19.1	0.92

Spacer Readings (Dry Basis %)			
8.1	13.4		
8.7	8.9		
9.3	14.1		
8.8	8.8		
16.7	12.8		
17.9	12.9		
17.0	17.1		
12.2	17.0		
17.0	14.4		
12.8	17.6		

Technician Signature:

Wood Heater Test Data - ASTM E2780 / ASTM E2515

Run: 4

Manufacturer: RAIS
Model: Viva L
Tracking No.: 2233
Project No.: 0138WS017E
Test Date: 09-Feb-17
Beginning Clock Time: 10:27

Total Sampling Time: 190 min
Recording Interval: 10 min
Background Sample Volume: 0 cubic feet

Meter Box Y Factor: 0.984 (1) 0.99 (2) 1 (Amb)

Barometric Pressure:

Begin	Middle	End	Average
29.51	29.51	29.50	29.51 "Hg

OMNI Equipment Numbers: 296-T55, 185, 340, 431, 335, 336, 594, 410, 559, 209, 132, 23, 592, 283A

PM Control Modules: 335/336
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.270 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 17.58 ft/sec.
Initial Tunnel Flow: 185.4 scfm
Average Tunnel Flow: 192.1 scfm
Post-Test Leak Check (1): 0.000 cfm @ 12 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 9 in. Hg
Average Test Piece Fuel Moisture: 20.95 Dry Basis %

Technician Signature: _____

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.048	0.070	0.076	0.058	0.044	0.076	0.076	0.056	0.098	"H2O
Temp:	92	92	92	92	93	93	93	93	93	°F

V_{strav} 17.54 ft/sec V_{scent} 21.39 ft/sec F_p 0.820

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface Temp	Catalyst Exit Temp	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			0.03	73	0.04	0.27	73	0.0	106	0.098			8.2		669	277	345	356	343	398.0	N/A	341	68	68	68	68	70	-0.048	4.05	0.24
10	1.673	1.661	0.17	0.17	1.40	74	2.23	1.15	74	1.3	94	0.102	99	99	7.2	-1.0	638	311	338	319	308	382.8	N/A	328	71	71	72	72	70	-0.047	8.55	0.46
20	3.356	3.327	0.17	0.17	1.39	76	2.21	1.14	76	1.3	93	0.098	101	101	6.4	-0.8	647	331	333	304	293	381.6	N/A	311	72	72	73	73	71	-0.045	8.98	0.36
30	5.039	4.994	0.17	0.17	1.39	77	2.20	1.14	78	1.3	93	0.098	101	101	5.7	-0.7	665	327	318	297	291	379.6	N/A	309	72	72	73	73	70	-0.044	9.85	0.69
40	6.725	6.663	0.17	0.17	1.39	79	2.21	1.14	79	1.3	96	0.098	101	101	4.7	-1.0	680	317	318	303	298	383.2	N/A	375	73	73	74	74	70	-0.051	12.74	0.88
50	8.413	8.335	0.17	0.17	1.38	80	2.21	1.14	81	1.3	98	0.098	101	101	3.6	-1.1	715	307	330	320	312	396.8	N/A	382	73	73	74	74	70	-0.052	11.52	3.9
60	10.103	10.006	0.17	0.17	1.38	81	2.21	1.14	82	1.3	99	0.100	100	100	2.6	-1.0	741	297	345	336	328	409.4	N/A	386	73	73	75	75	70	-0.053	11.86	2.4
70	11.794	11.680	0.17	0.17	1.38	82	2.21	1.14	82	1.3	96	0.096	102	102	1.9	-0.7	754	289	357	357	344	420.2	N/A	329	74	74	75	75	71	-0.044	9.09	0.44
80	13.489	13.357	0.17	0.17	1.39	82	2.22	1.14	83	1.3	92	0.098	101	100	1.6	-0.3	692	284	364	368	352	412.0	N/A	269	74	74	75	75	71	-0.036	7.79	0.49
90	15.185	15.036	0.17	0.17	1.39	83	2.22	1.15	83	1.3	90	0.098	100	100	1.4	-0.2	630	284	364	366	350	398.8	N/A	245	73	73	74	74	71	-0.033	7.32	0.6
100	16.883	16.716	0.17	0.17	1.39	83	2.22	1.15	84	1.3	87	0.097	101	100	1.2	-0.2	575	290	361	359	346	386.2	N/A	227	73	73	74	74	71	-0.029	6.7	1.02
110	18.581	18.398	0.17	0.17	1.39	83	2.21	1.15	84	1.3	85	0.100	99	99	1.1	-0.1	532	299	353	350	338	374.4	N/A	215	73	73	73	73	70	-0.027	6.54	0.95
120	20.282	20.081	0.17	0.17	1.40	83	2.21	1.14	83	1.3	85	0.099	100	100	1.0	-0.1	500	309	346	339	328	364.4	N/A	210	72	72	73	73	70	-0.025	6.82	0.91
130	21.982	21.763	0.17	0.17	1.39	83	2.22	1.14	83	1.3	84	0.100	99	99	0.8	-0.2	480	316	341	332	321	358.0	N/A	203	72	72	72	72	70	-0.024	6.44	1.05
140	23.681	23.446	0.17	0.17	1.40	83	2.21	1.15	83	1.3	84	0.102	98	98	0.7	-0.1	466	321	337	327	318	353.8	N/A	201	72	72	72	72	70	-0.024	6.69	1.08
150	25.382	25.128	0.17	0.17	1.40	83	2.21	1.15	83	1.3	84	0.096	101	101	0.6	-0.1	457	323	335	325	315	351.0	N/A	196	72	72	72	72	70	-0.023	6.38	1.22
160	27.081	26.810	0.17	0.17	1.39	83	2.21	1.14	83	1.3	83	0.098	100	100	0.4	-0.2	448	324	332	320	312	347.2	N/A	195	72	72	72	72	70	-0.023	6.37	1.3
170	28.782	28.494	0.17	0.17	1.39	83	2.22	1.15	83	1.3	83	0.100	99	99	0.3	-0.1	442	324	330	319	310	345.0	N/A	195	72	72	72	72	70	-0.023	6.24	1.34
180	30.484	30.178	0.17	0.17	1.40	83	2.22	1.14	83	1.3	83	0.100	99	99	0.1	-0.2	439	324	329	315	309	343.2	N/A	194	72	72	72	72	70	-0.023	6.06	1.46
190	32.183	31.861	0.17	0.17	1.39	83	2.22	1.15	83	1.3	83	0.105	96	97	0.0	-0.1	437	324	329	312	307	341.8	N/A	195	72	72	72	72	70	-0.023	5.94	1.33
Avg/Tot	32.183	31.861	0.17	0.17	1.32	81		1.10	81		90	0.099	100	100								56.2				72	73	73	70	-0.035		

Wood Heater Test Results - ASTM E2780 / ASTM E2515

Manufacturer: RAIS
Model: Viva L
Project No.: 0138WS017E
Tracking No.: 2233
Run: 4
Test Date: 02/09/17

Burn Rate	**0.991 kg/hr dry**
Average Tunnel Temperature	90 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	17.58 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11523.4 dscf/hour
Average Delta p	0.099 inches H20
Total Time of Test	190 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	32.183 cubic feet	31.861 cubic feet	10.103 cubic feet
Average Gas Meter Temperature	70 degrees Fahrenheit	81 degrees Fahrenheit	81 degrees Fahrenheit	81 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	30.577 dscf	30.422 dscf	9.599 dscf
Total Particulates - m_n	0 mg	2.4 mg	1.8 mg	0.9 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000000 grams/dscf	0.00008 grams/dscf	0.00006 grams/dscf	0.00009 grams/dscf
Total Particulate Emissions - E_T	0.00 grams	2.86 grams	2.16 grams	1.08 grams
Particulate Emission Rate	0.00 grams/hour	0.90 grams/hour	0.68 grams/hour	1.08 grams/hour
Emissions Factor		0.91 g/kg	0.69 g/kg	0.51 g/kg
Difference from Average Total Particulate Emissions		0.35 grams	0.35 grams	
	Dual Train Comparison Results Are Acceptable			

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	2.51 grams
Particulate Emission Rate	**0.79 grams/hour**
Emissions Factor	0.80 grams/kg
Train Precision g/kg ≤ 0.5	0.22 grams/kg
Train Precision ≤ 7.5%	14.0 %
First Hour Emissions	
Total Particulate Emissions - E_T	1.08 grams
Particulate Emission Rate	1.08 grams/hour
Emissions Factor	0.51 grams/kg

QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Stove Surface ΔT	OK

Technician Signature:_____

OMNI-Test Laboratories

Manufacturer:	**RAIS**
Model:	**Viva L**
Date:	**02/09/17**
Run:	**4**
Control #:	**0138WS017E**
Test Duration:	**190**
Output Category:	**II**

Technicians:

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	**72.2%**	**78.0%**
Combustion Efficiency	**91.2%**	**91.2%**
Heat Transfer Efficiency	**79%**	**85.5%**

Output Rate (kJ/h)	**13,889**	**13,175**	**(Btu/h)**
Burn Rate (kg/h)	**0.97**	**2.14**	**(lb/h)**
Input (kJ/h)	**19,244**	**18,255**	**(Btu/h)**

Test Load Weight (dry kg)	**3.08**	**6.78**	**dry lb**
MC wet (%)	**17.32**		
MC dry (%)	**20.95**		
Particulate (g)	**N/A**		
CO (g)	**376**		
Test Duration (h)	**3.17**		

Emissions	**Particulate**	**CO**
g/MJ Output	**N/A**	**8.54**
g/kg Dry Fuel	**N/A**	**122.08**
g/h	**N/A**	**118.59**
lb/MM Btu Output	**N/A**	**19.84**

Air/Fuel Ratio (A/F)	**13.68**

VERSION: **2.2** **12/14/2009**

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 4
Model: VIVA L Tracking Number: 2233 Date: ~~2/8/2017~~ 2/9/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Run Notes

Air Control Settings

Primary: Open 13mm

Secondary: Fixed

Tertiary/Pilot: Fixed

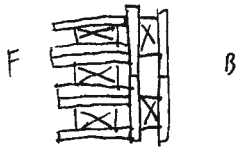
Fan: N/A

Preburn Notes

Time	Notes
0:00	Reduced air to test setting (logger ET = 10:00)
72:00	PB End, coal bed 2.0

Test Notes

Sketch test fuel configuration:



Start up procedures & Timeline:

Bypass: NA
Fuel loaded by: 0:20
Door closed at: 0:25
Primary air: ~~Set to~~ Start-up until 4:30
High until 4:50
Set from 4:50-5:00
Notes:

Time	Notes
	N/A

Technician Signature: Date: 2/9/17

Client: RAIS Project Number: 0138WS017E Run Number: 4
Model: VIVA L Tracking Number: 2233 Date: ~~2/6/2017~~ 2/9/2017 SB
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Supplemental Data

Start Time: 10:27 Booth #: E1
Stop Time: 13:37

Stack Gas Leak Check:
Initial: Ø Final: Ø

Sample Train Leak Check:
A: Ø @ 12 "Hg
B: Ø @ 9 "Hg

Calibrations: Span Gas CO_2: 16.74 CO(%): 4.20 CO(ppm): 500

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	8:15	8:17	19:09	19:05
CO_2	0.00	16.75	0.09	16.61
CO(%)	0.000	4.201	0.007	4.129
CO(ppm)	0	NA		

Air Velocity (ft/min): Initial: <50 Final: <50
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: Ø Final: Ø
Stack Diameter (in): 6"
Induced Draft: Ø
% Smoke Capture: 100%
Flue Pipe Cleaned Prior to First Test in Series:
Date: 2/2 Initials:

	Initial	Middle	Ending
P_b (in/Hg)	29.51	29.51	29.50
RH (%)	29.7	26.5	34.6
Ambient (°F)	69.4	72.8	70.5

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
0.024	0.048	92
0.035	0.070	
0.038	0.076	
0.029	0.058	
0.022	0.044	93
0.038	0.076	
0.038	0.076	
0.028	0.056	
Center:		
-	0.098	93

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-0.27	-0.27

Background Filter Volume: N/A

Technician Signature:
Date: 2/10/17

OMNI-Test Laboratories, Inc. **ASTM E2780 Wood Heater Run Sheets**

Client: RAIS Project Number: 0138WS017E Run Number: 4

Model: VIVA L Tracking Number: 2233 Date: ~~2/8/2017~~ 2/9/2017 SB

Test Crew: S. Button, A. Kravitz

OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Fuel Data

Fuel: Douglas fir, untreated and air dried, standard grade or better dimensional lumber

Pre-Burn Fuel

Calibration: Cal Value (1) = 12% Actual Reading 12.6

Cal Value (2) = 22% Actual Reading 22.6

Piece:	Length:	Reading:	Piece:	Length:	Reading:
1	8 in	21.7	7	8 in	19.4
2	" in	22.4	8	" in	20.2
3	" in	21.9	9	" in	19.1
4	" in	14.9	10	" in	14.6
5	" in	20.4	11	" in	21.7
6	" in	22.6	12	" in	

Total Pre-Burn Fuel Weight: 8.3 Pre-Burn Fuel Average Moisture: 20.81

Time (clock): 0930 Room Temperature (F): 69 Initials: A

Test Fuel

Firebox Volume (ft³): 1.29 Test Fuel Piece Length (in): 16.5

Load Weight Range (lb): 8.2-9.9 Total Wet Fuel Load Weight (lb): 8.2

Fuel Type & Amount: 2 x 4: 5 4 x 4:

Weight (with spacers): 8.2 Weight (with spacers):

Piece:	Weight (lbs):	Moisture Readings (%DB):			Fuel Type:
1	1.2	18.2	19.0	19.1	2x4
2	1.2	18.9	22.4	21.0	"
3	1.1	23.6	23.0	21.5	"
4	1.1	19.9	22.7	24.5	"
5	1.1	19.7	19.6	19.1	"
6					
7					

Spacer Moisture Readings (%DB)

8.1	16.7	17.6	14.1	17.1			
8.7	17.9	12.8	8.8	17.0			
9.3	17.0	13.4	12.8	14.4			
8.8	12.2	8.9	12.9	17.6			

Time (clock): 0930 Room Temperature (F): 68 Initials: A

Technician Signature: Date: 2/9/17

Run 5

Wood Heater Preburn Data - ASTM E2780

Run:	5

Technician Signature:

Manufacturer:	RAIS
Model:	Viva L
Tracking No.:	2233
Project No.:	0138WS017E
Test Date:	2/9/2017
Beginning Clock Time:	14:18

Coal Bed Range (lb):	1.6 (min)	2.1 (max)

Preburn Fuel Data

Fuel Piece Lengths (in.):	8.0		
Total Preburn Weight (lb):	8.3		
Fuel Moisture Readings (% DB):	20.8	19.9	24.6
	19.7	22.2	23.8
	24.3	18.6	20.1
	22.1	19.9	
Avg Preburn Moisture (% DB):	21.45		

			Temperatures (°F)							
Elapsed Time (min)	Scale (lb)	Stack Draft (in H_2O)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Avg. Firebox Surface	Stack	Ambient
0	7.9	-0.057	579	387	328	319	321	386.9	440	71
10	7.1	-0.042	568	403	331	314	311	385.4	278	72
20	6.2	-0.046	576	381	320	310	306	378.6	307	71
30	5.2	-0.043	613	354	325	325	322	387.7	298	71
40	4.5	-0.042	651	333	327	331	330	394.5	293	71
50	3.7	-0.044	674	317	329	335	334	397.7	316	72
60	3.0	-0.043	692	303	337	344	337	402.8	303	71
70	2.5	-0.04	692	292	346	354	344	405.7	289	72
80	2.2	-0.035	666	286	347	358	343	400.0	259	72
83	2.1	-0.034	651	285	347	357	340	396.0	252	72

Wood Heater Test Fuel Data - ASTM E2780

Manufacturer:	**RAIS**
Model:	**Viva L**
Tracking No.:	**2233**
Project No.:	**0138WS017E**
Test Date:	**2/9/2017**
Run No.:	**5**

Firebox Volume (ft^3):	**1.29**
Fuel Piece Length (in):	**10.5**
2x4 Crib Weight (lb):	**8.2**
4x4 Crib Weight (lb):	**0**

Total Fuel Weight (Dry Basis, lb):	**6.843**	
Fuel Density (lb/ft^3, Dry Basis):	**29.32**	**OK**
Loading Density (lb/ft^3, Wet Basis):	**6.36**	**OK**
2x4 Percentage:	**N/A**	**N/A**

Coal Bed Range (20-25%): 1.64 - 2.05

Test Fuel Piece	Weight (lb)	Size	Readings (Dry Basis %)			Dry Weight (lb)
1	1.1	2"x 4"	20.9	22.5	22.8	0.90
2	1.1	2"x 4"	23.3	21.2	21.3	0.90
3	1.2	2"x 4"	22.4	23.9	21.1	0.98
4	1.2	2"x 4"	22.1	21.7	21.1	0.99
5	1.1	2"x 4"	21.4	22.5	20.1	0.91

Spacer Readings (Dry Basis %)			
19.3	14.6		
14.8	12.8		
19.1	19.5		
18.3	9.9		
11.7	16.0		
8.9	13.3		
20.1	15.0		
14.1	18.8		
13.6	12.7		
20.4	14.9		

Technician Signature:

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E2780 / ASTM E2515

Run: 5

Manufacturer: RAIS
Model: Viva L
Tracking No.: 2233
Project No.: 0138WS017E
Test Date: 09-Feb-17
Beginning Clock Time: 15:41

Total Sampling Time: 200 min
Recording Interval: 10 min
Background Sample Volume: 0 cubic feet

Meter Box Y Factor: 0.984 (1) 0.99 (2) 1 (Amb)

Barometric Pressure: Begin 29.53 Middle 29.56 End 29.61 Average 29.57 "Hg

OMNI Equipment Numbers: 296-T55, 185, 340, 431, 335, 336, 594, 410, 559, 209, 132, 23, 592, 283A

PM Control Modules: 335/336
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.270 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 17.72 ft/sec.
Initial Tunnel Flow: 185.6 scfm
Average Tunnel Flow: 194.1 scfm
Post-Test Leak Check (1): 0.000 cfm @ 12 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 9 in. Hg
Average Test Piece Fuel Moisture: 21.89 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.048	0.070	0.076	0.058	0.044	0.076	0.076	0.056	0.098	"H2O
Temp:	92	92	92	92	93	93	93	93	93	°F

V_{strav} 17.53 ft/sec V_{scent} 21.38 ft/sec F_p 0.820

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)													Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface Temp	Catalyst Exit Temp	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			0.03	77	1.88	0.17	0.18	77.0	108	0.097			8.2		645	285	347	356	341	394.8	N/A	313	70	70	70	70	72	-0.045	3.89	0.29
10	1.685	1.673	0.17	0.17	1.40	77	2.26	0.17	1.16	78.0	96	0.099	102	101	7.2	-1.0	613	316	340	319	307	379.0	N/A	315	73	73	74	74	72	-0.046	9.35	1.09
20	3.370	3.345	0.17	0.17	1.39	79	2.25	0.17	1.14	79.0	93	0.100	101	100	6.4	-0.8	608	336	343	302	296	377.0	N/A	293	74	74	74	74	71	-0.044	9.62	0.92
30	5.055	5.017	0.17	0.17	1.38	80	2.24	0.17	1.14	80.0	93	0.098	102	101	5.5	-0.9	631	333	340	300	297	380.2	N/A	320	74	74	75	75	71	-0.047	11.45	2.13
40	6.741	6.691	0.17	0.17	1.38	81	2.25	0.17	1.15	81.0	95	0.101	100	100	4.6	-0.9	661	323	333	308	304	385.8	N/A	354	74	74	75	75	71	-0.051	13.13	0.63
50	8.430	8.367	0.17	0.17	1.38	82	2.24	0.17	1.15	82.0	98	0.103	99	99	3.6	-1.0	702	312	332	321	311	395.6	N/A	408	74	74	75	75	70	-0.056	14.11	1.61
60	10.120	10.045	0.17	0.17	1.39	82	2.25	0.17	1.15	83.0	99	0.099	102	102	2.7	-0.9	744	302	335	333	322	407.2	N/A	403	74	74	75	75	71	-0.055	13.91	0.95
70	11.812	11.723	0.17	0.17	1.39	83	2.25	0.17	1.15	84.0	95	0.103	99	99	2.0	-0.7	760	293	340	349	332	414.8	N/A	343	74	74	75	75	71	-0.049	10.34	0.16
80	13.507	13.404	0.17	0.17	1.39	83	2.25	0.17	1.15	84.0	92	0.102	100	100	1.7	-0.3	714	287	347	358	343	409.8	N/A	272	74	74	74	74	72	-0.039	8.77	0.31
90	15.202	15.087	0.17	0.17	1.39	83	2.24	0.17	1.16	84.0	87	0.106	97	97	1.5	-0.2	646	286	353	361	344	398.0	N/A	239	73	73	73	73	70	-0.034	7.13	1.15
100	16.900	16.772	0.17	0.17	1.39	83	2.24	0.17	1.15	84.0	85	0.103	99	99	1.4	-0.1	585	292	350	352	335	382.8	N/A	220	72	72	73	73	70	-0.031	7.15	1.17
110	18.596	18.457	0.17	0.17	1.40	83	2.24	0.17	1.15	83.0	84	0.100	100	100	1.2	-0.2	540	298	347	341	329	371.0	N/A	207	72	72	72	72	70	-0.027	6.64	1.51
120	20.295	20.141	0.17	0.17	1.39	83	2.25	0.17	1.15	83.0	84	0.102	99	99	1.1	-0.1	503	303	343	334	320	360.6	N/A	200	72	72	72	72	70	-0.025	6.72	1.38
130	21.991	21.826	0.17	0.17	1.40	83	2.24	0.17	1.16	83.0	84	0.101	99	100	0.9	-0.2	478	309	339	327	317	354.0	N/A	192	72	72	72	72	70	-0.024	6.77	1.35
140	23.689	23.512	0.17	0.17	1.40	83	2.25	0.17	1.15	83.0	84	0.098	101	101	0.8	-0.1	464	314	335	321	315	349.8	N/A	190	72	72	73	73	71	-0.023	6.34	1.48
150	25.386	25.197	0.17	0.17	1.40	83	2.25	0.17	1.15	83.0	84	0.105	98	98	0.7	-0.1	450	316	332	315	311	344.8	N/A	188	72	72	73	73	71	-0.022	6.18	1.62
160	27.085	26.881	0.17	0.17	1.40	83	2.25	0.17	1.16	83.0	83	0.101	99	100	0.6	-0.1	441	316	330	311	308	341.2	N/A	183	72	72	73	73	71	-0.021	6.25	1.72
170	28.782	28.565	0.17	0.17	1.39	83	2.24	0.17	1.15	84.0	83	0.099	100	101	0.4	-0.2	431	316	328	308	306	337.8	N/A	183	72	72	73	73	71	-0.021	5.99	1.93
180	30.480	30.250	0.17	0.17	1.40	84	2.24	0.17	1.15	84.0	84	0.100	100	100	0.3	-0.1	423	316	325	305	303	334.4	N/A	180	72	72	73	73	71	-0.021	6.16	1.86
190	32.178	31.935	0.17	0.17	1.40	84	2.25	0.17	1.15	84.0	83	0.102	99	99	0.2	-0.1	419	316	323	304	301	332.6	N/A	180	72	72	73	73	72	-0.020	6.39	1.68
200	33.877	33.619	0.17	0.17	1.40	84	2.24	0.17	1.15	84	83	0.100	100	100	0.0	-0.2	415	315	321	300	300	330	N/A	179	72	72	73	73	71	-0.021	4.86	3.22
Avg/Tot	33.877	33.619	0.17	0.17	1.33	82		0.17	1		89	0.101	100	100								64.6				73	73	73	71	-0.034		

Wood Heater Test Results - ASTM E2780 / ASTM E2515

Manufacturer: RAIS
Model: Viva L
Project No.: 0138WS017E
Tracking No.: 2233
Run: 5
Test Date: 02/09/17

Burn Rate	**0.931 kg/hr dry**
Average Tunnel Temperature	89 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	17.72 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11648.0 dscf/hour
Average Delta p	0.101 inches H20
Total Time of Test	200 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	33.877 cubic feet	33.619 cubic feet	10.120 cubic feet
Average Gas Meter Temperature	71 degrees Fahrenheit	82 degrees Fahrenheit	1 degrees Fahrenheit	82 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	32.181 dscf	37.662 dscf	9.613 dscf
Total Particulates - m_n	0 mg	2.8 mg	3.1 mg	1.3 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000000 grams/dscf	0.00009 grams/dscf	0.00008 grams/dscf	0.00014 grams/dscf
Total Particulate Emissions - E_T	0.00 grams	3.38 grams	3.20 grams	1.58 grams
Particulate Emission Rate	0.00 grams/hour	1.01 grams/hour	0.96 grams/hour	1.58 grams/hour
Emissions Factor		1.09 g/kg	1.03 g/kg	0.77 g/kg
Difference from Average Total Particulate Emissions		0.09 grams	0.09 grams	

Dual Train Comparison Results Are Acceptable

FINAL AVERAGE RESULTS	
Complete Test Run	
Total Particulate Emissions - E_T	3.29 grams
Particulate Emission Rate	**0.99 grams/hour**
Emissions Factor	1.06 grams/kg
Train Precision g/kg ≤ 0.5	0.06 grams/kg
Train Precision ≤ 7.5%	2.8 %
First Hour Emissions	
Total Particulate Emissions - E_T	1.58 grams
Particulate Emission Rate	1.58 grams/hour
Emissions Factor	0.77 grams/kg

QUALITY CHECKS	
Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Stove Surface ΔT	OK

Technician Signature:_____

OMNI-Test Laboratories

Manufacturer:	**RAIS**
Model:	**Viva L**
Date:	**02/09/17**
Run:	**5**
Control #:	**0138WS017E**
Test Duration:	**200**
Output Category:	**II**

Technicians:

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	**72.6%**	**78.4%**
Combustion Efficiency	**91.0%**	**91.0%**
Heat Transfer Efficiency	**80%**	**86.2%**

Output Rate (kJ/h)	**13,167**	**12,490**	**(Btu/h)**
Burn Rate (kg/h)	**0.92**	**2.02**	**(lb/h)**
Input (kJ/h)	**18,141**	**17,208**	**(Btu/h)**

Test Load Weight (dry kg)	**3.05**	**6.73**	**dry lb**
MC wet (%)	**17.96**		
MC dry (%)	**21.89**		
Particulate (g)	**N/A**		
CO (g)	**381**		
Test Duration (h)	**3.33**		

Emissions	Particulate	CO
g/MJ Output	**N/A**	**8.68**
g/kg Dry Fuel	**N/A**	**124.84**
g/h	**N/A**	**114.32**
lb/MM Btu Output	**N/A**	**20.18**

Air/Fuel Ratio (A/F)	**12.82**

VERSION: **2.2** **12/14/2009**

OMNI-Test Laboratories, Inc. **ASTM E2780 Wood Heater Run Sheets**

Client: RAIS Project Number: 0138WS017E Run Number: 5

Model: VIVA L Tracking Number: 2233 Date: ~~2/6/2017~~ 2/9/2017 SB

Test Crew: S. Button, A. Kravitz

OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Run Notes

Air Control Settings

Primary: 13 mm open

Secondary: Fixed

Tertiary/Pilot: Fixed

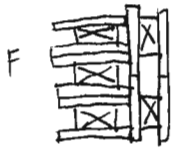
Fan: NA

Preburn Notes

Time	Notes
0:00	Begun PB @ test setting (logger ET = 11:00)
83:00	End PB, cowl bet = 2.1

Test Notes

Sketch test fuel configuration:



Start up procedures & Timeline:

Bypass: NA

Fuel loaded by: 0:25

Door closed at: 0:35

Primary air: Startup air until 4:30
High 4:30 - 4:50
Slowly set to test 4:50 - 5:00

Notes:

Time	Notes
	None

Technician Signature: _____ Date: 2/9/17

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 5
Model: VIVA L Tracking Number: 2233 Date: ~~2/6/2017~~ 2/9/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Supplemental Data

Start Time: 15:41 Booth #: E1
Stop Time: 19:01

Stack Gas Leak Check:
Initial: 0 Final: 0

Sample Train Leak Check:
A: 0 @ 15 "Hg
B: 0 @ 9 "Hg

Calibrations: Span Gas CO_2: 16.74 CO(%): 4.20 CO(ppm): 500

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	8:15	8:17	19:09	19:05
CO_2	0.00	16.75	0.09	16.66
CO(%)	0.002	4.201	0.007	4.129
CO(ppm)	6			

Air Velocity (ft/min): Initial: 450 Final: 450
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: 0 Final: 0
Stack Diameter (in): 6
Induced Draft: 0
% Smoke Capture: 100
Flue Pipe Cleaned Prior to First Test in Series:
Date: 2/2 Initials: [illegible]

	Initial	Middle	Ending
P_b (in/Hg)	29.53	29.56 ~~36.2~~	29.61
RH (%)	35.1	36.2	35.7
Ambient (°F)	71.0	72.8	73.0

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
0.024	0.048	92
0.035	0.070	↓
0.038	0.076	
0.029	0.058	↓
0.022	0.044	93
0.038	0.076	↓
0.038	0.086	
0.028	0.056	↓
Center:		
-	0.098	93

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-0.27	-0.27

Background Filter Volume: N/A

Technician Signature: [signature] Date: 2/10/17

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 5
Model: VIVA L Tracking Number: 2233 Date: 2/8/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Fuel Data

Fuel: Douglas fir, untreated and air dried, standard grade or better dimensional lumber

Pre-Burn Fuel

Calibration: Cal Value (1) = 12% Actual Reading 12.0
Cal Value (2) = 22% Actual Reading 22.12

Piece:	Length:	Reading:	Piece:	Length:	Reading:
1	8 in	20.8	7	8 in	22.2
2	8 in	19.7	8	8 in	19.9
3	8 in	24.7	9	8 in	24.6
4	8 in	22.1	10	8 in	23.8
5	8 in	18.9	11	8 in	20.4
6	8 in	18.6	12	8 in	

Total Pre-Burn Fuel Weight: 8.4 Pre-Burn Fuel Average Moisture: 21.45

Time (clock): 14:00 Room Temperature (F): 76 Initials: [illegible]

Test Fuel

Firebox Volume (ft³): 1.29 Test Fuel Piece Length (in): 10.5
Load Weight Range (lb): 6.2-9.1 Total Wet Fuel Load Weight (lb): 8.2

Fuel Type & Amount: 2 x 4: 8 @ 5 4 x 4:
Weight (with spacers): 8.2 Weight (with spacers):

Piece:	Weight (lbs):	Moisture Readings (%DB):			Fuel Type:
1	1.2	22.4	23.9	21.1	2x4
2	1.2	22.1	21.7	21.1	
3	1.1	20.9	22.5	22.8	
4	1.1	23.3	21.2	21.3	
5	1.1	21.4	22.5	20.1	
6					
7					

Spacer Moisture Readings (%DB)

19.3	11.7	20.4	19.5	15.0			
14.8	8.9	20.1	9.9	14.8			
19.1	14.1	17.6	16.0	12.7			
18.3	13.6	12.8	13.3	14.9			

Time (clock): 14:00 Room Temperature (F): 76 Initials: [illegible]

Technician Signature: [signature] Date: 2/9/17

Run 6

Wood Heater Preburn Data - ASTM E2780

Run:	6

Technician Signature:

Manufacturer:	RAIS
Model:	Viva L
Tracking No.:	2233
Project No.:	0138WS017E
Test Date:	2/10/2017
Beginning Clock Time:	8:54

Coal Bed Range (lb):	1.7 (min)	2.1 (max)

Preburn Fuel Data

Fuel Piece Lengths (in.):	8.0	
Total Preburn Weight (lb):	8.3	
Fuel Moisture Readings (% DB):	18.7	22.8
	20.3	19.6
	19.3	19.3
	25.4	19.5
	24.9	19.4
Avg Preburn Moisture (% DB):	20.92	

			Temperatures (°F)							
Elapsed Time (min)	Scale (lb)	Stack Draft (in H_2O)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Avg. Firebox Surface	Stack	Ambient
0	8.6	-0.044	454	130	225	261	255	265.0	309	68
10	7.2	-0.064	452	234	259	255	247	289.4	480	68
20	5.8	-0.054	575	297	293	286	273	344.6	369	68
30	4.6	-0.051	636	301	309	313	310	373.8	348	68
40	3.7	-0.049	681	293	326	332	329	392.2	337	68
50	3.0	-0.046	700	285	339	346	342	402.4	319	68
60	2.3	-0.044	694	280	348	358	348	405.7	309	68
70	1.9	-0.041	667	280	350	359	361	403.4	292	68
74	1.7	-0.041	658	280	352	358	359	401.5	281	68

Wood Heater Test Fuel Data - ASTM E2780

Manufacturer:	**RAIS**
Model:	**Viva L**
Tracking No.:	**2233**
Project No.:	**0138WS017E**
Test Date:	**2/10/2017**
Run No.:	**6**

Firebox Volume (ft^3):	**1.29**
Fuel Piece Length (in):	**10.5**
2x4 Crib Weight (lb):	**8.3**
4x4 Crib Weight (lb):	**0**

Total Fuel Weight (Dry Basis, lb):	**7.008**	
Fuel Density (lb/ft^3, Dry Basis):	**29.12**	**OK**
Loading Density (lb/ft^3, Wet Basis):	**6.43**	**OK**
2x4 Percentage:	**N/A**	**N/A**

Coal Bed Range (20-25%): 1.66 - 2.075

Test Fuel Piece	Weight (lb)	Size	Readings (Dry Basis %)			Dry Weight (lb)
1	1.2	2"x 4"	23.7	23.1	22.9	0.97
2	1.1	2"x 4"	19.8	22.4	22.6	0.90
3	1.1	2"x 4"	22.5	22.5	22.5	0.90
4	1.1	2"x 4"	23.1	23.3	23.3	0.89
5	1.2	2"x 4"	23.7	22.5	22.5	0.98

Spacer Readings (Dry Basis %)			
7.6	9.4		
18.3	10.2		
6.8	7.6		
8.0	11.3		
6.9	8.8		
8.8	9.6		
11.2	7.9		
14.3			
8.2			
12.1			
11.3			
9.7			
13.1			

Technician Signature:

Wood Heater Test Data - ASTM E2780 / ASTM E2515

Run: 6

Manufacturer: RAIS
Model: Viva L
Tracking No.: 2233
Project No.: 0138WS017E
Test Date: 10-Feb-17
Beginning Clock Time: 10:09

Total Sampling Time: 180 min
Recording Interval: 10 min
Background Sample Volume: 0 cubic feet

Meter Box Y Factor: 0.984 (1) 0.99 (2) 1 (Amb)

Barometric Pressure:

Begin	Middle	End	Average
29.96	29.98	29.99	29.98 "Hg

OMNI Equipment Numbers: 296-T55, 185, 340, 431, 335, 336, 594, 410, 559, 209, 132, 23, 592, 283A

PM Control Modules: 335/336
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.270 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 17.24 ft/sec.
Initial Tunnel Flow: 188.0 scfm
Average Tunnel Flow: 190.8 scfm
Post-Test Leak Check (1): 0.000 cfm @ 12 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 9 in. Hg
Average Test Piece Fuel Moisture: 22.69 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.056	0.076	0.074	0.056	0.044	0.072	0.072	0.056	0.103	"H2O
Temp:	90	90	90	90	89	89	89	89	90	°F

V_{strav} 17.46 ft/sec V_{scent} 21.70 ft/sec F_p 0.805

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)												Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface Temp	Catalyst Exit Temp	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			0.52	72	1.14	0.78	73	1.3	105	0.102			8.3		654	280	353	362	363	402.4	N/A	327	68	68	68	68	69	-0.050	4.07	0.29
10	1.672	1.661	0.17	0.17	1.43	72	2.29	1.17	73	1.3	95	0.100	101	101	7.1	-1.2	645	316	346	322	323	390.4	N/A	353	70	70	72	72	68	-0.051	9.84	1.26
20	3.354	3.328	0.17	0.17	1.41	74	2.27	1.16	75	1.3	95	0.101	100	100	6.1	-1.0	664	338	341	305	307	391.0	N/A	336	71	71	73	73	69	-0.050	10.26	1
30	5.036	4.995	0.17	0.17	1.41	76	2.28	1.16	77	1.3	97	0.099	101	101	5.0	-1.1	689	335	332	307	308	394.2	N/A	370	72	72	73	73	70	-0.053	11.86	0.96
40	6.720	6.665	0.17	0.17	1.41	78	2.28	1.16	78	1.3	100	0.101	100	100	4.0	-1.0	718	326	331	320	317	402.4	N/A	411	73	73	74	74	70	-0.056	13.29	0.65
50	8.406	8.334	0.17	0.17	1.41	79	2.27	1.17	80	1.3	104	0.100	101	101	2.9	-1.1	760	314	335	337	328	414.8	N/A	435	74	74	75	75	70	-0.058	13.36	1.01
60	10.095	10.007	0.17	0.17	1.41	80	2.27	1.17	81	1.3	101	0.103	99	99	2.1	-0.8	783	303	341	352	338	423.4	N/A	378	74	74	76	76	71	-0.053	11.42	0.17
70	11.797	11.684	0.17	0.17	1.42	81	2.26	1.16	82	1.3	95	0.100	101	100	1.7	-0.4	725	296	350	367	350	417.6	N/A	284	74	74	75	75	71	-0.040	3.49	3.3
80	13.495	13.362	0.17	0.17	1.42	82	2.26	1.17	83	1.3	91	0.101	99	99	1.5	-0.2	614	294	352	355	347	392.4	N/A	254	74	74	75	75	71	-0.036	7.61	0.62
90	15.196	15.043	0.17	0.17	1.42	82	2.26	1.17	83	1.3	89	0.096	102	102	1.3	-0.2	565	300	350	352	351	383.6	N/A	234	74	74	74	74	71	-0.032	6.75	0.93
100	16.897	16.725	0.17	0.17	1.43	83	2.26	1.17	83	1.3	87	0.101	99	99	1.1	-0.2	528	311	350	349	348	377.2	N/A	221	73	73	74	74	71	-0.029	7.28	0.83
110	18.598	18.407	0.17	0.17	1.42	83	2.26	1.17	84	1.3	87	0.102	98	98	1.0	-0.1	509	320	348	341	339	371.4	N/A	219	73	73	74	74	71	-0.028	7.06	0.86
120	20.303	20.090	0.17	0.17	1.43	83	2.26	1.17	84	1.3	86	0.099	100	100	0.8	-0.2	497	326	346	338	336	368.6	N/A	216	73	73	73	73	71	-0.027	6.79	1.06
130	22.007	21.775	0.17	0.17	1.43	83	2.27	1.17	84	1.3	85	0.100	99	99	0.7	-0.1	484	331	345	335	330	365.0	N/A	212	72	72	73	73	71	-0.027	6.4	1.22
140	23.710	23.458	0.17	0.17	1.42	83	2.26	1.17	84	1.3	85	0.099	100	100	0.5	-0.2	472	334	342	330	326	360.8	N/A	210	72	72	73	73	72	-0.026	6.29	1.3
150	25.413	25.141	0.17	0.17	1.43	83	2.27	1.17	84	1.3	86	0.100	100	99	0.4	-0.1	462	335	339	326	321	356.6	N/A	206	72	72	73	73	72	-0.025	6.31	1.15
160	27.117	26.825	0.17	0.17	1.43	83	2.27	1.17	84	1.3	85	0.101	99	99	0.2	-0.2	453	337	337	326	317	354.0	N/A	203	72	72	73	73	71	-0.025	5.07	1.26
170	28.821	28.509	0.17	0.17	1.42	84	2.27	1.17	84	1.3	85	0.100	99	99	0.1	-0.1	439	339	334	317	314	348.6	N/A	198	73	73	73	73	72	-0.025	5.79	1.11
180	30.524	30.192	0.17	0.17	1.42	84	2.26	1.17	84	1.3	85	0.099	100	100	0.0	-0.1	428	342	331	314	314	345.8	N/A	194	73	73	73	73	72	-0.023	5.92	1.08
Avg/Tot	30.524	30.192	0.17	0.17	1.37	80		1.15	81		92	0.100	100	100								56.6				72	73	73	71	-0.038		

Wood Heater Test Results - ASTM E2780 / ASTM E2515

Manufacturer: RAIS
Model: Viva L
Project No.: 0138WS017E
Tracking No.: 2233
Run: 6
Test Date: 02/10/17

Burn Rate	**1.060 kg/hr dry**
Average Tunnel Temperature	92 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	17.24 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11445.8 dscf/hour
Average Delta p	0.100 inches H20
Total Time of Test	180 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	30.524 cubic feet	30.192 cubic feet	10.095 cubic feet
Average Gas Meter Temperature	71 degrees Fahrenheit	80 degrees Fahrenheit	81 degrees Fahrenheit	80 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	29.497 dscf	29.295 dscf	9.755 dscf
Total Particulates - m_n	0 mg	2.5 mg	2.1 mg	0.6 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000000 grams/dscf	0.00008 grams/dscf	0.00007 grams/dscf	0.00006 grams/dscf
Total Particulate Emissions - E_T	0.00 grams	2.91 grams	2.46 grams	0.70 grams
Particulate Emission Rate	0.00 grams/hour	0.97 grams/hour	0.82 grams/hour	0.70 grams/hour
Emissions Factor		0.92 g/kg	0.77 g/kg	0.31 g/kg
Difference from Average Total Particulate Emissions		0.22 grams	0.22 grams	
	Dual Train Comparison Results Are Acceptable			

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	2.69 grams
Particulate Emission Rate	**0.90 grams/hour**
Emissions Factor	0.84 grams/kg
Train Precision g/kg ≤ 0.5	0.14 grams/kg
Train Precision ≤ 7.5%	8.4 %
First Hour Emissions	
Total Particulate Emissions - E_T	0.70 grams
Particulate Emission Rate	0.70 grams/hour
Emissions Factor	0.31 grams/kg

QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Stove Surface ΔT	OK

Technician Signature:_____

OMNI-Test Laboratories

Manufacturer:	**RAIS**
Model:	**Viva L**
Date:	**02/10/17**
Run:	**6**
Control #:	**0138WS017E**
Test Duration:	**180**
Output Category:	**II**

Technicians:

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	**71.9%**	**77.7%**
Combustion Efficiency	**91.7%**	**91.7%**
Heat Transfer Efficiency	**78%**	**84.8%**

Output Rate (kJ/h)	**14,568**	**13,820**	**(Btu/h)**
Burn Rate (kg/h)	**1.02**	**2.25**	**(lb/h)**
Input (kJ/h)	**20,268**	**19,226**	**(Btu/h)**

Test Load Weight (dry kg)	**3.07**	**6.76**	**dry lb**
MC wet (%)	**18.50**		
MC dry (%)	**22.69**		
Particulate (g)	**N/A**		
CO (g)	**356**		
Test Duration (h)	**3.00**		

Emissions	Particulate	CO
g/MJ Output	**N/A**	**8.14**
g/kg Dry Fuel	**N/A**	**115.93**
g/h	**N/A**	**118.61**
lb/MM Btu Output	**N/A**	**18.92**

Air/Fuel Ratio (A/F)	**13.70**

VERSION: **2.2** **12/14/2009**

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 6
Model: VIVA L Tracking Number: 2233 Date: 2/10/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Run Notes

Air Control Settings

Primary: 15 mm Open

Secondary: Fixed

Tertiary/Pilot: Fixed

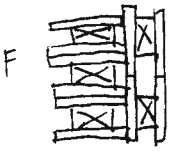
Fan: NA

Preburn Notes

Time	Notes
0:00	Air set to test setting
4:00	PB Fuel

Test Notes

Sketch test fuel configuration:



Start up procedures & Timeline:

Bypass: NA
Fuel loaded by: ~~3:00~~ 0:30
Door closed at: 0:35
Primary air: Start up until 4:30
Set fan 4:50 - 5:00

Notes:

Time	Notes

Technician Signature: _____ Date: 2/10/17

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 6
Model: VIVA L Tracking Number: 2233 Date: 2/10/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Supplemental Data

Start Time: 10:09 Booth #: E1
Stop Time: 13:09

Stack Gas Leak Check:
Initial: 0 Final: 0

Sample Train Leak Check:
A: 0 @ 12 "Hg
B: 0 @ 9 "Hg

Calibrations: Span Gas CO_2: 16.74 CO(%): 4.20 CO(ppm): 500

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	8:30	8:35		
CO_2	0.00	16.75	See Run #6 Data	
CO(%)	0.000	4.201		
CO(ppm)	0			

Air Velocity (ft/min): Initial: <50 Final: <50
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: 0 Final: 0
Stack Diameter (in): 6"
Induced Draft: 0
% Smoke Capture: 100%
Flue Pipe Cleaned Prior to First Test in Series:
Date: 2/2/17 Initials: [signature]

	Initial	Middle	Ending
P_b (in/Hg)	29.96	29.98	29.99
RH (%)	31.6	30.1	28.9
Ambient (°F)	69.1	69.9	71.6

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
0.028	0.056	90
0.038	0.076	↓
0.037	0.074	↓
0.028	0.056	↓
0.022	0.044	89
0.036	0.072	↓
0.036	0.072	↓
0.028	0.056	↓
Center:		
–	0.103	90

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-0.27	-0.27

Background Filter Volume: N/A

Technician Signature: [signature] Date: 2/10/17

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 6
Model: VIVA L Tracking Number: 2233 Date: 2/10/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Fuel Data

Fuel: Douglas fir, untreated and air dried, standard grade or better dimensional lumber

Pre-Burn Fuel

Calibration: Cal Value (1) = 12% Actual Reading 12%
Cal Value (2) = 22% Actual Reading 22%

Piece:	Length:	Reading:	Piece:	Length:	Reading:
1	8 in	18.7	7	8 in	19.6
2		20.3	8		19.7
3		19.3	9		19.3
4		25.4	10		19.5
5		24.9	11		15.4
6		22.8	12	in	

Total Pre-Burn Fuel Weight: 8.3 Pre-Burn Fuel Average Moisture: 20.92

Time (clock): 0830 Room Temperature (F): 65 Initials: [illegible]

Test Fuel

Firebox Volume (ft³): 1.29 Test Fuel Piece Length (in): 16.5
Load Weight Range (lb): 8.2 - 9.9 Total Wet Fuel Load Weight (lb): 8.3

Fuel Type & Amount: 2 x 4: 5 4 x 4:
Weight (with spacers): 8.3 Weight (with spacers):

Piece:	Weight (lbs):	Moisture Readings (%DB):				Fuel Type:
1	1.2	23.7	23.1	22.5		2x4
2	1.1	19.8	22.4	22.6		2x4
3	1.1	22.5	22.5	22.5		2x4
4	1.1	23.1	23.3	23.3		2x4
5	1.2	23.2	22.5	22.5		2x4
6						
7						

Spacer Moisture Readings (%DB)

7.6	6.9	8.2	18.1	11.3			
18.3	8.8	12.1	9.4	8.8			
6.8	11.2	11.3	10.2	9.6			
8.0	14.3	9.7	7.6	7.9			

Time (clock): 9:00 Room Temperature (F): 65 F Initials: SB

Technician Signature: [signature] Date: 2/10/17

Run 7

Wood Heater Preburn Data - ASTM E2780

Run:	7

Technician Signature:

Manufacturer:	RAIS
Model:	Viva L
Tracking No.:	2233
Project No.:	0138WS017E
Test Date:	2/10/2017
Beginning Clock Time:	14:44

Coal Bed Range (lb):	1.7 (min)	2.1 (max)

Preburn Fuel Data

Fuel Piece Lengths (in.):	8.0		
Total Preburn Weight (lb):	8.7		
Fuel Moisture Readings (% DB):	22.3	20.9	19.0
	20.0	22.0	21.6
	19.8	22.0	21.3
	20.8	18.6	
Avg Preburn Moisture (% DB):	20.75		

			Temperatures (°F)							
Elapsed Time (min)	Scale (lb)	Stack Draft (in H_2O)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Avg. Firebox Surface	Stack	Ambient
0	8.9	-0.052	597	320	336	364	357	394.7	356	72
10	7.7	-0.057	607	373	336	332	323	394.2	396	70
20	6.3	-0.059	656	370	331	333	329	403.7	403	70
30	5.1	-0.058	702	346	339	350	351	417.5	407	71
40	4.0	-0.062	756	325	350	366	359	431.3	451	71
50	3.1	-0.056	762	309	361	381	370	436.6	393	71
60	2.4	-0.054	735	301	376	397	404	442.6	387	71
68	2.1	-0.047	697	303	394	407	397	439.7	335	71

Wood Heater Test Fuel Data - ASTM E2780

Manufacturer:	**RAIS**
Model:	**Viva L**
Tracking No.:	**2233**
Project No.:	**0138WS017E**
Test Date:	**2/10/2017**
Run No.:	**7**

Firebox Volume (ft^3):	**1.29**
Fuel Piece Length (in):	**10.5**
2x4 Crib Weight (lb):	**8.4**
4x4 Crib Weight (lb):	**0**

Total Fuel Weight (Dry Basis, lb):	**7.097**	
Fuel Density (lb/ft^3, Dry Basis):	**30.13**	**OK**
Loading Density (lb/ft^3, Wet Basis):	**6.51**	**OK**
2x4 Percentage:	**N/A**	**N/A**

Coal Bed Range (20-25%): 1.68 - 2.1

Test Fuel Piece	Weight (lb)	Size	Readings (Dry Basis %)			Dry Weight (lb)
1	1.2	2"x 4"	22.8	23.0	22.5	0.98
2	1.2	2"x 4"	22.7	22.5	22.7	0.98
3	1.2	2"x 4"	23.0	23.1	23.5	0.97
4	1.1	2"x 4"	23.1	23.2	23.9	0.89
5	1.2	2"x 4"	22.6	21.2	22.1	0.98

Spacer Readings (Dry Basis %)			
8.0	8.9		
8.4	9.8		
7.0	11.2		
7.4	8.0		
13.2	8.8		
8.2	7.7		
9.9	8.0		
8.0	11.5		
11.5	7.8		
7.8	10.3		

Technician Signature:

Wood Heater Test Data - ASTM E2780 / ASTM E2515

Run: 7

Manufacturer: RAIS
Model: Viva L
Tracking No.: 2233
Project No.: 0138WS017E
Test Date: 10-Feb-17
Beginning Clock Time: 14:53

Total Sampling Time: 150 min
Recording Interval: 10 min
Background Sample Volume: 0 cubic feet

Meter Box Y Factor: 0.984 (1) 0.99 (2) 1 (Amb)

Barometric Pressure:

Begin	Middle	End	Average
30.02	30.07	30.09	30.06 "Hg

OMNI Equipment Numbers: 296-T55, 185, 340, 431, 335, 336, 594, 410, 559, 209, 132, 23, 592, 283A

PM Control Modules: 335/336
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.270 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 17.53 ft/sec.
Initial Tunnel Flow: 188.3 scfm
Average Tunnel Flow: 192.8 scfm
Post-Test Leak Check (1): 0.000 cfm @ 12 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ 9 in. Hg
Average Test Piece Fuel Moisture: 22.79 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.056	0.076	0.074	0.056	0.044	0.072	0.072	0.056	0.103	"H2O
Temp:	90	90	90	90	89	89	89	89	90	°F

V_{strav} 17.44 ft/sec V_{scent} 21.68 ft/sec F_p 0.805

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)											Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface Temp	Catalyst Exit Temp	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			0.03	76	1.68	0.40	78	1.0	112	0.104			8.4		688	302	396	408	397	438.2	N/A	365	69	69	70	70	71	-0.053	3.35	0.2
10	1.686	1.668	0.17	0.17	1.43	77	2.31	1.18	78	1.4	102	0.104	100	100	7.1	-1.3	680	342	380	359	351	422.4	N/A	411	73	73	74	74	71	-0.060	10.94	0.67
20	3.374	3.337	0.17	0.17	1.42	78	2.30	1.17	79	1.3	104	0.100	102	102	5.7	-1.4	719	358	366	338	332	422.6	N/A	452	74	74	75	75	70	-0.064	12.34	0.99
30	5.061	5.005	0.17	0.17	1.41	79	2.29	1.17	80	1.4	106	0.104	100	100	4.4	-1.3	764	348	354	345	338	429.8	N/A	473	74	74	75	75	70	-0.065	13.63	1.07
40	6.749	6.676	0.17	0.17	1.42	80	2.30	1.17	81	1.3	108	0.110	97	98	3.1	-1.3	802	332	350	356	347	437.4	N/A	499	75	75	76	76	70	-0.066	14.16	0.31
50	8.439	8.347	0.17	0.17	1.41	80	2.29	1.16	82	1.4	103	0.104	100	100	2.2	-0.9	806	316	353	375	357	441.4	N/A	426	75	75	75	75	71	-0.059	11.33	0.14
60	10.133	10.020	0.17	0.17	1.43	81	2.26	1.17	83	1.4	99	0.100	101	101	1.7	-0.5	755	307	363	393	375	438.6	N/A	349	74	74	75	75	70	-0.049	8.57	0.06
70	11.834	11.694	0.17	0.17	1.43	82	2.25	1.17	83	1.4	95	0.103	100	100	1.4	-0.3	675	303	380	403	388	429.8	N/A	304	75	75	75	75	71	-0.044	7.47	0.4
80	13.538	13.370	0.17	0.17	1.44	83	2.25	1.17	84	1.4	92	0.101	101	100	1.2	-0.2	613	307	389	397	394	420.0	N/A	283	74	74	74	74	72	-0.039	7.3	0.59
90	15.243	15.048	0.17	0.17	1.43	83	2.25	1.17	84	1.4	91	0.103	100	99	1.0	-0.2	571	314	388	387	396	411.2	N/A	270	74	74	74	74	71	-0.037	7.19	0.81
100	16.948	16.727	0.17	0.17	1.43	83	2.26	1.17	84	1.4	90	0.104	99	99	0.8	-0.2	541	322	384	377	390	402.8	N/A	260	74	74	74	74	71	-0.035	6.83	0.98
110	18.655	18.407	0.17	0.17	1.43	84	2.26	1.17	85	1.4	89	0.102	100	100	0.6	-0.2	522	327	381	373	371	394.8	N/A	251	73	73	74	74	71	-0.035	6.64	0.98
120	20.362	20.088	0.17	0.17	1.44	84	2.26	1.17	85	1.4	88	0.101	100	100	0.5	-0.1	505	330	371	361	353	384.0	N/A	245	73	73	74	74	72	-0.034	6.13	1
130	22.071	21.769	0.17	0.17	1.44	84	2.26	1.17	85	1.4	88	0.100	101	101	0.3	-0.2	487	332	356	349	340	372.8	N/A	244	73	73	74	74	71	-0.033	5.79	1.27
140	23.779	23.450	0.17	0.17	1.44	84	2.26	1.17	85	1.4	88	0.103	99	99	0.1	-0.2	473	333	348	337	331	364.4	N/A	240	73	73	73	73	72	-0.033	5.85	1.2
150	25.488	25.131	0.17	0.17	1.44	84	2.26	1.17	84	1.4	88	0.105	98	98	0.0	-0.1	461	337	340	328	324	358.0	N/A	237	73	73	74	74	71	-0.032	5.76	1.11
Avg/Tot	25.488	25.131	0.17	0.17	1.34	81		1.12	83		96	0.103	100	100								80.2				74	74	74	71	-0.046		

Wood Heater Test Results - ASTM E2780 / ASTM E2515

Manufacturer: RAIS
Model: Viva L
Project No.: 0138WS017E
Tracking No.: 2233
Run: 7
Test Date: 02/10/17

Burn Rate	**1.288 kg/hr dry**
Average Tunnel Temperature	96 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	17.53 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11570.5 dscf/hour
Average Delta p	0.103 inches H20
Total Time of Test	150 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	25.488 cubic feet	25.131 cubic feet	10.133 cubic feet
Average Gas Meter Temperature	71 degrees Fahrenheit	81 degrees Fahrenheit	83 degrees Fahrenheit	81 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	24.646 dscf	24.385 dscf	9.798 dscf
Total Particulates - m_n	0 mg	2.1 mg	1.9 mg	0.5 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000000 grams/dscf	0.00009 grams/dscf	0.00008 grams/dscf	0.00005 grams/dscf
Total Particulate Emissions - E_T	0.00 grams	2.46 grams	2.25 grams	0.59 grams
Particulate Emission Rate	0.00 grams/hour	0.99 grams/hour	0.90 grams/hour	0.59 grams/hour
Emissions Factor		0.77 g/kg	0.70 g/kg	0.24 g/kg
Difference from Average Total Particulate Emissions		0.11 grams	0.11 grams	

Dual Train Comparison Results Are Acceptable

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	2.36 grams
Particulate Emission Rate	**0.94 grams/hour**
Emissions Factor	0.73 grams/kg
Train Precision g/kg ≤ 0.5	0.07 grams/kg
Train Precision ≤ 7.5%	4.5 %
First Hour Emissions	
Total Particulate Emissions - E_T	0.59 grams
Particulate Emission Rate	0.59 grams/hour
Emissions Factor	0.24 grams/kg

QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Stove Surface ΔT	OK

Technician Signature:_____

OMNI-Test Laboratories

Manufacturer:	**RAIS**
Model:	**Viva L**
Date:	**02/10/17**
Run:	**7**
Control #:	**0138WS017E**
Test Duration:	**150**
Output Category:	**II**

Technicians:

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	**73.0%**	**78.9%**
Combustion Efficiency	**94.9%**	**94.9%**
Heat Transfer Efficiency	**77%**	**83.1%**

Output Rate (kJ/h)	**17,951**	**17,028**	**(Btu/h)**
Burn Rate (kg/h)	**1.24**	**2.74**	**(lb/h)**
Input (kJ/h)	**24,594**	**23,331**	**(Btu/h)**

Test Load Weight (dry kg)	**3.10**	**6.84**	**dry lb**
MC wet (%)	**18.56**		
MC dry (%)	**22.79**		
Particulate (g)	**N/A**		
CO (g)	**224**		
Test Duration (h)	**2.50**		

Emissions	Particulate	CO
g/MJ Output	**N/A**	**4.99**
g/kg Dry Fuel	**N/A**	**72.19**
g/h	**N/A**	**89.63**
lb/MM Btu Output	**N/A**	**11.60**

Air/Fuel Ratio (A/F)	**13.46**

VERSION: **2.2** **12/14/2009**

OMNI-Test Laboratories, Inc. **ASTM E2780 Wood Heater Run Sheets**

Client: RAIS Project Number: 0138WS017E Run Number: 7
Model: VIVA L Tracking Number: 2233 Date: 2/10/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Run Notes

Air Control Settings

Primary: Open 22 mm

Secondary: Fixed

Tertiary/Pilot: Fixed

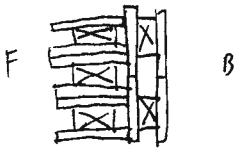
Fan: N/A

Preburn Notes

Time	Notes
0:00	Air set to test setting
68:00	PB End

Test Notes

Sketch test fuel configuration:



Start up procedures & Timeline:

Bypass: NA
Fuel loaded by: 0:25
Door closed at: 0:35
Primary air: Startup until 4:00
set from 4:50 - 5:00

Notes:

Time	Notes
	None

Technician Signature: _____ Date: 2/10/17

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 7
Model: VIVA L Tracking Number: 2233 Date: 2/10/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Supplemental Data

Start Time: 14:53
Stop Time: 17:23

Booth #: F1

Stack Gas Leak Check:
Initial: 0 Final: 0

Sample Train Leak Check:
A: 0 @ 12 "Hg
B: 0 @ 10 "Hg

Calibrations: Span Gas CO_2: 16.74 CO(%): 4.20 CO(ppm): 500

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time			17:46	17:47
CO_2	See Run		0.16	16.71
CO(%)	#6	Data	0.007	4.243
CO(ppm)			6	—

Air Velocity (ft/min): Initial: 650 Final: 650
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: 0 Final: 0
Stack Diameter (in): 6
Induced Draft: 0
% Smoke Capture: 100
Flue Pipe Cleaned Prior to First Test in Series:
Date: 2/2 Initials: A

	Initial	Middle	Ending
P_b (in/Hg)	30.02	30.07	30.09
RH (%)	27.7	28.5	30.6
Ambient (°F)	71.9	72.1	20.8

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
See Run		
	#6	
	Data	
Center:		

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-0.21	-0.27

Background Filter Volume: NA

Technician Signature: _____ Date: 2/10/17

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 7
Model: VIVA L Tracking Number: 2233 Date: 2/10/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Fuel Data

Fuel: Douglas fir, untreated and air dried, standard grade or better dimensional lumber

Pre-Burn Fuel

Calibration: Cal Value (1) = 12% Actual Reading 12.6
Cal Value (2) = 22% Actual Reading 22.0

Piece:	Length:	Reading:	Piece:	Length:	Reading:
1	8 in	22.3	7	8 in	22.0
2	in	20.0	8	in	18.6
3	in	19.8	9	in	19.0
4	in	20.8	10	in	21.6
5	in	20.9	11	in	21.3
6	in	22.0	12	in	

Total Pre-Burn Fuel Weight: 8.7 Pre-Burn Fuel Average Moisture: 20.75

Time (clock): 13:00 Room Temperature (F): 67 Initials: SB

Test Fuel

Firebox Volume (ft³): 1.2 Test Fuel Piece Length (in): 10.5
Load Weight Range (lb): 6.2-9.2 Total Wet Fuel Load Weight (lb): 8.4

Fuel Type & Amount: 2 x 4: 5 4 x 4: Ø
Weight (with spacers): 8.4 Weight (with spacers): Ø

Piece:	Weight (lbs):	Moisture Readings (%DB):			Fuel Type:
1	1.2	22.8	23.0	22.5	2x4
2	1.2	22.7	22.5	22.7	2x4
3	1.2	23.0	23.1	23.5	2x4
4	1.1	23.1	23.2	23.9	2x4
5	1.2	22.6	21.2	22.1	2x4
6					
7					

Spacer Moisture Readings (%DB)

8.0	13.2	11.5	11.5	8.0			
8.4	8.2	7.8	8.0	11.2			
7.0	9.9	10.3	7.7	9.8			
7.4	8.5	7.8	8.8	8.9			

Time (clock): 13:30 Room Temperature (F): 65 Initials: SB

Technician Signature: Date: 2/10/17

Run 8

Wood Heater Preburn Data - ASTM E2780

Run:	8

Technician Signature:

Manufacturer:	RAIS
Model:	Viva L
Tracking No.:	2233
Project No.:	0138WS017E
Test Date:	2/13/2017
Beginning Clock Time:	10:37

Coal Bed Range (lb):	1.7 (min)	2.1 (max)

Preburn Fuel Data

Fuel Piece Lengths (in.):	8.0		
Total Preburn Weight (lb):	9.5		
Fuel Moisture Readings (% DB):	21.2	19.2	22.4
	19.4	18.6	
	23.6	24.2	
	22.1	22.1	
	18.4	21	
Avg Preburn Moisture (% DB):	21.11		

			Temperatures (°F)							
Elapsed Time (min)	Scale (lb)	Stack Draft (in H_2O)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Avg. Firebox Surface	Stack	Ambient
0	8.9	-0.062	457	211	257	272	264	292.5	424	70
10	7.4	-0.067	582	277	280	277	287	340.7	476	69
20	5.8	-0.069	678	297	301	312	327	382.9	497	70
30	4.1	-0.071	761	300	330	349	364	420.7	547	71
40	2.8	-0.066	782	304	360	387	398	446.2	511	70
50	2.0	-0.059	754	317	390	430	420	462.1	433	71
60	1.7	-0.051	673	348	413	434	413	456.0	364	71

Wood Heater Test Fuel Data - ASTM E2780

Manufacturer:	**RAIS**
Model:	**Viva L**
Tracking No.:	**2233**
Project No.:	**0138WS017E**
Test Date:	**2/13/2017**
Run No.:	**8**

Firebox Volume (ft^3):	**1.29**
Fuel Piece Length (in):	**10.5**
2x4 Crib Weight (lb):	**8.3**
4x4 Crib Weight (lb):	**0**

Total Fuel Weight (Dry Basis, lb):	**6.995**	
Fuel Density (lb/ft^3, Dry Basis):	**29.00**	**OK**
Loading Density (lb/ft^3, Wet Basis):	**6.43**	**OK**
2x4 Percentage:	**N/A**	**N/A**

Coal Bed Range (20-25%): 1.66 - 2.075

Test Fuel Piece	Weight (lb)	Size	Readings (Dry Basis %)			Dry Weight (lb)
1	1.2	2"x 4"	19.8	21.1	21.2	0.99
2	1.1	2"x 4"	22.6	22.4	21.8	0.90
3	1.1	2"x 4"	21.5	20.3	21.9	0.91
4	1.1	2"x 4"	21.0	21.3	19.7	0.91
5	1.1	2"x 4"	20.1	22.1	19.3	0.91

Spacer Readings (Dry Basis %)			
11.4	14.4		
14.8	13.6		
12.7	12.4		
11.2	13.6		
14.0	12.3		
15.8	12.7		
14.3	13.7		
15.5	12.1		
16.4			
14.5			
16.4			
17.0			

Technician Signature:

Wood Heater Test Data - ASTM E2780 / ASTM E2515

Run: 8

Manufacturer: RAIS
Model: Viva L
Tracking No.: 2233
Project No.: 0138WS017E
Test Date: 13-Feb-17
Beginning Clock Time: 11:38

Total Sampling Time: 110 min
Recording Interval: 10 min
Background Sample Volume: 0 cubic feet

Meter Box Y Factor: 0.984 (1) 0.99 (2) 1 (Amb)

Barometric Pressure:

Begin	Middle	End	Average
30.29	30.27	30.24	30.27 "Hg

OMNI Equipment Numbers: 296-T55, 185, 340, 431, 335, 336, 594, 410, 559, 209, 132, 23, 592, 283A

PM Control Modules: 335/336
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 percent
Dilution Tunnel Static: -0.270 "H2O
Tunnel Area: 0.19635 ft2
Pitot Tube Cp: 0.99

Avg. Tunnel Velocity: 17.00 ft/sec.
Initial Tunnel Flow: 186.1 scfm
Average Tunnel Flow: 184.9 scfm
Post-Test Leak Check (1): 0.000 cfm @ -11 in. Hg
Post-Test Leak Check (2): 0.000 cfm @ -9 in. Hg
Average Test Piece Fuel Moisture: 21.07 Dry Basis %

Technician Signature:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center	
Initial dP	0.048	0.080	0.074	0.060	0.048	0.074	0.076	0.058	0.062	"H2O
Temp:	119	119	119	119	119	119	119	119	119	°F

V_{strav} 17.45 ft/sec V_{scent} 17.18 ft/sec F_p 1.015

	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)											Stack Gas Data		
Elapsed Time (min)	Gas Meter 1 (ft^3)	Gas Meter 2 (ft^3)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 ("H_2O)	Meter 1 Temp (°F)	Meter 1 Vacuum ("Hg)	Orifice dH 2 ("H_2O)	Meter 2 Temp (°F)	Meter 2 Vacuum ("Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface Temp	Catalyst Exit Temp	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft ("H_2O)	CO_2 (%)	CO (%)
0	0.000	0.000			0.46	75	0.93	0.03	77	1.3	115	0.066			8.3		666	350	414	430	414	454.8	N/A	375	70	70	71	71	72	-0.054	2.85	0.25
10	1.677	1.667	0.17	0.17	1.44	76	2.32	1.20	77	1.4	110	0.057	103	104	6.8	-1.5	673	398	389	367	365	438.4	N/A	456	74	74	75	75	71	-0.065	11.45	0.76
20	3.359	3.340	0.17	0.17	1.42	77	2.32	1.18	79	1.4	117	0.061	100	101	5.2	-1.6	731	412	379	353	352	445.4	N/A	505	75	75	77	77	72	-0.069	12.96	0.97
30	5.039	5.011	0.17	0.17	1.41	79	2.33	1.17	81	1.4	126	0.058	103	104	3.6	-1.6	797	399	385	371	371	464.6	N/A	570	77	77	80	80	73	-0.074	14.82	0.63
40	6.715	6.678	0.17	0.17	1.40	81	2.35	1.17	83	1.4	125	0.060	101	102	2.2	-1.4	825	383	398	408	394	481.6	N/A	526	79	79	80	80	73	-0.069	12.7	0.34
50	8.392	8.341	0.17	0.17	1.40	83	2.36	1.16	84	1.4	113	0.058	101	102	1.4	-0.8	785	373	411	444	425	487.6	N/A	412	79	79	80	80	74	-0.056	8.02	0.05
60	10.072	10.007	0.17	0.17	1.40	84	2.36	1.16	85	1.4	102	0.066	94	94	1.1	-0.3	687	374	427	450	422	472.0	N/A	360	78	78	79	79	72	-0.051	7.14	0.42
70	11.784	11.676	0.17	0.17	1.43	84	2.29	1.16	86	1.4	98	0.065	96	95	0.9	-0.2	619	381	423	429	412	452.8	N/A	334	77	77	78	78	73	-0.047	6.63	0.58
80	13.487	13.348	0.17	0.17	1.43	85	2.29	1.17	86	1.4	96	0.061	98	98	0.7	-0.2	573	390	403	409	407	436.4	N/A	323	76	76	76	76	72	-0.044	6.57	0.68
90	15.192	15.022	0.17	0.17	1.44	85	2.29	1.16	86	1.4	93	0.054	104	104	0.4	-0.3	544	397	391	393	398	424.6	N/A	313	75	75	75	75	71	-0.045	6.65	0.7
100	16.899	16.696	0.17	0.17	1.44	84	2.28	1.17	86	1.4	93	0.060	99	99	0.2	-0.2	522	404	383	377	393	415.8	N/A	303	75	75	75	75	71	-0.042	6.49	0.77
110	18.606	18.369	0.17	0.17	1.44	84	2.29	1.17	85	1.4	92	0.056	103	102	0.0	-0.2	506	415	380	373	390	412.8	N/A	297	74	74	74	74	71	-0.041	6.1	0.89
Avg/Tot	18.606	18.369	0.17	0.17	1.34	81		1.08	83		107	0.060	100	100								42.0				76	77	77	72	-0.055		

Wood Heater Test Results - ASTM E2780 / ASTM E2515

Manufacturer: RAIS
Model: Viva L
Project No.: 0138WS017E
Tracking No.: 2233
Run: 8
Test Date: 02/13/17

Burn Rate	**1.731 kg/hr dry**
Average Tunnel Temperature	107 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	17.00 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11092.4 dscf/hour
Average Delta p	0.060 inches H20
Total Time of Test	110 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	18.606 cubic feet	18.369 cubic feet	10.072 cubic feet
Average Gas Meter Temperature	72 degrees Fahrenheit	81 degrees Fahrenheit	83 degrees Fahrenheit	81 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	18.113 dscf	17.930 dscf	9.805 dscf
Total Particulates - m_n	0 mg	2.4 mg	2.5 mg	0.9 mg
Particulate Concentration (dry-standard) - C_f/C_s	0.000000 grams/dscf	0.00013 grams/dscf	0.00014 grams/dscf	0.00009 grams/dscf
Total Particulate Emissions - E_T	0.00 grams	2.69 grams	2.84 grams	1.02 grams
Particulate Emission Rate	0.00 grams/hour	1.47 grams/hour	1.55 grams/hour	1.02 grams/hour
Emissions Factor		0.85 g/kg	0.89 g/kg	0.38 g/kg
Difference from Average Total Particulate Emissions		0.07 grams	0.07 grams	

Dual Train Comparison Results Are Acceptable

FINAL AVERAGE RESULTS

Complete Test Run	
Total Particulate Emissions - E_T	2.77 grams
Particulate Emission Rate	**1.51 grams/hour**
Emissions Factor	0.87 grams/kg
Train Precision g/kg ≤ 0.5	0.04 grams/kg
Train Precision ≤ 7.5%	2.5 %
First Hour Emissions	
Total Particulate Emissions - E_T	1.02 grams
Particulate Emission Rate	1.02 grams/hour
Emissions Factor	0.38 grams/kg

QUALITY CHECKS

Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Stove Surface ΔT	OK

Technician Signature:_____

OMNI-Test Laboratories

Manufacturer:	**RAIS**
Model:	**Viva L**
Date:	**02/13/17**
Run:	**8**
Control #:	**0138WS017E**
Test Duration:	**110**
Output Category:	**III**

Technicians: _____

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	**71.7%**	**77.5%**
Combustion Efficiency	**95.5%**	**95.5%**
Heat Transfer Efficiency	**75%**	**81.2%**

Output Rate (kJ/h)	**24,096**	**22,857**	**(Btu/h)**
Burn Rate (kg/h)	**1.70**	**3.74**	**(lb/h)**
Input (kJ/h)	**33,609**	**31,882**	**(Btu/h)**

Test Load Weight (dry kg)	**3.11**	**6.86**	**dry lb**
MC wet (%)	**17.41**		
MC dry (%)	**21.07**		
Particulate (g)	**N/A**		
CO (g)	**199**		
Test Duration (h)	**1.83**		

Emissions	Particulate	CO
g/MJ Output	**N/A**	**4.51**
g/kg Dry Fuel	**N/A**	**64.12**
g/h	**N/A**	**108.79**
lb/MM Btu Output	**N/A**	**10.49**

Air/Fuel Ratio (A/F)	**13.39**

VERSION: **2.2** **12/14/2009**

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 8
Model: VIVA L Tracking Number: 2233 Date: 2/13/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Run Notes

Air Control Settings

Primary: Fully open

Secondary: N/A - Fixed

Tertiary/Pilot: Fixed

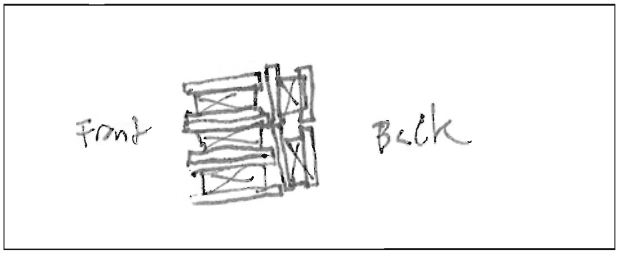
Fan: N/A

Preburn Notes

Time	Notes
	N/A

Test Notes

Sketch test fuel configuration:



Start up procedures & Timeline:

Bypass: N/A
Fuel loaded by: 30 seconds
Door closed at: 40 seconds
Primary air: Start-up air for 4 min then set to High

Notes: N/A

Time	Notes
	N/A

Technician Signature: _____ Date: 2/13/2017

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 8
Model: VIVA L Tracking Number: 2233 Date: 2/13/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Supplemental Data

Start Time: 11:38 Booth #: E1
Stop Time: 13:28

Stack Gas Leak Check:
Initial: Ø Final: Ø

Sample Train Leak Check:
A: Ø @ -1 "Hg
B: Ø @ -9 "Hg

Calibrations: Span Gas CO_2: 16.74 CO(%): 4.20 CO(ppm): 500

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	10:01	10:05	13:39	13:36
CO_2	0.00	16.75	0.14	16.50
CO(%)	0.000	4.199	0.001	4.190
CO(ppm)	0	-	0	-

Air Velocity (ft/min): Initial: 250 Final: 250
Scale Audit (lbs): Initial: 10.0 Final: 10.0
Pitot Tube Leak Test: Initial: Ø Final: Ø
Stack Diameter (in): 6"
Induced Draft: Ø
% Smoke Capture: 100%
Flue Pipe Cleaned Prior to First Test in Series:
Date: 2/2/17 Initials:

	Initial	Middle	Ending
P_b (in/Hg)	30.29	30.27	30.24
RH (%)	19.9	18.5	18.9
Ambient (°F)	72	73	74

Tunnel Traverse

Microtector Reading	dP (in H_2O)	T(°F)
0.024	0.048	119
0.040	0.080	119
0.037	0.074	119
0.030	0.060	119
0.024	0.048	119
0.037	0.074	119
0.038	0.076	119
0.029	0.058	119
Center:		
0.031	0.062	119

Tunnel Static Pressure (in H_2O):	
Beginning of Test	End of Test
-0.27	-0.27

Background Filter Volume: N/A

Technician Signature: Date: 2/13/2017

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 8
Model: VIVA L Tracking Number: 2233 Date: 2/13/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

Wood Heater Fuel Data

Fuel: Douglas fir, untreated and air dried, standard grade or better dimensional lumber

Pre-Burn Fuel

Calibration: Cal Value (1) = 12% Actual Reading 12%
Cal Value (2) = 22% Actual Reading 22%

Piece:	Length:	Reading:	Piece:	Length:	Reading:
1	8" in	21.2	7	8" in	18.6
2		19.4	8		24.2
3		23.6	9		22.1
4		22.1	10		21.0
5		18.4	11		22.4
6		19.2	12	in	

Total Pre-Burn Fuel Weight: 9.5 lbs Pre-Burn Fuel Average Moisture: 21.1
Time (clock): 9:50 Room Temperature (F): 65 Initials: SB

Test Fuel

Firebox Volume (ft³): 1.29 ft³ Test Fuel Piece Length (in): 16.5
Load Weight Range (lb): 8.2 - 9.9 Total Wet Fuel Load Weight (lb): 8.3

Fuel Type & Amount: 2 x 4: 5 4 x 4: ∅
Weight (with spacers): 8.3 Weight (with spacers): ∅

Piece:	Weight (lbs):	Moisture Readings (%DB):			Fuel Type:
1	1.2	19.8	21.1	21.2	2x4
2	1.1	22.6	22.4	21.8	2x4
3	1.1	21.5	20.3	21.9	2x4
4	1.1	21.6	21.3	19.7	2x4
5	1.1	20.1	22.1	19.3	2x4
6					
7					

Spacer Moisture Readings (%DB)

11.4	14.0	16.4	14.4	12.3			
14.8	15.8	14.5	13.6	12.7			
12.7	14.3	16.4	12.4	13.7			
16.2	15.5	17.0	13.6	12.1			

Time (clock): 10:15 Room Temperature (F): 65 Initials: SB

Technician Signature: Date: 2/13/2017

Section 4

Quality Assurance/Quality Control

QUALITY ASSURANCE/QUALITY CONTROL

OMNI follows the guidelines of ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories," and the quality assurance/quality control (QA/QC) procedures found in *OMNI*'s Quality Assurance Manual.

OMNI's scope of accreditation includes, but is not limited to, the following:

- ANSI (American National Standards Institute) for certification of product to safety standards.
- To perform product safety testing by the International Accreditation Service, Inc. (formerly ICBO ES) under accreditation as a testing laboratory designated TL-130.
- To perform product safety testing as a "Certification Organization" by the Standards Council of Canada (SCC).
- Serving as a testing laboratory for the certification of wood heaters by the U.S. Environmental Protection Agency.

This report is issued within the scope of *OMNI*'s accreditation. Accreditation certificates are available upon request.

The manufacturing facilities and quality control system for the production of the Viva L Series at RAIS A/S were evaluated to determine if sufficient to maintain conformance with OMNI's requirements for product certification. OMNI has concluded that the manufacturing facilities, processes, and quality control system are adequate to produce the appliance congruous with the standards and model codes to which it was evaluated.

This report shall not be reproduced, except in full, without the written approval of OMNI-Test Laboratories, Inc.

Sample Analysis

Analysis Worksheets
Tared Filter, Probe, and O-Ring Data

Wood Heater Lab Data - ASTM E2780 / ASTM E2515

Manufacturer:	RAIS	Equipment Numbers:	
Model:	Viva L		
Tracking No.:	2233		
Project No.:	0138WS017E		
Run #:	1		
Date:	2/6/17		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D21	158.8	121.6	37.2
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total	Total Particulate, mg:	37.2

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D22	128.4	124.2	4.2
C. Rear filter catch	Filter	D23	121.4	120.7	0.7
D. Probe catch*	Probe	16	114269.9	114269.1	0.8
E. Filter seals catch*	Seals	R417	3293.9	3293.3	0.6

Sub-Total	Total Particulate, mg:	6.3
Train 1 Aggregate	Total Particulate, mg:	43.5

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	D24	164.1	121.7	42.4
B. Rear filter catch	Filter	D25	123.8	122.9	0.9
C. Probe catch*	Probe	17	114563.3	114562.9	0.4
D. Filter seals catch*	Seals	R418	3324.4	3324.0	0.4

Total Particulate, mg:	44.1

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter				0.0

Total Particulate, mg:	0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature:

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 1
Model: VIVA L Tracking Number: 2233 Date: 2/6/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

ASTM E2515 Lab Sheet

Assembled By: S. Button

Date/Time in Dessicator: 2/6/17 - 17:25

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
	Date/Time: 2/10/17 11:30	Date/Time: 2/13/17 9AM	Date/Time:	Date/Time:	Date/Time:
	R/H %: 12.4	R/H %: 7.9	R/H %:	R/H %:	R/H %:
	Temp: 72.6	Temp: 65.3	Temp:	Temp:	Temp:
	200 mg Audit: 200.0	200 mg Audit: 200.0	200 mg Audit:	200 mg Audit:	200 mg Audit:
	2 g Audit: 1999.0	2 g Audit: 1999.9	2 g Audit:	2 g Audit:	2 g Audit:
	100 g Audit: 99998.3	100 g Audit 99998.3	100 g Audit	100 g Audit	100 g Audit
	Initials:	Initials: SB	Initials:	Initials:	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	D21	121.6	158.9	158.8			
	Rear Filter	N/A						
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	D22	124.2	128.6	128.4			
	Rear Filter	D23	120.7	121.6	121.4			
	Probe	16	114269.1	114270.0	114269.9			
	O-Ring Set	R417	3293.3	3294.0	3293.9			
B	Front Filter	D24	121.7	164.3	164.1			
	Rear Filter	D25	122.9	123.9	123.8			
	Probe	17	114562.9	114563.5	114563.3			
	O-Ring Set	R418	3324.0	3324.6	3324.4			
BG	Filter	N/A						

Technician Signature: _____ Date: 2/14/17

Wood Heater Lab Data - ASTM E2780 / ASTM E2515

Manufacturer:	RAIS	Equipment Numbers:	
Model:	Viva L		
Tracking No.:	2233		
Project No.:	0138WS017E		
Run #:	2		
Date:	2/7/17		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D26	169.5	119.9	49.6
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total	Total Particulate, mg:	49.6

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D27	218.0	122.4	95.6
C. Rear filter catch	Filter	D28	125.4	123.9	1.5
D. Probe catch*	Probe	21	114396.0	114393.4	2.6
E. Filter seals catch*	Seals	R419	3344.5	3343.8	0.7

Sub-Total	Total Particulate, mg:	100.4
Train 1 Aggregate	Total Particulate, mg:	150.0

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	D29	266.5	120.9	145.6
B. Rear filter catch	Filter	D30	124.8	123.4	1.4
C. Probe catch*	Probe	22	114349.7	114347.1	2.6
D. Filter seals catch*	Seals	R420	3308.8	3308.0	0.8

Total Particulate, mg:	150.4

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter				0.0

Total Particulate, mg:	0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature:

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 2
Model: VIVA L Tracking Number: 2233 Date: ~~2/6/2017~~ 2/7/17
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

ASTM E2515 Lab Sheet

Assembled By: A. Kravitz

Date/Time in Dessicator: 2/7/17

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
	Date/Time: 2/6/17 11:30	Date/Time: 2/13/17 8:20	Date/Time:	Date/Time:	Date/Time:
	R/H %: 12.4	R/H %: 7.9	R/H %:	R/H %:	R/H %:
	Temp: 72.6	Temp: 65.3	Temp:	Temp:	Temp:
	200 mg Audit: 200.0	200 mg Audit: 200.0	200 mg Audit:	200 mg Audit:	200 mg Audit:
	2 g Audit: 1999.9	2 g Audit: 1999.9	2 g Audit:	2 g Audit:	2 g Audit:
	100 g Audit: 99998.3	100 g Audit 99998.3	100 g Audit	100 g Audit	100 g Audit
	Initials: AK	Initials: SB	Initials:	Initials:	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	D26	119.9	169.6	169.5			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	D27	122.4	218.1	218.0			
	Rear Filter	D28	123.9	125.6	125.4			
	Probe	21	114393.4	114396.32	114396.0			
	O-Ring Set	R419	3343.8	3344.6	3344.5			
B	Front Filter	D29	120.9	266.7	266.5			
	Rear Filter	D30	123.4	125.0	124.8			
	Probe	22	114347.1	114349.8	114349.7			
	O-Ring Set	R420	3308.0	3308.9	3308.8			
BG	Filter							

Technician Signature: _____ Date: 2/14/17

Wood Heater Lab Data - ASTM E2780 / ASTM E2515

Manufacturer:	**RAIS**	**Equipment Numbers:**	
Model:	**Viva L**		
Tracking No.:	**2233**		
Project No.:	**0138WS017E**		
Run #:	**3**		
Date:	**2/8/17**		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D31	126.5	123.9	2.6
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total	**Total Particulate, mg:**	**2.6**

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D32	120.7	120.4	0.3
C. Rear filter catch	Filter	D33	123.1	123.0	0.1
D. Probe catch*	Probe	29	114280.4	114280.2	0.2
E. Filter seals catch*	Seals	R421	3524.6	3524.3	0.3

Sub-Total	**Total Particulate, mg:**	**0.9**
Train 1 Aggregate	**Total Particulate, mg:**	**3.5**

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	D34	125.5	123.7	1.8
B. Rear filter catch	Filter	D35	120.0	120.6	-0.6
C. Probe catch*	Probe	30	114335.1	114334.8	0.3
D. Filter seals catch*	Seals	R422	4554.5	4553.4	1.1

Total Particulate, mg:	**2.6**

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter				0.0

Total Particulate, mg:	**0.0**

***Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.**

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature:

OMNI-Test Laboratories, Inc. **ASTM E2780 Wood Heater Run Sheets**

Client: RAIS Project Number: 0138WS017E Run Number: 3

Model: VIVA L Tracking Number: 2233 Date: 2/8/2017

Test Crew: S. Button, A. Kravitz

OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

ASTM E2515 Lab Sheet

Assembled By: A. Kravitz

Date/Time in Dessicator: 2/8/17

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
	Date/Time: 2/10 11:00	Date/Time: 2/13 0800	Date/Time: 2/14 1500	Date/Time:	Date/Time:
	R/H %: 8.5	R/H %: 7.9	R/H %: 9.5	R/H %:	R/H %:
	Temp: 73.5	Temp: 65.3	Temp: 70.7	Temp:	Temp:
	200 mg Audit: 99998.3	200 mg Audit: 200.0	200 mg Audit: 200.0	200 mg Audit:	200 mg Audit:
	2 g Audit: 1999.8	2 g Audit: 1999.8	2 g Audit: 1999.9	2 g Audit:	2 g Audit:
	100 g Audit: 100.1	100 g Audit 99998.8	100 g Audit 99998.5	100 g Audit	100 g Audit
	Initials: A	Initials: A	Initials: A	Initials:	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	D31	123.9	126.6	126.5	-		
	Rear Filter	~~D32~~						
	Probe	~~29~~						
	O-Ring Set							
A (Remainder)	Front Filter	D32	120.4	120.7	120.7	-		
	Rear Filter	D33	123.0	123.1	123.1	-		
	Probe	29	114280.2	114280.5	114280.4	-		
	O-Ring Set	R421	3524.3	3524.7	3524.6	-		
B	Front Filter	D34	123.7	125.7	125.5	-		
	Rear Filter	D35	120.6	120.0	120.0	-		
	Probe	30	114334.8	114335.4	114335.0	114335.1		
	O-Ring Set	R422	4553.4	4554.7	4554.4	4554.5		
BG	Filter							

Technician Signature: [signature] Date: 2/14/17

Wood Heater Lab Data - ASTM E2780 / ASTM E2515

Manufacturer:	RAIS	Equipment Numbers:	
Model:	Viva L		
Tracking No.:	2233		
Project No.:	0138WS017E		
Run #:	4		
Date:	2/9/17		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D36	123.7	122.8	0.9
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total	Total Particulate, mg:	0.9

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D37	124.2	124.0	0.2
C. Rear filter catch	Filter	D38	120.8	120.9	-0.1
D. Probe catch*	Probe	34	115869.2	115868.4	0.8
E. Filter seals catch*	Seals	R423	3606.6	3606.0	0.6

Sub-Total	Total Particulate, mg:	1.5
Train 1 Aggregate	Total Particulate, mg:	2.4

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	D39	123.4	122.2	1.2
B. Rear filter catch	Filter	D40	124.2	124.0	0.2
C. Probe catch*	Probe	58	117068.3	117068.0	0.3
D. Filter seals catch*	Seals	R424	3314.7	3314.6	0.1

Total Particulate, mg:	1.8

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter				0.0

Total Particulate, mg:	0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature:

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 4
Model: VIVA L Tracking Number: 2233 Date: ~~2/6/2017~~ 2/9/2017
Test Crew: S. Button, A. Kravitz SB
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

ASTM E2515 Lab Sheet

Assembled By: A. Kravitz

Date/Time in Dessicator: 2/9/17

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
	Date/Time: 2/14 1500	Date/Time: 2/15 1000	Date/Time: 2/16 1200	Date/Time:	Date/Time:
	R/H %: 9.5	R/H %: 9.0	R/H %: 6.8	R/H %:	R/H %:
	Temp: 76.3	Temp: 71.4	Temp: 68.9	Temp:	Temp:
	200 mg Audit: 200.0	200 mg Audit: 200.0	200 mg Audit: 200.6	200 mg Audit:	200 mg Audit:
	2 g Audit: 1999.9	2 g Audit: 1999.9	2 g Audit: 1999.8	2 g Audit:	2 g Audit:
	100 g Audit: 99998.5	100 g Audit 99998.4	100 g Audit 99998.5	100 g Audit	100 g Audit
	Initials:	Initials:	Initials:	Initials:	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	D36	122.8	123.8	123.87	–		
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	D37	124.0	124.2	124.2	–		
	Rear Filter	D38	120.9	120.8	120.8	–		
	Probe	34	115868.4	115868.8	115869.2	115869.2		
	O-Ring Set	R423	3606.0	3606.4	3306.6	–		
B	Front Filter	D39	122.2	123.3	123.4	–		
	Rear Filter	D40	124.0	124.1	124.2	–		
	Probe	58	117068.0	117068.0	117068.3	117068.3		
	O-Ring Set	R424	3314.6	3314.7	3314.7	–		
BG	Filter							

Technician Signature: _____ Date: 3/9/17

Wood Heater Lab Data - ASTM E2780 / ASTM E2515

Manufacturer:	RAIS	Equipment Numbers:	
Model:	Viva L		
Tracking No.:	2233		
Project No.:	0138WS017E		
Run #:	5		
Date:	2/9/17		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D14	122.7	121.4	1.3
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total	Total Particulate, mg:	1.3

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D15	123.2	122.9	0.3
C. Rear filter catch	Filter	D16	124.4	124.2	0.2
D. Probe catch*	Probe	59	117789.3	117789.1	0.2
E. Filter seals catch*	Seals	R425	3419.8	3419.0	0.8

Sub-Total	Total Particulate, mg:	1.5
Train 1 Aggregate	Total Particulate, mg:	2.8

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	D17	122.6	121.2	1.4
B. Rear filter catch	Filter	D18	121.4	121.4	0.0
C. Probe catch*	Probe	62	117663.2	117662.4	0.8
D. Filter seals catch*	Seals	R426	3343.5	3342.6	0.9

Total Particulate, mg:	3.1

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter				0.0

Total Particulate, mg:	0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature:

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 5
Model: VIVA L Tracking Number: 2233 Date: ~~2/6/2017~~ 2/9/2017 SB
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

ASTM E2515 Lab Sheet

Assembled By: A. Kravitz

Date/Time in Dessicator: 2/9/17

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time:	2/14 1500	2/15/17 1000	2/16 1200		
R/H %:	9.5	40	6.8		
Temp:	70.3	71.4	68.9		
200 mg Audit:	200.6	200.0	200.0		
2 g Audit:	1999.1	1999.9	1998.8		
100 g Audit	99998.5	99998.5	99998.5		
Initials:	A	A	A		

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	D14	121.1	122.8	122.7	-		
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	D15	122.9	123.2	123.2	-		
	Rear Filter	D16	124.2	124.4	124.4	-		
	Probe	59	117789.1	117786.7	117789.3	117789.3		
	O-Ring Set	R425	3419.0	3419.6	3419.8	-		
B	Front Filter	D17	121.2	122.7	122.6	-		
	Rear Filter	D18	121.4	121.4	121.4	-		
	Probe	62	117662.4	117662.6	117663.1	117663.2		
	O-Ring Set	R426	3342.6	3343.4	3343.5	-		
BG	Filter							

Technician Signature: [signature] Date: 2/16/17

Wood Heater Lab Data - ASTM E2780 / ASTM E2515

Manufacturer:	RAIS	Equipment Numbers:	
Model:	Viva L		
Tracking No.:	2233		
Project No.:	0138WS017E		
Run #:	6		
Date:	2/10/17		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D19	124.3	123.7	0.6
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total	Total Particulate, mg:	0.6

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D20	121.3	120.8	0.5
C. Rear filter catch	Filter	D82	123.3	123.1	0.2
D. Probe catch*	Probe	66	118461.1	118461.1	0.0
E. Filter seals catch*	Seals	R427	4333.7	4332.5	1.2

Sub-Total	Total Particulate, mg:	1.9
Train 1 Aggregate	Total Particulate, mg:	2.5

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	D83	122.0	120.7	1.3
B. Rear filter catch	Filter	D84	123.1	123.1	0.0
C. Probe catch*	Probe	67	117768.6	117768.5	0.1
D. Filter seals catch*	Seals	R428	3360.0	3359.3	0.7

Total Particulate, mg:	2.1

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter				0.0

Total Particulate, mg:	0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature:

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 6
Model: VIVA L Tracking Number: 2233 Date: 2/10/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

ASTM E2515 Lab Sheet

Assembled By: A. Kravitz

Date/Time in Dessicator: 2/10/17

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
	Date/Time: 2/14 1500	Date/Time: 2/15 1000	Date/Time:	Date/Time:	Date/Time:
	R/H %: 9.5	R/H %: 9.0	R/H %:	R/H %:	R/H %:
	Temp: 70.3	Temp: 71.7	Temp:	Temp:	Temp:
	200 mg Audit: 200.0	200 mg Audit: 200.0	200 mg Audit:	200 mg Audit:	200 mg Audit:
	2 g Audit: 1949.9	2 g Audit: 1999.9	2 g Audit:	2 g Audit:	2 g Audit:
	100 g Audit: 99998.5	100 g Audit 99996.4	100 g Audit	100 g Audit	100 g Audit
	Initials:	Initials:	Initials:	Initials:	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	D19	123.7	124.2	124.3			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	D20	120.8	121.3	121.3			
	Rear Filter	D82	123.1	123.2	123.3			
	Probe	66	118461.1	118460.9	118461.1			
	O-Ring Set	R427	4332.5	4333.6	4333.7			
B	Front Filter	D83	120.7	122.0	122.0			
	Rear Filter	D84	123.1	123.0	123.1			
	Probe	67	117768.5	117768.4	117768.6			
	O-Ring Set	R428	3359.3	3359.9	3360.0			
BG	Filter							

Technician Signature: _____ Date: 2/15/17

Wood Heater Lab Data - ASTM E2780 / ASTM E2515

Manufacturer:	**RAIS**	**Equipment Numbers:**	
Model:	**Viva L**		
Tracking No.:	**2233**		
Project No.:	**0138WS017E**		
Run #:	**7**		
Date:	**2/10/17**		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D85	125.3	124.8	0.5
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total	Total Particulate, mg:	0.5

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D86	121.4	121.1	0.3
C. Rear filter catch	Filter	D87	123.1	123.2	-0.1
D. Probe catch*	Probe	2	115017.3	115017.3	0.0
E. Filter seals catch*	Seals	R429	4331.9	4330.5	1.4

Sub-Total	Total Particulate, mg:	1.6
Train 1 Aggregate	Total Particulate, mg:	2.1

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	D88	125.1	123.8	1.3
B. Rear filter catch	Filter	D89	120.6	120.9	-0.3
C. Probe catch*	Probe	14	114552.6	114552.3	0.3
D. Filter seals catch*	Seals	R430	3302.4	3301.8	0.6

Total Particulate, mg:	1.9

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter				0.0

Total Particulate, mg:	0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature:

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 7
Model: VIVA L Tracking Number: 2233 Date: 2/10/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

ASTM E2515 Lab Sheet

Assembled By: A. Kravitz

Date/Time in Dessicator: 2/10/17 17:40

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time:	2/14 1500	2/15 1000	2/16 1200		
R/H %:	9.5	6.0	6.8		
Temp:	70.3	71.4	68.9		
200 mg Audit:	200.0	200.0	200.0		
2 g Audit:	1999.1	1999.6	1999.8		
100 g Audit:	99998.5	99998.4	99996.5		
Initials:	A	A	A		

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	D85	124.8	125.3	125.3	-		
	Rear Filter							
	Probe	2A	11A					
	O-Ring Set							
A (Remainder)	Front Filter	D86	121.1	121.3	121.4	-		
	Rear Filter	D87	123.2	123.0	123.1	-		
	Probe	2	115017.3	115017.1	115017.3	-		
	O-Ring Set	R429	4330.5	4331.8	4331.9	-		
B	Front Filter	D88	123.8	125.0	125.1	-		
	Rear Filter	D89	120.9	120.5	120.6	-		
	Probe	14	114552.3	114552.2	114552.6	114552.6		
	O-Ring Set	R430	3301.8	3302.4	3302.4	-		
BG	Filter							

Technician Signature: [signature] Date: 2/16/17

Wood Heater Lab Data - ASTM E2780 / ASTM E2515

Manufacturer:	RAIS	Equipment Numbers:	
Model:	Viva L		
Tracking No.:	2233		
Project No.:	0138WS017E		
Run #:	8		
Date:	2/13/17		

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D90	123.5	122.6	0.9
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total	Total Particulate, mg:	0.9

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	D91	125.5	124.2	1.3
C. Rear filter catch	Filter	D92	121.4	121.2	0.2
D. Probe catch*	Probe	18	114404.0	114404.0	0.0
E. Filter seals catch*	Seals	R431	4099.8	4099.8	0.0

Sub-Total	Total Particulate, mg:	1.5
Train 1 Aggregate	Total Particulate, mg:	2.4

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	D93	124.0	121.9	2.1
B. Rear filter catch	Filter	D94	123.9	123.9	0.0
C. Probe catch*	Probe	27	114280.1	114280.0	0.1
D. Filter seals catch*	Seals	R432	3354.7	3354.4	0.3

Total Particulate, mg:	2.5

AMBIENT

Sample Component	Reagent	Filter # or Probe #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch*	Filter				0.0

Total Particulate, mg:	0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and seals, negative numbers for filters are assumed to be part of the seal weight.

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Probe catch	Final (mg) - Tare (mg) = Particulate, mg

Technician Signature:

ASTM E2780 Wood Heater Run Sheets

Client: RAIS Project Number: 0138WS017E Run Number: 8
Model: VIVA L Tracking Number: 2233 Date: 2/13/2017
Test Crew: S. Button, A. Kravitz
OMNI Equipment ID numbers: 296-T55, 185, 340, 431, 355 336, 594, 410, 559, 209, 132, 23, 592, 283A

ASTM E2515 Lab Sheet

Assembled By: S. Button

Date/Time in Dessicator: 2/13/2017 13:40

	Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time:	2/14 1500	2/15 1000			
R/H %:	9.5	9.0			
Temp:	70.3	71.4			
200 mg Audit:	200.0	200.0			
2 g Audit:	1999.9	1999.9			
100 g Audit:	99996.5	99998.4			
Initials:	JB	JB			

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	D90	122.6	123.4	123.5			
	Rear Filter	N/A						
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	D91	124.2	125.6	125.5			
	Rear Filter	D92	121.2	121.3	121.4			
	Probe	18	114404.0	114407.0	114404.0			
	O-Ring Set	R431	4099.8	4099.8	4099.8			
B	Front Filter	D93	121.9	124.0	124.0			
	Rear Filter	D94	123.9	123.9	123.9			
	Probe	27	114280.0	114280.1	114280.1			
	O-Ring Set	R432	3354.4	3354.7	3354.7			
BG	Filter	N/A						

Technician Signature: _____ Date: 2/15/17

Tare Sheet: (check one) Probes_____ 47mm Filters ✓ 100mm Filters_____ O-Ring Pair_____

Prepared By: A. Kravitz Balance ID #: 244 Thermohygrometer ID #: 592 Audit Weight ID #/Mass: 131 / 500.0 mg

Placed in Dessicator: Date: 2/8/17 Time: 10:00 ID #	Date: 2/9/17 Time: 12:60 RH %: 8.3 T (°F): 72.3 Audit: 500.1	Date: 2/9/17 Time: 18:30 RH %: 8.5 T (°F): 70.7 Audit: 500.1	Date: Time: RH %: T (°F): Audit:	Date: Time: RH %: T (°F): Audit:	Date Used	Project Number	Run No.
D82	123.1	123.1			2/10/17	0138WS017E	6
D83	120.6	120.7			↓	↓	↓
D84	123.0	123.1			↓	↓	↓
D85	124.7	124.8			↓	↓	7
D86	121.0	121.1			↓	↓	↓
D87	123.1	123.2			↓	↓	↓
D88	123.7	123.8			↓	↓	↓
D89	121.0	120.9			↓	↓	↓
D90	122.5	122.6			2/13/17	↓	8
D91	124.2	124.2			↓	↓	↓
D92	121.2	121.2			↓	↓	↓
D93	121.9	121.9			↓	↓	↓
D94	123.8	123.9			↓	↓	↓
D95	121.0	121.0					
D96	121.8	121.7					
D97	123.1	123.1					
D98	121.0	121.0					
D99	123.8	123.9					
D100	122.8	122.7					
D101	120.6	120.6					
	Initials: AK	Initials: A	Initials:	Initials:			

Final Technician Signature: _____ Date: ~~120 of 234~~ 2/9/17

Evaluator signature: _____ 2/9/2017

Tare Sheet: Probes___ 47mm Filters✓ 100mm Filters___ O-Ring Pair___

Date/time Placed in Dessicator: 12/16/16 11:08

Thermohygrometer ID #: 542

Prepared By: A. Krauth

Analytical Balance ID #: 23

Audit Weight ID #/Mass: 131 / 5000 mg

ID #	Date: 12/19/16 Time: 15:00 RH %: 3.8 T (°F): 68.3 Audit: 500.1	Date: 2/1/17 Time: 0900 RH %: 4.4 T (°F): 66.7 Audit: 500.1	Date: Time: RH %: T (°F): Audit:	Date: Time: RH %: T (°F): Audit:	Date Used	Project Number	Run No.
D21	121.7	121.6			2/6/17	138WS017E	1
D22	124.3	124.2			↓	↓	↓
D23	120.8	120.7					
D24	121.9	121.7					
D25	123.0	122.9			↓	↓	↓
D26	120.0	119.9			2/7/17	↓	2
D27	122.5	122.4			↓		↓
D28	124.0	123.9					
D29	121.0	120.9					
D30	123.4	123.4			↓	↓	↓
D31	123.8	123.9			2/8/17	↓	3
D32	120.4	120.4			↓		↓
D33	123.0	123.0					
D34	123.6	123.7					
D35	120.6	120.6			↓	↓	↓
D36	~~122.~~ 122.1	122.8			2/9/17	↓	4
D37	124.0	124.0			↓		↓
D38	121.0	120.9					
D39	122.3	122.2					
D40	124.1	124.0			↓	↓	↓
	Initials:	Initials:	Initials:	Initials:			

Final Technician Signature: _____ Date: 2/1/17

Evaluator signature: _____ 3/9/2017

Tare Sheet: Probes___ 47mm Filters_✓_ 100mm Filters___ O-Ring Pair___

Date/time Placed in Dessicator: 12/16/16 10:00

Thermohygrometer ID #: ~~137~~ 592

Prepared By: A. Kravitz

Analytical Balance ID #: 23

Audit Weight ID #/Mass: 131 / 500.0 mg

ID #	Date: 12/19/16 Time: 15:00 RH %: 3.8 T (°F): 83.3 Audit: 500.1	Date: 1/5/17 Time: 1000 RH %: 6.3 T (°F): 64.7 Audit: 500.1	Date: Time: RH %: T (°F): Audit:	Date: Time: RH %: T (°F): Audit:	Date Used	Project Number	Run No.
D1	124.0	123.9			1/5/17	0486[illegible]002N	1
D2	121.5	121.4			↓	↓	↓
D3	122.3	122.3					
D4	123.4	123.3			↓	↓	↓
D5	121.6	121.5					2
D6	121.6	121.5					↓
D7	121.1	120.9					
D8	121.8	121.7			↓	↓	↓
D9	123.2	123.0			1/10/17	0135P[illegible]03LE.REV001	1
D10	123.0	122.9			↓	↓	↓
D11	121.1	121.01					
D12	121.4	121.3					
D13	123.9	123.9			↓	↓	↓
D14	121.5	121.4			2/9/17	0138WS017E	5
D15	123.0	122.9			↓	↓	↓
D16	124.4	124.2					
D17	121.4	121.3					
D18	121.5	121.4			↓	↓	↓
D19	123.7	123.7			2/10/17	↓	6
D20	120.8	120.8			↓		↓
	Initials: AK	Initials: AK	Initials:	Initials:			

Final Technician Signature: _____ Date: 1/5/17

Evaluator signature: _____ 3/9/2017

Tare Sheet: (check one) Probes ✓ **47mm Filters**_____ **100mm Filters**_____ **O-Ring Pair**_____

Prepared By: A. Kravitz Balance ID #: 249 Thermohygrometer ID #: 592 Audit Weight ID #/Mass: 283A / 99.9983

Placed in Dessicator: Date: 2/8/17 Time: 11400 ID #	Date: 2/9/17 Time: 12:30 RH %: 8.3 T (°F): 72.3 Audit: 99998.3	Date: 2/10/17 Time: 1000 RH %: 9.7 T (°F): 73.2 Audit: 99998.3	Date: Time: RH %: T (°F): Audit:	Date: Time: RH %: T (°F): Audit:	Date Used	Project Number	Run No.
2	115017.2	115017.3			2/10/17	0138W5017E	7
14	114552.3	114552.3			↓	↓	↓
18	114404.0	114404.0			2/13/17	↓	8
27	114280.1	114280.0			↓		8
35	114331.6	114331.7					
38	114152.9	114152.8					
53	118274.3	118274.3					
56	118614.4	118614.4					
64	118223.9	118223.9					
65	117096.6	117096.4					
68	116810.0	116810.1					
69	117374.7	117374.7					
	Initials:	Initials:	Initials:	Initials:			

Final Technician Signature: _____ Date: 2/16/17

Evaluator signature: _____ 3/9/2017

Tare Sheet: Probes ✓ **47mm Filters** ___ **100mm Filters** ___ **O-Ring Pair** ___

Date/time Placed in Dessicator: 1/28/17

Thermohygrometer ID #: 592

Prepared By: A. Gravity

Analytical Balance ID #: 23

Audit Weight ID #/Mass: 283A / 100g

ID #	Date: ~~2/1/17~~ 2/1/17 Time: 0900 RH %: 4.4 T (°F): 86.7 Audit: 99.9985	Date: 2/2/17 Time: 0830 RH %: 3.7 T (°F): 70.9 Audit: 99.9980	Date: 2/2/17 Time: 1630 RH %: 2.0 T (°F): 78.9 Audit: 99.9982	Date: Time: RH %: T (°F): Audit:	Date Used	Project Number	Run No.
16	114270.4	114269.2	114269.1		2/6/17	138W5017B	1
17	114563.9	114563.0	114562.9		↓	↓	↓
21	114394.4	114393.5	114392.4		2/7/17	↓	2
22	114348.2	114347.2	114347.1		↓	↓	↓
29	114281.4	114280.3	114280.2		2/8/17	↓	3
30	114335.8	114334.9	114334.8		↓	↓	↓
34	115869.4	115868.5	115868.4		2/9/17	↓	4
58	117069.4	117068.1	117068.0		↓	↓	↓
59	117790.9	117789.3	117789.1		↓	↓	5
62	117664.5	117662.5	117662.4		↓	↓	↓
66	118462.9	118461.3	118461.1		2/10/17	↓	6
67	117769.4	117768.4	117768.5		↓	↓	↓
	Initials: A	Initials: A	Initials: A	Initials:			

Final Technician Signature: _____ Date: 2/2/17

Control No. P-SFDP-0001.xls, Effective date: 9/9/2015

Evaluator signature: _____ 9/9/2017

Tare Sheet: Probes___ 47mm Filters___ 100mm Filters___ O-Ring Pair ✓

Date/time Placed in Dessicator: 12/16/16 1100

Thermohygrometer ID #: 592

Prepared By: A. Cravitz

Analytical Balance ID #: 23*

Audit Weight ID #/Mass: 283A 1g / 2000.0 ~~500.0 mg~~

ID #	Date: 1/9/17 Time: 0930 RH %: 3.8 T (°F): 65.7 Audit: ~~500.1~~ 1999.9	Date: 1/9/17 Time: 1600 RH %: 3.1 T (°F): 71.6 Audit: 2000.0	Date: Time: RH %: T (°F): Audit:	Date: Time: RH %: T (°F): Audit:	Date Used	Project Number	Run No.
R415	3287.9	3287.9			1/10/17	01355 31E. REV001	1
R416	3305.0	3306.0			↓	↓	↓
R417	3293.2	3293.3			2/6/17	01383w5017E	1
R418	3324.0	3324.0			↓	↓	1
~~R419~~ R419	3343.7	3343.8			2/7/17	↓	2
R420	3307.9	3308.0			↓	↓	↓
R424	3524.2	3524.3			2/8/17	↓	3
R422	4553.3	4553.4			↓	↓	↓
R423	3606.1	3606.0			2/9/17	↓	4
R424	3314.5	3314.6			↓	↓	↓
R425	3419.1	3419.0			↓	↓	5
R426	3342.6	3342.6			↓	↓	↓
R427	4332.5	4332.5			2/10/17	↓	6
R428	3359.2	3359.3			↓	↓	↓
R429	4330.4	4330.5			↓	↓	7
R430	3301.8	3301.8			↓	↓	↓
R431	4092.6	4092.8			2/13/17	↓	8
R432	3354.2	3354.4			↓	↓	8
R433	3353.5	3353.5					
R434	3321.8	3321.8					
	Initials:	Initials:	Initials:	Initials:			

Final Technician Signature: _____ Date: 1/9/17

Control No. P-SFDP-0001.xls, Effective Date: 9/9/2015

Evaluator signature: _____ 3/9/2017

Calibrations

Methods EPA 28R, ASTM E2515, ASTM E2780

ID #	Lab Name/Purpose	Log Name	Attachment Type
23	Scale-Analytical Balance	Mettler Analytical Balance	Calibration Certificate
132	10 lb Weight	Weight Standard, 10 lb.	Calibration Certificate
185	Platform Scale	Weigh-Tronix Platform Scale	Calibration Certificate
209	Barometer	Barometer – Princo	Equipment Record
283A	Calibration Weights	Troemner Metric Weight Standards	Calibration Certificate
296-T55	Tape Measure	DeWalt 16’ Tape Measure	Calibration Log
335	Sample Box / Dry Gas Meter	Apex Automated Emissions Sampling Box	Calibration Log
336	Sample Box / Dry Gas Meter	Apex Automated Emissions Sampling Box	Calibration Log
340	Wood Moisture Meter	Moisture Meter - Delmhorst	See Test Run Notes
410	Microtector	Dwyer Microtector	Calibration Certificate
431	Moisture Meter Calibrator	Delmhorst Moisture Content Calibrator	Calibration Log
559	Vaneometer	Dwyer Vaneometer	Equipment Record
592	Thermohygrometer	Omega Digital Thermohygrometer	Calibration Log
594	Combustion Gas Analyzer	ZRE Combustion Gas Analyzer	Equipment Record

Certificate of Calibration

Certificate Number: **632003**

JJ Calibrations, Inc.
7007 SE Lake Rd
Portland, OR 97267-2105
Phone 503.786.3005
FAX 503.786.2994

OnSite

0723.01
Calibration

Omni-Test Laboratories
13327 NE Airport Way
Portland, OR 97230

PO: **160104**
Order Date: **09/27/2016**
Authorized By: **N/A**

Property #: **OMNI-00023**
User: **N/A**
Department: **N/A**
Make: **Mettler**
Model: **AE200**
Serial #: **E17657**
Description: **Scale, 205g**
Procedure: **DCN 500818/500887**
Accuracy: **±0.0004g ±1 LSD**

Calibrated on: **09/27/2016**
*Recommended Due: **03/27/2017**
Environment: **20** °C **44** % RH
* As Received: **Out of Tolerance**
* As Returned: **Within Tolerance**
Action Taken: **Adjusted**
Technician: **123**

Remarks: * Many factors may cause the unit to drift out of calibration before the recommended due date. Any reported error is the absolute value between the reference and the unit. Uncertainties include the effects of the unit.

Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
723A	Rice Lake	1mg-200g (Class 0)	Mass Set	12/01/2016	603626

Measurement Data

Parameter / Measurement Description	Range	Unit	Reference	Min	Max	*Error	UUT	Uncertainty	
Before									Accredited = Ü
Force									
		g	0.00100	0.0005	0.0015	0.0000	0.0010 g	5.7E-04	Ü
		g	0.01000	0.0095	0.0105	0.0000	0.0100 g	5.7E-04	Ü
		g	0.10000	0.0995	0.1005	0.0000	0.1000 g	5.7E-04	Ü
		g	0.50000	0.4995	0.5005	0.0000	0.5000 g	5.7E-04	Ü
		g	1.00000	0.9995	1.0005	0.0000	1.0000 g	5.7E-04	Ü
		g	40.00000	39.9995	40.0005	0.0005	40.0005 g	5.7E-04	Ü
		g	80.00000	79.9995	80.0005	0.0005	80.0005 g	5.7E-04	Ü
		g	120.00000	119.9995	120.0005	0.0008	120.0008 g	5.7E-04	Ü
		g	160.00000	159.9995	160.0005	0.0010	160.0010 g	5.8E-04	Ü
		g	200.00000	199.9995	200.0005	0.0012	200.0012 g	5.7E-04	Ü
After			Reference	Min	Max	*Error			Accredited = Ü
		g	0.00100	0.0005	0.0015	0.0000	0.0010 g	5.7E-04	Ü
		g	0.01000	0.0095	0.0105	0.0000	0.0100 g	5.7E-04	Ü
		g	0.10000	0.0995	0.1005	0.0000	0.1000 g	5.7E-04	Ü
		g	0.50000	0.4995	0.5005	0.0000	0.5000 g	5.7E-04	Ü
		g	1.00000	0.9995	1.0005	0.0000	1.0000 g	5.7E-04	Ü
		g	40.00000	39.9995	40.0005	0.0001	40.0001 g	5.7E-04	Ü
		g	80.00000	79.9995	80.0005	0.0002	80.0002 g	5.7E-04	Ü
		g	120.00000	119.9995	120.0005	0.0002	120.0002 g	5.7E-04	Ü
		g	160.00000	159.9995	160.0005	0.0003	160.0003 g	5.8E-04	Ü
		g	200.00000	199.9995	200.0005	0.0003	200.0003 g	5.7E-04	Ü

JJ Calibrations, Inc. certifies that this instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual with the stated procedure using standards that are traceable to the National Institute of Standards and Technology (NIST), or other National Measurement Institutes (NMI's), or by using natural physical constants, intrinsic standards or ratio calibration techniques. The quality system and this certificate are in compliance with ANSI/NCSL Z540-1-1994, ISO/IEC 17025-2005, ISO 10012-1, the ISO 9000 family and QS 9000. The expanded uncertainties of measurements for this calibration are based upon 95% (2 sigma) confidence limits. Unless otherwise stated, a test accuracy ratio (TAR) of 4:1, if achievable, is maintained. The results reported herein apply only to the calibration of the item described above. This report may not be reproduced, except in full, without prior written consent of JJ Calibrations, Inc.
JJ Calibrations, Inc. quality system has been assessed and accredited to ISO/IEC 17025:2005.

Reviewer

3 Issued 10/04/2016 Rev # 15

Inspector

SCALE WEIGHT CALIBRATION DATA SHEET

Weight to be calibrated: 10 lb

ID Number: 132

Standard Calibration Weight: 10 lb

ID Number: 256

Scale Used: MTW-150K

ID Number: 353

Date: 2/19/13 By: A. Kravitz

Standard Weight (A) (Lb.)	Weight Verified (B) (Lb.)	Difference (A - B)	% Error
10.0	10.0	0.0	Ø

*Acceptable tolerance is 1%.

This calibration is traceable to NIST using calibrated standard weights.

Technician signature: Date: 2/19/13

Established 1974

QUALITY CONTROL SERVICES

LABORATORY EQUIPMENT • SALES • SERVICE • CALIBRATION • REPAIRS
2340 SE 11TH Ave. Portland, Oregon 97214 • Box 14831 Portland, Oregon 97293
(503) 236-2712 • FAX (503) 235-2535 • www.qc-services.com

ACCREDITED
Calibration Services
Certificate Number: 1550.01
Laboratory code: 115953

OMNI-Test Laboratories, Inc.
13327 NE Airport Way
Portland, OR 97230

Report Number: OMNE0321676161011

A2LA ACCREDITED
CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Weigh-Tronix	WI-127 1000x0.1lb	21676	185	Lab
Units	**Readability**	**SOP**	**Cal Date**	**Last Cal Date**	**Cal Due Date**
lbs	0.1	QC033	10/11/16	10/27/15	10/2017

FUNCTIONAL CHECKS

SHIFT TEST	LINEARITY	REPEATABILITY	ENVIRONMENTAL CONDITIONS
Test Wt: 500 Tol: 0.5	Test Wt: HB44 Tol: HB44	Test Wt: 200 Tol: 0.2	☐ Good ☑ Fair ☐ Poor
As-Found: Pass:☑ Fail:☐	As-Found: Pass:☑ Fail:☐	As-Found: Pass:☑ Fail:☐	Temperature: 20.3°C
As-Left: Pass:☑ Fail:☐	As-Left: Pass:☑ Fail:☐	As-Left: Pass:☑ Fail:☐	

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
1000	1000.1	1000.1	0.12
700	700.1	700.1	0.12
500	500.0	500.0	0.08
200	200.0	200.0	0.08
100	100.0	100.0	0.05
50	50.0	50.0	0.05

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Avoirdupois Cast W	Rice Lake	25 and 50lb	PWO990-CA	11/4/15	11/2017	20152112

Permanent Information Concerning this Equipment:

Comments/Information Concerning this Calibration

Report prepared/reviewed by: S. King **Date:** 10-11-16

Technician: S. King
Signature:

THIS CERTIFICATE SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE APPROVAL OF QUALITY CONTROL SERVICES, INC.

The uncertainty is calculated according to the ISO Guide to the Expression of Uncertainty in Measurement and includes the uncertainty of standards used combined with the observed standard deviation of the unit under test. The uncertainty is expanded with a k factor of 2 for an approximate 95% level of confidence. Instruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy.

OMNI-Test Laboratories, Inc.
Beaverton, OR (503) 643-3788

Equipment Record

Name: Fortin Type Mercurial Barometer

Type of Equipment: Barometer

S/N: 0674 **OMNI ID #:** OMNI-00209

Manufacturer: PRINCO Instruments, Inc.

Is Manufacturer's manual available in the equipment file? : Yes, if not why?

Date Received: June 2000 **Date Placed in Service:** June 2000

Condition When Received: : New 9 Used 9 Reconditioned

Location: Lab

Location of Calibration Procedures: All PRINCO Fortin mercurial barometers have scales which are set at the time of manufacture to a near zero correction by comparison with a Fortin type mercurial barometer whose scales were calibrated traceable to NIST. If the barometer is not abused an any way , it should never go out of calibration.

Location of Dates/Results of Calibrations: If the barometer is not abused an any way , it should never go out of calibration. The barometer currently hangs on the wall and is never moved.

Location of Maintenance Procedures: Maintenance is performed on an "as needed" basis.

Dates / Results of Maintenance: Regularly scheduled maintenance is not required. Pre-service and post-service maintenance is conducted per QA Manual Section 5.3.5. To date, maintenance has not been required beyond the in-service maintenance prescribed in QA Manual Section 5.3.5.

Any Planned Maintenance? : No, if yes what:

Equipment History of any damage, malfunction, modification and/or repair (including a statement on the suitability of the equipment for testing): To date, this instrument has not been damaged, has not malfunctioned, has not been modified, and has not been repaired.

Certificate of Calibration

Certificate Number: **543402**

JJ Calibrations, Inc.
7007 SE Lake Rd
Portland, OR 97267-2105
Phone 503.786.3005
FAX 503.786.2994

ACCREDITED
0723.01
Calibration

Omni-Test Laboratories
13327 NE Airport Way
Portland, OR 97230

PO: OTL-13-031
Order Date: 09/27/2013
Authorized By: N/A

Property #: OMNI-00283A
User: N/A
Department: N/A
Make: Troemner Inc
Model: 1mg-100g (Class F)
Serial #: 47883
Description: Mass Set, 21 Pc.
Procedure: DCN 500901
Accuracy: Class F

Calibrated on: 10/09/2013
*Recommended Due: 10/09/2018
Environment: 20 °C 41 % RH
As Received: Other - See Remarks
As Returned: Within Tolerance
Action Taken: Calibrated
Technician: 34

Remarks: * Any number of factors may cause the calibration item to drift out of calibration before the recommended interval has expired

Changed set from a Class 4 to a Class F per Jeremy Clark.
Received missing 1g weight.
Refer to attachment for measurement results.

Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
432A	Sartorius	C-44	Microbalance 5.1g	03/11/2014	517747
479A	Sartorius	MC210S	Scale, 210g	02/22/2014	517755
503A	Rice Lake	1mg-200g (Class O)	Mass Set	12/07/2013	517746
723A	Rice Lake	1mg-200g (Class O)	Mass Set	09/05/2014	540048

JJ Calibrations, Inc. certifies that this instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual with the stated procedure using standards that are traceable to the National Institute of Standards and Technology (NIST), or other National Measurement Institutes (NMI's), or by using natural physical constants, intrinsic standards or ratio calibration techniques. The quality system and this certificate are in compliance with ANSI/NCSL Z540-1-1994, ISO/IEC 17025-2005, ISO 10012-1, the ISO 9000 family and QS 9000. The expanded uncertainties of measurements for this calibration are based upon 95% (2 sigma) confidence limits. Unless otherwise stated, a test accuracy ratio (TAR) of 4:1, if achievable, is maintained. The results reported herein apply only to the calibration of the item described above. This report may not be reproduced, except in full, without prior written consent of JJ Calibrations, Inc.
JJ Calibrations, Inc. quality system has been assessed and accredited to ISO/IEC 17025:2005.

Reviewer

3 Issued 10/11/2013 Rev # 14

Inspector

JJ Calibrations, Inc.

Manufacturer: Troemner Inc.
Model: 1mg-100g (Class F)
Nomenclature: Mass Set, 21 Pc.
Serial: 47883

Certificate #: 543402
Date: 09Oct2013
Technician: 34
Calibration Interval: 60 Months

Parameter		Nominal	JJ Standard	UUT	UUT ± Limit	Uncertainty ±
Mass Verification						
Data in mg		1	0.996	1.048	0.100	0.0115
	dot	2	2.002	1.973	0.120	0.0115
		2	2.002	2.048	0.120	0.0115
		5	4.996	5.033	0.170	0.0115
		10	10.000	10.053	0.210	0.0115
	dot	20	19.999	19.966	0.260	0.0115
		20	19.999	20.069	0.260	0.0115
		50	49.998	50.018	0.350	0.0115
		100	99.998	100.144	0.430	0.0115
	dot	200	199.999	200.045	0.540	0.0115
		200	199.999	199.967	0.540	0.0115
		500	499.996	500.334	0.720	0.0115
Data in grams		1		Missing		
	dot	2	2.000000	1.999888	0.0011	0.0000394
		2	2.000000	2.000335	0.0011	0.0000394
		5	5.000002	4.999996	0.0015	0.0000395
		10	9.99998	9.99984	0.0020	0.0000580
	dot	20	19.99999	20.00100	0.0040	0.0000855
		20	19.99999	20.00079	0.0040	0.0000855
		50	49.99997	49.99949	0.0100	0.0001390
		100	99.99999	99.99802	0.0200	0.0002900

Supplement Data Sheet
Bold Italics Indicates Out of Tolerance Value.

Thermal Metering System Calibration
Y Factor

Manufacturer:	APEX
Model:	XC-60-EP
Serial Number:	606001
OMNI Tracking No.:	OMNI-00335
Calibrated Orifice:	☐ Yes

Previous Calibration Comparision

Date	7/7/2016	Acceptable Deviation (5%)	Deviation
y Factor	0.999	0.04995	0.015
Acceptance	Acceptable		

Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.006
Acceptable dH@ Deviation	N/A
Maximum dH@ Deviation	N/A
Acceptance	Acceptable

Average Gas Meter y Factor	Orifice Meter dH@
0.984	N/A

Calibration Date:	01/03/17	
Calibrated by:	B. Davis	
Calibration Frequency:	Six months	
Next Calibration Due:	7/3/2017	
Instrument Range:	1.000	cfm
Standard Temp.:	68	oF
Standard Press.:	29.92	"Hg
Barometric Press., Pb:	30.24	"Hg
Signature/Date:		1/6/2017

Reference Standard *			
Standard Calibrator	Model	Standard Test Meter	
	S/N	OMNI-00001	
	Calib. Date	27-Oct-16	
	Calib. Value	0.9823	y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Reference Meter Pressure ("H2O), Pr	0.00	0.00	0.00
DGM Pressure ("H2O), Pd	2.25	1.25	0.75
Initial Reference Meter	222.4	233.7	238.8
Final Reference Meter	233.608	238.735	244.617
Initial DGM	0	0	0
Final DGM	11.284	5.124	5.938
Temp. Ref. Meter (°F), Tr	67.0	67.0	68.0
Temperature DGM (°F), Td	78.0	78.0	79.0
Time (min)	53.0	32.0	48.0
Net Volume Ref. Meter, Vr	11.208	5.035	5.817
Net Volume DGM, Vd	11.284	5.124	5.938
Gas Meter y Factor =	**0.991**	**0.982**	**0.981**
Gas Meter y Factor Deviation (from avg.)	0.006	0.002	0.004
Orifice dH@	**N/A**	**N/A**	**N/A**
Orifice dH@ Deviation (from avg.)	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|

** 2. y = [Vr x (y factor (ref)) x (Pb + (Pr/ 13.6)) x (Td + 460)]/ [Vd x (Pb + (Pd / 13.6)) x (Tr + 460)]

** 3. dH@ = 0.0317 x Pd / (Pb (Td + 460)) x [(Tr + 460) x time) / Vr]^2

* Reference calibration is traceable to NIST through NIST Test # 40674, Kimble ASTM E1272, or NIST traceable laboratory

** Equations come from EPA Method 5

The u□□ertai□ty o□measureme□t is □0□14 □^{3}□mi□□ This is □ased o□ the re□ere□□e sta□dard ha□□g a TAR □Test A□□ura□y Ratio□o□at least 4:1□

DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET

Instrument to be calibrated: Pressure Transducer

Maximum Range: 2"WC ID Number: OMI-00335B

Calibration Instrument: Digital Manometer ID Number: OMI-00633

Date: 1/3/17 By: B Davis

This form is to be used only in conjunction with Standard Procedure C-SPC.

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span
0-20% Max Range 0 to 0.4	0.155	0.16	0.005	0.25
20-40% Max Range 0.4 to 0.8	0.505	0.50	0.005	0.25
40-60% Max Range 0.8 to 1.2	1.001	1.00	0.001	0.05
60-80% Max Range 1.2 to 1.6	1.495	1.48	0.015	0.75
80-100% Max Range 1.6 to 2.0	1.985	1.99	0.005	0.25

Acceptable tolerance is 4%

The uncertainty of measurement is 0.4"WC. This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

Technician signature: _____ Date: 1/3/17

Reviewed by: _____ Date: ~~1/6/2017~~

Temperature Calibration
EPA Method 28R, ASTM 2515

Booth:	Temperature Monitor Type:	Equipment Number:
E1	National Instruments Logger	00335, 00336

Reference Meter Equipment Number: 00373	Calibration Due Date: 8/02/17

Calibration Performed By:	Date:	Ambient Temperature:	Barometric Pressure:
B. Davis	1/4/17	66	30.16

Input Temperature (F)	Ambient	Meter A	Meter B	Filter A	Filter B	Tunnel	FB Interior
0	0	0	0	0	0	0	0
100	100	100	100	100	100	100	100
300	300	300	300	300	300	300	300
500	500	501	501	500	500	500	500
700	700	701	701	701	701	700	700
1000	1001	1001	1001	1001	1001	1000	1000

Input (F)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Imp A	Imp B	Cat	Stack
0	0	0	0	0	0	0	0	0	0
100	100	100	100	100	100	100	100	100	100
300	300	300	300	300	300	300	300	300	300
500	506	500	506	500	500	500	501	500	500
700	700	700	700	700	700	701	701	701	700
1000	1000	1000	1000	1000	1000	1001	1001	1001	1000
1500								1501	
2000								2001	

Technician signature: _____ Date: 1/4/17

Reviewed By: _____ Date: _____

1/6/2017

Thermal Metering System Calibration
Y Factor

Manufacturer:	APEX
Model:	XC-60-EP
Serial Number:	606002
OMNI Tracking No.:	OMNI-00336
Calibrated Orifice:	☐ Yes

Previous Calibration Comparision

Date	7/7/2016	Acceptable Deviation (5%)	Deviation
y Factor	1.005	0.05025	0.015
Acceptance	Acceptable		

Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.002
Acceptable dH@ Deviation	N/A
Maximum dH@ Deviation	N/A
Acceptance	Acceptable

Average Gas Meter y Factor	Orifice Meter dH@
0.990	N/A

Calibration Date:	01/03/17	
Calibrated by:	B. Davis	
Calibration Frequency:	Six months	
Next Calibration Due:	7/3/2017	
Instrument Range:	1.000	cfm
Standard Temp.:	68	oF
Standard Press.:	29.92	"Hg
Barometric Press., Pb:	30.24	"Hg
Signature/Date:		1/6/2017

Reference Standard *			
Standard Calibrator	Model	Standard Test Meter	
	S/N	OMNI-00001	
	Calib. Date	27-Oct-16	
	Calib. Value	0.9823	y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Reference Meter Pressure ("H2O), Pr	0.00	0.00	0.00
DGM Pressure ("H2O), Pd	1.90	1.00	0.70
Initial Reference Meter	249.7	257	262.227
Final Reference Meter	256.938	262.17	269.982
Initial DGM	0	0	0
Final DGM	7.263	5.214	7.847
Temp. Ref. Meter (°F), Tr	68.0	68.0	68.0
Temperature DGM (°F), Td	76.0	79.0	79.0
Time (min)	34.0	33.0	59.0
Net Volume Ref. Meter, Vr	7.238	5.170	7.755
Net Volume DGM, Vd	7.263	5.214	7.847
Gas Meter y Factor =	**0.989**	**0.992**	**0.989**
Gas Meter y Factor Deviation (from avg.)	0.001	0.002	0.001
Orifice dH@	**N/A**	**N/A**	**N/A**
Orifice dH@ Deviation (from avg.)	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|

** 2. y = [Vr x (y factor (ref)) x (Pb + (Pr/ 13.6)) x (Td + 460)]/ [Vd x (Pb + (Pd / 13.6)) x (Tr + 460)]

** 3. dH@ = 0.0317 x Pd / (Pb (Td + 460)) x [(Tr + 460) x time) / Vr]^2

* Reference calibration is traceable to NIST through NIST Test # 40674, Kimble ASTM E1272, or NIST traceable laboratory

** Equations come from EPA Method 5

The u□□ertai□ty o□measureme□t is □0□14 □^{3}□mi□□ This is □ased o□ the re□ere□□e sta□dard ha□i□g a TAR □Test A□□ura□y Ratio□o□at least 4:1□

DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET

Instrument to be calibrated: Pressure Transducer

Maximum Range: 2"WC ID Number: OMI-00336B

Calibration Instrument: Digital Manometer ID Number: OMI-00633

Date: 1/3/17 By: B Davis

This form is to be used only in conjunction with Standard Procedure C-SPC.

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span
0-20% Max Range 0 to 0.4	0.134	0.140	0.006	0.30
20-40% Max Range 0.4 to 0.8	0.514	0.52	0.006	0.30
40-60% Max Range 0.8 to 1.2	0.925	0.93	0.005	0.25
60-80% Max Range 1.2 to 1.6	1.356	1.35	0.006	0.30
80-100% Max Range 1.6 to 2.0	1.917	1.91	0.007	0.35

Acceptable tolerance is 4%

The uncertainty of measurement is 0.4"WC. This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

Technician signature: Date: 1/3/17

Reviewed by: Date: 1/6/2017

Temperature Calibration
EPA Method 28R, ASTM 2515

Booth:	Temperature Monitor Type:	Equipment Number:
E1	National Instruments Logger	00335, 00336

Reference Meter Equipment Number: 00373	Calibration Due Date: 8/02/17

Calibration Performed By:	Date:	Ambient Temperature:	Barometric Pressure:
B. Davis	1/4/17	66	30.16

Input Temperature (F)	Ambient	Meter A	Meter B	Filter A	Filter B	Tunnel	FB Interior
0	0	0	0	0	0	0	0
100	100	100	100	100	100	100	100
300	300	300	300	300	300	300	300
500	500	501	501	500	500	500	500
700	700	701	701	701	701	700	700
1000	1001	1001	1001	1001	1001	1000	1000

Input (F)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Imp A	Imp B	Cat	Stack
0	0	0	0	0	0	0	0	0	0
100	100	100	100	100	100	100	100	100	100
300	300	300	300	300	300	300	300	300	300
500	506	500	506	500	500	500	501	500	500
700	700	700	700	700	700	701	701	701	700
1000	1000	1000	1000	1000	1000	1001	1001	1001	1000
1500								1501	
2000								2001	

Technician signature: _____ Date: 1/4/17

Reviewed By: _____ Date: _____

1/6/2017

Certificate of Calibration

Certificate Number: **629694**

JJ Calibrations, Inc.
7007 SE Lake Rd
Portland, OR 97267-2105
Phone 503.786.3005
FAX 503.786.2994

ACCREDITED
0723.01
Calibration

Omni-Test Laboratories
13327 NE Airport Way
Portland, OR 97230

PO: **160099**
Order Date: **08/18/2016**
Authorized By: **N/A**

Property #: **OMNI-00410**
User: **N/A**
Department: **N/A**
Make: **Dwyer**
Model: **1430**
Serial #: **OMNI-00410**
Description: **Microtector**
Procedure: **500908**
Accuracy: **±0.00025" WC**

Calibrated on: **08/29/2016**
*Recommended Due: **08/29/2017**
Environment: **19 °C 50 % RH**
* As Received: **Other - See Remarks**
* As Returned: **Limited**
Action Taken: **Calibrated**
Technician: **34**

Remarks: * Many factors may cause the unit to drift out of calibration before the recommended due date. Any reported error is the absolute value between the reference and the unit. Uncertainties include the effects of the unit.

Calibrated micrometer head only per Bruce Davis.

Limited Calibration - Calibrated micrometer head only.

Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
541A	Select	E8FED2	8 Piece Gage Block Set	11/24/2016	607288

Measurement Data

Parameter / Measurement Description	Range	Unit	Reference	Min	Max	§Error	UUT	Uncertainty
Before/After								Accredited = ✓
Length								
		Inch	0.1300	0.129	0.131	0.000	0.130 Inch	1.1E-03 ✓
		Inch	0.3850	0.384	0.386	0.000	0.385 Inch	1.1E-03 ✓
		Inch	0.6150	0.614	0.616	0.000	0.615 Inch	1.1E-03 ✓
		Inch	0.8700	0.869	0.871	0.001	0.871 Inch	1.1E-03 ✓
		Inch	1.0000	0.999	1.001	0.001	1.001 Inch	1.1E-03 ✓

JJ Calibrations, Inc. certifies that this instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual with the stated procedure using standards that are traceable to the National Institute of Standards and Technology (NIST), or other National Measurement Institutes (NMI's), or by using natural physical constants, intrinsic standards or ratio calibration techniques. The quality system and this certificate are in compliance with ANSI/NCSL Z540-1-1994, ISO/IEC 17025-2005, ISO 10012-1, the ISO 9000 family and QS 9000. The expanded uncertainties of measurements for this calibration are based upon 95% (2 sigma) confidence limits. Unless otherwise stated, a test accuracy ratio (TAR) of 4:1, if achievable, is maintained. The results reported herein apply only to the calibration of the item described above. This report may not be reproduced, except in full, without prior written consent of JJ Calibrations, Inc.
JJ Calibrations, Inc. quality system has been assessed and accredited to ISO/IEC 17025:2005.

Reviewer

3 Issued 08/31/2016 Rev #15

Stacy Heath
Inspector

WOOD MOISTURE CONTENT CALIBRATION WORKSHEET

Moisture Content Standard OMNI ID #: 00431

Reference Moisture Content Standard: **OMNI # 00430**

Date	Temp.	Barometric Pressure	Fixed Moisture %	Fixed Moisture %	Observed Moisture %		Initials
11/14/16	68° F	30.10 in Hg	22%	12%	22%	12%	AB2
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			
			22%	12%			

Notes: _____

Technician signature: _____ Date: 11/15/16

OM□I Tra□k □	OM□I-00559
E□uipme□t □ame□Des□riptio□	□a□eometer, Air □el□Meter - Dwyer
E□uipme□t S□□:	T36□
Comme□ts	□ew □a□e i□stalled
Status	A□ti□e
Part □	480

Re□ere□□e Sta□dard:	YES	X	□O	□Che□k □X□□or a□swer□

Lo□atio□ o□E□uipme□t:	Ca□ 1
Cali□ratio□ □e□dor	OM□I i□ house
Type o□Cali□ratio□	6 mo□th
Cali□ratio□ Period □Mo□ths□	6
Date o□Last Cali□ratio□	11□15□2016
Date o□□ext Cali□ratio□	5□15□2017

Do the □ollowi□g:

1□Complete Cali□ratio□ do□ume□tatio□
2□Complete top hal□o□this □orm
3□Atta□h appropriate □ali□ratio□ □orms a□d sa□e i□ □ollowi□g lo□atio□
□om□i-ser□□Test E□uipme□t□E□uipme□t□OM□I-XXXXX - E□uipme□t □ame
4□Repopulate data□ase with updated i□□ormatio□
5□Pri□t, lami□ate a□d adhere □ali□ratio□ tag to e□uipme□t

Six Month
OMNI-00559
Vaneometer

Last Cal Date: **11/15/2016**
Due Date o□Cal: **5/15/2017**

Six Month
OMNI-00559
Vaneometer

Last Cal Date: **11/15/2016**
Due Date o□Cal: **5/15/2017**

OMNI Environmental, Inc.
OMNI-Test Laboratories, Inc.

VWR Temperature Hygrometer Calibration Procedure and Data Sheet

Frequency: Every Two Years

Step 1: Locate NIST traceable standard.

Step 2: Place unit to be calibrated, tracking No. OMNI- 00592, inside OMNI desiccate box on the same shelf with the NIST traceable standard.

Step 3: After a period of not less than four hours record the temperature and humidity of both units in the spaces provide below.

Step 4: If the unit to be calibrated matches the NIST standard within ± 4%, it is acceptable. If not, the unit needs to be sent to a repair company or replaced.

Verification Data:

Date: 1/5/17 Technician: B Davis

Time in desiccate: 0900 Recording time: 0845 1/6/17

NIST Standard Temperature: 67.5 °F NIST Standard Humidity: 9.5

Test Unit Temperature Reading: 66.9 °F Test Unit Humidity Reading: 6.1

Test unit OMNI- 00592 is X or was not __ within acceptable limits.

Technician Signature:

Comments: Humidity Results of 00592 are within ± 4% of Reference meter BD

OM□I Tra□k □	OM□I-00594
E□uipme□t □ame□Des□riptio□	CAI □RE-4 Gas A□aly□er
E□uipme□t S□□:	□5F0112
Comme□ts	CO2, O2, a□d dual ra□ge CO gas a□aly□er□
Status	A□ti□e, □ali□rate prior to use□
Part □	□RE-4

Re□ere□□e Sta□dard:		YES	X	□O	□Che□k □X□□or a□swer□

Lo□atio□ o□E□uipme□t:	Porta□le gas □art□
Cali□ratio□ □e□dor	OM□I i□ house
Type o□Cali□ratio□	Cali□rate Prior to use□
Cali□ratio□ Period □Mo□ths□ □□A	
Date o□Last Cali□ratio□	□□A
Date o□□ext Cali□ratio□	□□A

Do the □ollowi□g:

1□Complete Cali□ratio□ do□ume□tatio□
2□Complete top hal□ o□ this □orm
3□Atta□h appropriate □ali□ratio□ □orms a□d sa□e i□ □ollowi□g lo□atio□
□om□i-ser□□Test E□uipme□t□E□uipme□t□OM□I-XXXXX - E□uipme□t □ame
4□Repopulate data□ase with updated i□□ormatio□
5□Pri□t, lami□ate a□d adhere □ali□ratio□ tag to e□uipme□t

Verify before use
OMNI-00594
Gas Analyzer

Verify before use
OMNI-00594
Gas Analyzer

Example Calculations

Equations and Sample Calculations – ASTM E2780 & E2515

Manufacturer:	RAIS
Model:	Viva L
Run:	1
Category:	II

Equations used to calculate the parameters listed below are described in this appendix. Sample calculations are provided for each equation. The raw data and printout results from a sample run are also provided for comparison to the sample calculations.

M_{Sdb} – Weight of test fuel spacers, dry basis, kg

M_{Cdb}– Weight of test fuel crib, excluding nails and spacers, dry basis, kg

D_{Cdb} - Density of fuel crib, excluding spacers and nails, dry basis, lbs/ft^3

M_{FTAdb} - Total weight of fuel crib excluding nails, dry basis, kg

BR – Dry burn rate, kg/hr

V_s – Average gas velocity in the dilution tunnel, ft/sec

Q_{sd} – Average gas flow rate in dilution tunnel, dscf/hr

$V_{m(std)}$ – Volume of gas sampled, corrected to dry standard conditions, dscf

m_n – Total particulate matter collected, mg

C_s - Concentration of particulate matter in tunnel gas, dry basis, corrected to standard conditions, g/dscf

E_T – Total particulate emissions, g

PR - Proportional rate variation

PM_R – Particulate emissions for test run, g/hr

PM_F – Particulate emission factor for test run, g/dry kg of fuel burned

M_{Sdb} – Weight of test fuel spacers, dry basis, kg
ASTM E2780 equation (1)

$$M_{Sdb} = (M_{Swb})(100/(100 + FM_S))$$

Where,

FM_S = average fuel moisture of test fuel spacers, % dry basis

M_{Swb} = weight of test fuel spacers, wet basis, kg

Sample Calculation:

FM_S = 20.9 %

M_{Swb} = 2.0 lbs

0.4536 = Conversion factor from lbs to kg

M_{Sdb} = [(2.0 x 0.4536) (100/(100 + 20.9)

M_{Sdb} = **0.8** kg

M_{Cdb}– Weight of test fuel crib, excluding nails and spacers, dry basis, kg
ASTM E2780 equation (2)

$$M_{Cdb} = \Sigma[(M_{CPnwb})(100/(100 + FM_{CPn}))]$$

Where,

M_{CPnwb} = weight of each test fuel piece n in fuel crib, excluding nails and spacers, wet basis, kg

FM_{CPn} = Average fuel moisture of test fuel n in fuel crib, % dry basis

Sample Calculation (test fuel piece 1):

MC_{Pnwb} = 1

FM_{CPn} = 22.9

= 1.0 (100/(100+ 22.9)

= 0.8 lbs

Total crib weight, excluding spacer 5.22 lbs

M_{Cdb} = **2.37** kg

D_{Cdb} - Density of fuel crib, excluding spacers and nails, dry basis, lbs/ft^3
ASTM E2780 equation (3)

$$D_{Cdb} = M_{Cdb}/V_C$$

Where,

V_C = Volume of fuel crib, ft^3

Sample calculation:

V_C = 307 in^3

1728 = conversion from in^3 to ft^3

D_{Cdb} = 5.22 / 307 * 1728

= **29.4** lbs/ft^3

M_{FTAdb} - Total weight of fuel crib excluding nails, dry basis, kg
ASTM E2780 equation (4)

$$M_{FTAdb} = M_{Sdb} + M_{Cdb}$$

Sample calculation:

$$M_{FTAdb} = 0.75 + 2.37$$

$$= \mathbf{3.12} \text{ kg}$$

BR – dry burn rate, kg/hr
ASTM E2780 equation (5)

$$BR = \frac{60\ M_{FTAdb}}{\theta}$$

Where,

θ = Total length of test run, min

Sample Calculation:

M_{Bdb} = 3.12 kg

θ = 180 min

$$BR = \frac{60 \times 3.12}{180}$$

BR = **1.04** kg/hr

V_s – Average gas velocity in the dilution tunnel, ft/sec
ASTM E2515 equations (9)

$$v_s = F_P \times k_p \times C_p \times (\sqrt{\Delta P})_{avg} \times \sqrt{\frac{T_{s(avg)}}{P_s \times M_s}}$$

Where:

F_p = Adjustment factor for center of tunnel pitot tube placement, $Fp = \frac{V_{strav}}{V_{scent}}$, ASTM E2515 Equation (1)

v_{scent} = Dilution tunnel velocity calculated after the multi-point pitot traverse at the center, ft/sec

v_{strav} = Dilution tunnel velocity calculated after the multi-point pitot traverse, ft/sec

k_p = Pitot tube constant, 85.49

C_p = Pitot tube coefficient: 0.99, unitless

ΔP* = Velocity pressure in the dilution tunnel, in H_2O

T_s = Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)

P_s = Absolute average gas static pressure in dilution tunnel, = $P_{bar} + P_g$, in Hg

P_{bar} = Barometric pressure at test site, in. Hg

P_g = Static pressure of tunnel, in. H_20; (in Hg = in H_20/13.6)

M_s = **The dilution tunnel wet molecular weight; M_s = 28.78 assuming a dry weight of 29 lb/lb-mole

Sample calculation:

$$Fp = \frac{17.78}{20.18} = 0.881$$

$$V_s = 0.881 \times 85.49 \times 0.99 \times 0.297 \times \left(\frac{85.6 + 460}{\left(29.75 + \frac{-0.28}{13.6} \right) \times 28.78} \right)^{1/2}$$

V_s = **17.67** ft/s

*The ASTM test standard mistakenly has the square root of the average delta p instead of the average of the square root of delta p. The current EPA Method 2 is also incorrect. This was verified by Mike Toney at EPA.

**The ASTM test standard mistakenly identifies Ms as the dry molecular weight. It should be the wet molecular weight as indicated in EPA Method 2.

Q_{sd} – Average gas flow rate in dilution tunnel, dscf/hr
ASTM E2515 equation (3)

$$Q_{sd} = 3600 \times (1 - B_{ws}) \times v_s \times A \times \frac{T_{std}}{T_{s(avg)}} \times \frac{P_s}{P_{std}}$$

Where:

3600	=	Conversion from seconds to hours (ASTM method uses 60 to convert in minutes)
B_{ws}	=	Water vapor in gas stream, proportion by volume; assume 2%
A	=	Cross sectional area of dilution tunnel, ft^2
T_{std}	=	Standard absolute temperature, 528 °R
P_s	=	Absolute average gas static pressure in dilution tunnel, = P_{bar} + P_g , in Hg
$T_{s(avg)}$	=	Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)
P_{std}	=	Standard absolute pressure, 29.92 in Hg

Sample calculation:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 17.67 \times 0.196 \times \frac{528}{85.6 + 460} \times \frac{29.8 + \frac{-0.28}{13.6}}{29.92}$$

Q_{sd} = **#####** dscf/hr

$V_{m(std)}$ – Volume of Gas Sampled Corrected to Dry Standard Conditions, dscf
ASTM E2515 equation (6)

$$V_{m(std)} = K_1 \, V_m \, Y \frac{P_{bar} + \left(\frac{\Delta H}{13.6}\right)}{T_m}$$

Where:

K_1	=	17.64 °R/in. Hg
V_m	=	Volume of gas sample measured at the dry gas meter, dcf
Y	=	Dry gas meter calibration factor, dimensionless
P_{bar}	=	Barometric pressure at the testing site, in. Hg
ΔH	=	Average pressure differential across the orifice meter, in. H_2O
T_m	=	Absolute average dry gas meter temperature, °R

Sample Calculation:

Using equation for Train 1:

$$V_{m(std)} = 17.64 \times 29.793 \times 0.984 \times \frac{\left(29.75 + \frac{1.31}{13.6}\right)}{(80.7 + 460)}$$

$V_{m(std)}$ = **28.550** dscf

Using equation for Train 2:

$$V_{m(std)} = 17.64 \times 30.524 \times 0.99 \times \frac{\left(29.75 + \frac{1.16}{13.6}\right)}{(80.8 + 460)}$$

$V_{m(std)}$ = **29.409** dscf

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 0.00 \times 1 \times \frac{\left(\underline{29.75} + \frac{0.00}{13.6}\right)}{(70.4 + 460)}$$

$V_{m(std)}$ = **0** dscf

m_n – Total Particulate Matter Collected, mg
ASTM E2515 Equation (12)

$$m_n = m_p + m_f + m_g$$

Where:

m_p = mass of particulate matter from probe, mg

m_f = mass of particulate matter from filters, mg

m_g = mass of particulate matter from filter seals, mg

Sample Calculation:

Using equation for Train 1 (first hour):

m_n = 0.0 + 37.2 + 0.0

m_n = 37.2 mg

Using equation for Train 1 (post-first hour):

m_n = 0.8 + 4.9 + 0.6

m_n = 6.3 mg

Train 1 aggregate:

m_n = 37.2 + 6.3

m_n = **43.5** mg

Using equation for Train 2:

m_n = 0.4 + 43.3 + 0.4

m_n = **44.1** mg

C_s - Concentration of particulate matter in tunnel gas, dry basis, corrected to standard conditions, g/dsc
ASTM E2515 equation (13)

$$C_s = K_2 \times \frac{m_n}{V_{m(std)}}$$

Where:

K_2	=	Constant, 0.001 g/mg
m_n	=	Total mass of particulate matter collected in the sampling train, mg
$V_{m(std)}$	=	Volume of gas sampled corrected to dry standard conditions, dscf

Sample calculation:

For Train 1:

$$C_s = 0.001 \times \frac{43.5}{28.55}$$

C_s = **0.00152** g/dscf

For Train 2

$$C_s = 0.001 \times \frac{44.1}{29.41}$$

C_s = **0.00150** g/dscf

For Ambient Train

$$C_r = 0.001 \times \frac{0.0}{0}$$

C_r = **0** g/dscf

E_T – Total Particulate Emissions, g
ASTM E2515 equation (15)

$$E_T = (c_s - c_r) \times Q_{std} \times \theta$$

Where:

C_s	=	Concentration of particulate matter in tunnel gas, g/dscf
C_r	=	Concentration particulate matter room air, g/dscf
Q_{std}	=	Average dilution tunnel gas flow rate, dscf/hr
θ	=	Total time of test run, minutes

Sample calculation:

For Train 1

E_T = (0.001524 - 0) x ###### x 180 /60

E_T = 53.79 g

For Train 2

E_T = (0.001500 - 0) x ###### x 180 /60

E_T = 52.94 g

Average

E = 53.37 g

Total emission values shall not differ by more than 7.5% from the total average emissions

7.5% of the average =	4.00
Train 1 difference =	0.43
Train 2 difference =	0.43

PR - Proportional Rate Variation

ASTM E2515 equation (16)

$$PR = \left[\frac{\theta \times V_{mi} \times V_s \times T_m \times T_{si}}{\theta_i \times V_m \times V_{si} \times T_{mi} \times T_s} \right] \times 100$$

Where:

θ = Total sampling time, min

θ_i = Length of recording interval, min

V_{mi} = Volume of gas sample measured by the dry gas meter during the “ith” time interval, dcf

V_m = Volume of gas sample as measured by dry gas meter, dcf

V_{si} = Average gas velocity in the dilution tunnel during the "ith" time interval, ft/sec

V_s = Average gas velocity in the dilution tunnel, ft/sec

T_{mi} = Absolute average dry gas meter temperature during the "ith" time interval, ^oR

T_m = Absolute average dry gas meter temperature, ^oR

T_{si} = Absolute average gas temperature in the dilution tunnel during the "ith" time interval, ^oR

T_s = Absolute average gas temperature in the dilution tunnel, ^oR

Sample calculation (for the first 1 minute interval of Train 1):

$$PR = \left(\frac{180 \times 1.666 \times 17.67 \times (85.0 + 460) \times (80.7 + 460)}{10 \times 29.79 \times 17.66 \times (85.6 + 460) \times (74.0 + 460)} \right) \times 100$$

PR = 102 %

PM_R – Particulate emissions for test run, g/hr
ASTM E2780 equation (6)

$$PM_R = 60\ (E_T/\theta)$$

Where,

E_T = Total particulate emissions, grams

θ = Total length of full integrated test run, min

Sample Calculation:

E_T (Dual train average) = 53.37 g

θ = 180 min

$PM_R = 60$ x (53.37 / 180)

PM_R = **17.79** g/hr

PM_F – Particulate emission factor for test run, g/dry kg of fuel burned
ASTM E2780 equation (7)

$$PM_F = E_T/M_{FTAdb}$$

Sample Calculation:

E_T (Dual train average) = 53.37 g

M_{Bdb} = 3.12 kg

PM_F = 53.37 / 3.12

PM_F = **17.10** g/kg

Section 5

Labeling & Owner's Manual

Manufactured by:

RAIS A/S
Industrivej 20, DK-9900 Frederikshavn, Denmark

Tested to:
UL 1482-2011
ULC S627-00

Tested & Listed By O-T-L Portland Oregon USA
C US
OMNI-Test Laboratories, Inc.

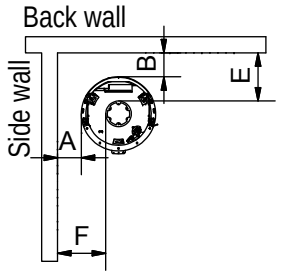
Model: VIVA L USA. VIVA L G USA. VIVA L CA USA. VIVA L G CA USA
Solid Fuel Room Heater
For Use With Solid Wood Fuel Only

Report No. # 0138WS017S

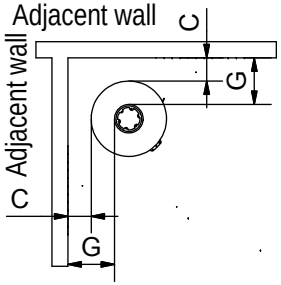
Model / Modéle		Date of manufacture / Date of fabrication	Month / Mois		Year / Année		Serial no. / N° de série		Made in Denmark / Fabriqué au Danemark

Clearances to combustible surfaces

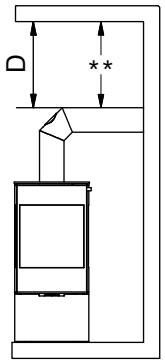
Parallel wall Installation



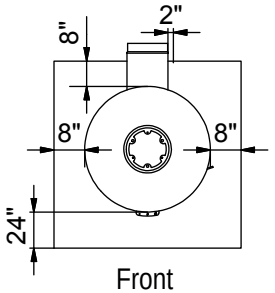
Corner Installation



**Rear/Top vent option
Ceiling



FLOOR PROTECTOR



See further floor protection requirements at bottom of this label.

Floor protection for
Canada: 30" (76 cm)
from unit to front of floor protector.

Floor protector must be under the pipe and 2"
(5cm) beyond each side for back venting.

MINIMUM CLEARANCE		Rear Vent	Écartement minimum		Évent arrière
A: Side Wall To □□it	21"	22"	A: Mur lat□ral - Appareil	21"	22"
B: Ba□k Wall To □□it	12"	11"	B: Mur arri□re - Appareil	12"	11"
C: Cor□er Wall To □□it	14"	22"	C: Mur de □oi□ - Appareil	14"	22"
D: Celi□g Height	□A	22□5"	D: Pla□□d - Lappareil	□A	22□5"
E: Fro□t Wall - Fur□ishi□g	29"	29"	E: Dista□□e meu□le de□a□t	29"	29"
F: Ba□k Wall to Pipe	18"	17"	F: Paroi arri□re de □hemi□□e	18"	17"
G: Side Wall to Pipe	27"	28"	G: Paroi arri□re de □hemi□□e	27"	28"
H: Cor□er Wall to Pipe	20"	28"	"H: Coi□ mur pour □hemi□□e	20"	28"

FLOOR PROTECTION:
Floor protection must be non-combustible material extending beneath the stove, and to the front and sides from door opening and to the rear as indicated. the floor protection is not required to have thermal protection (R=0)

Replace glass with only Rais authorized dealer supplied ceramic glass

** Not Tested - NFPA Guidelines in USA, CAN/CSA B365-M91 in Canada

U.S. ENVIRONMENTAL PROTECTION AGENCY Certified to comply with 2020 particulate emission standards using crib wood. 1.1 g/hr, Method 28R

This wood heater needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operating instructions in the owner's manual.

** Non testé - NFPA Guidelines au USA, CAN/CSA B365-M91 au Canada

La protection de sol doit être au moins de 3/8 inch matériel non combustible placé sous le foyer s'étendant vers l'avant, les côtés les ouvertures et l'arriére comme induqué.

US

USER MANUAL
MANUEL DE L'UTILISATEUR
VIVA L USA

RAIS®
ART OF FIRE

Tested & Listed By

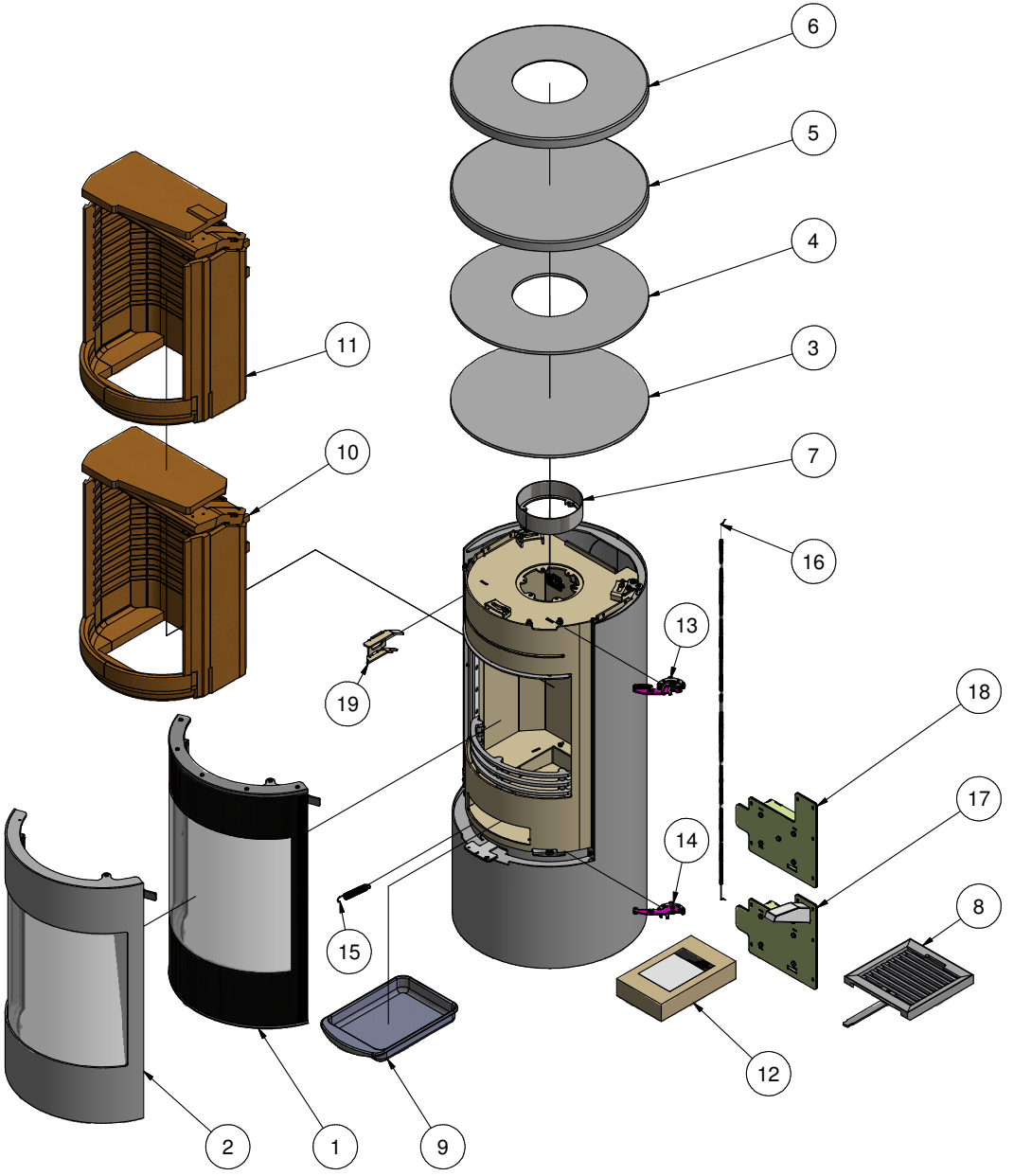
O-TL
C US

Portland Oregon USA

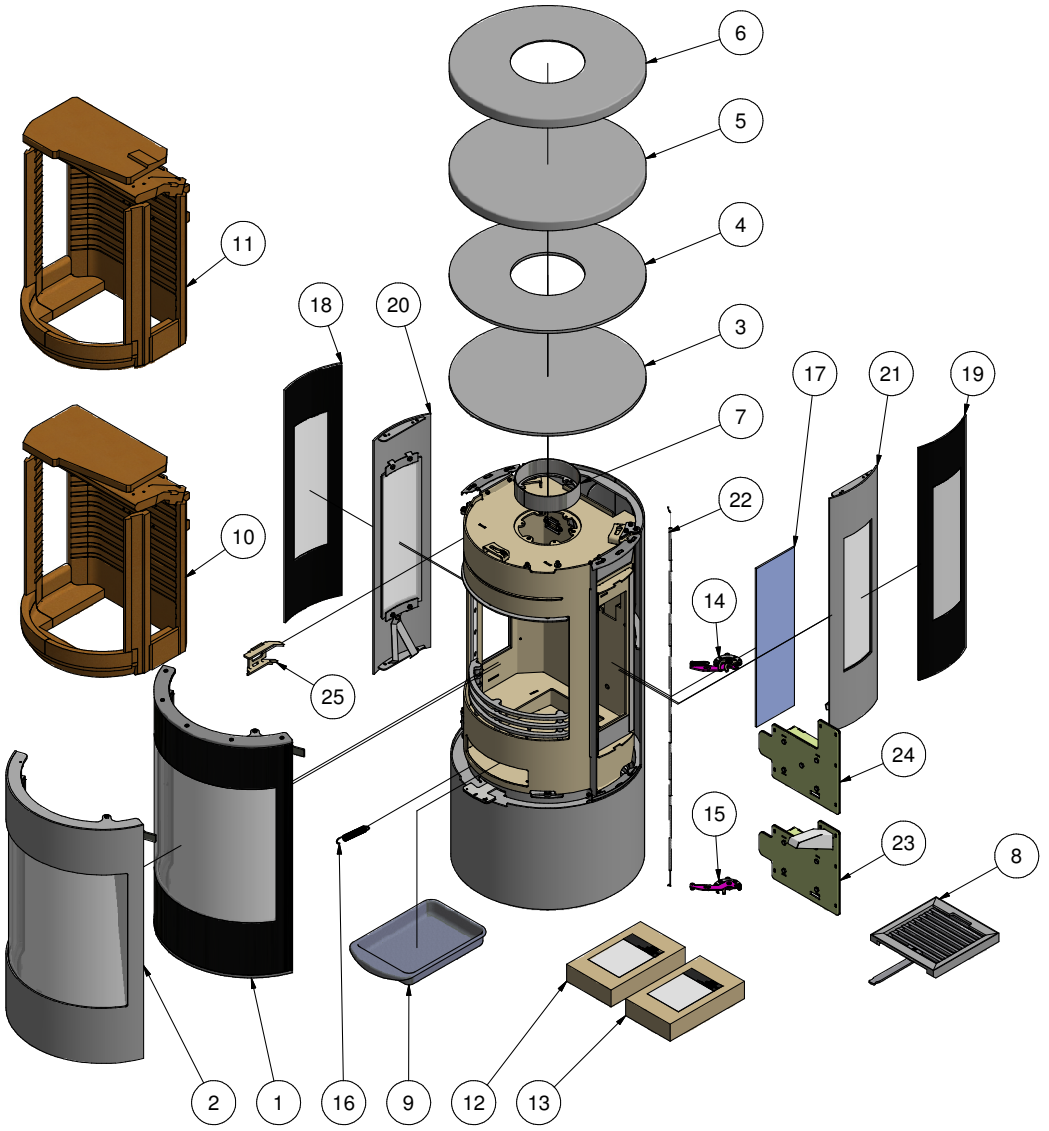
OMNI-Test Laboratories, Inc.

Report Number: 0138WS017S

VIVA 100/120/160 L USA
Sparepart drawing
Illustration des pièces détachées



VIVA 100/120/160 L G USA
Sparepart drawing
Illustration des pièces détachées



FIRE ENVIRONMENTALLY FRIENDLY!

5 Eco-friendly advices for sensible heating
- common sense both environmentally and economically.

1. Effective lighting. Use small pieces of wood (fir tree) and a suitable fire lighter, for example paraffined wood wool/saw-dust. Open the air damper, so plenty of air is fed to the stove and the gases from the heated wood can burn rapidly.

2. Light the fire with only little wood at a time - this gives the best combustion. Remember plenty of air for every time new wood is added.

3. When the flames are diminished, adjust the air damper so that the air supply is reduced.

4. When only glowing embers remain, air flow can be reduced further, so heating demand is just covered. With a lower air supply the charcoal will burn slower and the heat loss through the chimney is reduced.

5. Use only dry wood - ie. wood with a humidity of 15 to 20%.

RECYCLING:
The oven is wrapped in packaging that is recyclable. This must be disposed of according to national rules regarding the disposal of waste.

The glass can not be reused.
The glass should be discarded along with the residual waste from ceramics and porcelain.
Pyrex glass has a higher melting temperature and therefore can not be reused.

If discarded you make an important positive contribution to the environment.

We cannot be held responsible for any misprints

LIST OF CONTENT - VIVA L USA

OMNI report no. : # 0138WS017E

Revision :8
Date (DMY) :25-05-2021

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Introduction

Congratulations on the purchase of your new RAIS woodburning stove.

A RAIS woodburning stove is more than just a source of heat, it is a symbol of the emphasis you put on decorating your home with superiorly designed high-quality products.

PLEASE READ THIS ENTIRE MANUAL BEFORE YOU INSTALL AND USE YOUR NEW RAIS STOVE. FAILURE TO FOLLOW INSTRUCTIONS MAY RESULT IN PROPERTY DAMAGE, BODILY INJURY, OR EVEN DEATH.SAVE THIS MANUAL AND KEEP IT HANDY FOR EASY REFERRAL.

"DO NOT INSTALL IN A MOBILE HOME"

"WARNING: Do not overfire. If the stovetop or chimney connector pipe glow red, you are overfiring".

"Warning: Do not use other, than the specified original Rais components!

Safety and environmental testing
The Stove have been tested by OMNI-Test Laboratories, Inc. 13327 NE Airport Way, Portland, OR 97230 USA and are listed to **UL 1482-11 (R2015)** and **ULC S627-00**. It is also EPA certified..

For future reference, please write down the production number of your RAIS woodburning stove here. The number must be stated in all inquiries or complaints concerning this product.

Warranty

We offer a five-year warranty on your RAIS stove. The warranty covers any defects in materials or workmanship. However, it does not cover damage from misuse or neglect, and the glass, gaskets and firebricks are not covered either. Warranties are void if the unit is used to burn any materials other than wood or not operated in accordance with this owner's manual

Production number:

Produced by:
RAIS A/S
9900 Frederikshavn, DK

Distributor:

Date:

U.S. ENVIRONMENTAL PROTECTION AGENCY Certified to comply with 2020 particulate emission standards using crib wood. 1.1 g/hr, Method 28R

This wood heater needs periodic inspection and repair for proper operation. It is against federal regulations to operate this wood heater in a manner inconsistent with operating instructions in this manual.

This wood heater has a manufacturer-set minimum low burn rate that must not be altered. It is against federal regulations to alter this setting or otherwise operate this wood heater in a manner inconsistent with operating instructions in this manual.

Specifications:

	VIVA 100 L USA	VIVA 120 L USA	VIVA 160 L USA
Weight of Stove	App. 198 lbs (90 kg)	App. 220 lbs (100 kg)	App. 251 lbs (114 kg)
Stove exterior: Width/depth/height	Ø18,5" / 39,4 " Ø470mm / 1000 mm	Ø18,5" / 47,25" Ø470mm / 1200mm	Ø18,5" / 63" Ø470mm / 1600mm
Firebox interior Width/depth/height	13.9" / 11.5" / 17.6" 352mm / 292mm / 446mm	13.9" / 11.5" / 17.6" 352mm / 292mm / 446mm	13.9" / 11.5" / 17.6" 352mm / 292mm / 446mm
Heating capacity at -20°C/-4°F	App. 110 m² / 1184 Square Feet	App. 110 m² / 1184 Square Feet	App. 110 m² / 1184 Square Feet
Recommended amount of wood when fueling (kg) wood: 2-3 logs of wood of app. 25-33cm	1.4(kg) / 3(lbs)	1.4(kg) / 3(lbs)	1.4(kg) / 3(lbs)
Intermittent operation:	Refuelling should be undertaken within 60 minutes.	Refuelling should be undertaken within 60 minutes.	Refuelling should be undertaken within 60 minutes.
Flue gas mass flow:	5,2 grams per second	5,2 grams per second	5,2 grams per second
Flue gas temperature:	263°C / 505°F	263°C / 505°F	263°C / 505°F
Single wall connector stove pipe:	6" (15 cm)	6" (15 cm)	6" (15 cm)
Chimney pipe - class A, UL-103 HT:	6" (15 cm)	6" (15 cm)	6" (15 cm)
Optimal thermal output :	22 kBTU (6,5kW)	22 kBTU (6,5kW)	22 kBTU (6,5kW)
Min./Max. output (kW):	10 - 27 kBTU (3 - 8kW)	10 - 27 kBTU (3 - 8kW)	10 - 27 kBTU (3 - 8kW)
Minimum stove draft pressure at above output:	0.048"WC (12 Pa)	0.048"WC (12 Pa)	0.048"WC (12 Pa)
Tested EPA emission particulate rate:	1.1 g/hr	1.1 g/hr	1.1 g/hr

Convection

All RAIS stoves are convection stoves, which means that the sides of the stove never get too hot. Convection works by pulling cold air into the system at the base of the stove and up through the convection duct that is located along the combustion chamber of the stove. The heated air is released from the top of the stove, creating rapid air circulation in the room.

Glass and replacement of glass.

All RAIS stoves supplied with Robax® glass in the door. Robax® glass is a ceramic glass type suitable for stoves. The glass is installed from RAIS as an integral part of the door and stove.

Inspect the glass for cracks prior to the first fire.

Abuse may cause damage to the glass and door.
Do not strike the door or glass nor slam the door
Do not build the fire close to the glass or opening.

Do not use the stove if the glass is broken - contact your local authorized dealer.

In case of broken glass during use of stove - let the stove slowly burn the remaining firewood under supervision. Do not close the chimney baffle if installed. Contact you local authorized dealer

The glass is supplied as an integral part of the door for spare part. The Robax® glass may only be replaced by genuine spare parts from RAIS. Do not use substitute material. Replacement of the glass as separate component is only for authorized personnel.

Chimney

RAIS stoves must be installed using a Class A UL 103 HT approved factory-built chimney system or a code-approved masonry chimney with a flue liner. In Canada, the appliance must be connected to a factory-built chimney conforming to CAN/ULC-S629.

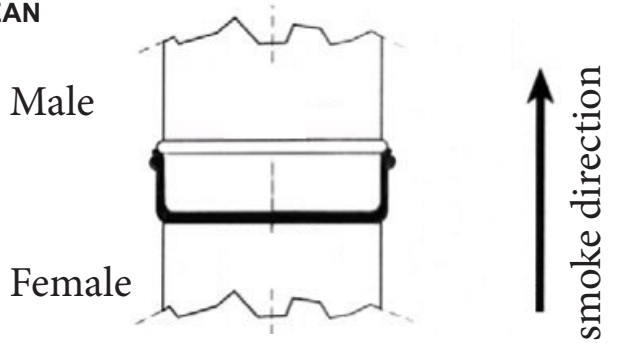
The chimney pipe must be 6” in diameter.

The chimney must extend through the roof at least 3’ (1m), and 2’ (.6m) above any structure within 10’ (3m).

The condition and height of the chimney are very important for optimal use of the stove and we recommend a total minimum height of 10’ (3m).

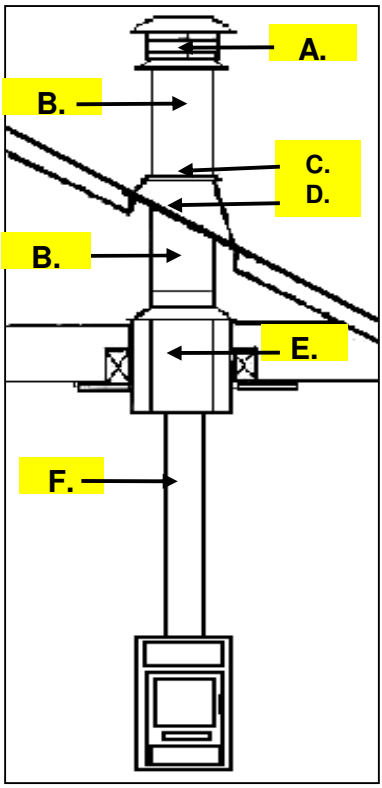
Note the chimney connector pipe should not pass through an attic, roof space, closet, concealed space, floor or ceiling.
where passage through a wall, or partition of combustible construction is desired, the installation shall conform to CAN/CSA-B365, installation Code for Solid Fuel-Burning Appliances and Equipment.

DO NOT CONNECT THIS STOVE TO A CHIMNEY FLUE OR AIR DISTRIBUTION DUCT OR ANY SYSTEM SERVING ANOTHER APPLIANCE.
NEVER MAKE “MAKE-SHIFT” COMPROMISES WHEN INSTALLING THE HEATER OR CHIMNEY. CHIMNEY CONNECTOR SHOULD BE IN GOD CONDITION AND KEPT CLEAN



Each chimney connector or stove pipe section, must be installed to each other with the crimped end toward the stove. This prevents any amount of condensed or liquid creosote from running down the outside of the pipe or the stove top.

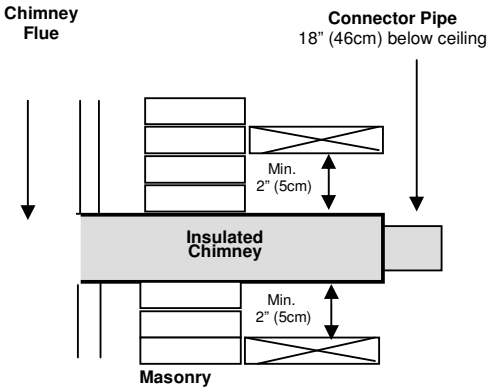
Fasten the connector pipe to the flue collar with 3 self tapping/drilling screws through the holes in the flue collar.



A. Chimney Cap
B. Insulated Chimney
C. Storm Collar
D. Roof Flashing
E. Ceiling Support Box or Joist Shield/Firestop Spacer
F. Chimney Connector

For venting vertically into a Class A chimney, a single wall pipe (at least 24 gauge) may be used in the room where the stove is installed. Refer to the manufacturer's instructions for the connection to the listed chimney. The chimney/stove pipe must not be smaller than 6" (15cm) in diameter.

For venting directly into a masonry chimney or through a thimble, the top of the single wall pipe must be at least 18" (46cm) below a combustible ceiling and must conform to NFPA 211 guidelines and methods. Please see the diagram to the left.



For rear venting or other unlisted configurations, consult the local building codes and follow the NFPA 211 guidelines.

If the stovepipe is fitted with a baffle, it must be manually operated, visibly placed for ease of use, and must not close completely. Consult your chimney expert if you have any questions.

Important note:

Please ensure that there is easy access to the chimney cleanout door.

IF THIS STOVE IS NOT INSTALLED PROPERLY, A HOME FIRE MAY RESULT. TO REDUCE THIS RISK, PLEASE FOLLOW THE DIRECTIONS FOR INSTALLATION CAREFULLY.

Installation

Precautions and Specifications

Before installation, remember to consult your local building inspector or fire marshal to determine the need to obtain a permit. Also enquire about restrictions and installation inspection requirements in your area. If utilizing an existing chimney, it is recommended that a professional mason or stove installer do a complete check-up of the chimney, liner, and flue beforehand.

In order for the stove to work and draw properly, sufficient air supply is important. Be especially aware of any mechanical fans (e.g. kitchen or bathroom exhaust systems) that may affect the proper draw.

Do not use grates, andirons, or other fuel support methods. Build fire directly on hearth.

Floor protection.

The floor protection plate must lie under the stove and extend 24” (60cm) (30” 76cm in Canada) in front of the stove door, 8” (20cm) beyond the sides of the fuel-loading door, and under the pipe and 2” (5cm) beyond each side for back venting. in front of the stove door, an 8” (20cm) floor protection is required beyond the sides of the stove and in the back of the stove (0” in the back for the US). Make sure that the floor and the sub-floor of the room in which the stove is installed is designed to carry the extra weight of the stove. The floor protector plate must be made of a non-combustible material.

When deciding where to install your stove, the heat distribution to other rooms should be taken into consideration. Put the stove at a safe distance from combustible materials; see the references at the name tag of the stove.

Manufactured by:

RAIS A/S
Industrivej 20, DK-9900 Frederikshavn, Denmark

Tested to:
UL 1482-11 (R2015)
ULC S627-00

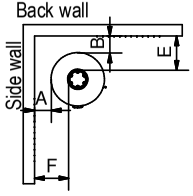
Tested & Listed By O-T-L Portland Oregon USA
C US
OMNI-Test Laboratories, Inc.
Report No. # 0138WS017S

Model: VIVA L USA. VIVA L G USA. VIVA L CA USA. VIVA L G CA USA
Solid Fuel Room Heater
For Use With Solid Wood Fuel Only

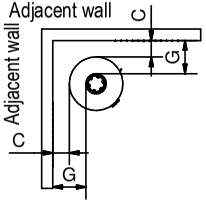
Model / Modéle		Date of manufacture / Date of fabrication	Month / Mois		Year / Année		Serial no. / N° de série		Made in Denmark / Fabriqué au Danemark

Clearances to combustible surfaces

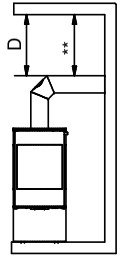
Parallel wall Installation



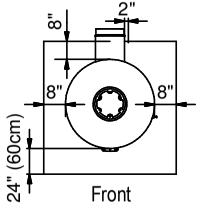
Corner Installation



**Rear/Top vent option



FLOOR PROTECTOR



See further floor protection requirements at bottom of this label.

Floor protection for
Canada: 30" (76 cm)
from unit to front of floor protector.

Floor protector must be under the pipe and 2" (5cm) beyond each side for back venting.

MINIMUM CLEARANCE		Rear Vent	Ecartement minimim		Évent arrière
A: Side Wall to Unit	21"	22"	Mur latéral à L'unité	21"	22"
B: Back Wall to Unit	12"	11"	Mur arrié à L'unité	12"	11"
C: Corner Wall to Unit	14"	22"	Mur d'angle á L'unité	14"	22"
D: Celing Height	N/A	22.5"	Plafond - Lappareil	N/A	22.5"
E: Back Wall to Vent Pipe	18"	17"	Mur arrié au tuyau d'évacuation	18"	17"
F: Side Wall to Vent Pipe	27"	28"	Paroi latéral à tuyau d'évacuation	27"	28"
G: Corner Wall to Vent Pipe	20"	28"	Mur d'angle à tuyau d'évacuation	20"	28"
Front Wall - Furnishing	29"	29"	Distance meuble devant	29"	29"

FLOOR PROTECTION:
Floor protection must be non-combustible material extending beneath the stove, and to the front and sides from door opening and to the rear as indicated.
The floor protection is not required to have thermal protection (R=0)

Replace glass with only Rais authorized dealer supplied ceramic glass

** Not Tested - NFPA Guidelines in USA, CAN/CSA B365-M91 in Canada

U.S. ENVIRONMENTAL PROTECTION AGENCY
Certified to comply with 2020 particulate emission
standards using crib wood. 1.1 g/hr, Method 28R

This wood heater needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operating instructions in the owner's manual.

** Non testé - NFPA Guidelines au USA, CAN/CSA B365-M91 au Canada

La protection de sol doit être au moins de 3/8 inch matériel non combustible placé sous le foyer
s'étendant vers l'avant, les côtés les ouvertures et l'arriére comme induqué.

TO PREVENT HOUSE FIRES

Contact local Building or Fire officials about restrictions and installation inspection in your area.

Install and use only in accordance with manufacture's installation and operating instructions and local codes.
In absence of any local codes, installation must meet minimum requirements of NFPA 221 in USA and B365 in Canada.
Refer to manufacture's instruction and local codes for precautions required for passing chimney through a combustible wall or ceiling.
Inspect and clean chimney system frequently in accordance with manufacture's instruction.
Do not connect this stove to a chimney flue serving another appliance.

Do not use grate or elevate fire.
Build wood fire directly on hearth.

Flue connector pipe must be 6 inch diameter, minimum single wall 24 msg black or 25 msg blued steel.

Chimeney must be factory built 6" diameter Class "A" 103HT, or masonry.

TO PREVENT CREOSOTE FIRES
Inspect and clean chimney frequently - Under certain conditions of use, creosote buildup may occur rapidly.

Do not use other fuels than Fire wood.

CAUTION: Fully open combustion air control before opening the fuel feed door.

CAUTION: Only operate the wood heater with the doors closed.

POUR EVITER LES INCENDIES DOMESTIQUES

Contactez les Autorités des Bâtiments et des pompiers concernant les restrictions et inspections d'installation dans votre région.

Insallez et utilisez cet appareil uniquement en respactant les instructions d'installation et d'utilisation du fabriquant.
Respectez aussi les réglementations locales.
En l'absence de réglementations locales, l'installation doit respecter les normes minimums de NFPA 211 aux USA et B365 au Canada.
Référez-vous aux instructions du fabricant et réglement locaux concernant les précautions nécessaires á prendre pour le passage de la cheminiée á travers une paroi ou un plafond combustible.
Inspectez et nettoyez le systéme de cheminée fréquemment selon les instructions du fabricant.

Ne connectez pas ce poêle á un conduit de cheminée utilisée par un autre appareil.

N'utilisez pas de grille et ne faites pas monter le feu.
Établissez le feu de bois directement dans L'âtre

Le tuyau de connexion au conduit doit avoir un diamétre de 6 inch, minimum simple conduit 24 msg acier noir ou 25 msg acier belui.

La cheminée doit être une fabrication de 6" de diametre Class "A" 103 HT, ou en maconnerie.

POR EVITER FEUX DE CREOSOTE
Inspectez et nettoyez la chemiée réguliérement - Sous certaines condition d'emploi, la créosote peut s'accumuler rapidement.

Ne pas utiliser d'autres combustibles que le bois.

AVIS: Ouvrez complétement le contrôle d'air de combustion avant d'ouvrir la porte du foyer.

AVIS: Seulement se servir du poële portes fermees.

CAUTION:
HOT WHILE IN OPERATION-DO NOT TOUCH
KEEP CHILDREN AND CLOTHING AWAY-
CONTACT MAY CAUSE SKIN BURNS.
SEE NAMEPLATE AND INSTRUCTIONS.
KEEP FURNISHINGS AND OTHER COMBUSTIBLE MATERIALS A CONSIDERABLE DISTANCE AWY FROM THE APPLIANCE.

Do not overfire - if heater or chimney connector glows, you are overfiring.

ATTENTION:
CHAUD PENDANT LE FONCTIONNEMENT - NE PAS TOUCHER ECARTE LES ENFANTS ET LES VETEMENTS- LE CONTACT PEU CAUSER DES BRULURES. CONSULTE LA PLAQUE ET LES INSTRUCTIONS. TENIR LES MEUBLES ET AUTRES MATIERES COMBUSTIBLES A GRANDE DISTANCE DE LAPPAREIL.

Évitez de surshauffer-si le feu ou la cheminée rougeoie, vois surchauffez.

DO NOT REMOVE THIS LABEL / NE PAS ENLEVER CETTE ÉTIQUETTE

Clearance to combustible walls

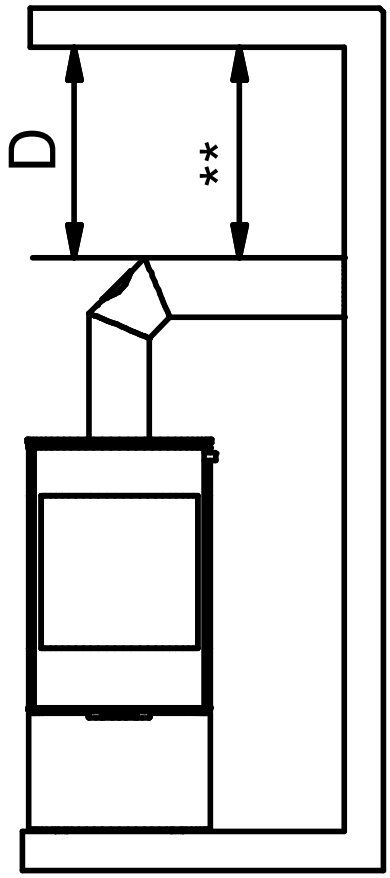
To find out whether the wall by which the stove is to be placed is combustible or not, please contact your architect or the local building authorities.

If the floor is combustible, the stove must be placed on a non-combustible plate such as steel, glass or stone. See pages 12 and 17 for additional information concerning floor protection.

It may be possible to reduce clearances to combustible walls using the methods detailed in NFPA 211. Seek guidance and permission in your locality as permits or inspections may be required.

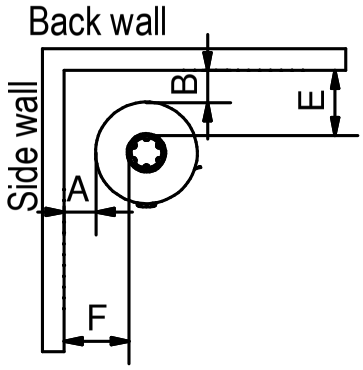
Clearances may only be reduced by means approved by regulatory authority

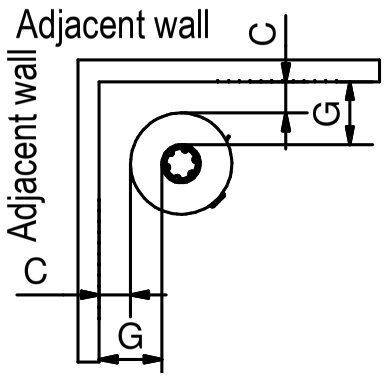
** Rear / Top vent option Celing



**:
Please refer to NFPA guidelines in USA and CAN/CSA B365-M91 in Canada.

Minimum Clearance	Single Wall Vent Pipe	Double Wall Vent Pipe	With Swivel Base - 2711590	Back Wall Flue Exit
A: Side Wall to Unit	21” / 533mm	21” / 533mm	29” / 737mm	22” / 559mm
B: Back Wall to Unit	12” / 305mm	9” / 229mm	29” / 737mm	11” / 279mm
C: Corner Wall to Unit	14” / 356mm	12” / 305mm	29” / 737mm	14” / 356mm
D: Ceiling from Vent Pipe	22.5” / 572mm	22.5” / 572mm	22.5” / 572mm	22.5” / 572mm
E: Back Wall to Vent Pipe	18” / 457mm	15” / 381mm	34.5” / 876mm	17” / 432mm
F: Side Wall to Vent Pipe	27” / 686mm	27” / 686mm	34.5” / 876mm	28” / 711mm
G: Corner Wall to Vent Pipe	20” / 508mm	17.5” / 445mm	34.5” / 876mm	20” / 508mm





Clearance to non-combustible wall

We recommend a minimum clearance to non-combustible material of at least 2” (50 mm) so that cleaning is easy. The cleaning door of the chimney should be accessible at all times.

Clearances may only be reduced by means approved by the regulatory authority.

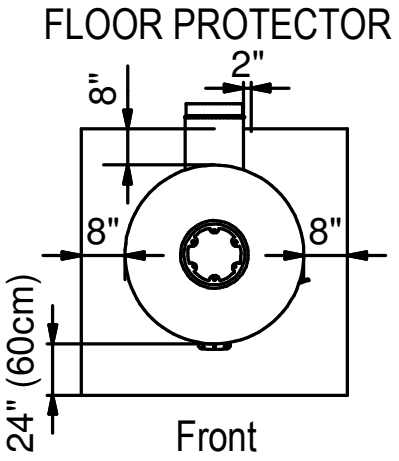
Floor protection

Floor protection must be non-combustible material extending beneath the stove, and to the front and sides from door opening and to rear as indicated.

The size of the floor protection is different in US compared to Canada. See User Manual pages 12 & 15 for more information.

Thermal Floor Protection

Non-combustible ember protection with an R = 0 is required.



Floor protection for
Canada: 30" (76 cm)
from unit to front of floor protector.

Firewood

Only burn wood that has been seasoned for at least one full year (two years is better). If the wood has not been seasoned or dried, energy will be lost in evaporating the water held in the wood. Furthermore, condensation or creosote might occur in the stove and pipe when damp wood is burnt.

Freshly cut wood contains approx. 60-70% water and is completely unsuited for burning.

Log size should be about 2" (5 cm) less than the width of the firebox

NEVER BURN TRASH (PLASTIC AND OTHER TYPES OF ARTIFICIAL MATERIALS EMIT HARMFUL GASES), DRIFTWOOD, TREATED OR PAINTED WOOD, ARTIFICIAL LOGS OR NON-SEASONED WOOD.
NEVER BURN FUELS OTHER THAN SPECIFIED!
BURNING CHARCOAL FOR EXAMPLE, CONTAINS THE RISK OF GENERATING CARBON MONOXIDE HAZARDS

All types of wood heat equally per pound; however, the density of wood is not the same as is shown in the table below, where the combustible value of wood dried for two years with a moisture of 15-20% is taken into account. See table to the left.

Drying and storage

Wood to be used for burning in a stove should be dried for two years to ensure optimal burning.

Here are some storage tips:
- Cut and split the wood before storing.
- Keep the woodpile in a dry sunny place, protected from the rain. Do not cover the pile with plastic, because that prevents the wood from drying properly.
- Stack the wood with enough space between the rows to ensure good air circulation.
- Bring the logs inside the house two-three days prior to use.

Wood type	Dry wood kg/m³	In comparison to beech
Beech and oak	580	100 %
Ash	570	98 %
Maple	540	93 %
Birch	510	88 %
Mountain pine	480	83 %
Fir	390	67 %
Poplar	380	65 %

DO NOT STORE SOLID FUEL WITHIN SPACE HEATER INSTALLATION CLEARANCES OR WITHIN THE SPACE REQUIRED FOR CHARGING AND ASH REMOVAL.

Ventilation

Extractor fans may not be fitted in the same room as the stove, as this can cause the stove to emit smoke and fumes into the room.

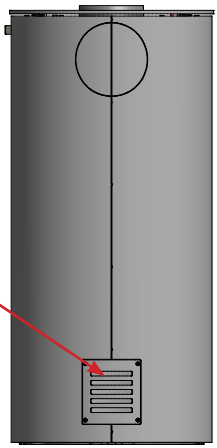
The stove requires a permanent and adequate air supply to operate safely and effectively. The installer may have fitted a permanent air supply vent into the room in which the stove is installed to provide combustion air

This air vent should not be shut off or sealed under any circumstances.

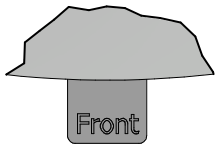
Installation of Viva L with swivel base

Please note, that when using a swivel base the clearances to side and backwall have special clearances. see table on page 15.
The stove is available with or without a swivel base.
If the stove is delivered with a swivel base, the swivel base is mounted under the stove. The upper and lower part are held together and locked with 2 transport screws (thumbscrews). after the stove is installed, remove the transport screws to free the swivel base.

Remove the Cover, on the rear side of the stove. before installing, to acces the swivel base.

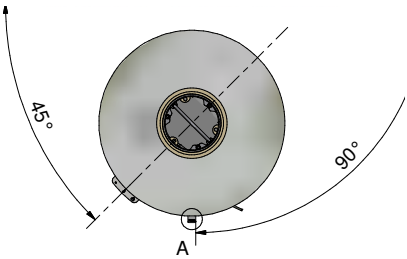


For easy acces to the Cover on the back, when installing the stove. The swivel base is locked in possition, turned 45° to the left. The middle position of the swivel base is shown by a label marked “FRONT”.

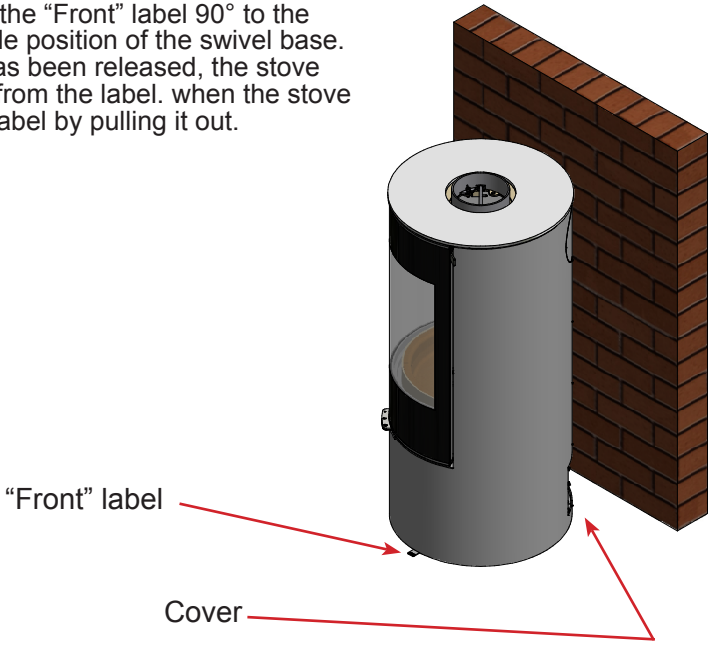


The swivel base can be installed:

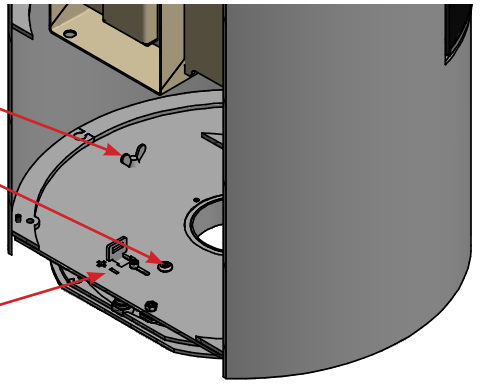
- at 90 degrees (45 degrees on each side) - (factory default setting)
- at 360 degrees



Place the stove with the the “Front” label 90° to the back wall. this is the midle position of the swivel base. When the swivel base has been released, the stove can turn 45° right or left from the label. when the stove is installed, remove the label by pulling it out.



Transportscrews



Installing a 360° swivel base. Remove the stop screw. The stove can now rotate freely.

The swivel base lock (spring) can be tightened by loosening the screw to adjust the bracket. Move the bracket toward the plus symbol and tighten the screw again.

Mount the hatch again when done.

Adjusting the combustion air

All RAIS stoves are equipped with an easy-to-use handle for adjusting the air control.
Alternatively, the stove can be equipped with a self-regulating, automatic CleverAIR ™ air damper.
For the various positions of the control please see the following illustrations. To ensure proper combustion process it is very important to supply the correct quantity of air at the right time and place. The adjustment range made from factory may not be altered for increasing firing for any reason.

Primary air is defined as combustion air for burning the mass of wood and stimulates production of volatile gases.

Secondary air is used to burn off the gases at high temperatures (above 1,000°F/540°C) and to keep the glass free of soot. The secondary air is let through the air control beneath the combustion chamber and is heated through the side channels, which is then directed to the glass. The warm air runs along the glass, keeping it free of soot.

At the very back of the combustion chamber there is a tertiary channel at the top that helps to combust the remaining gases.

When positioning the air control between Pos. 1 and 2 optimum utilization of the energy contents of the wood is obtained, because of sufficient oxygen for combustion. When the flames burn bright and yellow, the control has been adjusted correctly. Finding the correct position takes some trial and error, but is easy to find.

A typical error is to close the control too soon, because the heat gets too intense. This results in the appearance of a dark cloud of smoke from the chimney and that means the energy value of the wood is not being used properly.

It is important for proper control of the fire that the instructions in the manual are followed and the stove door normally is kept closed. It is also necessary to keep the seals in a good condition.

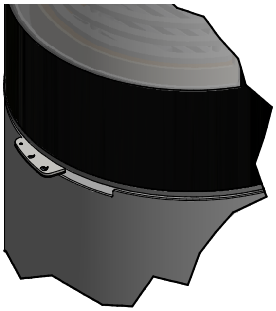
REMEMBER THE STOVE IS HOT WHILE IN OPERATION, SO KEEP CHILDREN, CLOTING, AND FURNITURE AWAY. CONTACT WITH A STOVE WHEN BURNING MAY CAUSE SKIN BURNS.Warning: Do not fire the stove with the door open!

Using the stove

Only use wood as fuel as described in the firewood section of this manual.

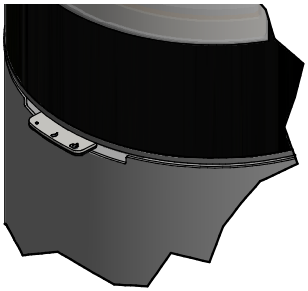
Adjusting the air control
with a manual air damper

There are three different positions for air control:



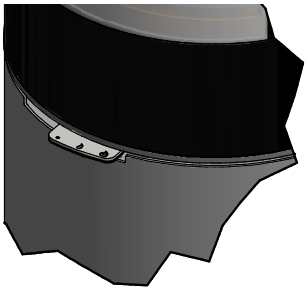
Position 1:

Handle is adjusted completely to the Left, this is the minimum air intake position (Low Burn).



Position 2:

Handle is adjusted to the middle position, which is marked by a click/small resistance. This position provides full secondary air intake. In the event of ordinary combustion the handle is to be adjusted to the interval between pos. 1 and 2.
When the flames are clear and yellow, the damper has been adjusted correctly resulting in slow/optimal combustion.



Position 3:

Handle is adjusted completely to the right. The damper is fully open and provides full primary and secondary air intake. This position is for the kindling phase and is not used in connection with normal operation.

Carbon monoxide detectors

Normal activity of loading fuel could result in emissions of smoke. It might be necessary to move carbon monoxide detectors, if they are triggered during normal useage of the stove.

Control

If the ashes are white and the combustion chamber walls not covered with soot, the air adjustment has been correct and the wood sufficiently dry.

First Fire

Your new RAIS should be broken into gently for top performance and to prevent paint damage, cracks in the firebrick, and excessive wear and tear. Start with a small fire (never overload the firebox) to allow the materials to get accustomed to the higher temperatures, and then gradually increase the intensity. Use up to a maximum of two logs.

For the first few fires you may detect a strange smell that comes from heat treating the paint and materials. This is normal and will soon disappear. Just ensure there is plenty of fresh air in the room. Furthermore, during the initial heating up and cooling down, the metal may emanate some clicking sounds due to being exposed to the large differences in temperature. This is normal as well.

For wood to burn properly, the right amount of air has to be supplied at the right time and place.

Cold handle

If the stove is supplied with a loose “cold” handle cover, which enables you to operate the handle without the use of a glove. Please note that one must always be very careful when touching any other part of the stove while it is still hot.

The loose cold handle cover is placed over the door handle.

when not in use, place the cold handle cover in its resting position on the magnetic holder supplied with the stove.

Lighting and fuelling

PLEASE NOTE!

If the air system is connected, the valve must remain open

".Top-down" lighting

- Start by placing 3-4 pieces of chopped wood - approx. 1 ½-2 kg in the bottom of the combustion chamber. Place approx. 1kg of dry wood, chopped to pieces, on top, and 2-3 fuel tablets or similar (1).
  Adjust the air damper so that it is completely open, i.e. position 3.

- The fire is lit and the door is closed ajar (2-3).
  PLEASE NOTE! It is important to have a quick lighting of the wood.

- When the fire has caught the kindling wood, shut the door completely (after approx. 10-15 minutes, depending on the draft conditions in the chimney.
  The damper is set to position 2 - see adjustment of air dampers.

- When the last flame is extinguished and there is a good layer of embers (5), add 2-3 pieces of wood - approx. 1½ kg wood (6).

- Close the door ajar, and when the fire has taken hold, close the door completely.

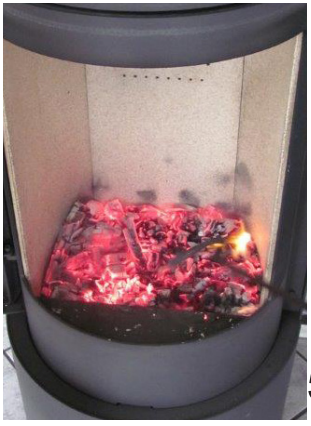
- After approximately 5 min - or until clear and stable flames appear (6) - close the damper gradually (see "adjusting the air control").

1

2

3

4


5

6

7

Fuel caution

DO NOT BURN GARBAGE OR FLAMMABLE FLUIDS SUCH AS GASOLINE, NAPTHA, OR ENGINE OIL(plastic and other artificial materials emit harmful gases), driftwood, treated wood, artificial logs, or non-seasoned wood.

DO NOT USE CHEMICALS OR FLUIDS TO START THE FIRE

NEVER USE GASOLINE, GASOLINE-TYPE LANTERN FUEL, KEROSENE, CHARCOAL LIGHTER FLUID, OR SIMILAR LIQUIDS TO START OR 'FRESHEN UP' A FIRE IN THIS HEATER. KEEP ALL SUCH LIQUIDS WELL AWAY FROM THE HEATER WHILE IT IS IN USE.

Care and maintenance

You should have your chimney, stove and connector pipe checked once every two months during the heating season or at least once a year by a professional chimney sweep and cleaned as needed.

When cleaning the stove carefully inspect the seals for damage. The seals should be in good conditions and without damage.

When cleaning, checking or repairing, the stove must be cold.

If the glass has been covered in soot, here is a simple piece of advice:
- Dampen a piece of paper or newspaper, dip it into the cold ashes and rub the soot-covered glass.
- Use another piece of paper to polish the glass.
- A good commercial glass cleaner can also be used.
- Do not use abrasive cleaners.

The outer surfaces can be wiped with a soft, dry rag and if needed a small amount of mild detergent. NEVER scrub the surfaces.

Cleaning the soapstone:
Day-to-day cleaning can be made with a damp rag. If necessary the soapstone can be carefully cleaned with some paint-thinner from the hardware store. For difficult stains that cannot be dissolved by the paint-thinner, lightly sand them.

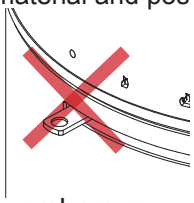
Cleaning the combustion chamber:
Rake out the ashes and store them in a metal container with a tight-fitting lid until cooled completely before throwing them in the trash can. Other waste shall not be placed in this container.

Remember NEVER to clean all ashes from the combustion chamber. Leave about a 3/4" layer for better combustion.

Warning!!

If the firewood is only burning slowly without flames or is smoking, and too little air is added, unburned exhaust gasses are developed.
Exhaust gasses can be ignited and explode, leading to damage to material and possibly personal injury.

Never close the air supply completely when lighting a fire in the stove.



Sample photos

If there are only a few embers remaining,
you must rekindle the fire.

If you simply add firewood, the fire will not
be lit, instead, unburned exhaust gasses will
develop.

Here, firewood has been added to a too small
ember layer, the air supply is insufficient - smoke is produced.

Avoid heavy smoke emission - danger of deflagration.

In case of very heavy smoke, open the damper in full, open any doors ajar, or light the fire again.

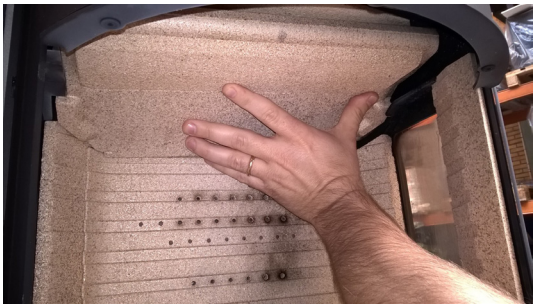
Maintaining the installation.

Establish a routine for the fuel, wood burner and firing tecnique. Check daily for creosote build-up until experience shows how often you need to clean to be safe. Be aware that the hotter the fire the less creosote is deposited, and weekly cleaning may be necessary in mild weather even though monthly cleaning may be enough in the coldest months. Contact your local municipal or provincial fire authority for information on how to handle a chimney fire. Have a clearly understood plan to handle a chimney fire.

CLEANING THE SMOKE/BAFFLE SYSTEM

Remove the Front left skamol corner, by lifting the steel skamol bracket. Then carefully lift the corner out of the stove.

Remove the Ash stopper, by lifting it upwards.



Remove the Baffle plate, by pushing it up to the right.

Remove the Back left skamol corner,
by carefully lifting it up and out.

Then lower the left side, and take it out.

Remove the steel skamol bracket, holding the Upper baffle plate.

Remove the Upper baffle plate, by lowering the left side. now there is a clear path to the smoke outlet.

CREOSOTE
FORMATION AND NEED FOR REMOVAL

WHEN WOOD IS BURNED SLOWLY, IT PRODUCES TAR AND OTHER ORGANIC VAPORS, WHICH COMBINE WITH EXPELLED MOISTURE TO FORM CREOSOTE. THE CREOSOTE VAPORS CONDENSE IN THE RELATIVELY COOL CHIMNEY FLUE OF A SLOW-BURNING FIRE. AS A RESULT, CREOSOTE RESIDUE ACCUMULATES ON THE FLUE LINING. WHEN IGNITED, THIS CREOSOTE MAKES AN EXTREMELY HOT FIRE. THE CHIMNEY AND CHIMNEY CONNECTOR SHOULD BE INSPECTED AT LEAST ONCE EVERY TWO MONTHS DURING THE HEATING SEASON TO DETERMINE IF A CREOSOTE BUILDUP HAS OCCURRED. IF CREOSOTE HAS ACCUMULATED, IT SHOULD BE REMOVED TO REDUCE THE RISK OF A CHIMNEY FIRE.

DISPOSAL OF ASHES

ASHES SHOULD BE PLACED IN A METAL CONTAINER WITH A TIGHTFITTING LID. THE CLOSED CONTAINER OF ASHES SHOULD BE PLACED ON A NONCOMBUSTIBLE FLOOR OR ON THE GROUND, WELL AWAY FROM ALL COMBUSTIBLE MATERIALS, PENDING FINAL DISPOSAL. IF THE ASHES ARE DISPOSED OF BY BURIAL IN SOIL OR OTHERWISE LOCALLY DISPERSED, THEY SHOULD BE RETAINED IN THE CLOSED CONTAINER UNTIL ALL EMBERS HAVE THOROUGHLY COOLED. OTHER WASTE SHALL NOT BE PLACED IN THIS CONTAINER.

The firebox lining is made out of vermiculite slab insulation (skamol), which protects the outer steel plates from overheating. With time small cracks might appear; this is normal. If it breaks however, it must be replaced. Vermiculite is a porous, high-insulated material and must therefore be handled with care.

Trouble Shooting

Smoke seeping through the door:
- Not enough draft in the chimney (<12 Pa)
- Check if there are any obstructions in the chimney or the wind pipe
- Check whether the kitchen exhaust fan is in use and if so, turn it off and open the window for a short period of time

Soot on the glass:
- The wood is too damp
- Make sure that the stove is sufficiently heated up before closing the door
- The air control has been set too low

The stove burns too quickly:
- Gasket may not be tight, please check and replace if necessary
- Chimney draft maybe too high >22 Pa, if this is the case, please install a damper

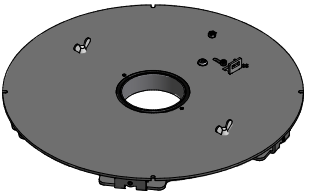
The stove is burning too slowly:
- Not sufficient amount of firewood
- Not enough air is getting into the stove
- Blocked chimney
- Leaking chimney
- Leak between chimney and pipe

If the problems continue we recommend contacting your chimney sweep or your local RAIS dealer.

Chimney fire, soot fire or creosote fire:
In case of a fire in the chimney quickly close all doors, dampers, vents and call your local fire department. **NEVER** use water to extinguish the fire.

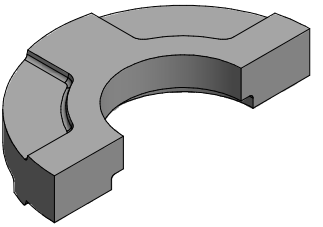
Accessories

2711590 - Swivel base - VIVA

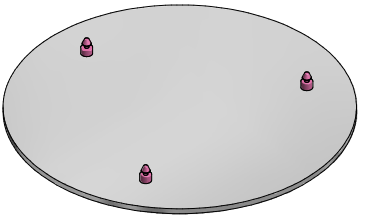


8142390 - Flue collar for Swivel base

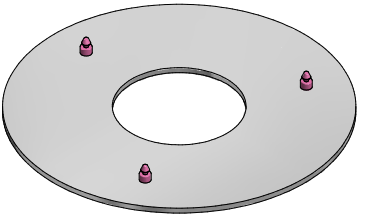
6KG heat accumulating stones for
2796521 - Viva 120 L 4-pcs. set.
2876521 - Viva 160 L 16-pcs. set



2710611SV - Stainless classic top plate for rear outlet



2710612SV - Stainless classic top plate for top outlet



000651705xx / 3 - Air kit back (xx: optional color code)

000651735xx - Air kit floor - Viva L (xx: optional color code)

Spare parts VIVA 100/120/160 L USA

Only use the specified original Rais components!
If spare parts other than those recommended by RAIS are used, the warranty is voided.

All replaceable parts can be bought as spare parts from your RAIS distributor.
For reference see spare parts drawing (front of the user manual).
(XX: optional color code)

Ref. no.	Quantity	Part no.	Description
1	1	17120xx	Glass door with single glass
2	1	17121xx	Classic glass door with single glass
3	1	2710601xx	Top plate for back outlet
4	1	2710602xx	Top plate for top outlet
5	1	2720601xx	Top plate for back outlet - Deep-drawn
6	1	2720602xx	Top plate for back outlet - Deep-drawn
7	1	61-110	Flue collar for USA-England
8	1	1713800USA	Shaking grate USA
9	1	1314001	Ash pan
10	1	1712200USA	Skamol set for Viva L USA
11		1712200-2USA	Skamol set for Viva L CA USA
12	1	1715500	Seal set for glass door
13	1	1711890	Clasp - Top
14	1	1711891	Clasp - Bottom
15	1	7301026	BA1 spring
16	1	1710924	Wire for airdamper
17	1	1710990	Airdamper - Clever air unit
18	1	1711790USA	Airdamper USA - Complete
19	1	1711224USA	Skamol bracket

Spare parts VIVA 100/120/160 L G USA
(model with sideglasses)

Only use the specified original Rais components!
If spare parts other than those recommended by RAIS are used, the warranty is voided.

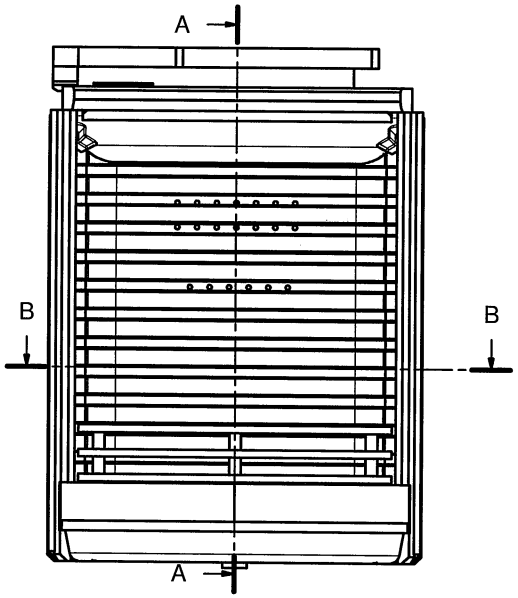
All replaceable parts can be bought as spare parts from your RAIS distributor.
For reference see spare parts drawing (front of the user manual).
(XX: optional color code)

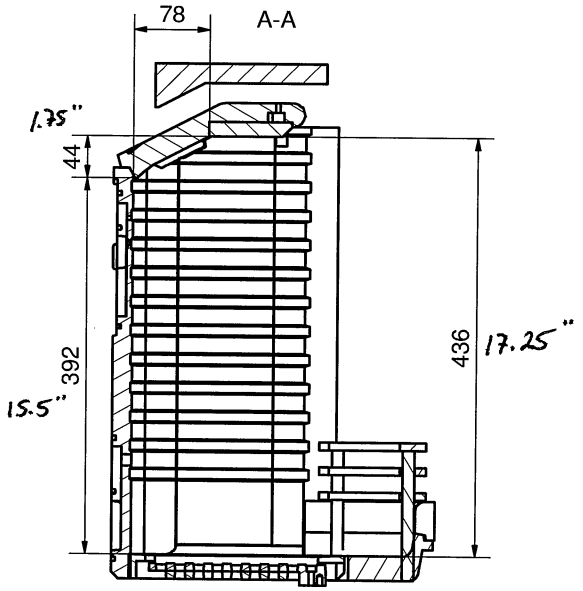
Ref. no.	Quantity	Part no.	Description
1	1	17110xx	Glass door with double glass
2	1	17111xx	Classic door with double glass
3	1	2710601xx	Top plate for back outlet
4	1	2710602xx	Top plate for top outlet
5	1	2720601xx	Top plate for back outlet - Deep-drawn
6	1	2720602xx	Top plate for back outlet - Deep-drawn
7	1	61-110	Flue collar for USA-England
8	1	1713800USA	Shaking grate USA
9	1	1314001	Ash pan
10	1	1712200-1USA	Skamol set for Viva L G USA
11		1712200-3USA	Skamol set for Viva L G CA USA
12	1	1715500	Seal set for glass door
13		1715501	Seal side glass
14	1	1711890	Clasp - Top
15	1	1711891	Clasp - Bottom
16	1	7301026	BA1 spring
17	2	1715002	Int. glass t / side (Energy Plus)
18	1	1715003	Left side glass
19	1	1715004	Right side glass
20	1	1712701xx	Steel side - left
21	1	1712702xx	Steel side - right
22	1	1710924	Wire for airdamper
23	1	1710990	Airdamper - Clever air unit
24	1	1711790USA	Airdamper USA - Complete
25	1	1711224USA	Skamol bracket

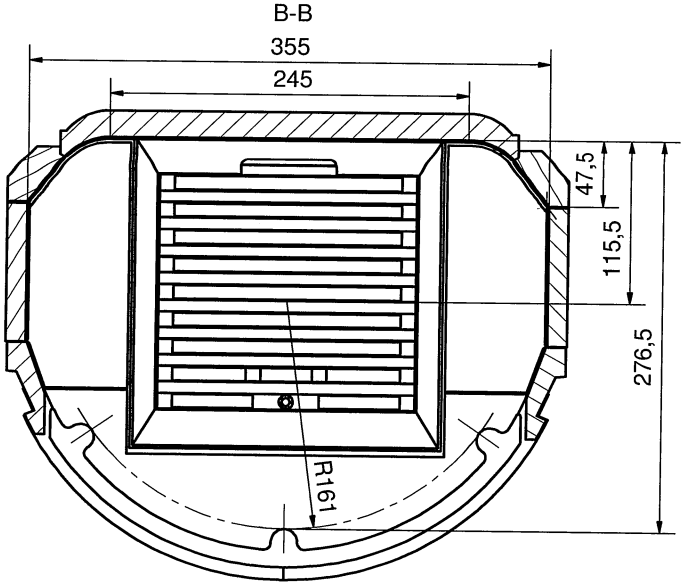
RAIS®
ART OF FIRE

RAIS A/S
Industrivej 20
DK-9900 Frederikshavn
Denmark
www.rais.dk

Appendix A – Firebox Volume







TILLADTE AFVIGELSER FOR LINIEÆRE MÅL						
0.5-3	3-6	6-30	30-120	120-400	400-1000	1000-2000
± 0.1	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2

TILLADTE AFVIGELSER FOR VINKELMÅL					
KORTESTE SIDE	0-10	10-50	50-120	120-400	> 400
VINKELAFVIGELSE	± 60'	± 0-30'	± 0-20'	± 0-10'	± 0-05'

AFVIGELSE I MM					
pr. 100 mm	± 1.8	± 0.9	± 0.6	± 0.3	± 0.15

D M Y	Corrections:		
Change order Drawing change: Improvement proposal:	Designer: ksj	Project manager:	Approved:
	Established: 21-05-2021		Format: A3

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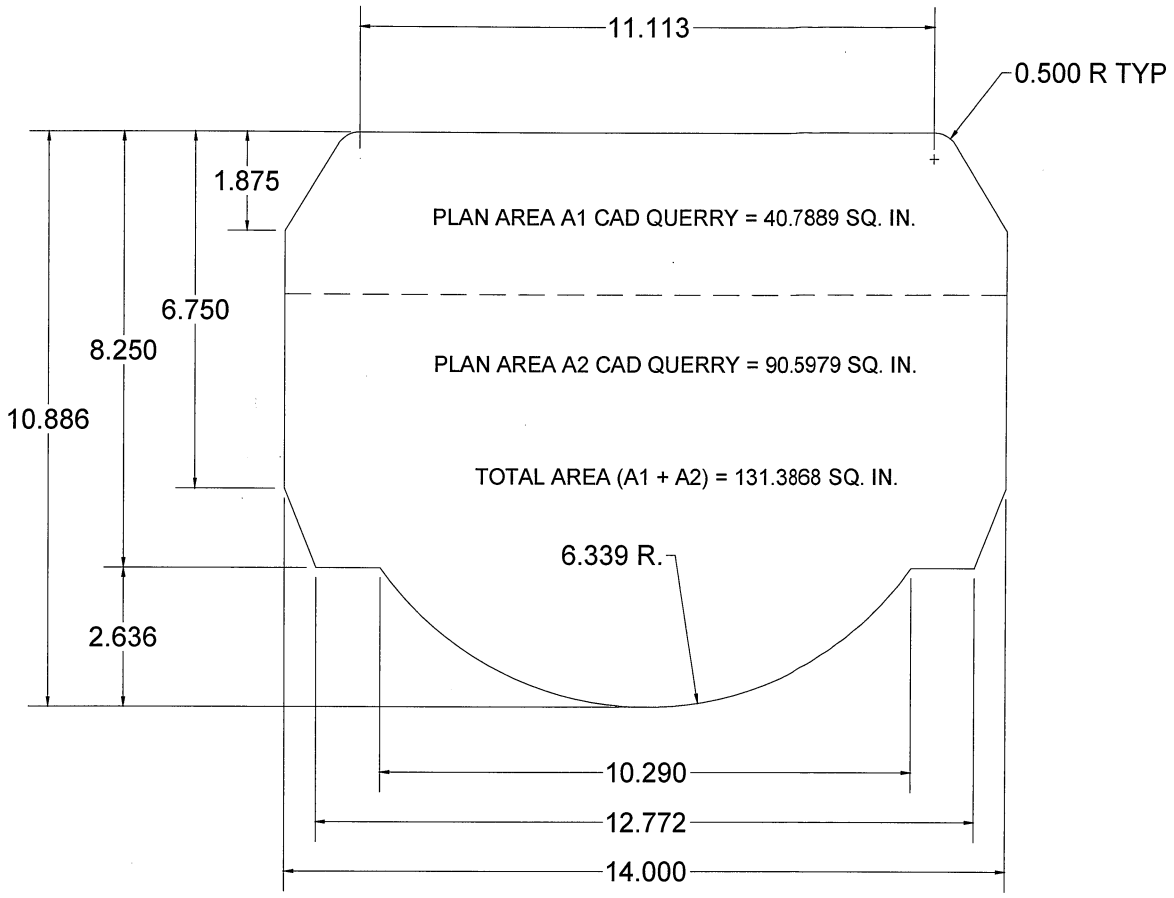
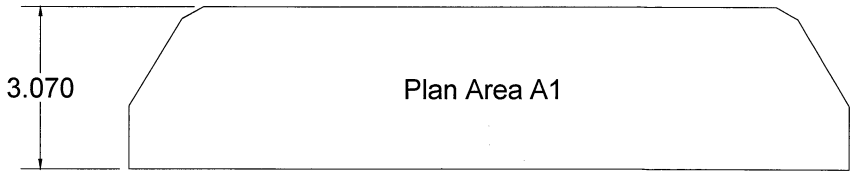
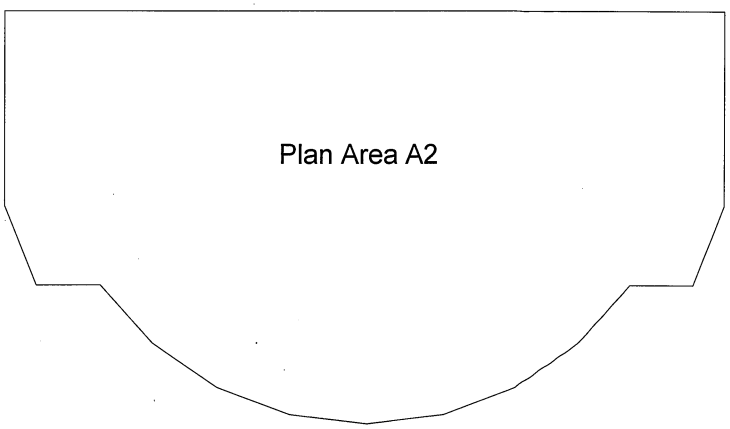
Bend Tool: OV UV	
Remarks:	
Material:	
Drawing name:	
Project:	Revision: –
Drawing no.: 27190USA - Viva L USA firebox volume	

RAIS VIVA L FIREBOX PLAN VIEW DIMENSIONS
AND COMPUTER CAD GENERATED AREAS







RAIS VIVA L
0138WS017E

Fire box Volume

5/24/21
BDAVIS

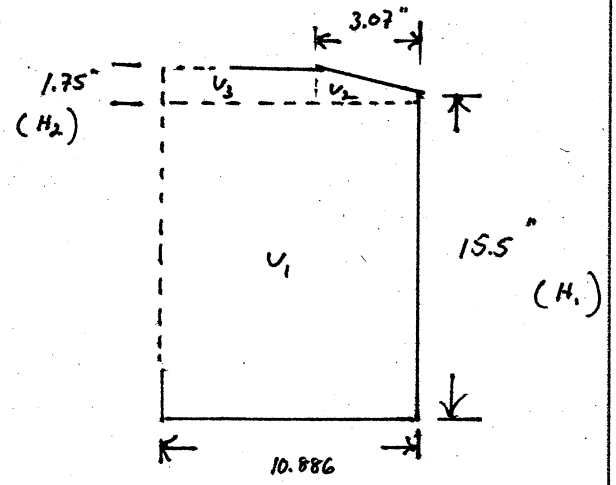
From Computor (CAD) Generated volume

$V_1 = (A_1 + A_2)\ H_1$

$V_2 = \frac{1}{2}(A_1 \times H_2)$

$V_3 = (A_2 \times H_2)$

V_1	$(40.7889 + 90.5979) \times 15.5 =$	$\overset{in^2}{2036.4954}$
V_2	$\frac{1}{2}(40.7889 \times 1.75) =$	35.902875
V_3	$(90.5979 \times 1.75) =$	158.54633
		2230.9446
		÷ 1728.00
		1.29 ft^3



Appendix B – Revision History

Date	Project No.	Tech. & Evaluator	Report Sect.	Summary of Changes
4/13/17	0138WS017E	Aaron Kravitz	All	Original report was generated.
5/24/21	0138WS017E Edition 001	Bruce Davis	Preface	Cover updated to show Edition 001 and revision date, signatories were changed, and table of content updated to show firebox volume and revision history.
			1	Sampling procedure updated to show fuel species, ambient filter, and B415.1 information. Testing narrative updated with negative filter explanation for tests 3, 4, and 7.
			3	Updated conditioning data on page 24 to show fuel weight. Added testing instructions on page 25 – 28. Updated results with train precision on pages 33, 42, 51, 60, 69, 78, 87, and 96.
			5	Replaced manual with updated version on page 163.
			Appendix A	Added Firebox Volume Calculations.
			Appendix B	Added revision history.