
Pacific Energy Fireplace Products Ltd.

Project # 18-424

Model: Vista LE

AKA: Vista Classic LE, Neo 1.6 LE,
Neostone 1.6 LE

Type: Residential Non-catalytic Wood
Fired Heater

October 17, 2018

EPA Test Method 28R for Certification and Auditing of Wood Heaters

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Affidavit

PFS-TECO was contracted by Pacific Energy Fireplace Products Ltd. (Pacific Energy) to provide testing services for the Vista LE Non-Catalytic Wood-Fired Room Heater per EPA Method 28R, *Certification and Auditing of Wood Heaters*. All testing and associated procedures were conducted at PFS-TECO's Portland Laboratory beginning on 8/8/2018 and ending on 8/14/2018. PFS-TECO's Portland Laboratory is located at 11785 SE Highway 212 – Suite 305, Clackamas, Oregon 97015. Testing procedures followed EPA Method 28R and ASTM E2780, *Standard Test Method for Determining Particulate Matter Emissions from Wood Heaters*. Particulate sampling was performed per ASTM E2515, *Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel*.

PFS-TECO is accredited by the U.S. Environmental Protection Agency for the certification and auditing of wood heaters pursuant to subpart AAA of 40 CFR Part 60, New Source Performance Standards for Residential Wood Heaters and subpart QQQQ of 40 CFR Part 60, Standards of Performance for New Hydronic Heaters and Forced Air Furnaces, Methods 28R, 28WHH, 28 WHH-PTS, and all methods listed in Sections 60.534 and 60.5476. PFS-TECO holds EPA Accreditation Certificate Numbers 4 and 4M (mobile). PFS-TECO is accredited by IAS to ISO 17020:2012 "Criteria for Bodies Performing Inspections, By A2LA to ISO 17025:2005 "Requirements for Testing Laboratories", and by Standards Council of Canada to ISO 17065:2012 "Requirements for Bodies Operating Product Certification Systems".

The following people were associated with the testing, analysis and report writing associated with this project.



Sebastian Button, Laboratory Supervisor

Introduction

Pacific Energy of Duncan, BC, contracted with PFS-TECO to perform EPA certification testing on Vista LE Non-Catalytic Wood-Fired Room Heater. All testing was performed at PFS-TECO's Portland Laboratory. Testing was performed by Mr. Sebastian Button.

Notes

- Prior to start of testing, 50 hours of conditioning was performed per ASTM E2780.
- Prior to start of testing, the dilution tunnel was cleaned with a steel brush.
- Front filters were changed on sample train A at one hour for all 6 test runs.
- A total of 6 test runs were performed in accordance with EPA Method 28R, 1 at the maximum burn rate category, 2 at the medium high burn rate category, 2 at the medium low burn rate category, one of which was meets the 1.00 kg/hr or less requirement for stoves operating at minimum air setting, and 1 fan confirmation test, all 6 test runs met validity requirements, and all but the fan confirmation test are included in the weighted average. See Run Narrative section for further detail on each run.

Wood Heater Identification and Testing

- Appliance Tested: **Vista LE**
- Serial Number: **Un-serialized Prototype – PFS Tracking Number 0006**
- Manufacturer: **Pacific Energy Fireplace Products Ltd.**
- Catalyst: **No**
- Heat exchange blower: **Optional**
- Type: **Wood Stove**
- Style: **Free Standing**
- Date Received: **Thursday, July 26, 2018**
- Wood Heater Aging: **May 29, 2018 - July 18, 2018**
- Testing Period – Start: **Wednesday, August 08, 2018** Finish: **Tuesday, August 14, 2018**
- Test Location: **PFS-TECO Portland Laboratory, 11785 SE HWY 212 - Suite 305, Clackamas, OR 97015**
- Elevation: **≈131 Feet above sea level**
- Test Technician(s): **Sebastian Button**
- Observers: **Ken Davis of Pacific Energy (Test Runs 1 through 4 only).**

Test Procedures and Equipment

All Sampling and analytical procedures were performed by Sebastian Button. All procedures used are directly from ASTM E2780 and ASTM E2515. See the list below for equipment used. See Appendix C submitted with this report for calibration data.

Equipment List:

Equipment ID#	Equipment Description
040	Delmhorst J-2000 Wood Moisture Meter
041	Rice Lake 3'x3' floor scale w/digital weight indicator
050	Digiweigh DWP12i Platform Scale
053	APEX XC-60 Digital Emissions Sampling Box A
054	APEX XC-60 Digital Emissions Sampling Box B
055	APEX Ambient sampling box
057	California Analytical ZRE CO2/CO/O2 IR ANALYZER
109A/B	Troemner 100mg/200mg Audit Weights
107	Sartorius Analytical Balance
051	10 lb audit weight
090	Dewalt Tape Measure
092	Digital Calipers
095	Anemometer
111	Microtector
CC144992	Gas Analyzer Calibration Span Gas
CC332147	Gas Analyzer Calibration Mid Gas

Results

A total of 6 test runs were performed on the Vista LE. Run #6, a fan confirmation test was not used in any weighted average results calculations. The weighted average emissions rate for the 5 run test series was measured to be **1.9 g/hr** with a Higher Heating Value efficiency of **72.3%**. The average CO emission rate for the 5 tests was **1.4 g/min.** The Pacific Energy Vista LE Non-Catalytic Wood-Fired Room Heater meets the 2020 crib wood PM emission standard of ≤ 2.0 g/hr per CFR 40 part 60, §60.532 (b).

Detailed individual run data can be found in Appendix A submitted with this report.

Summary Table

	Cat. 2 ≤1.00 kg/hr.	Cat. 2 0.80 - 1.25 kg/hr.	Cat. 3 1.25 - 1.90 kg/hr.	Cat. 3 1.25 - 1.90 kg/hr.	Cat. 4 Max Burn Rate	Fan Confirmation (Cat. 2)*
Date	8/8/2018	8/12/2018	8/10/2018	8/9/2018	8/9/2018	8/14/2018
Run Number	1	5	4	2	3	6
Emission Rate (g/hr).	2.91	1.38	1.10	1.86	1.13	1.69
Burn Rate (kg/hr)	1.00	1.22	1.36	1.51	1.93	1.25
Heat Output (Btu/hr)	13,494	16,792	18,643	20,550	23,186	17,067
Overall Efficiency (% HHV)	73.0	74.6	74.1	73.9	65.0	73.1
CO Emissions (g/MJ Output)	6.9	4.0	4.4	3.8	3.1	5.0
CO Emissions (g/kg Dry Fuel)	99.6	58.7	65.0	56.2	40.5	72.3
CO Emissions (g/min)	1.6	1.2	1.5	1.4	1.3	1.5
ASTM E2515 Emissions – First Hour (g/hr)	5.45	1.81	1.81	2.0	0.68	3.05
Weighted particulate emission average of 5 test runs: 1.9 grams per hour.						
Weighted average HHV efficiency of 5 test runs: 72.3%.						

*Fan Confirmation test not included in weighted average calculations.

Weighted Average Calculation Summary

28R Weighted Average.xlsm

EPA Method 28R Weighted Average Emissions

Client: Pacific Energy
 Stove Model: Vista LE
 Test Dates: 8/8/18 - 8/14/18
 Job Number: 18-424

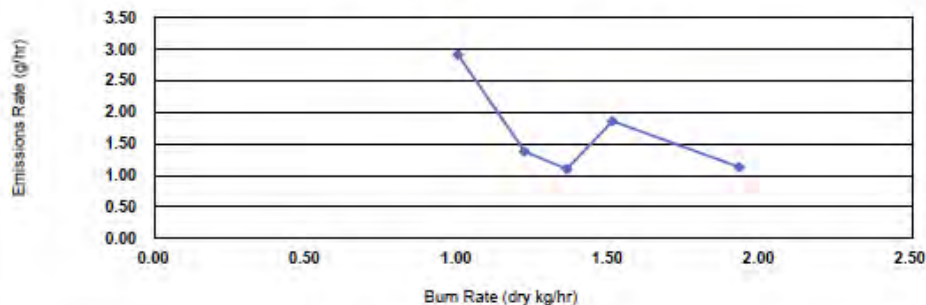
Signature/Date:  8/16/2018

Weighted Average Particulate Emissions (g/hr):	1.9
Weighted Average HHV Efficiency (%):	72.3%
Weighted Average LHV Efficiency (%):	78.2%
Average CO Emissions (g/min):	1.4

Individual Run Summaries

Run Number:	1	Run Number:	5
Burn Rate (dry kg/hr):	1.00	Burn Rate (dry kg/hr):	1.22
Emissions Rate (g/hr):	2.91	Emissions Rate (g/hr):	1.38
HHV Efficiency (%):	73.0%	HHV Efficiency (%):	74.6%
LHV Efficiency (%):	78.9%	LHV Efficiency (%):	80.7%
Weighting Percentage (%):	36.72%	Weighting Percentage (%):	18.55%
Run Number:	4	Run Number:	2
Burn Rate (dry kg/hr):	1.36	Burn Rate (dry kg/hr):	1.51
Emissions Rate (g/hr):	1.10	Emissions Rate (g/hr):	1.86
HHV Efficiency (%):	74.1%	HHV Efficiency (%):	73.9%
LHV Efficiency (%):	80.1%	LHV Efficiency (%):	79.8%
Weighting Percentage (%):	12.95%	Weighting Percentage (%):	15.73%
Run Number:	3		
Burn Rate (dry kg/hr):	1.93		
Emissions Rate (g/hr):	1.13		
HHV Efficiency (%):	65.0%		
LHV Efficiency (%):	70.3%		
Weighting Percentage (%):	16.05%		

Emission Rate vs Burn Rate Plot



Test Run Narrative

Run 1

Run 1 was performed on 8/8/2018 as a category 2 test, per EPA Method 28R. The total test time was 240 minutes. The particulate emissions rate for the test was 2.91 g/hr, the burn rate was 1.00 kg/hr with an HHV efficiency of 74.3%. The Train A front filter was changed at 1 hr to determine 1st hour emissions. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

This test meets the burn rate requirements described in EPA Method 28 Section 8.1.1.3.2 as a category 2 test with a burn rate of 1.00 kg/hr or less for wood stoves that cannot be operated at burn rates less than 0.8 kg/hr. This test was performed with the air control set to its lowest setting, it is not possible to operate the stove at a lower air setting. Therefore, this test will be used in lieu of a category 1 test.

Run 2

Run 2 was performed on 8/9/2018 as a category 3 test, per EPA Method 28R. The total test time was 160 minutes. The particulate emissions rate for the test was 1.86 g/hr, the burn rate was 1.51 kg/hr with an HHV efficiency of 73.9%. The Train A front filter was changed at 1 hr to determine 1st hour emissions. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

Run 3

Run 3 was performed on 8/9/2018 as a category 4 test, per EPA Method 28R. The total test time was 120 minutes. The particulate emissions rate for the test was 1.13 g/hr, the burn rate was 1.93 kg/hr with an HHV efficiency of 65.0%. The Train A front filter was changed at 1 hr to determine 1st hour emissions. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

Run 4

Run 4 was performed on 8/10/2018 with an air setting targeting a category 2 burn rate, per EPA Method 28R, but ended up being a category 3 test. The total test time was 170 minutes. The particulate emissions rate for the test was 1.10 g/hr, the burn rate was 1.36 kg/hr with an HHV efficiency of 74.1%. The Train A front filter was changed at 1 hr to determine 1st hour emissions. All test results were appropriate and valid. There were no anomalies and all test criteria were met. Due to the missed burn rate, another test (run 5) at a slightly lower air setting was performed to get another category 2 burn rate test.

Run 5

Run 5 was performed on 8/12/2018 as a category 2 test, per EPA Method 28R. The total test time was 190 minutes. The particulate emissions rate for the test was 1.38 g/hr, the burn rate was 1.22 kg/hr with an HHV efficiency of 74.6%. The Train A front filter was changed at 1 hr to determine 1st hour emissions. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

Run 6

Run 6 was performed on 8/14/2018 as a category 2 fan confirmation test, per EPA Method 28R. The total test time was 190 minutes. The particulate emissions rate for the test was 1.69 g/hr with a burn rate of 1.25 kg/hr. All test results were appropriate and valid. There were no anomalies and all test criteria were met. Since the particulate emissions rate is within 1.0 g/hr of the other category 2 test (run 5, 1.10 g/hr) the blower is determined not to have a significant impact on emissions performance and may therefore be approved as an optional accessory. This test run is not included in the weighted average calculations presented in the results summary.

Test Conditions Summary

Testing conditions for all runs fell within allowable specifications of ASTM E2780 and ASTM E2515. A summary of facility conditions, fuel burned, and run times is listed below.

Runs	Ambient (°F)		Relative Humidity (%)		Average Barometric Pressure (In. Hg.)	Preburn Fuel Weight (lbs)	Test Fuel Weight (lbs)	Test Fuel Moisture (%DB)	Test Run Time (Min)
	Pre	Post	Pre	Post					
1	83	88	38.3	32.9	29.73	9.6	10.4	19.9	240
2	74	78	50.1	46.9	29.85	9.0	10.4	19.5	160
3	87	89	37.6	28.3	29.79	9.1	10.0	19.6	120
4	79	83	39.5	32.4	29.83	9.4	10.0	19.6	170
5	74	81	41.3	35.2	29.89	8.9	10.0	19.7	190
6	78	83	39.0	31.8	29.75	9.4	10.3	19.9	190

Appliance Operation and Test Settings

The appliance was operated according to procedures as described in the Operations Manual, found in Appendix B submitted with this report. Detailed run information can be found in Appendix A submitted with this report.

Settings & Run Notes

	Pre-Burn Air Setting	Test Run Air and Fan Settings ¹
Run 1	Adjustable Primary Air Control (PAC) fully closed.	Adjustable PAC fully closed, fan on turned on to high setting 15 minutes after loading, per manufacturer's instructions
Run 2	Adjustable PAC open 5/16"	Adjustable PAC open 5/16", fan on turned on to high setting 15 minutes after loading, per manufacturer's instructions.
Run 3	Adjustable PAC fully open	Adjustable PAC fully open, fan on turned on to high setting for full duration of test, per manufacturer's instructions.
Run 4	Adjustable PAC open 7/32"	Adjustable PAC open 7/32", fan on turned on to high setting 15 minutes after loading, per manufacturer's instructions.
Run 5	Adjustable PAC open 3/16"	Adjustable PAC open 3/16", fan on turned on to high setting 15 minutes after loading, per manufacturer's instructions.
Run 6	Adjustable PAC fully closed	Adjustable PAC open 5/16", fan on turned on to high setting 15 minutes after loading, per manufacturer's instructions.

Appliance Description

Model(s): Vista LE

Additional Models Discussion: There are several additional models that utilize the same firebox design tested under this certification test series. In addition to the Vista LE are the Vista Classic LE, Neo 1.6 LE, and Neostone 1.6 LE. All units feature the firebox design discussed below, differing only in their outer cladding, enameled porcelain for the Classic and Neo 1.6, and soapstone for the Neostone 1.6. The Neo 1.6 and the Neostone 1.6 both feature a modern leg design aesthetic, compared to the traditional leg/pedestal design utilized on the Vista LE and Vista Classic LE. None of the design differences between the four models are expected to cause the model line to exceed the emissions performance limit and are therefore included as part of this certification report.

Appliance Type: Non-Catalytic Wood-Fired Room Heater

Firebox Volume: 1.55 ft³

Air Introduction System: Primary Air enters the firebox from the front bottom of the appliance and is channeled up the sides on the appliance and down through the air wash, as well as through a pilot air opening in the front of the firebox. Primary air is controlled via a damper arm located below the ashlip which moves left (open) to right (closed). Secondary air is pulled through a fixed opening in to rear bottom of the appliance and channeled up through the hybrid baffle/2 secondary air tubes. Dimensions on all these features can be found in Appendix D.

Baffles: A hybrid baffle air manifold/secondary air tube system is constructed of 12 Gauge Stainless Steel, with a “M” board baffle lying on top of the tube portion on the baffle.

Refractory Insulation: The firebox is lined with 1” thick firebrick.

Flue Outlet: 6-inch exhaust outlet located on the top of the appliance.

Catalytic Combustor: N/A

Fan: The appliance is optionally offered with a convection fan that attached to the bottom rear on the appliance.

Gasketing: 7/8” fiberglass rope gasket seals the door against the firebox, 3/4” fiberglass “u” channel gasket is used to seal the 5mm ceramic glass against the door frame.

Appliance Dimensions

Vista LE Unit Dimensions

Height	Width	Depth	Firebox Volume	Weight
28.6"	23.8"	17"	1.55ft ³	267 lbs

Appliance design drawings can be found in Appendix D submitted with the CBI copy of this report.

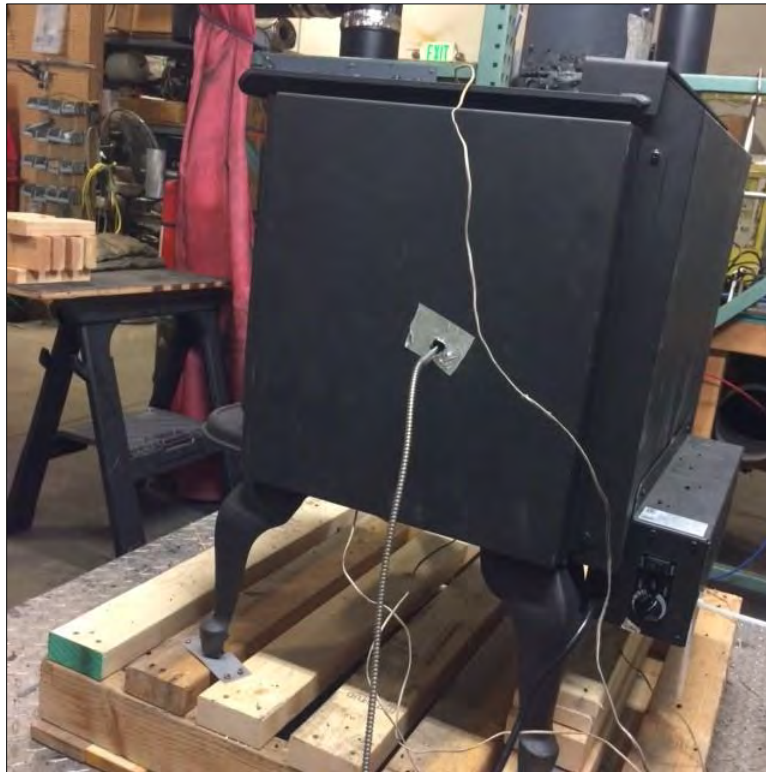
Appliance Front



Appliance Left



Appliance Right



Appliance Rear



Test Fuel Properties

Test fuel used was dimensional Doug fir lumber, air-dried to the specified moisture content range. Typical fuel loads are pictured below:

Typical Test Fuel Load Configuration



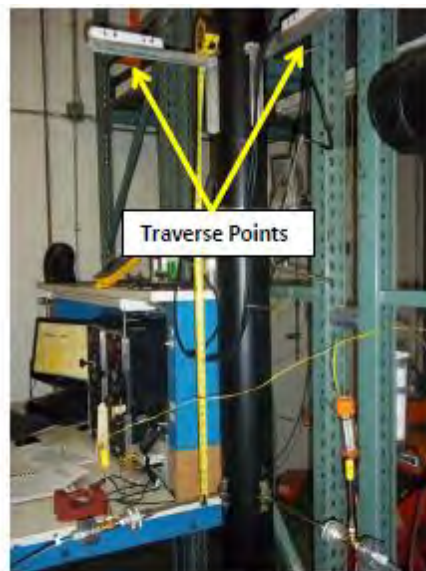
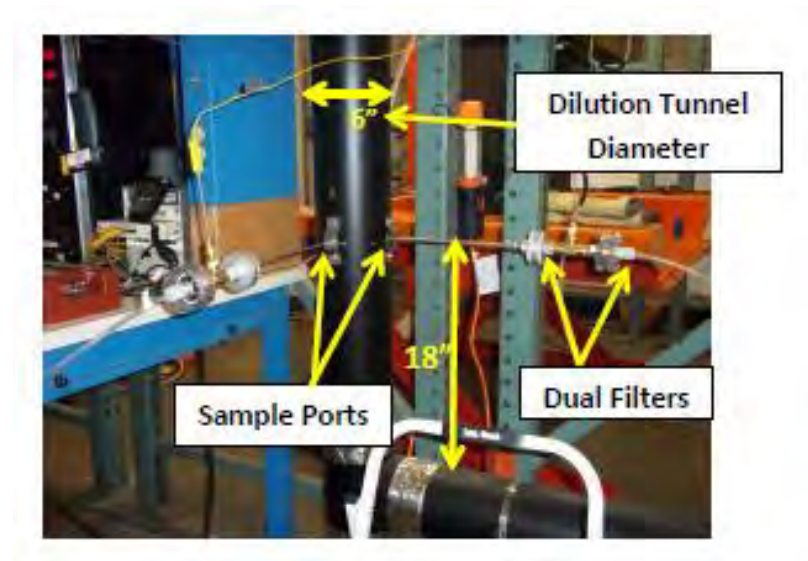
Typical Test Fuel Loaded in Test Stove



Sampling Locations and Descriptions

Sample ports are located 16.5 feet downstream from any disturbances and 1 foot upstream from any disturbances. Flow rate traverse data was collected 12 feet downstream from any disturbances and 5.5 feet upstream from any disturbances. (See below).

Sample Points



Sampling Methods

ASTM E2515 was used in collecting particulate samples. The dilution tunnel is 6 inches in diameter. All sampling conditions per ASTM E2515 were followed. No alternate procedures were used, and no sampling intervals fell outside of proportional rates of +/- 10%.

Analytical Methods Description

All sample recovery and analysis procedures followed ASTM E2515 procedures. At the end of each test run, filters, O-Rings and probes were removed from their housings, dessicated for a minimum of 24 hours, and then weighed at 6 hour intervals to a constant weight per ASTM E2515-11 Section 10.

Calibration, Quality Control and Assurances

Calibration procedures and results were conducted per EPA Method 28R, ASTM E2515-11 and ASTM E2780. Test method quality control procedures (leak checks, volume meter checks, stratification checks, proportionality results) followed the procedures outlined.

Appliance Sealing and Storage

Upon completion of testing, the appliance was secured with metal strapping and the seal below was applied, the appliance was then returned to the manufacturer's location at: 2975 Allenby Road Duncan, BC V9L 6V8, Canada, for archival.

Sealing Label

ATTENTION:

THIS SEAL IS NOT TO BE BROKEN WITHOUT PRIOR AUTHORIZATION FROM THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY.

THIS APPLIANCE HAS BEEN SEALED INACCORDANCE WITH REQUIREMNTS OF 40CFR
PART 60 SUBPART AAA §60.535 (a)(2)(vii)

REPORT # _____

DATE SEALED _____

MANUFACTURER _____

MODEL # _____

Sealed Unit



List of Appendices

The following appendices have been submitted electronically in conjunction with this report:

Appendix A – Test Run Data, Technician Notes, Sample Analysis, and Photos

Appendix B – Labels and Manuals

Appendix C –Equipment Calibration Records

Appendix D – Design Drawings (CBI Report Only)

Appendix E – Manufacturer QAP (CBI Report Only)

Conditioning Data

Client: Pacific Energy
 Model: Vista LE
 Date(s): 7/31/18 - 8/7/2018

Job #: 18-424
 Tracking #: 0006
 Technician: SJB

Elapsed Time (hrs)	Scale Reading (lbs)	Average: Weight Change (lbs)	331.6	80.5	N/A
			Flue (°F)	Ambient (°F)	Catalyst Exit (°F)
0	5.2	-	779	81	N/A
1	2.8	-2.4	348	81	N/A
2	2.3	-0.5	282	81	N/A
3	10.0	7.7	278	81	N/A
4	6.0	-4.0	470	82	N/A
5	3.2	-2.8	416	83	N/A
6	1.5	-1.7	334	83	N/A
7	0.9	-0.6	256	83	N/A
8	0.5	-0.4	223	84	N/A
9	0.1	-0.4	195	84	N/A
10	5.0	4.9	776	74	N/A
11	2.9	-2.1	297	74	N/A
12	2.3	-0.6	246	75	N/A
13	9.9	7.6	243	75	N/A
14	7.6	-2.3	294	76	N/A
15	5.1	-2.5	387	77	N/A
16	2.9	-2.2	408	78	N/A
17	1.5	-1.4	294	79	N/A
18	1.1	-0.4	213	78	N/A
19	0.7	-0.4	196	79	N/A
20	0.0	-0.7	187	80	N/A
21	5.0	5.0	750	81	N/A
22	3.1	-1.9	284	82	N/A
23	2.4	-0.7	241	82	N/A
24	9.8	7.4	244	73	N/A
25	5.8	-4.0	463	74	N/A
26	2.7	-3.1	390	74	N/A
27	1.6	-1.1	274	73	N/A
28	1.0	-0.6	232	73	N/A
29	0.5	-0.5	209	72	N/A
30	0.0	-0.5	195	73	N/A
31	4.9	4.9	811	79	N/A
32	3.0	-1.9	294	79	N/A
33	2.3	-0.7	247	81	N/A
34	10.1	7.8	245	85	N/A
35	7.6	-2.5	395	85	N/A
36	4.5	-3.1	398	86	N/A
37	2.4	-2.1	326	87	N/A
38	1.4	-1.0	282	87	N/A
39	0.9	-0.5	228	87	N/A
40	0.5	-0.4	210	87	N/A
41	0.0	-0.5	196	87	N/A
42	4.7	4.7	755	83	N/A
43	3.1	-1.6	272	83	N/A
44	2.2	-0.9	220	83	N/A
45	10.4	8.2	217	81	N/A
46	8.2	-2.2	266	82	N/A
47	4.9	-3.3	382	83	N/A
48	2.7	-2.2	292	84	N/A
49	1.8	-0.9	244	84	N/A
50	1.1	-0.7	226	85	N/A



Sample Calculations – ASTM E2780 & E2515

Client: Pacific Energy
 Model: Vista LE
 Run: 1

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/ft³
 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 STP, 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:

$$FM_S = 9.9 \%$$

$$M_{Swb} = 1.9 \text{ lbs}$$

0.4536 = Conversion factor from lbs to kg

$$M_{Sdb} = [(1.9 \times 0.4536) (100/(100 + 9.9))]$$

$$M_{Sdb} = \mathbf{0.76 \text{ kg}}$$

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, kgFM_{CPn} = Average fuel moisture of test fuel n in fuel crib, % dry basis

Sample Calculation (test fuel piece 1):

$$M_{CPnwb} = 1.18$$

$$FM_{CPn} = 19.6$$

$$= 1.2 \quad (100/(100 + 19.6))$$

$$= 1.0 \text{ lbs}$$

Total dry crib weight, excluding spacers = 7.12 lbs

$$M_{Cdb} = 3.23 \text{ kg}$$

D_{Cdb} - Density of fuel crib, excluding spacers and nails, dry basis, lbs/ft³
ASTM E2780 equation (3)

$$D_{Cdb} = M_{Cdb} / V_C$$

Where,

$$V_C = \text{Volume of fuel crib, ft}^3$$

Sample calculation:

$$V_C = 399 \text{ in}^3$$

$$1728 = \text{conversion from in}^3 \text{ to ft}^3$$

$$D_{Cdb} = 7.12 / 399 * 1728$$

$$= \mathbf{30.84 \text{ lbs/ft}^3}$$

M_{FTAdb} - Total weight of fuel crib excluding nails, dry basis, kg
ASTM E2780 equation (4)

$$M_{FTAdb} = M_{Sdb} + M_{Cdb}$$

Sample calculation:

$$M_{FTAdb} = 0.76 + 3.23$$

$$= 3.99 \text{ kg}$$

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:

$$M_{Bdb} = 3.99 \quad \text{kg}$$

$$\theta = 240 \quad \text{min}$$

$$BR = \frac{60 \times 3.99}{240}$$

$$BR = 1.00 \quad \text{kg/hr}$$

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 pitot tube center point reading = $\frac{V_{strav}}{V_{scent}}$, 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 H₂O
 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. H₂O; (in Hg = in H₂O/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:

$$F_p = \frac{13.85}{15.05} = 0.920$$

$$V_s = 0.920 \times 85.49 \times 0.99 \times 0.214 \times \left(\left(\frac{100.7}{29.73} + \frac{460}{-0.13} \right) \times \frac{28.78}{13.6} \right)^{1/2}$$

$$V_s = 13.52 \text{ ft/s}$$

*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 M_s 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, ft²
- 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:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 13.52 \times 0.1963 \times \frac{528}{100.7 + 460} \times \frac{29.73 + \frac{-0.13}{13.6}}{29.92}$$

Q_{sd} = 8761.5 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 ₂ O
T_m	=	Absolute average dry gas meter temperature, °R

Sample Calculation:

Using equation for Train 1:

$$V_{m(std)} = 17.64 \times 34.405 \times 1.002 \times \frac{\left(29.73 + \frac{1.91}{13.6} \right)}{\left(104.5 + 460 \right)}$$

$$V_{m(std)} = \mathbf{32.177} \text{ dscf}$$

Using equation for Train 2:

$$V_{m(std)} = 17.64 \times 34.067 \times 0.997 \times \frac{\left(29.73 + \frac{1.90}{13.6} \right)}{\left(103.6 + 460 \right)}$$

$$V_{m(std)} = \mathbf{31.756} \text{ dscf}$$

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 39.41 \times 0.999 \times \frac{\left(\underline{29.73} + \frac{0.00}{13.6} \right)}{\left(85.8 + 460 \right)}$$

$$V_{m(std)} = \mathbf{37.828} \text{ dscf}$$

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 A (first hour):

$$m_n = 0.0 + 6.2 + 0.0$$

$$m_n = 6.2 \text{ mg}$$

Using equation for Train A (post-first hour):

$$m_n = 0.1 + 4.5 + 0.1$$

$$m_n = 4.7 \text{ mg}$$

Train A aggregate:

$$m_n = 6.2 + 4.7$$

$$m_n = \mathbf{10.9 \text{ mg}}$$

Using equation for Train B:

$$m_n = 0 + 9.8 + 0.7$$

$$m_n = \mathbf{10.5 \text{ mg}}$$

C_s - Concentration of particulate matter in tunnel gas, dry basis, corrected to STP, g/dscf
 ASTM E2515 equation (13)

$$C_s = K_2 \times \frac{m_n}{V_{m(\text{std})}}$$

Where:

- K_2 = Constant, 0.001 g/mg
 m_n = Total mass of particulate matter collected in the sampling train, mg
 $V_{m(\text{std})}$ = Volume of gas sampled corrected to dry standard conditions, dscf

Sample calculation:

For Train 1:

$$C_s = 0.001 \times \frac{10.9}{32.18}$$

$$C_s = \mathbf{0.00034} \text{ g/dscf}$$

For Train 2

$$C_s = 0.001 \times \frac{10.5}{31.76}$$

$$C_s = \mathbf{0.00033} \text{ g/dscf}$$

For Ambient Train

$$C_r = 0.001 \times \frac{0.1}{37.83}$$

$$C_r = \mathbf{0.000003} \text{ g/dscf}$$

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

$$E_T = (\underline{0.000339} - 0.000003) \times \underline{8761.5} \times \underline{240} / 60$$

$$E_T = \underline{11.78} \text{ g}$$

For Train 2

$$E_T = (\underline{0.000331} - 0.000003) \times \underline{8761.5} \times \underline{240} / 60$$

$$E_T = \underline{11.50} \text{ g}$$

Average

$$E = \underline{11.64} \text{ g}$$

Total emission values shall not differ by more than 7.5% from the total average emissions

$$7.5\% \text{ of the average} = \underline{0.87}$$

$$\text{Train 1 difference} = \underline{0.14}$$

$$\text{Train 2 difference} = \underline{0.14}$$

PR - Proportional Rate Variation

ASTM E2515 equation (16)

$$PR = \left[\frac{\theta \times V_{mi} \times V_s \times T_m \times T_{si}}{\theta_i \times V_m \times V_{si} \times T_m \times T_s} \right] \times 100$$

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, °R
 T_m = Absolute average dry gas meter temperature, °R
 T_{si} = Absolute average gas temperature in the dilution tunnel during the "ith" time interval, °R
 T_s = Absolute average gas temperature in the dilution tunnel, °R

Sample calculation (for the first 1 minute interval of Train 1):

$$PR = \left(\frac{240 \times 1.397 \times 13.52 \times (108.0 + 460) \times (104.5 + 460)}{10 \times 34.405 \times 13.61 \times (100.7 + 460) \times (83.0 + 460)} \right) \times 100$$

$$PR = \underline{102} \%$$

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:

$$E_T \text{ (Dual train average)} = 11.64 \text{ g}$$

$$\theta = 240 \text{ min}$$

$$PM_R = 60 \times (11.64 / 240)$$

$$PM_R = 2.91 \text{ g/hr}$$

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:

$$E_T \text{ (Dual train average)} = 11.64 \text{ g}$$

$$M_{Bdb} = 3.99 \text{ kg}$$

$$PM_F = 11.64 / 3.99$$

$$PM_F = \mathbf{2.91} \text{ g/kg}$$

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 1 Data Summary

Client: Pacific Energy
Model: Vista LE
Job #: 18-424
Tracking #: 0006
Test Date: 8/8/2017

Technician Signature

8/14/18

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Pacific Energy

Model: Vista LE

Run #: 1

Job #: 18-424

Tracking #: 0006

Technician: SJB

Date: 8/8/2017

Burn Rate (kg/hr):	1.00
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	39.408	34.405	34.067	8.489
Average Gas Velocity in Dilution Tunnel (ft/sec)	13.5			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	8761.5			
Average Gas Meter Temperature (°F)	85.8	104.5	103.6	91.6
Total Sample Volume (dscf)	37.828	32.177	31.756	9.919
Average Tunnel Temperature (°F)	100.7			
Total Time of Test (min)	240			
Total Particulate Catch (mg)	0.1	10.9	10.5	6.2
Particulate Concentration, dry-standard (g/dscf)	0.0000026	0.0003387	0.0003306	0.0006251
Total PM Emissions (g)	0.09	11.78	11.50	5.45
Particulate Emission Rate (g/hr)	0.02	2.94	2.87	5.45
Emissions Factor (g/kg)	-	2.95	2.88	-
Difference from Average Total Particulate Emissions (g)	-	0.14	0.14	-
Difference from Average Emissions Factor (g/kg)	-	0.04	0.04	-

Final Average Results	
Total Particulate Emissions (g)	11.64
Particulate Emission Rate (g/hr)	2.91
Emissions Factor (g/kg)	2.91
HHV Efficiency (%)	73.0%
LHV Efficiency (%)	78.9%
CO Emissions (g/min)	1.63

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	87.0	OK
Face Velocity	< 30 ft/min	7.8	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min: 83 / Max: 88	OK
Negative Probe Weight Evaluation	<5% of Total Catch	-1.0%	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	126.0	OK

B415.1 Efficiency Results

Manufacturer: Pacific Energy
Model: Vista LE
Date: 08/08/17
Run: 1
Control #: 18-424
Test Duration: 240
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	73.0%	78.9%
Combustion Efficiency	92.9%	92.9%
Heat Transfer Efficiency	78.6%	84.9%

Output Rate (kJ/h)	14,225	13,494	(Btu/h)
Burn Rate (kg/h)	0.98	2.17	(lb/h)
Input (kJ/h)	19,487	18,486	(Btu/h)

Test Load Weight (dry kg)	3.93	8.67	dry lb
MC wet (%)	16.61		
MC dry (%)	19.92		
Particulate (g)	11.64		
CO (g)	392		
Test Duration (h)	4.00		

Emissions	Particulate	CO
g/MJ Output	0.20	6.88
g/kg Dry Fuel	2.96	99.55
g/h	2.91	97.93
g/min	0.05	1.63
lb/MM Btu Output	0.48	16.00

Air/Fuel Ratio (A/F)	14.74
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 1

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/8/2017

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	12.00	18.6				
2x4	12.00	19.1				
2x4	12.00	19.0				
2x4	12.00	21.9				
2x4	10.00	22.5				
2x4	10.00	23.8				
2x4	10.00	18.4				
2x4	10.00	18.9				
Total Fuel Weight (lbs):		9.55	Average Moisture (%DB):		20.3	

Firebox Volume (ft³): 1.55
 Total 2x4 Crib Weight, with spacers (lbs): 6.71
 Total 4x4 Crib Weight, with spacers (lbs): 3.70
 Total Wet Fuel Weight, with spacers (lbs): 10.41

Coal Bed Range (20-25%):

Min (lbs): 2.08
 Max (lbs): 2.60

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	12.00	1.18	19.0	19.5	20.2	0.99
2x4	12.00	1.23	20.5	19.5	20.5	1.02
2x4	12.00	1.30	19.3	19.1	18.8	1.09
2x4	12.00	1.37	20.9	18.9	19.4	1.14
4x4	12.00	3.48	20.9	20.1	22.2	2.87
Total Dry Weight, no spacers (lbs):						7.12
Total Dry Weight, with spacers (lbs):						8.80

Spacer Moisture Readings (%DB)							
10.1	9.8	11.2	9.3	9.8			
9.8	11.4	10.4	9.4	9.4			
10.5	9.1	10.6	10.0				
8.2	9.8	10.1	8.7				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	30.8	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.72	OK
2x4 Fuel Mix	35 - 65 % of total weight	64%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 1

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/8/2017

Preburn Start Time: 10:59
 Recording Interval (min): 10
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	4.9	-0.082	539	552	653	988	433	633.0	815	66
10	3.5	-0.054	543	567	383	758	432	536.6	471	66
20	3.1	-0.051	515	539	346	527	421	469.6	343	66
30	3.0	-0.038	482	500	325	410	409	425.2	294	65
40	2.8	-0.034	448	462	299	356	399	392.8	273	65
50	2.5	-0.029	416	431	257	323	395	364.4	256	65
60	2.3	-0.027	393	407	235	299	393	345.4	242	65

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 1
 Test Start Time: 11:59

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/8/2017

Total Sampling Time (min): 240
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.75	29.73	29.71	29.73

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.130 in H₂O

Post-Test Leak Check

(A) 0.001 cfm @ -12 in. Hg
 (B) 0.001 cfm @ -11 in. Hg
 (AMB) 0.001 cfm @ -12 in. Hg

Ambient Sample Volume: 39.408 ft³

	Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.038	0.046	0.044	0.032	0.030	0.044	0.048	0.038	0.048
Tunnel Temp (°F)	104	104	104	104	104	104	104	104	104

V_{strav}: 13.85 ft/sec
 V_{scent}: 15.05 ft/sec

F_p: 0.920 [ratio]
 Initial Tunnel Flow: 147.1 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	D. Fir	Oak
HHV (kJ/kg)	19,810	19,887
%C	48.73	50
%H	6.87	6.6
%O	43.9	42.9
%Ash	0.5	0.5

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	19.9

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific EnergyJob #: 18-424Model: Vista LETracking #: 0006Run #: 1Technician: SJBDate: 8/8/2017

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft ³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.000		0.046	0.02	83	-0.08		10.4		99	239	85	83
10	1.397	0.140	0.046	2.01	85	-1.78	102	9.2	-1.2	108	323	85	83
20	2.831	0.143	0.046	1.98	88	-1.93	104	8.3	-0.9	106	377	85	83
30	4.243	0.141	0.046	1.98	92	0	102	7.1	-1.2	110	431	85	84
40	5.654	0.141	0.046	1.98	95	-0.2	101	5.7	-1.4	113	462	85	84
50	7.070	0.142	0.046	1.98	98	-0.01	101	4.7	-1	112	425	85	85
60	8.489	0.142	0.046	1.98	100	-2.35	101	3.7	-1	112	436	86	85
70	9.926	0.144	0.046	1.98	102	-2.36	102	2.8	-0.9	110	385	86	85
80	11.358	0.143	0.046	1.99	104	-2.32	100	2.4	-0.4	105	309	86	85
90	12.792	0.143	0.046	1.97	105	-1.41	100	2.2	-0.2	102	285	86	85
100	14.227	0.144	0.046	1.99	106	-0.32	100	1.9	-0.3	100	268	86	85
110	15.661	0.143	0.046	2.00	107	-2.33	99	1.6	-0.3	99	273	86	86
120	17.099	0.144	0.046	2.01	108	-0.02	100	1.3	-0.3	99	261	86	86
130	18.539	0.144	0.046	1.97	109	-0.02	99	1.1	-0.2	98	235	85	86
140	19.976	0.144	0.046	1.98	110	-0.96	99	1.0	-0.1	97	220	86	87
150	21.414	0.144	0.046	1.98	110	-2.25	99	0.9	-0.1	96	209	85	87
160	22.856	0.144	0.046	1.99	111	-1.85	99	0.8	-0.1	96	204	84	87
170	24.298	0.144	0.046	2.00	111	-0.83	99	0.7	-0.1	95	197	85	87
180	25.738	0.144	0.046	1.99	112	-1.31	99	0.6	-0.1	95	193	85	87
190	27.180	0.144	0.046	1.99	112	-2.23	99	0.4	-0.2	95	185	85	87
200	28.625	0.145	0.046	1.98	112	-2.27	99	0.3	-0.1	95	183	86	87
210	30.070	0.145	0.046	1.99	113	-0.43	99	0.2	-0.1	94	178	86	87
220	31.511	0.144	0.046	1.96	113	-0.21	98	0.2	0	94	173	86	88
230	32.951	0.144	0.046	1.96	113	-0.84	98	0.1	-0.1	94	167	86	88
240	34.405	0.145	0.046	2.03	114	-0.08	99	0.0	-0.1	94	163	85	88
Avg/Tot	34.405	0.143	0.046	1.91	105	-1.14	100			101	271	85	85.8

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 1

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/8/2017

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.000		0.00	83	-1		86	0.000	4.05	1.20
10	1.400	0.140	2.03	84	-2.87	103	85	-0.050	6.02	0.84
20	2.799	0.140	1.99	87	-2.83	102	84	-0.050	11.63	0.32
30	4.197	0.140	1.99	91	-2.5	102	84	-0.060	14.42	0.28
40	5.602	0.141	2.00	94	-0.8	102	86	-0.060	15.97	0.34
50	7.008	0.141	1.99	97	-0.64	101	86	-0.060	13.18	0.22
60	8.418	0.141	1.99	99	-2.84	101	86	-0.060	14.22	0.11
70	9.833	0.142	1.99	101	-1.47	101	85	-0.050	9.80	0.61
80	11.249	0.142	1.97	103	-1.02	100	84	-0.040	7.81	1.00
90	12.669	0.142	1.98	104	-2.64	100	84	-0.030	7.65	1.01
100	14.088	0.142	1.99	105	-1.98	100	84	-0.040	7.34	1.23
110	15.511	0.142	1.99	106	-2.09	100	86	-0.030	7.51	1.11
120	16.934	0.142	1.97	107	-2.33	99	86	-0.030	6.55	1.44
130	18.359	0.143	1.99	108	-1.45	99	85	-0.020	5.46	1.74
140	19.785	0.143	1.98	109	-2.42	99	85	-0.030	4.67	1.91
150	21.209	0.142	1.98	109	-1.34	99	84	-0.030	4.24	1.94
160	22.639	0.143	1.98	110	-1.68	99	85	-0.030	4.39	2.01
170	24.063	0.142	1.98	110	-0.73	99	87	-0.010	4.24	2.05
180	25.492	0.143	1.97	111	-1.58	99	86	-0.020	3.78	2.02
190	26.922	0.143	1.98	111	-2.34	99	86	0.000	3.68	2.05
200	28.349	0.143	1.94	111	-2.78	99	85	-0.020	4.53	1.88
210	29.780	0.143	1.99	112	-1.62	99	84	-0.010	3.73	1.73
220	31.209	0.143	1.99	112	-2.21	99	84	-0.020	3.43	1.63
230	32.636	0.143	1.97	112	-2.49	98	85	-0.010	3.17	1.66
240	34.067	0.143	1.96	113	-1.24	99	87	-0.010	2.94	1.63
Avg/Tot	34.067	0.142	1.90	104	-1.88	100	85	-0.031	6.98	1.28

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Pacific Energy

Job #: 18-424

Model: Vista LE

Tracking #: 0006

Run #: 1

Technician: SJB

Date: 8/8/2017

Stove ΔT : 126

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	392	406	241	301	393	346.6	N/A
10	366	378	320	407	384	371.0	N/A
20	340	356	208	379	371	330.8	N/A
30	329	350	176	427	353	327.0	N/A
40	337	363	179	520	341	348.0	N/A
50	357	384	190	532	332	359.0	N/A
60	370	394	200	546	329	367.8	N/A
70	382	401	212	551	329	375.0	N/A
80	386	401	218	428	330	352.6	N/A
90	384	390	221	369	329	338.6	N/A
100	379	379	221	334	329	328.4	N/A
110	370	371	218	324	330	322.6	N/A
120	362	362	216	327	327	318.8	N/A
130	355	353	211	297	329	309.0	N/A
140	345	340	200	273	325	296.6	N/A
150	331	325	190	253	316	283.0	N/A
160	316	310	184	242	308	272.0	N/A
170	303	298	181	234	300	263.2	N/A
180	292	287	177	226	295	255.4	N/A
190	281	276	173	216	289	247.0	N/A
200	271	267	170	211	284	240.6	N/A
210	264	260	168	207	282	236.2	N/A
220	257	254	166	200	281	231.6	N/A
230	250	248	163	193	278	226.4	N/A
240	243	241	158	186	275	220.6	N/A
Average	330	336	198	327	322	303	N/A

LAB SAMPLE DATA - ASTM E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 1

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/8/2017

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3224	130.3	124.1	6.2
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 6.2

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3225	124.8	121.0	3.8
B. Rear filter catch	Filter	3226	118.6	117.9	0.7
C. Probe catch*	Probe	7A	116740.1	116740.0	0.1
D. O-Ring catch*	O-Ring	7A	3573.6	3573.5	0.1

Sub-Total Total Particulate, mg: 4.7

Train A Aggregate Total Particulate, mg: **10.9**

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3227	133.6	124.4	9.2
B. Rear filter catch	Filter	3228	125.1	124.5	0.6
C. Probe catch*	Probe	7B	117304.5	117304.6	0.0
D. O-Ring catch*	O-Ring	7B	3251.8	3251.1	0.7

Total Particulate, mg: **10.5**

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3229	118.0	117.9	0.1

Total Particulate, mg: **0.1**

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

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 1 Test Date: 8/8/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Fully Closed: Fixed Air opening = 0.690" diameter hole

Preburn Notes

Preburn Start Time: 9:07

Time	Notes
9:07	Kindling load – 8 lbs
9:56	With 1 lb of kindling remaining, loaded 1 st preburn loaded (4-2"x4"x12" and 4-2"x4"x10"), 8.5 lbs total
10:30	With 1.8 lbs left, scooped coals, zeroed scale, added coals back in, and loaded second "official" preburn load.
10:59	At 4.8 lbs, set air control to test setting described above and turned convection fan on to high setting.
11:39	Stirred coals and removed 0.2 lbs.
11:59	At 2.3 lbs, leveled and raked coals, zeroed scale, turned fan off, in preparation for fuel loading.

Test Notes

Test Burn Start Time: 12:00
 Test Fuel Loaded by: 40 seconds
 Door Closed: 60 seconds
 Air Control Set at: 5 minutes
 Other Loading Notes: N/A

Time	Notes
15 min	Turned convection fan on high, per manufacturer's instructions.
60 min	Changed 1-hour filter.
240 min	End of Test

Test Burn End Time: 16:00
 Background Filter Volume (ft³): 39.408

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3224	3225	3226	7A	7A	3227	3228	7B	7B	3229
Tare (mg)	124.1	121.0	117.9	116740.0	3573.5	124.4	124.5	117304.6	3521.1	117.9
Final Weight (mg)	130.3	124.8	118.6	116740.1	3573.6	133.6	12.1	117304.5	3251.1	118.0

Sample Train Leak Check: A: 0.001 @ -12 "Hg B: 0.001 @ -11 "Hg AMB: 0.001 @ -12 "Hg

Technician Signature: 

Date: 8/18/2018

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 1 Test Date: 8/8/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.06 CO (%): 4.25
 Mid Gas CO₂ (%): - CO (%): -

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	10:08	-	10:10	16:32	-	16:35
CO ₂	0.00	-	17.06	0.18	-	17.21
CO	0.000	-	4.251	0.009	-	4.296

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.038	0.046	0.044	0.032	0.030	0.044	0.048	0.038	0.048
Temp (°F):	104	104	104	104	104	104	104	104	104

Dilution Tunnel Static Pressure (inH₂O): -0.130

Supplemental Data

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

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

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 8/7/2018

	Initial	Middle	Ending
P _b (inHg)	29.75	29.73	29.71
RH (%)	38.3	34.4	32.9

Technician Signature: [Signature]

Date: 8/18/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 2 Data Summary

Client: Pacific Energy
Model: Vista LE
Job #: 18-424
Tracking #: 0006
Test Date: 8/9/2018

Technician Signature

8/14/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Pacific Energy

Model: Vista LE

Run #: 2

Job #: 18-424

Tracking #: 0006

Technician: SJB

Date: 8/9/2018

Burn Rate (kg/hr):	1.51
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	26.567	23.165	22.410	8.469
Average Gas Velocity in Dilution Tunnel (ft/sec)	13.5			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	8796.6			
Average Gas Meter Temperature (°F)	76.0	92.1	91.1	84.1
Total Sample Volume (dscf)	26.070	22.239	21.443	9.913
Average Tunnel Temperature (°F)	101.7			
Total Time of Test (min)	160			
Total Particulate Catch (mg)	0.1	4.6	4.8	2.3
Particulate Concentration, dry-standard (g/dscf)	0.0000038	0.0002068	0.0002238	0.0002320
Total PM Emissions (g)	0.09	4.76	5.16	2.01
Particulate Emission Rate (g/hr)	0.03	1.79	1.94	2.01
Emissions Factor (g/kg)	-	1.19	1.28	-
Difference from Average Total Particulate Emissions (g)	-	0.20	0.20	-
Difference from Average Emissions Factor (g/kg)	-	0.05	0.05	-

Final Average Results	
Total Particulate Emissions (g)	4.96
Particulate Emission Rate (g/hr)	1.86
Emissions Factor (g/kg)	1.24
HHV Efficiency (%)	73.9%
LHV Efficiency (%)	79.8%
CO Emissions (g/min)	1.39

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	86.0	OK
Face Velocity	< 30 ft/min	7.7	OK
Leakage Rate	Less than 4% of average sample rate	0.002 cfm	OK
Ambient Temp	55-90 °F	Min: 74 / Max: 78	OK
Negative Probe Weight Evaluation	<5% of Total Catch	-2.2%	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	57.8	OK

B415.1 Efficiency Results

Manufacturer: Pacific Energy
Model: Vista LE
Date: 08/09/18
Run: 2
Control #: 18-424
Test Duration: 160
Output Category: 3

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	73.9%	79.8%
Combustion Efficiency	96.1%	96.1%
Heat Transfer Efficiency	76.9%	83.1%

Output Rate (kJ/h)	21,663	20,550	(Btu/h)
Burn Rate (kg/h)	1.48	3.26	(lb/h)
Input (kJ/h)	29,329	27,822	(Btu/h)

Test Load Weight (dry kg)	3.95	8.70	dry lb
MC wet (%)	16.33		
MC dry (%)	19.52		
Particulate (g)	4.96		
CO (g)	222		
Test Duration (h)	2.67		

Emissions	Particulate	CO
g/MJ Output	0.09	3.84
g/kg Dry Fuel	1.26	56.18
g/h	1.86	83.18
g/min	0.03	1.39
lb/MM Btu Output	0.20	8.92

Air/Fuel Ratio (A/F)	13.07
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 2

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/9/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	12.00	19.8				
2x4	12.00	19.7				
2x4	12.00	18.9				
2x4	12.00	19.7				
2x4	10.00	18.9				
2x4	10.00	19.5				
2x4	10.00	20.1				
2x4	10.00	19.3				
Total Fuel Weight (lbs):		9.02	Average Moisture (%DB):		19.5	

Firebox Volume (ft³): 1.55
 Total 2x4 Crib Weight, with spacers (lbs): 6.70
 Total 4x4 Crib Weight, with spacers (lbs): 3.68
 Total Wet Fuel Weight, with spacers (lbs): 10.43

Coal Bed Range (20-25%):

Min (lbs): 2.09
 Max (lbs): 2.61

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	12.00	1.26	19.1	19.4	19.0	1.06
2x4	12.00	1.37	19.3	18.9	19.5	1.15
2x4	12.00	1.23	19.3	18.8	19.5	1.03
2x4	12.00	1.23	20.5	20.6	19.4	1.02
4x4	12.00	3.53	20.3	19.3	19.9	2.95
Total Dry Weight, no spacers (lbs):						7.21
Total Dry Weight, with spacers (lbs):						8.86

Spacer Moisture Readings (%DB)							
9.9	9.6	10.3	9.9	10.3			
9.6	10.1	9.6	9.9	9.6			
9.4	10.8	9.5	9.3				
9.8	8.5	9.9	10.9				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	31.2	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.73	OK
2x4 Fuel Mix	35 - 65 % of total weight	64%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 2

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/9/2018

Preburn Start Time: 6:45
 Recording Interval (min): 10
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	5.0	-0.091	533	565	682	999	443	644.4	790	72
10	3.6	-0.065	540	577	428	776	434	551.0	524	72
20	3.0	-0.050	517	554	374	562	420	485.4	393	72
30	2.8	-0.051	484	512	321	427	407	430.2	329	70
40	2.6	-0.045	450	470	282	362	396	392.0	300	66
50	2.5	-0.034	420	436	257	324	384	364.2	280	62
60	2.3	-0.034	399	408	244	297	375	344.6	263	59

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 2
 Test Start Time: 7:45

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/9/2018

Total Sampling Time (min): 160
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.84	29.85	29.85	29.85

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.130 in H₂O

Post-Test Leak Check

(A) 0.002 cfm @ -15 in. Hg
 (B) 0.000 cfm @ -11 in. Hg
 (AMB) 0.001 cfm @ -13 in. Hg

Ambient Sample Volume: 26.567 ft³

	Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.030	0.044	0.046	0.040	0.032	0.042	0.048	0.040	0.048
Tunnel Temp (°F)	102	102	102	102	102	102	102	102	102

V_{strav}: 13.84 ft/sec
 V_{scent}: 15.00 ft/sec

F_p: 0.923 [ratio]
 Initial Tunnel Flow: 148.2 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	D. Fir	Oak
HHV (kJ/kg)	19,810	19,887
%C	48.73	50
%H	6.87	6.6
%O	43.9	42.9
%Ash	0.5	0.5

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	19.5

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific EnergyJob #: 18-424Model: Vista LETracking #: 0006Run #: 2Technician: SJBDate: 8/9/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft ³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.279		0.046	0.00	78	-0.08		10.4		96	266	84	74
10	1.677	0.140	0.046	1.99	79	-0.86	99	9.1	-1.3	107	411	84	74
20	3.087	0.141	0.046	2.04	81	-2.46	100	7.5	-1.6	113	505	85	75
30	4.498	0.141	0.046	2.02	84	-2.51	100	5.8	-1.7	118	553	85	75
40	5.911	0.141	0.046	2.03	87	-1.77	100	4.3	-1.5	118	523	84	76
50	7.327	0.142	0.046	2.03	89	-0.12	99	3.2	-1.1	114	471	85	76
60	8.748	0.142	0.046	2.03	91	-2.48	99	2.5	-0.7	109	416	85	76
70	10.190	0.144	0.046	2.04	93	-2.08	99	2.0	-0.5	102	353	84	76
80	11.625	0.144	0.046	2.06	95	-2.4	98	1.6	-0.4	100	341	85	76
90	13.063	0.144	0.046	2.05	96	-0.2	98	1.3	-0.3	98	329	86	76
100	14.504	0.144	0.046	2.06	97	-0.25	98	1.0	-0.3	97	317	85	76
110	15.944	0.144	0.046	2.05	98	-0.08	98	0.8	-0.2	95	289	84	76
120	17.385	0.144	0.046	2.05	98	-0.04	98	0.6	-0.2	94	278	84	77
130	18.829	0.144	0.046	2.04	99	-1.57	98	0.4	-0.2	93	266	86	77
140	20.275	0.145	0.046	2.05	100	-1.96	98	0.2	-0.2	92	254	85	77
150	21.721	0.145	0.046	2.05	100	-0.5	98	0.1	-0.1	92	251	84	77
160	23.165	0.144	0.046	2.06	101	-0.35	97	0.0	-0.1	91	243	83	78
Avg/Tot	23.165	0.143	0.046	1.92	92	-1.16	99			102	357	85	76.0

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 2

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/9/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.001		0.00	77	-1		86	0.000	3.58	1.05
10	1.385	0.138	2.03	78	-2.47	102	83	-0.060	10.54	0.26
20	2.769	0.138	2.02	80	-1.15	102	85	-0.080	14.31	0.44
30	4.155	0.139	2.00	83	-1.81	102	85	-0.080	16.96	0.39
40	5.542	0.139	1.98	86	-0.96	101	84	-0.080	14.71	0.10
50	6.934	0.139	1.99	88	-0.77	101	86	-0.060	12.40	0.23
60	8.328	0.139	1.99	90	-2.75	100	84	-0.060	9.89	0.32
70	9.727	0.140	2.00	92	-2.26	100	86	-0.040	7.79	0.84
80	11.131	0.140	2.00	94	-2.71	100	84	-0.040	8.04	0.66
90	12.536	0.141	2.00	95	-0.61	99	86	-0.030	7.47	0.86
100	13.941	0.141	2.00	96	-0.67	99	84	-0.050	6.73	1.06
110	15.352	0.141	2.00	97	-0.75	99	85	-0.050	5.93	1.47
120	16.759	0.141	1.98	97	-2.2	99	84	-0.030	5.83	1.45
130	18.171	0.141	1.99	98	-2.21	99	85	-0.030	5.28	1.59
140	19.582	0.141	1.99	99	-0.79	98	84	-0.040	4.85	1.60
150	20.998	0.142	1.99	99	-2.35	99	84	-0.010	4.82	1.33
160	22.410	0.141	1.99	100	-0.65	98	84	-0.030	4.80	0.99
Avg/Tot	22.410	0.140	1.88	91	-1.54	100	85	-0.045	8.47	0.86

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Pacific EnergyJob #: 18-424Model: Vista LETracking #: 0006Run #: 2Technician: SJBDate: 8/9/2018Stove ΔT : 58

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	399	407	252	300	374	346.4	N/A
10	371	375	328	438	364	375.2	N/A
20	357	373	214	529	349	364.4	N/A
30	362	388	190	633	337	382.0	N/A
40	377	411	205	658	333	396.8	N/A
50	398	443	230	614	330	403.0	N/A
60	416	458	247	525	328	394.8	N/A
70	417	454	256	437	327	378.2	N/A
80	410	441	252	390	327	364.0	N/A
90	400	430	245	372	328	355.0	N/A
100	392	420	239	353	332	347.2	N/A
110	381	406	235	324	333	335.8	N/A
120	368	394	223	307	332	324.8	N/A
130	355	381	217	290	333	315.2	N/A
140	345	369	217	274	327	306.4	N/A
150	333	354	211	264	321	296.6	N/A
160	322	340	203	256	322	288.6	N/A
Average	377	403	233	410	335	351	N/A

LAB SAMPLE DATA - ASTM E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 2

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/9/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3231	126.6	124.3	2.3
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 2.3

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3232	119.6	118.2	1.4
B. Rear filter catch	Filter	3233	121.6	121.6	0.0
C. Probe catch*	Probe	8A	116829.6	116829.7	0.0
D. O-Ring catch*	O-Ring	8A	3551.0	3550.1	0.9

Sub-Total Total Particulate, mg: 2.3

Train A Aggregate Total Particulate, mg: **4.6**

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3234	127.7	124.3	3.4
B. Rear filter catch	Filter	3235	118.5	118.2	0.3
C. Probe catch*	Probe	8B	116825.4	116825.3	0.1
D. O-Ring catch*	O-Ring	8B	3584.7	3583.7	1.0

Total Particulate, mg: **4.8**

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3236	122.0	121.9	0.1

Total Particulate, mg: **0.1**

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

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 2 Test Date: 8/9/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Medium High Air Setting: (5/16" drill bit in main Primary Air Inlet + fixed opening)

Preburn Notes

Preburn Start Time: 5:15

Time	Notes
5:15	Kindling load – 8 lbs
5:50	With 1 lb of kindling remaining, loaded 1 st preburn loaded (4-2"x4"x12" and 4-2"x4"x10"), 8 lbs total
6:22	With 1.8 lbs left, scooped coals, zeroed scale, added coals back in, and loaded second "official" preburn load.
6:45	At 5.0 lbs, set air control to test setting described above and turned convection fan on to high setting.
7:45	At 2.3 lbs, leveled and raked coals, zeroed scale, turned fan off, in preparation for fuel loading.

Test Notes

Test Burn Start Time: 7:45
 Test Fuel Loaded by: 30 seconds
 Door Closed: 50 seconds
 Air Control Set at: 5 minutes
 Other Loading Notes: N/A

Time	Notes
15 min	Turned convection fan on high, per manufacturer's instructions.
60 min	Changed 1-hour filter.
160 min	End of Test

Test Burn End Time: 10:25
 Background Filter Volume (ft³): 26.567

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3231	3232	3233	8A	8A	3234	3235	8B	8B	3236
Tare (mg)	124.3	118.2	121.6	116829.7	3550.1	124.3	118.2	116825.3	3583.7	121.9
Final Weight (mg)	126.6	119.6	121.6	116829.6	3551.0	127.7	118.5	116825.4	3584.7	122.0

Sample Train Leak Check: A: 0.002 @ -15 "Hg B: 0.000 @ -11 "Hg AMB: 0.001 @ -13 "Hg

Technician Signature: 

Date: 8/15/2018

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 2 Test Date: 8/9/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.06 CO (%): 4.25
 Mid Gas CO₂ (%): - CO (%): -

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	6:35	-	6:38	10:46	-	10:50
CO ₂	0.00	-	17.06	0.08	-	16.99
CO	0.000	-	4.250	-0.008	-	4.293

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.030	0.044	0.046	0.040	0.032	0.042	0.048	0.040	0.048
Temp (°F):	102	102	102	102	102	102	102	102	102

Dilution Tunnel Static Pressure (inH₂O): -0.130

Supplemental Data

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

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

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 8/7/2018

	Initial	Middle	Ending
P _b (inHg)	29.84	29.85	29.85
RH (%)	50.1	46.9	41.8

Technician Signature: 

Date: 8/15/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 3 Data Summary

Client: Pacific Energy
Model: Vista LE
Job #: 18-424
Tracking #: 0006
Test Date: 8/9/2018

Technician Signature

8/14/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Pacific Energy

Model: Vista LE

Run #: 3

Job #: 18-424

Tracking #: 0006

Technician: SJB

Date: 8/9/2018

Burn Rate (kg/hr):	1.93
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	19.788	17.387	17.070	8.600
Average Gas Velocity in Dilution Tunnel (ft/sec)	14.0			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	8552.9			
Average Gas Meter Temperature (°F)	88.2	102.1	101.2	95.7
Total Sample Volume (dscf)	18.949	16.362	16.009	10.073
Average Tunnel Temperature (°F)	135.1			
Total Time of Test (min)	120			
Total Particulate Catch (mg)	0.0	2.4	1.9	0.8
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0001467	0.0001187	0.0000794
Total PM Emissions (g)	0.00	2.51	2.03	0.68
Particulate Emission Rate (g/hr)	0.00	1.25	1.02	0.68
Emissions Factor (g/kg)	-	0.65	0.53	-
Difference from Average Total Particulate Emissions (g)	-	0.24	0.24	-
Difference from Average Emissions Factor (g/kg)	-	0.06	0.06	-

Final Average Results	
Total Particulate Emissions (g)	2.27
Particulate Emission Rate (g/hr)	1.13
Emissions Factor (g/kg)	0.59
HHV Efficiency (%)	65.0%
LHV Efficiency (%)	70.3%
CO Emissions (g/min)	1.28

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	87.0	OK
Face Velocity	< 30 ft/min	7.9	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min: 87 / Max: 90	OK
Negative Probe Weight Evaluation	<5% of Total Catch	Probe Catch Not Negative	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	89.6	OK

B415.1 Efficiency Results

Manufacturer: Pacific Energy
Model: Vista LE
Date: 08/09/18
Run: 3
Control #: 18-424
Test Duration: 120
Output Category: 4

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	65.0%	70.3%
Combustion Efficiency	97.4%	97.4%
Heat Transfer Efficiency	66.8%	72.2%

Output Rate (kJ/h)	24,442	23,186	(Btu/h)
Burn Rate (kg/h)	1.90	4.18	(lb/h)
Input (kJ/h)	37,580	35,649	(Btu/h)

Test Load Weight (dry kg)	3.79	8.36	dry lb
MC wet (%)	16.38		
MC dry (%)	19.59		
Particulate (g)	2.27		
CO (g)	154		
Test Duration (h)	2.00		

Emissions	Particulate	CO
g/MJ Output	0.05	3.14
g/kg Dry Fuel	0.60	40.51
g/h	1.13	76.85
g/min	0.02	1.28
lb/MM Btu Output	0.11	7.31

Air/Fuel Ratio (A/F)	17.61
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 3

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/9/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	12.00	20.3				
2x4	12.00	19.9				
2x4	12.00	19.1				
2x4	12.00	19.9				
2x4	10.00	19.7				
2x4	10.00	18.8				
2x4	10.00	20.9				
2x4	10.00	22.5				
Total Fuel Weight (lbs):		9.11	Average Moisture (%DB):		20.1	

Firebox Volume (ft³): 1.55
 Total 2x4 Crib Weight, with spacers (lbs): 6.51
 Total 4x4 Crib Weight, with spacers (lbs): 3.54
 Total Wet Fuel Weight, with spacers (lbs): 10.05

Coal Bed Range (20-25%):

Min (lbs): 2.01
 Max (lbs): 2.51

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	12.00	1.26	19.7	18.9	19.3	1.06
2x4	12.00	1.21	18.9	18.8	19.6	1.02
2x4	12.00	1.17	18.6	19.1	19.4	0.98
2x4	12.00	1.28	19.1	19.4	18.8	1.07
4x4	12.00	3.30	20.8	21.4	22.0	2.72
Total Dry Weight, no spacers (lbs):						6.85
Total Dry Weight, with spacers (lbs):						8.52

Spacer Moisture Readings (%DB)							
9.4	10.2	11.1	8.7	7.7			
9.6	9.7	9.4	9.4	10.4			
8.7	8.4	9.3	7.6				
10.2	7.6	8.9	10.1				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	29.7	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.48	OK
2x4 Fuel Mix	35 - 65 % of total weight	65%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 3

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/9/2018

Preburn Start Time: 12:24
 Recording Interval (min): 10
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	10.8	-0.054	529	564	402	529	437	492.2	357	64
10	8.2	-0.089	487	518	302	744	429	496.0	790	64
20	5.5	-0.092	468	528	345	846	410	519.4	807	65
30	3.3	-0.093	489	559	398	855	405	541.2	704	65
40	2.7	-0.073	512	563	353	590	406	484.8	492	66
50	2.4	-0.055	479	515	290	436	403	424.6	404	66
60	2.3	-0.045	437	459	249	354	389	377.6	345	66

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 3
 Test Start Time: 13:24

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/9/2018

Total Sampling Time (min): 120
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.81	29.79	29.76	29.79

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.130 in H₂O

Post-Test Leak Check

(A) 0.001 cfm @ -12 in. Hg
 (B) 0.001 cfm @ -11 in. Hg
 (AMB) 0.000 cfm @ -13 in. Hg

Ambient Sample Volume: 19.788 ft³

Tunnel Traverse Information									
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.028	0.046	0.048	0.040	0.032	0.044	0.048	0.038	0.048
Tunnel Temp (°F)	112	112	112	112	112	112	112	112	112

V_{strav}: 14.00 ft/sec

F_p: 0.924 [ratio]

V_{scent}: 15.14 ft/sec

Initial Tunnel Flow: 147.0 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	D. Fir	Oak
HHV (kJ/kg)	19,810	19,887
%C	48.73	50
%H	6.87	6.6
%O	43.9	42.9
%Ash	0.5	0.5

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	19.6

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific EnergyJob #: 18-424Model: Vista LETracking #: 0006Run #: 3Technician: SJBDate: 8/9/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.000		0.046	0.02	88	-0.1		10.0		122	346	84	87
10	1.422	0.142	0.046	2.08	89	-0.08	101	8.6	-1.4	142	582	85	87
20	2.858	0.144	0.046	2.05	92	-2.53	103	6.4	-2.2	161	666	86	88
30	4.293	0.144	0.046	2.04	96	-0.24	103	4.8	-1.6	168	680	84	89
40	5.724	0.143	0.046	2.02	99	-2.04	101	3.4	-1.4	159	619	86	90
50	7.159	0.144	0.046	2.02	102	-0.36	100	2.2	-1.2	152	572	85	88
60	8.600	0.144	0.046	2.02	104	-0.09	100	1.5	-0.7	140	482	86	88
70	10.066	0.147	0.046	2.05	106	-2.3	100	1.1	-0.4	131	420	85	88
80	11.527	0.146	0.046	2.04	108	-1.76	99	0.8	-0.3	124	375	86	88
90	12.990	0.146	0.046	2.05	109	-2.2	98	0.5	-0.3	118	339	85	88
100	14.454	0.146	0.046	2.05	111	-1.04	98	0.3	-0.2	114	310	86	88
110	15.921	0.147	0.046	2.06	111	-0.34	98	0.1	-0.2	113	314	85	88
120	17.387	0.147	0.046	2.05	112	-1.03	97	0.0	-0.1	112	305	86	89
Avg/Tot	17.387	0.145	0.046	1.89	102	-1.09	100			135	462	85	88.2

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific EnergyJob #: 18-424Model: Vista LETracking #: 0006Run #: 3Technician: SJBDate: 8/9/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.000		0.00	87	-1		86	0.000	3.26	0.63
10	1.403	0.140	2.02	89	-2.74	101	85	-0.080	11.90	0.06
20	2.800	0.140	1.99	91	-1.82	102	85	-0.080	5.98	0.00
30	4.196	0.140	1.96	95	-2.43	102	86	-0.070	12.83	0.01
40	5.611	0.142	2.02	98	-2.86	102	87	-0.070	10.77	0.05
50	7.031	0.142	2.02	101	-0.74	101	84	-0.080	9.79	0.02
60	8.457	0.143	2.01	103	-2.14	100	85	-0.050	6.90	0.37
70	9.886	0.143	2.01	105	-2.67	99	86	-0.050	4.56	0.82
80	11.316	0.143	2.02	107	-2.59	99	87	-0.060	3.99	1.11
90	12.753	0.144	2.01	108	-2.8	98	87	-0.040	3.02	1.18
100	14.190	0.144	2.03	110	-2.69	98	86	-0.050	2.75	1.15
110	15.628	0.144	2.01	110	-2.11	98	85	-0.030	3.49	1.30
120	17.070	0.144	2.02	111	-2.86	98	84	-0.040	3.22	1.01
Avg/Tot	17.070	0.142	1.86	101	-2.27	100	86	-0.054	6.34	0.59

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Pacific Energy
 Model: Vista LE
 Run #: 3

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/9/2018

Stove ΔT : 90

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	435	458	248	352	388	376.2	N/A
10	387	406	201	426	369	357.8	N/A
20	374	418	204	628	352	395.2	N/A
30	398	468	231	733	342	434.4	N/A
40	430	501	257	680	336	440.8	N/A
50	452	512	291	624	333	442.4	N/A
60	467	509	343	513	332	432.8	N/A
70	458	491	333	433	334	409.8	N/A
80	433	456	278	369	331	373.4	N/A
90	401	418	246	328	321	342.8	N/A
100	371	381	227	289	309	315.4	N/A
110	345	351	216	271	299	296.4	N/A
120	327	335	211	264	296	286.6	N/A
Average	406	439	253	455	334	377	N/A

LAB SAMPLE DATA - ASTM E2515

Client: Pacific Energy

Job #: 18-424

Model: Vista LE

Tracking #: 0006

Run #: 3

Technician: SJB

Date: 8/9/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3237	125.0	124.2	0.8
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total

Total Particulate, mg:

0.8

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3238	119.7	118.8	0.9
B. Rear filter catch	Filter	3239	121.1	121.3	-0.2
C. Probe catch*	Probe	9A	116720.5	116720.5	0.0
D. O-Ring catch*	O-Ring	9A	3581.2	3580.3	0.9

Sub-Total

Total Particulate, mg:

1.6

Train A Aggregate

Total Particulate, mg:

2.4

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3240	125.2	124.0	1.2
B. Rear filter catch	Filter	3241	118.1	118.4	-0.3
C. Probe catch*	Probe	9B	117135.5	117135.4	0.1
D. O-Ring catch*	O-Ring	9B	3523.9	3523.0	0.9

Total Particulate, mg:

1.9

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3242	121.5	121.5	0.0

Total Particulate, mg:

0.0

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

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 3 Test Date: 8/9/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): High Air Setting: Fully Open

Preburn Notes

Preburn Start Time: 11:02

Time	Notes
11:02	Kindling load – 8 lbs, convection fan on high.
11:46	With 1 lb of kindling remaining, loaded 1 st preburn loaded (4-2"x4"x12" and 4-2"x4"x10"), 8.2 lbs total
12:24	With 1.8 lbs left, scooped coals, zeroed scale, added coals back in, and loaded second "official" preburn load.
12:54	With 3.3 lbs remaining, leveled coal bed.
13:09	With 2.6 lbs remaining, leveled coal bed.
13:24	At 2.3 lbs, leveled and raked coals, zeroed scale in preparation for fuel loading.

Test Notes

Test Burn Start Time: 13:24
 Test Fuel Loaded by: 30 seconds
 Door Closed: 50 seconds
 Air Control Set at: 0 minutes
 Other Loading Notes: N/A

Time	Notes
0 min	Convection fan on for duration of test, air setting at fully open.
60 min	Changed 1-hour filter
120 min	End of Test

Test Burn End Time: 15:24
 Background Filter Volume (ft³): 19.788

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3237	3238	3239	9A	9A	3240	3241	9B	9B	3242
Tare (mg)	124.2	118.8	121.3	116720.5	3580.3	124.0	118.4	117135.4	3523.0	121.5
Final Weight (mg)	125.0	119.7	121.1	16720.5	3581.2	125.2	118.1	117135.5	3523.9	121.5

Sample Train Leak Check: A: 0.001 @ -12 "Hg B: 0.001 @ -11 "Hg AMB: 0.000 @ -13 "Hg

Technician Signature: 

Date: 8/15/2018

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 3 Test Date: 8/9/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.06 CO (%): 4.25
 Mid Gas CO₂ (%): - CO (%): -

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	12:05	-	12:08	16:10	-	16:15
CO ₂	0.00	-	17.06	0.13	-	17.16
CO	0.000	-	4.250	-0.011	-	4.286

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.028	0.046	0.048	0.040	0.032	0.044	0.048	0.038	0.048
Temp (°F):	112	112	112	112	112	112	112	112	112

Dilution Tunnel Static Pressure (inH₂O): -0.130

Supplemental Data

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

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

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 8/7/2018

	Initial	Middle	Ending
P _b (inHg)	29.81	29.79	29.76
RH (%)	37.6	35.0	28.3

Technician Signature: 

Date: 8/15/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 4 Data Summary

Client: Pacific Energy
Model: Vista LE
Job #: 18-424
Tracking #: 0006
Test Date: 8/10/2018

Technician Signature

8/14/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Pacific Energy

Model: Vista LE

Run #: 4

Job #: 18-424

Tracking #: 0006

Technician: SJB

Date: 8/10/2018

Burn Rate (kg/hr):	1.36
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	28.071	24.551	23.891	8.453
Average Gas Velocity in Dilution Tunnel (ft/sec)	12.6			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	8135.7			
Average Gas Meter Temperature (°F)	80.9	98.0	97.0	88.4
Total Sample Volume (dscf)	27.284	23.310	22.608	9.899
Average Tunnel Temperature (°F)	104.3			
Total Time of Test (min)	170			
Total Particulate Catch (mg)	0.0	3.3	2.9	2.2
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0001416	0.0001283	0.0002222
Total PM Emissions (g)	0.00	3.26	2.96	1.81
Particulate Emission Rate (g/hr)	0.00	1.15	1.04	1.81
Emissions Factor (g/kg)	-	0.85	0.77	-
Difference from Average Total Particulate Emissions (g)	-	0.15	0.15	-
Difference from Average Emissions Factor (g/kg)	-	0.04	0.04	-

Final Average Results	
Total Particulate Emissions (g)	3.11
Particulate Emission Rate (g/hr)	1.10
Emissions Factor (g/kg)	0.81
HHV Efficiency (%)	74.1%
LHV Efficiency (%)	80.1%
CO Emissions (g/min)	1.45

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	86.0	OK
Face Velocity	< 30 ft/min	7.7	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min: 78 / Max: 83	OK
Negative Probe Weight Evaluation	<5% of Total Catch	-3.4%	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	92.8	OK

B415.1 Efficiency Results

Manufacturer: Pacific Energy
Model: Vista LE
Date: 08/10/18
Run: 4
Control #: 18-424
Test Duration: 170
Output Category: 3

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	74.1%	80.1%
Combustion Efficiency	95.4%	95.4%
Heat Transfer Efficiency	77.6%	83.9%

Output Rate (kJ/h)	19,653	18,643	(Btu/h)
Burn Rate (kg/h)	1.34	2.95	(lb/h)
Input (kJ/h)	26,530	25,167	(Btu/h)

Test Load Weight (dry kg)	3.79	8.36	dry lb
MC wet (%)	16.37		
MC dry (%)	19.57		
Particulate (g)	3.11		
CO (g)	247		
Test Duration (h)	2.83		

Emissions	Particulate	CO
g/MJ Output	0.06	4.43
g/kg Dry Fuel	0.82	65.06
g/h	1.10	87.13
g/min	0.02	1.45
lb/MM Btu Output	0.13	10.30

Air/Fuel Ratio (A/F)	13.65
-----------------------------	-------

VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 4

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/10/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	12.00	22.5				
2x4	12.00	18.7				
2x4	12.00	19.0				
2x4	12.00	18.7				
2x4	10.00	19.1				
2x4	10.00	19.2				
2x4	10.00	18.9				
2x4	10.00	19.7				
Total Fuel Weight (lbs):		9.37	Average Moisture (%DB):		19.5	

Firebox Volume (ft³): 1.55
 Total 2x4 Crib Weight, with spacers (lbs): 6.48
 Total 4x4 Crib Weight, with spacers (lbs): 3.52
 Total Wet Fuel Weight, with spacers (lbs): 10.00

Coal Bed Range (20-25%):

Min (lbs): 2.00
 Max (lbs): 2.50

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	12.00	1.32	20.2	19.8	19.4	1.10
2x4	12.00	1.30	19.3	18.9	19.0	1.09
2x4	12.00	1.19	19.2	19.7	19.0	1.00
2x4	12.00	1.17	19.9	18.9	19.3	0.98
4x4	12.00	3.33	19.8	20.1	21.1	2.77
Total Dry Weight, no spacers (lbs):						6.94
Total Dry Weight, with spacers (lbs):						8.47

Spacer Moisture Readings (%DB)							
11.1	10.2	10.3	10.7	10.4			
9.8	10.7	10.6	10.0	9.4			
8.9	10.2	10.3	10.1				
10.4	8.0	10.4	10.9				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	30.1	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.45	OK
2x4 Fuel Mix	35 - 65 % of total weight	65%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 4

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/10/2018

Preburn Start Time: 10:06
 Recording Interval (min): 10
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	4.9	-0.090	542	563	667	997	482	650.2	776	71
10	3.4	-0.080	556	587	393	806	469	562.2	518	69
20	3.0	-0.069	532	570	343	559	449	490.6	373	66
30	2.7	-0.027	497	535	314	434	433	442.6	328	65
40	2.5	-0.048	464	500	294	380	420	411.6	306	62
50	2.4	-0.043	435	467	268	349	411	386.0	289	60
60	2.2	-0.041	411	438	252	323	401	365.0	270	59

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 4
 Test Start Time: 11:06

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/10/2018

Total Sampling Time (min): 170
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.86	29.83	29.81	29.83

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.130 in H₂O

Post-Test Leak Check

(A) 0.001 cfm @ -15 in. Hg
 (B) 0.000 cfm @ -11 in. Hg
 (AMB) 0.000 cfm @ -10 in. Hg

Ambient Sample Volume: 28.071 ft³

	Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.030	0.042	0.038	0.022	0.028	0.040	0.040	0.022	0.046
Tunnel Temp (°F)	108	108	108	108	108	108	108	108	108

V_{strav}: 12.63 ft/sec
 V_{scent}: 14.76 ft/sec

F_p: 0.856 [ratio]
 Initial Tunnel Flow: 132.3 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	D. Fir	Oak
HHV (kJ/kg)	19,810	19,887
%C	48.73	50
%H	6.87	6.6
%O	43.9	42.9
%Ash	0.5	0.5

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	19.6

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific EnergyJob #: 18-424Model: Vista LETracking #: 0006Run #: 4Technician: SJBDate: 8/10/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.280		0.046	0.01	81	-0.12		10.0		100	268	84	79
10	1.664	0.138	0.046	1.99	82	-2.47	99	8.7	-1.3	111	392	85	78
20	3.070	0.141	0.046	2.01	85	-0.45	100	7.3	-1.4	113	442	85	79
30	4.478	0.141	0.046	2.01	88	-2.28	100	5.9	-1.4	117	470	84	80
40	5.894	0.142	0.046	2.01	92	-2.35	100	4.7	-1.2	117	468	84	80
50	7.309	0.142	0.046	2.00	94	-0.7	100	3.5	-1.2	117	471	85	80
60	8.733	0.142	0.046	2.26	97	-0.62	100	2.6	-0.9	114	434	85	80
70	10.168	0.144	0.046	2.02	99	-1.87	100	2.0	-0.6	108	351	85	81
80	11.600	0.143	0.046	2.02	100	-1.45	99	1.7	-0.3	104	314	85	81
90	13.034	0.143	0.046	2.02	102	-0.01	98	1.4	-0.3	101	302	85	81
100	14.468	0.143	0.046	2.02	103	0	98	1.2	-0.2	100	295	85	81
110	15.905	0.144	0.046	2.01	104	-2.48	98	0.9	-0.3	99	276	85	81
120	17.345	0.144	0.046	2.03	104	-1.41	98	0.7	-0.2	98	270	85	81
130	18.784	0.144	0.046	2.01	105	-0.54	98	0.6	-0.1	97	258	85	82
140	20.222	0.144	0.046	2.02	106	-0.42	97	0.4	-0.2	96	243	85	83
150	21.665	0.144	0.046	1.99	107	-0.38	98	0.3	-0.1	96	231	85	83
160	23.109	0.144	0.046	2.00	107	-1.25	98	0.1	-0.2	95	226	85	83
170	24.551	0.144	0.046	2.03	108	-0.89	97	0.0	-0.1	95	219	85	83
Avg/Tot	24.551	0.143	0.046	1.91	98	-1.09	99			104	329	85	80.9

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 4

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/10/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.027		0.00	80	-1		86	0.000	3.63	1.01
10	1.405	0.138	2.01	81	-0.7	102	86	-0.050	9.35	0.32
20	2.792	0.139	2.00	84	-2.03	102	85	-0.060	12.75	0.28
30	4.177	0.139	1.98	87	-1.11	101	84	-0.070	15.30	0.33
40	5.567	0.139	1.96	91	-2.46	101	85	-0.070	13.70	0.09
50	6.965	0.140	1.98	93	-2.74	101	86	-0.080	14.05	0.10
60	8.362	0.140	1.96	96	-0.89	100	85	-0.060	12.57	0.14
70	9.765	0.140	1.98	98	-1.05	100	84	-0.060	7.58	0.80
80	11.172	0.141	1.97	99	-1.28	100	86	-0.050	6.66	1.19
90	12.579	0.141	1.98	100	-2.67	99	85	-0.040	6.59	1.17
100	13.989	0.141	1.97	102	-1.41	99	84	-0.040	6.73	1.13
110	15.400	0.141	1.97	103	-1.98	99	86	-0.030	5.68	1.48
120	16.811	0.141	1.98	104	-0.59	99	85	-0.030	5.81	1.33
130	18.227	0.142	1.98	104	-2.67	99	83	-0.030	5.07	1.43
140	19.640	0.141	1.96	105	-1.94	98	85	-0.030	4.48	1.78
150	21.058	0.142	1.97	106	-0.58	99	85	-0.030	4.28	1.87
160	22.471	0.141	1.96	106	-2.67	98	84	-0.010	4.45	1.75
170	23.891	0.142	1.97	107	-0.69	98	85	-0.030	4.09	1.68
Avg/Tot	23.891	0.140	1.87	97	-1.58	100	85	-0.043	7.93	0.99

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Pacific Energy
 Model: Vista LE
 Run #: 4

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/10/2018

Stove ΔT : 93

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	411	437	262	325	401	367.2	N/A
10	383	404	334	448	390	391.8	N/A
20	366	394	217	477	373	365.4	N/A
30	369	398	191	525	357	368.0	N/A
40	385	415	196	573	350	383.8	N/A
50	400	424	211	587	347	393.8	N/A
60	414	442	233	569	345	400.6	N/A
70	423	462	250	478	345	391.6	N/A
80	411	452	246	396	342	369.4	N/A
90	393	433	236	361	340	352.6	N/A
100	377	416	229	342	336	340.0	N/A
110	365	401	221	325	333	329.0	N/A
120	353	385	211	308	334	318.2	N/A
130	344	371	203	297	337	310.4	N/A
140	334	357	196	276	335	299.6	N/A
150	325	343	194	258	328	289.6	N/A
160	316	330	193	245	320	280.8	N/A
170	309	319	195	237	312	274.4	N/A
Average	371	399	223	390	346	346	N/A

LAB SAMPLE DATA - ASTM E2515

Client: Pacific Energy

Job #: 18-424

Model: Vista LE

Tracking #: 0006

Run #: 4

Technician: SJB

Date: 8/10/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3243	126.2	124.0	2.2
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total

Total Particulate, mg:

2.2

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3244	118.2	117.4	0.8
B. Rear filter catch	Filter	3245	121.4	121.7	-0.3
C. Probe catch*	Probe	10A	116826.4	116826.4	0.0
D. O-Ring catch*	O-Ring	10A	3431.1	3430.5	0.6

Sub-Total

Total Particulate, mg:

1.1

Train A Aggregate

Total Particulate, mg:

3.3

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3246	126.3	124.1	2.2
B. Rear filter catch	Filter	3247	118.5	118.7	-0.2
C. Probe catch*	Probe	10B	117167.5	117167.6	0.0
D. O-Ring catch*	O-Ring	10B	3570.1	3569.2	0.9

Total Particulate, mg:

2.9

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3248	121.1	121.1	0.0

Total Particulate, mg:

0.0

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

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 4 Test Date: 8/10/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Medium Low Air Setting: (7/32" drill bit in main Primary Air Inlet + fixed opening)
 Note: This air setting ended up yielding a medium high burn rate, another test at a slightly lower air setting will be performed.

Preburn Notes

Preburn Start Time: 8:21

Time	Notes
8:21	Kindling load – 8 lbs
9:05	With 0.5 lb of kindling remaining, loaded 1 st preburn loaded (4-2"x4"x12" and 4-2"x4"x10"), 8.4 lbs total
9:44	With 1.6 lbs left, scooped coals, zeroed scale, added coals back in, and loaded second "official" preburn load.
10:06	With 4.9 lbs left, turned air down to test setting, turned convection fan on high.
11:06	At 2.2 lbs, leveled and raked coals, zeroed scale, turned fan off, in preparation for fuel loading.

Test Notes

Test Burn Start Time: 11:06
 Test Fuel Loaded by: 40 seconds
 Door Closed: 60 seconds
 Air Control Set at: 5 minutes
 Other Loading Notes: N/A

Time	Notes
15 min	Turned convection fan on to High, per manufacturer's instructions.
60 min	Changed 1-hour filter
170 min	End of Test

Test Burn End Time: 13:56
 Background Filter Volume (ft³): 28.071

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3243	3244	3245	10A	10A	3246	3247	10B	10B	3248
Tare (mg)	124.0	117.4	121.7	116826.4	3430.5	124.1	118.7	117167.6	3569.2	121.1
Final Weight (mg)	126.2	118.2	121.4	116826.4	3431.1	126.3	118.5	117167.5	3570.1	121.1

Sample Train Leak Check: A: 0.001 @ -15 "Hg B: 0.000 @ -11 "Hg AMB: 0.000 @ -10 "Hg

Technician Signature: _____

Date: 8/15/2018

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 4 Test Date: 8/10/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.06 CO (%): 4.25
 Mid Gas CO₂ (%): - CO (%): -

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	10:20	-	10:23	15:07	-	15:11
CO ₂	0.00	-	17.06	0.22	-	17.19
CO	0.000	-	4.250	-0.011	-	4.304

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.030	0.042	0.038	0.022	0.028	0.040	0.040	0.022	0.046
Temp (°F):	108	108	108	108	108	108	108	108	108

Dilution Tunnel Static Pressure (inH₂O): -0.130

Supplemental Data

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

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

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 8/7/2018

	Initial	Middle	Ending
P _b (inHg)	29.86	29.83	29.81
RH (%)	39.5	35.1	32.4

Technician Signature: _____

Date: 8/15/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 5 Data Summary

Client: Pacific Energy
Model: Vista LE
Job #: 18-424
Tracking #: 0006
Test Date: 8/12/2018

A handwritten signature in black ink, appearing to be "JL", is written over a horizontal line.

Techician Signature

8/16/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Pacific Energy

Model: Vista LE

Run #: 5

Job #: 18-424

Tracking #: 0006

Technician: SJB

Date: 8/12/2018

Burn Rate (kg/hr):	1.22
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	31.503	27.393	26.872	8.454
Average Gas Velocity in Dilution Tunnel (ft/sec)	13.3			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	8658.2			
Average Gas Meter Temperature (°F)	79.6	98.5	97.6	86.7
Total Sample Volume (dscf)	30.755	26.039	25.455	9.912
Average Tunnel Temperature (°F)	100.8			
Total Time of Test (min)	190			
Total Particulate Catch (mg)	0.1	4.5	3.9	2.1
Particulate Concentration, dry-standard (g/dscf)	0.0000033	0.0001728	0.0001532	0.0002119
Total PM Emissions (g)	0.09	4.65	4.11	1.81
Particulate Emission Rate (g/hr)	0.03	1.47	1.30	1.81
Emissions Factor (g/kg)	-	1.21	1.07	-
Difference from Average Total Particulate Emissions (g)	-	0.27	0.27	-
Difference from Average Emissions Factor (g/kg)	-	0.07	0.07	-

Final Average Results	
Total Particulate Emissions (g)	4.38
Particulate Emission Rate (g/hr)	1.38
Emissions Factor (g/kg)	1.14
HHV Efficiency (%)	74.6%
LHV Efficiency (%)	80.7%
CO Emissions (g/min)	1.17

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	86.0	OK
Face Velocity	< 30 ft/min	7.8	OK
Leakage Rate	Less than 4% of average sample rate	0 cfm	OK
Ambient Temp	55-90 °F	Min: 74 / Max: 81	OK
Negative Probe Weight Evaluation	<5% of Total Catch	Probe Catch Not Negative	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	71.8	OK

B415.1 Efficiency Results

Manufacturer: Pacific Energy
Model: Vista LE
Date: 08/12/18
Run: 5
Control #: 18-424
Test Duration: 190
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	74.6%	80.7%
Combustion Efficiency	95.9%	95.9%
Heat Transfer Efficiency	77.8%	84.1%

Output Rate (kJ/h)	17,701	16,792	(Btu/h)
Burn Rate (kg/h)	1.20	2.64	(lb/h)
Input (kJ/h)	23,720	22,501	(Btu/h)

Test Load Weight (dry kg)	3.79	8.36	dry lb
MC wet (%)	16.43		
MC dry (%)	19.66		
Particulate (g)	4.38		
CO (g)	222		
Test Duration (h)	3.17		

Emissions	Particulate	CO
g/MJ Output	0.08	3.97
g/kg Dry Fuel	1.16	58.68
g/h	1.38	70.26
g/min	0.02	1.17
lb/MM Btu Output	0.18	9.22

Air/Fuel Ratio (A/F)	14.00
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 5

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/12/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	12.00	19.4				
2x4	12.00	20.1				
2x4	12.00	21.1				
2x4	12.00	19.6				
2x4	10.00	22.4				
2x4	10.00	20.4				
2x4	10.00	19.6				
2x4	10.00	18.9				
Total Fuel Weight (lbs):		8.86	Average Moisture (%DB):		20.2	

Firebox Volume (ft³): 1.55
 Total 2x4 Crib Weight, with spacers (lbs): 6.42
 Total 4x4 Crib Weight, with spacers (lbs): 3.59
 Total Wet Fuel Weight, with spacers (lbs): 10.01

Coal Bed Range (20-25%):

Min (lbs): 2.00
 Max (lbs): 2.50

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	13.00	1.23	20.1	19.4	19.7	1.03
2x4	13.00	1.17	18.9	19.3	19.6	0.98
2x4	13.00	1.28	21.1	20.4	20.3	1.06
2x4	13.00	1.25	19.5	19.3	19.4	1.05
4x4	13.00	3.41	20.2	19.0	18.7	2.86
Total Dry Weight, no spacers (lbs):						6.97
Total Dry Weight, with spacers (lbs):						8.50

Spacer Moisture Readings (%DB)							
10.1	8.4	11.1	7.4	10.5			
9.5	8.6	10.6	8.1	10.1			
8.9	9.3	9.1	9.5				
8.6	8.7	9.6	8.9				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	27.9	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.46	OK
2x4 Fuel Mix	35 - 65 % of total weight	64%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 5

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/12/2018

Preburn Start Time: 21:58
 Recording Interval (min): 10
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	4.9	-0.087	510	561	652	962	459	628.8	797	57
10	3.5	-0.046	512	578	390	740	447	533.4	477	56
20	3.1	-0.054	492	552	328	534	434	468.0	361	55
30	2.9	-0.047	462	508	298	415	418	420.2	309	55
40	2.6	-0.044	438	468	270	359	402	387.4	285	55
50	2.5	-0.035	417	436	251	328	392	364.8	272	56
60	2.3	-0.030	398	412	242	310	387	349.8	264	56

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 5
 Test Start Time: 22:58

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/12/2018

Total Sampling Time (min): 190
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.89	29.89	29.89	29.89

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.130 in H₂O

Post-Test Leak Check

(A) 0.000 cfm @ -14 in. Hg
 (B) 0.000 cfm @ -11 in. Hg
 (AMB) 0.000 cfm @ -12 in. Hg

Ambient Sample Volume: 31.503 ft³

	Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.028	0.044	0.048	0.030	0.030	0.040	0.046	0.032	0.046
Tunnel Temp (°F)	99	99	99	99	99	99	99	99	99

V_{strav}: 13.27 ft/sec
 V_{scent}: 14.64 ft/sec

F_p: 0.907 [ratio]
 Initial Tunnel Flow: 142.7 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	D. Fir	Oak
HHV (kJ/kg)	19,810	19,887
%C	48.73	50
%H	6.87	6.6
%O	43.9	42.9
%Ash	0.5	0.5

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	19.7

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific EnergyJob #: 18-424Model: Vista LETracking #: 0006Run #: 5Technician: SJBDate: 8/12/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft ³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.175		0.046	0.01	80	-0.09		10.0		97	268	84	74
10	1.548	0.137	0.046	2.07	80	-0.31	99	9.0	-1	104	371	85	74
20	2.963	0.142	0.046	2.02	83	0	102	7.7	-1.3	109	437	85	76
30	4.372	0.141	0.046	2.03	86	-1.76	101	6.3	-1.4	112	467	84	77
40	5.785	0.141	0.046	2.03	89	-0.81	101	4.9	-1.4	114	467	85	78
50	7.204	0.142	0.046	2.03	93	-2.27	100	3.9	-1	111	427	84	79
60	8.629	0.143	0.046	2.04	96	-0.16	100	3.1	-0.8	111	434	86	80
70	10.065	0.144	0.046	2.04	98	-1.65	100	2.4	-0.7	107	383	84	81
80	11.500	0.144	0.046	2.04	100	-0.04	99	2.0	-0.4	103	338	86	81
90	12.938	0.144	0.046	2.03	102	-2.21	99	1.7	-0.3	102	329	85	81
100	14.375	0.144	0.046	2.05	103	-1.89	99	1.4	-0.3	99	291	84	81
110	15.816	0.144	0.046	2.06	104	-2.07	99	1.2	-0.2	97	274	86	81
120	17.261	0.145	0.046	2.05	105	-0.36	99	1.0	-0.2	96	262	85	81
130	18.705	0.144	0.046	2.05	106	-1.15	98	0.8	-0.2	95	255	84	81
140	20.148	0.144	0.046	2.03	106	0	98	0.6	-0.2	95	253	84	81
150	21.594	0.145	0.046	2.06	107	0	98	0.5	-0.1	94	251	86	81
160	23.043	0.145	0.046	2.05	107	-0.09	98	0.4	-0.1	94	239	85	81
170	24.493	0.145	0.046	2.04	108	-1.17	98	0.2	-0.2	93	231	84	81
180	25.943	0.145	0.046	2.04	108	0	98	0.1	-0.1	92	221	86	81
190	27.393	0.145	0.046	2.05	108	-0.49	98	0.0	-0.1	91	214	85	81
Avg/Tot	27.393	0.143	0.046	1.94	98	-0.83	99			101	321	85	79.6

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 5

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/12/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.000		0.00	79	-1		86	0.000	4.06	1.04
10	1.367	0.137	2.03	80	-1.49	100	83	-0.040	8.85	0.37
20	2.746	0.138	1.99	82	-0.54	101	86	-0.060	12.30	0.23
30	4.127	0.138	1.98	85	-1.2	101	84	-0.060	15.43	0.46
40	5.525	0.140	2.01	88	-0.75	102	84	-0.070	14.59	0.27
50	6.927	0.140	2.01	92	-1.34	101	85	-0.060	11.32	0.27
60	8.338	0.141	2.01	95	-0.68	101	86	-0.050	12.28	0.15
70	9.752	0.141	2.02	97	-2.74	101	85	-0.050	9.10	0.41
80	11.170	0.142	2.01	99	-1.28	100	85	-0.050	8.00	0.67
90	12.589	0.142	2.02	101	-2.44	100	84	-0.040	7.31	0.73
100	14.013	0.142	2.02	102	-1.22	100	84	-0.040	6.87	0.85
110	15.437	0.142	2.01	103	-0.66	99	86	-0.040	6.90	1.00
120	16.865	0.143	2.02	104	-1.31	99	85	-0.040	5.90	0.98
130	18.291	0.143	2.01	105	-2.75	99	84	-0.040	6.37	0.97
140	19.721	0.143	2.02	106	-1.87	99	85	-0.040	6.23	1.04
150	21.151	0.143	2.01	106	-1.64	99	86	-0.050	5.65	1.29
160	22.580	0.143	2.01	106	-2.56	99	85	-0.030	4.84	1.35
170	24.011	0.143	2.02	107	-2.78	99	84	-0.030	4.72	1.17
180	25.443	0.143	2.02	107	-2.8	99	86	-0.040	4.07	1.32
190	26.872	0.143	2.01	107	-0.66	98	85	-0.020	3.76	1.16
Avg/Tot	26.872	0.141	1.91	98	-1.59	100	85	-0.043	7.93	0.79

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Pacific Energy

Job #: 18-424

Model: Vista LE

Tracking #: 0006

Run #: 5

Technician: SJB

Date: 8/12/2018

Stove ΔT : 72

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	397	412	252	312	387	352.0	N/A
10	371	382	322	420	377	374.4	N/A
20	356	373	212	498	360	359.8	N/A
30	359	381	188	521	342	358.2	N/A
40	380	405	195	575	332	377.4	N/A
50	402	425	204	558	325	382.8	N/A
60	407	422	210	552	317	381.6	N/A
70	405	417	220	511	311	372.8	N/A
80	403	415	228	426	307	355.8	N/A
90	398	416	234	393	305	349.2	N/A
100	389	413	257	353	306	343.6	N/A
110	382	407	273	325	310	339.4	N/A
120	375	399	271	307	312	332.8	N/A
130	366	388	256	294	315	323.8	N/A
140	360	379	249	288	319	319.0	N/A
150	356	372	243	284	323	315.6	N/A
160	348	364	233	273	324	308.4	N/A
170	334	354	225	259	326	299.6	N/A
180	320	342	211	247	328	289.6	N/A
190	307	329	202	236	327	280.2	N/A
Average	371	390	234	382	328	341	N/A

LAB SAMPLE DATA - ASTM E2515

Client: Pacific EnergyModel: Vista LERun #: 5Job #: 18-424Tracking #: 0006Technician: SJBDate: 8/12/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3249	123.7	121.6	2.1
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total

Total Particulate, mg:

2.1

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3250	119.1	118.1	1.0
B. Rear filter catch	Filter	3251	122.5	122.5	0.0
C. Probe catch*	Probe	11A	117035.0	117034.7	0.3
D. O-Ring catch*	O-Ring	11A	3416.0	3414.9	1.1

Sub-Total

Total Particulate, mg:

2.4

Train A Aggregate

Total Particulate, mg:

4.5

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3252	120.8	118.6	2.2
B. Rear filter catch	Filter	3253	121.1	121.0	0.1
C. Probe catch*	Probe	11B	116674.3	116673.9	0.4
D. O-Ring catch*	O-Ring	11B	4228.4	4227.2	1.2

Total Particulate, mg:

3.9

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3254	122.1	122.0	0.1

Total Particulate, mg:

0.1

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

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 5 Test Date: 8/12/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Medium Low Air Setting: (3/16" drill bit in main Primary Air Inlet + fixed opening).

Preburn Notes

Preburn Start Time: 20:15

Time	Notes
20:15	Kindling load – 8 lbs
20:50	With 0.8 lb of kindling remaining, loaded 1 st preburn loaded (4-2"x4"x12" and 4-2"x4"x10"), 8.7 lbs total
21:30	With 1.6 lbs left, scooped coals, zeroed scale, added coals back in, and loaded second "official" preburn load.
21:58	With 4.9 lbs left, turned air down to test setting, turned convection fan on high.
22:58	At 2.3 lbs, leveled and raked coals, zeroed scale, turned fan off, in preparation for fuel loading.

Test Notes

Test Burn Start Time: 22:58
 Test Fuel Loaded by: 40 seconds
 Door Closed: 50 seconds
 Air Control Set at: 5 minutes
 Other Loading Notes: N/A

Time	Notes
15 min	Turned convection fan on to High, per manufacturer's instructions.
60 min	Changed 1-hour filter
190 min	End of Test

Test Burn End Time: 2:06
 Background Filter Volume (ft³): 31.503

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3249	3250	3251	11A	11A	3252	3253	11B	11B	3254
Tare (mg)	121.6	118.1	122.5	117034.7	3414.9	118.6	121.0	116673.9	4227.2	122.0
Final Weight (mg)	123.7	119.1	122.5	117035.0	3416.0	120.8	121.1	116674.3	4228.4	122.1

Sample Train Leak Check: A: 0.000 @ -14 "Hg B: 0.000 @ -11 "Hg AMB: 0.000 @ -12 "Hg

Technician Signature: 

Date: 8/16/2018

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 5 Test Date: 8/12/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.06 CO (%): 4.25
 Mid Gas CO₂ (%): - CO (%): -

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	22:20	-	22:24	2:15	-	2:19
CO ₂	0.00	-	17.06	0.11	-	17.22
CO	0.000	-	4.250	0.026	-	4.316

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.028	0.044	0.048	0.030	0.030	0.040	0.046	0.032	0.046
Temp (°F):	99	99	99	99	99	99	99	99	99

Dilution Tunnel Static Pressure (inH₂O): -0.13

Supplemental Data

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

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

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 8/7/2018

	Initial	Middle	Ending
P _b (inHg)	29.89	29.89	29.89
RH (%)	41.3	37.6	35.2

Technician Signature: [Signature]

Date: 8/16/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 6 Data Summary

Client: Pacific Energy
Model: Vista LE
Job #: 18-424
Tracking #: 0006
Test Date: 8/14/2018



Technician Signature

8/16/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Pacific Energy

Model: Vista LE

Run #: 6

Job #: 18-424

Tracking #: 0006

Technician: SJB

Date: 8/14/2018

Burn Rate (kg/hr):	1.25
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	31.566	27.286	26.893	8.512
Average Gas Velocity in Dilution Tunnel (ft/sec)	13.5			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	8665.1			
Average Gas Meter Temperature (°F)	80.5	86.1	97.9	82.9
Total Sample Volume (dscf)	30.617	26.396	25.339	9.933
Average Tunnel Temperature (°F)	105.9			
Total Time of Test (min)	190			
Total Particulate Catch (mg)	0.0	4.9	5.2	3.5
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0001856	0.0002052	0.0003524
Total PM Emissions (g)	0.00	5.09	5.63	3.05
Particulate Emission Rate (g/hr)	0.00	1.61	1.78	3.05
Emissions Factor (g/kg)	-	1.29	1.42	-
Difference from Average Total Particulate Emissions (g)	-	0.27	0.27	-
Difference from Average Emissions Factor (g/kg)	-	0.07	0.07	-

Final Average Results	
Total Particulate Emissions (g)	5.36
Particulate Emission Rate (g/hr)	1.69
Emissions Factor (g/kg)	1.36
HHV Efficiency (%)	73.1%
LHV Efficiency (%)	79.0%
CO Emissions (g/min)	1.50

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	86.0	OK
Face Velocity	< 30 ft/min	7.8	OK
Leakage Rate	Less than 4% of average sample rate	0.002 cfm	OK
Ambient Temp	55-90 °F	Min: 78 / Max: 83	OK
Negative Probe Weight Evaluation	<5% of Total Catch	-3.8%	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	94.8	OK

B415.1 Efficiency Results

Manufacturer: Pacific Energy
Model: Vista LE
Date: 08/14/18
Run: 6
Control #: 18-424
Test Duration: 190
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	73.1%	79.0%
Combustion Efficiency	94.9%	94.9%
Heat Transfer Efficiency	77.0%	83.2%

Output Rate (kJ/h)	17,991	17,067	(Btu/h)
Burn Rate (kg/h)	1.24	2.74	(lb/h)
Input (kJ/h)	24,621	23,356	(Btu/h)

Test Load Weight (dry kg)	3.94	8.67	dry lb
MC wet (%)	16.59		
MC dry (%)	19.89		
Particulate (g)	5.36		
CO (g)	285		
Test Duration (h)	3.17		

Emissions	Particulate	CO
g/MJ Output	0.09	4.99
g/kg Dry Fuel	1.36	72.30
g/h	1.69	89.86
g/min	0.03	1.50
lb/MM Btu Output	0.22	11.61

Air/Fuel Ratio (A/F)	13.83
-----------------------------	-------

VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 6

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/14/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	12.00	22.1				
2x4	12.00	20.1				
2x4	12.00	19.8				
2x4	12.00	18.8				
2x4	10.00	23.6				
2x4	10.00	20.4				
2x4	10.00	21.4				
2x4	10.00	19.4				
Total Fuel Weight (lbs):		9.44	Average Moisture (%DB):		20.7	

Firebox Volume (ft³): 1.55
 Total 2x4 Crib Weight, with spacers (lbs): 6.71
 Total 4x4 Crib Weight, with spacers (lbs): 3.59
 Total Wet Fuel Weight, with spacers (lbs): 10.30

Coal Bed Range (20-25%):

Min (lbs): 2.06
 Max (lbs): 2.58

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	12.50	1.39	22.7	22.3	20.1	1.14
2x4	12.50	1.23	19.3	19.3	18.8	1.03
2x4	12.50	1.37	18.8	19.1	19.3	1.15
2x4	12.50	1.27	19.9	18.8	19.3	1.06
4x4	12.50	3.38	22.0	19.0	19.7	2.81
Total Dry Weight, no spacers (lbs):						7.20
Total Dry Weight, with spacers (lbs):						8.72

Spacer Moisture Readings (%DB)							
8.4	9.8	8.8	8.7	9.9			
8.9	8.4	8.5	10.7	8.9			
9.6	10.0	9.6	9.9				
9.9	9.2	8.0	9.2				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	29.9	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.65	OK
2x4 Fuel Mix	35 - 65 % of total weight	65%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Pacific Energy
 Model: Vista LE
 Run #: 6

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/14/2018

Preburn Start Time: 9:26
 Recording Interval (min): 10
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	5.5	-0.092	519	548	589	1002	439	619.4	779	59
10	4.0	-0.087	532	563	570	916	439	604.0	536	58
20	3.3	-0.058	521	547	538	765	426	559.4	421	56
30	3.0	-0.054	498	520	515	613	409	511.0	349	54
40	2.8	-0.035	473	490	506	529	395	478.6	318	54
50	2.4	-0.040	453	465	501	481	387	457.4	303	53
60	2.2	-0.038	435	443	494	448	382	440.4	292	54

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 6
 Test Start Time: 10:26

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/14/2018

Total Sampling Time (min): 190
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.76	29.77	29.71	29.75

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.120 in H₂O

Post-Test Leak Check

(A) 0.001 cfm @ -11 in. Hg
 (B) 0.002 cfm @ -11 in. Hg
 (AMB) 0.000 cfm @ -12 in. Hg

Ambient Sample Volume: 31.566 ft³

	Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.030	0.038	0.044	0.032	0.032	0.042	0.048	0.036	0.046
Tunnel Temp (°F)	109	109	109	109	109	109	109	109	109

V_{strav}: 13.52 ft/sec
 V_{scent}: 14.80 ft/sec

F_p: 0.914 [ratio]
 Initial Tunnel Flow: 142.3 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	D. Fir	Oak
HHV (kJ/kg)	19,810	19,887
%C	48.73	50
%H	6.87	6.6
%O	43.9	42.9
%Ash	0.5	0.5

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	19.9

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific EnergyJob #: 18-424Model: Vista LETracking #: 0006Run #: 6Technician: SJBDate: 8/14/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft ³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.000		0.046	0.00	81	-0.11		10.4		103	289	85	78
10	1.411	0.141	0.046	2.07	82	0	99	9.1	-1.3	108	359	85	78
20	2.828	0.142	0.046	2.03	82	-0.01	100	7.9	-1.2	111	456	84	78
30	4.245	0.142	0.046	2.02	83	0	100	6.3	-1.6	117	504	85	78
40	5.664	0.142	0.046	2.02	83	0	100	4.9	-1.4	118	489	84	79
50	7.089	0.143	0.046	2.00	84	-0.02	100	3.9	-1	116	455	85	80
60	8.512	0.142	0.046	2.02	85	-1.44	100	3.1	-0.8	115	438	84	80
70	9.956	0.144	0.046	2.04	86	-0.88	101	2.5	-0.6	112	385	85	80
80	11.394	0.144	0.046	2.03	86	-2.03	100	2.2	-0.3	108	354	85	80
90	12.832	0.144	0.046	2.02	86	-2.25	100	1.8	-0.4	105	344	85	81
100	14.273	0.144	0.046	2.03	87	0	100	1.6	-0.2	104	320	84	81
110	15.717	0.144	0.046	2.02	87	-0.36	100	1.4	-0.2	102	302	84	81
120	17.160	0.144	0.046	2.03	88	-2.38	100	1.2	-0.2	102	294	85	81
130	18.603	0.144	0.046	2.04	88	-0.18	100	1.0	-0.2	101	285	85	81
140	20.047	0.144	0.046	2.03	88	-0.03	100	0.8	-0.2	100	278	85	81
150	21.496	0.145	0.046	2.02	89	-0.24	100	0.6	-0.2	100	270	85	82
160	22.944	0.145	0.046	2.01	89	-0.24	100	0.5	-0.1	99	265	85	82
170	24.391	0.145	0.046	2.02	89	-2.1	100	0.3	-0.2	99	261	85	82
180	25.837	0.145	0.046	2.03	89	-0.34	100	0.1	-0.2	99	252	85	83
190	27.286	0.145	0.046	2.02	90	-1.7	99	0.0	-0.1	98	244	84	83
Avg/Tot	27.286	0.144	0.046	1.93	86	-0.72	100			106	342	85	80.5

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 6

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/14/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.000		0.00	81	-1		84	0.000	3.69	1.00
10	1.384	0.138	2.04	82	-1.45	101	84	-0.060	6.97	0.42
20	2.783	0.140	2.02	84	-2.35	102	86	-0.070	13.58	0.23
30	4.184	0.140	2.01	87	-0.93	102	85	-0.070	16.82	0.75
40	5.585	0.140	2.00	90	-1.58	101	84	-0.070	15.62	0.28
50	6.991	0.141	2.00	93	-2.75	101	85	-0.060	13.72	0.16
60	8.402	0.141	1.99	95	-0.92	101	86	-0.040	11.90	0.11
70	9.812	0.141	2.00	97	-2.54	100	85	-0.050	8.81	0.49
80	11.230	0.142	2.00	99	-0.93	100	84	-0.060	7.76	0.57
90	12.647	0.142	2.00	100	-2.72	100	84	-0.050	7.84	0.60
100	14.070	0.142	1.99	101	-2.23	100	86	-0.040	6.07	1.16
110	15.490	0.142	1.99	103	-1.89	99	85	-0.040	6.12	1.12
120	16.915	0.143	1.99	103	-2.63	99	84	-0.030	6.11	1.25
130	18.336	0.142	2.00	104	-0.67	99	84	-0.040	5.71	1.47
140	19.763	0.143	2.00	105	-1.42	99	86	-0.050	5.13	1.47
150	21.189	0.143	1.99	105	-2.32	99	86	-0.040	4.70	1.45
160	22.612	0.142	2.00	106	-2.75	98	85	-0.030	4.67	1.58
170	24.041	0.143	1.99	107	-2.71	99	84	-0.030	4.39	1.77
180	25.465	0.142	1.99	107	-1.4	98	86	-0.020	4.42	1.19
190	26.893	0.143	1.98	108	-2.69	98	86	-0.020	3.99	1.22
Avg/Tot	26.893	0.142	1.90	98	-1.89	100	85	-0.044	7.90	0.91

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Pacific Energy

Job #: 18-424

Model: Vista LE

Tracking #: 0006

Run #: 6

Technician: SJB

Date: 8/14/2018

Stove ΔT: 95

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	435	442	493	447	382	439.8	N/A
10	405	410	407	484	374	416.0	N/A
20	381	391	359	567	359	411.4	N/A
30	386	404	358	701	351	440.0	N/A
40	410	435	377	755	345	464.4	N/A
50	436	455	403	727	342	472.6	N/A
60	456	463	427	715	339	480.0	N/A
70	459	464	444	659	340	473.2	N/A
80	449	461	456	584	342	458.4	N/A
90	434	453	449	545	343	444.8	N/A
100	422	445	440	518	339	432.8	N/A
110	407	432	428	479	338	416.8	N/A
120	391	423	417	459	340	406.0	N/A
130	379	416	415	441	341	398.4	N/A
140	368	408	416	426	339	391.4	N/A
150	359	397	409	409	336	382.0	N/A
160	348	386	393	395	335	371.4	N/A
170	339	375	387	385	332	363.6	N/A
180	331	364	370	374	328	353.4	N/A
190	326	352	356	363	328	345.0	N/A
Average	396	419	410	522	344	418	N/A

LAB SAMPLE DATA - ASTM E2515

Client: Pacific Energy
 Model: Vista LE
 Run #: 6

Job #: 18-424
 Tracking #: 0006
 Technician: SJB
 Date: 8/14/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3255	122.2	118.7	3.5
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 3.5

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3256	122.0	121.5	0.5
B. Rear filter catch	Filter	3257	121.2	122.3	-1.1
C. Probe catch*	Probe	12A	116888.7	116888.8	0.0
D. O-Ring catch*	O-Ring	12A	3397.4	3395.4	2.0

Sub-Total Total Particulate, mg: 1.4

Train A Aggregate Total Particulate, mg: **4.9**

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3258	121.9	118.9	3.0
B. Rear filter catch	Filter	3259	122.3	121.4	0.9
C. Probe catch*	Probe	12B	117052.4	117052.6	0.0
D. O-Ring catch*	O-Ring	12B	3424.8	3423.5	1.3

Total Particulate, mg: **5.2**

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3260	121.5	121.5	0.0

Total Particulate, mg: **0.0**

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

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 6 Test Date: 8/14/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Low Air Setting (fixed opening only) – Fan Confirmation Test

Preburn Notes

Preburn Start Time: 8:00

Time	Notes
8:00	Kindling load – 8 lbs.
8:30	With 0.8 lb of kindling remaining, loaded 1 st preburn loaded (4-2"x4"x12" and 4-2"x4"x10"), 8.4 lbs total.
9:05	With 1.6 lbs left, scooped coals, zeroed scale, added coals back in, and loaded second "official" preburn load.
9:26	With 5.5 lbs left, turned air down to test setting.
10:11	Removed 0.2 lbs of coals
10:26	At 2.2 lbs, leveled and raked coals, zeroed scale, in preparation for fuel loading.

Test Notes

Test Burn Start Time: 10:26
 Test Fuel Loaded by: 40 seconds
 Door Closed: 90 seconds
 Air Control Set at: 5 minutes
 Other Loading Notes: Fan Off – Fan Confirmation Test

Time	Notes
60 min	Changed 1-hour filter
190 min	End of Test

Test Burn End Time: 13:36
 Background Filter Volume (ft³): 31.566

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3255	3256	3257	12A	12B	3258	3259	12B	12B	3260
Tare (mg)	118.7	121.5	122.3	116888.8	3395.4	118.9	121.4	117052.6	3423.5	121.5
Final Weight (mg)	122.2	122.0	121.2	116888.7	3397.4	121.9	122.3	117052.4	3424.8	121.5

Sample Train Leak Check: A: 0.001 @ -11 "Hg B: 0.002 @ -11 "Hg AMB: 0.000 @ -12 "Hg

Technician Signature: 

Date: 8/16/2018

ASTM E2780 Wood Heater Run Sheets

Client: Pacific Energy Job Number: 18-424 Tracking #: 0006
 Model: Vista LE Run Number: 6 Test Date: 8/14/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.06 CO (%): 4.25
 Mid Gas CO₂ (%): - CO (%): -

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	9:16	-	9:20	14:00	-	14:05
CO ₂	0.00	-	17.06	0.06	-	16.99
CO	0.000	-	4.250	-0.024	-	4.187

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.030	0.038	0.044	0.032	0.032	0.042	0.048	0.036	0.046
Temp (°F):	109	109	109	109	109	109	109	109	109

Dilution Tunnel Static Pressure (inH₂O): -0.12

Supplemental Data

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

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

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 8/7/2018

	Initial	Middle	Ending
P _b (inHg)	29.76	29.77	29.71
RH (%)	39.0	33.2	31.8

Technician Signature: 

Date: 8/16/2018

Sample Pre-Test Tare Sheet: ☐ Probes☒ Filters☐ O-RingsDate/Time In Desiccator: 3/2/18 - 15:30 Balance ID#: 107 Audit Weight ID# / Weight(mg): 1094 - 100mg

Sample ID	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials	Project/Run #
3201	3/27-9:30	122.6 121.8	4/6-9:00							—
3202		124.6		124.2	4/10-9:00	124.1	—	—	SB	—
3203		118.2		117.5	↓	117.4	—	—	SB	—
3204		121.4		120.8	4/18-8:00	120.7	—	—	SB	—
3205		121.8		121.5	↓	121.5	—	—	SB	—
3206		124.0		123.6	4/23-9:50	123.5	—	—	SB	18-409 #1
3207		118.2		117.5		117.6	—	—	SB	↓
3208		124.7		123.9		124.0	—	—	SB	↓
3209		118.3		117.8		117.7	—	—	SB	↓
3210		121.5		120 121.0	↓	121.1	—	—	SB	↓
3211		121.4		121.4	↓	121.4	—	—	SB	↓
3212		124.3		124.3	—	—	—	—	SB	18-415 #1
3213		121.5		121.3	—	—	—	—	SB	↓
3214		123.7		123.6	—	—	—	—	SB	↓
3215		118.0		118.0	—	—	—	—	SB	↓
3216		124.5		124.4	—	—	—	—	SB	↓
3217		121.1		121.1	—	—	—	—	SB	↓
3218		118.4		118.4	—	—	—	—	SB	18-424 #1 (42)
3219		121.3		121.2	—	—	—	—	SB	↓
3220		118.5		118.6	—	—	—	—	SB	↓
3221		124.1		124.1	—	—	—	—	SB	↓
3222		120.9		120.8	—	—	—	—	SB	↓
3223		117.8		117.6	—	—	—	—	SB	↓
3224		124.1		124.1	—	—	—	—	SB	18-424 #1
3225		121.2		121.0	—	—	—	—	SB	↓
3226		118.0		118.3 117.9	—	—	—	—	SB	↓
3227		124.3		124.4	—	—	—	—	SB	↓
3228		124.4		124.5	—	—	—	—	SB	↓
3229		118.0		117.9	—	—	—	—	SB	↓
3230	↓	121.4	↓	121.5	—	—	—	—	SB	—

Sample Post-Test Analysis Sheet: ☐ Probes☒ Filters☐ O-Rings

Balance ID#: 107 Audit Weight ID# / Weight (mg): 109A / 100mg

Sample ID	Tare (mg)	Date/ Time in Desiccator	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Tech. Initials
3201											
3202											
3203											
3204											
3205											
3206	123.5	4/23-16:45	4/25-8:45	125.2	4/27-9:00	125.2					SB
3207	117.6	↓	↓	122.8	↓	122.5	5/1/20-9:00 122.6	122.6			SB
3208	124.0	↓	↓	124.0	↓	123.9					SB
3209	117.7	↓	↓	124.2	↓	124.3					SB
3210	121.1	↓	↓	121.1	↓	121.0					SB
3211	121.4	↓	↓	121.5	↓	121.4					SB
3212	124.3	7/11-15:30	7/13-8:30	126.0	7/16-8:30	125.9					SB
3213	121.3	↓	↓	127.0	↓	127.0					SB
3214	123.6	↓	↓	123.3	↓	123.3					SB
3215	118.0	↓	↓	125.3	↓	125.2					SB
3216	124.4	↓	↓	124.3	↓	124.3					SB
3217	121.1	↓	↓	121.2	↓	121.2					SB
3218	118.4										SB
3219	121.2										SB
3220	118.6										SB
3221	124.1										SB
3222	120.8										SB
3223	117.6										SB
3224	124.1	8/8-16:15	8/10-10:00	130.4	8/12-21:20	130.3					SB
3225	121.0	↓	↓	124.8	↓	124.8					SB
3226	117.9	↓	↓	118.8	↓	118.6					SB
3227	124.4	↓	↓	133.5	↓	133.6					SB
3228	124.5	↓	↓	125.1	↓	125.1					SB
3229	117.9	↓	↓	118.0	↓	118.0					SB
3230											SB

Sample Pre-Test Tare Sheet: ☐ Probes☒ Filters☐ O-RingsDate/Time In Desiccator: 7/24/18 - 10:30 Balance ID#: 107 Audit Weight ID# / Weight(mg): 109A - 100mg

Sample ID	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials	Project/Run #
3231	8/1/18-12:30	124.2	8/8/18-14:45	124.3	-	-	-	-	SB	18-424 #2
3232		118.4		118.2	-	-	-	-	SB	
3233		121.5		121.4	8/9/18-7:00	121.6	-	-	SB	
3234		124.5		124.3	-	-	-	-	SB	
3235		118.3		118.2	-	-	-	-	SB	
3236		122.0		121.7	8/9/18-7:00	121.9	-	-	SB	
3237		124.3		124.2	-	-	-	-	SB	18-424 #3
3238		118.9		118.8	-	-	-	-	SB	
3239		121.3		121.3	-	-	-	-	SB	
3240		124.1		124.0	-	-	-	-	SB	
3241		118.4		118.4	-	-	-	-	SB	
3242		121.6		121.5	-	-	-	-	SB	
3243		124.0	8/9/18-7:00	124.0	-	-	-	-	SB	18-424 #4
3244		117.4		117.4	-	-	-	-	SB	
3245		121.6		121.7	-	-	-	-	SB	
3246		124.1		124.1	-	-	-	-	SB	
3247		118.6		118.7	-	-	-	-	SB	
3248		121.1		121.1	-	-	-	-	SB	
3249		121.5		121.6	-	-	-	-	SB	18-424 #5
3250		118.2		118.1	-	-	-	-	SB	
3251	8/7/18-13:00	122.4		122.5	-	-	-	-	SB	
3252		118.5		118.6	-	-	-	-	SB	
3253		121.0		121.0	-	-	-	-	SB	
3254		121.8		122.0	-	-	-	-	SB	
3255		118.7	8/10-12:00	118.7	-	-	-	-	SB	18-424 #6
3256		121.5		121.5	-	-	-	-	SB	
3257		122.4		122.3	-	-	-	-	SB	
3258		118.9		118.9	-	-	-	-	SB	
3259		121.5		121.4	-	-	-	-	SB	
3260		121.4		121.5	-	-	-	-	SB	

Sample Post-Test Analysis Sheet: ☐ Probes☒ Filters☐ O-Rings

Balance ID#: 107 Audit Weight ID# / Weight (mg): 101A - 10 mg

Sample ID	Tare (mg)	Date/ Time in Desiccator	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Tech. Initials
3231	124.3	8/9 - 10:40	8/12/18-21:20	126.6	8/13/18-9:00	126.6					SB
3232	118.2			119.6		119.6					SB
3233	121.6			121.5		121.6					SB
3234	124.3			127.7		127.7					SB
3235	118.2			118.5		118.5					SB
3236	121.9			122.0		122.0					SB
3237	124.2	8/9 - 16:00		125.1		125.0					SB
3238	118.8			119.7		119.7					SB
3239	121.3			121.1		121.1					SB
3240	124.0			125.2		125.2					SB
3241	118.4			118.2		118.1					SB
3242	121.5			121.5		121.5					SB
3243	124.0	8/10 - 16:15		126.3		126.2					SB
3244	117.4			118.1		118.2					SB
3245	121.7			121.5		121.4					SB
3246	124.1			126.3		126.3					SB
3247	118.7			118.7		118.5					SB
3248	121.1			121.1		121.1					SB
3249	121.6	8/13 - 9:30	8/14/18-12:00	123.7	8/16/18-8:00	123.7					SB
3250	118.1			119.1		119.1					SB
3251	122.5			122.6		122.5					SB
3252	118.6			120.8		120.8					SB
3253	121.0			121.1		121.1					SB
3254	122.0			122.1		122.1					SB
3255	118.7	8/14 - 14:00	8/16 - 8:00	122.2	8/16 - 15:3	122.2					SB
3256	121.5			121.9		122.0					SB
3257	122.3			121.2		121.2					SB
3258	118.9			121.8		121.9					SB
3259	121.4			122.2		122.3					SB
3260	121.5			121.5		121.5					SB

Sample Pre-Test Tare Sheet: ☒ Probes☐ Filters☐ O-RingsDate/Time In Desiccator: 4/2/18-10:00 Balance ID#: 107 Audit Weight ID# / Weight(mg): 109-A / 100 mg

Sample ID	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials	Project/Run #
1A	4/17-14:00	115626.3	4/23-9:45	115626.7					SB	18-409 #1
1B		115901.3	↓	115901.4					SB	↓
2A		116237.4	6/22/18-14:33	116237.5	-	-	-	-	SB	18-414 #1
2B		116328.3		116328.5	-	-	-	-	SB	↓
3A		116072.5		116073.2	6/23/18-7:30	116073.0	-	-	SB	18-410 #2
3B		116340.1		116340.5		116340.3	-	-	SB	↓
4A		116182.5		116183.2		116183.1	-	-	SB	18-414 #3
4B		116365.1	↓	116365.9		116365.8	-	-	SB	↓
5A		116769.6	7/11/18-8:00	116769.6	-	-	-	-	SB	18-415 #1
5B		116565.0	7/10/18-10:22	116880.3	-	-	-	-	SB	↓
6A		116565.0	7/31/18-11:30	116564.9	-	-	-	-	SB	18-424 #1 RHD
6B		116117.2		116117.3	-	-	-	-	SB	↓
7A		116739.9		116740.0	-	-	-	-	SB	18-424 #1
7B		117304.5		117304.6	-	-	-	-	SB	18-424 #1
8A		116829.6		116829.7	-	-	-	-	SB	18-424 #2
8B		116825.2		116825.3	-	-	-	-	SB	18-424 #2
9A		116720.6		116720.5	-	-	-	-	SB	18-424 #3
9B		117135.4		117135.4	-	-	-	-	SB	18-424 #3
10A		116826.4		116826.4	-	-	-	-	SB	18-424 #4
10B		117167.5	↓	117167.6	-	-	-	-	SB	18-424 #4
11A		117034.8	8/10-9:45	117034.7	-	-	-	-	SB	18-424 #5
11B		116674.0	↓	116673.9	-	-	-	-	SB	18-424 #5
12A	8/10-9:45	116888.7	8/14-7:00	116888.8	-	-	-	-	SB	18-424 #6
12B	8/10-9:45	117052.7	8/14-7:00	117052.6	-	-	-	-	SB	18-424 #6
13A										
13B										
14A										
14B										

Sample Post-Test Analysis Sheet: ☒ Probes☐ Filters☐ O-RingsBalance ID#: 107 Audit Weight ID# / Weight (mg): _____

Sample ID	Tare (mg)	Date/Time in Desiccator	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials
1A	115626.7	4/23-16:45	4/25-8:45	115626.6	4/27-9:46	115626.7	-	-	-	-	SB
1B	115901.4	↓	↓	115901.6	4/27-9:46	115901.6	-	-	-	-	SB
2A	116237.5	6/25-11:30	6/26-13:00	116238.5	6/27-10:00	116238.0	6/28-7:00	116237.9	-	-	SB
2B	116328.5	6/25-11:30	6/26-13:00	116329.8	6/27-10:00	116329.1	6/28-7:00	116328.9	-	-	SB
3A	116073.0	6/26-20:00	6/28-7:00	116073.3	6/29-6:30	116073.4	-	-	-	-	SB
3B	116340.3	6/26-20:00	6/28-7:00	116341.0	6/29-6:30	116340.8	-	-	-	-	SB
4A	116183.1	6/27-19:00	6/29-6:30	116183.2	6/29-16:00	116183.3	-	-	-	-	SB
4B	116365.8	6/27-19:00	6/29-6:30	116365.9	6/29-16:00	116366.0	-	-	-	-	SB
5A	116769.6	7/11-15:30	7/13-8:30	116770.2	7/16-8:30	116770.1	-	-	-	-	SB
5B	116880.3	7/11-15:30	↓	116880.8	7/16-8:30	116880.3	7/17-8:00	116880.3	-	-	SB
6A	116564.9										SB
6B	116117.3										SB
7A	116740.0	8/8-16:15	8/10-10:00	116740.6	8/12-21:20	116740.1					SB
7B	117304.6	8/8-16:15	8/10-10:00	117304.6	8/12-21:20	117304.5					SB
8A	116829.7	8/9-10:45	8/12-21:20	116829.8	8/13-9:00	116829.6					SB
8B	116825.3	8/9-10:45	↓	116825.4	↓	116825.4					SB
9A	116720.5	8/9-16:00		116720.6		116720.5					SB
9B	117135.4	8/9-16:00		117135.3		117135.5					SB
10A	116826.4	8/10-14:15	↓	116826.4	↓	116826.4					SB
10B	117167.6	8/10-14:15	↓	117167.4	↓	117167.5					SB
11A	117034.7	8/13-9:30	8/14-7:00	117035.0	8/16-8:00	117035.0					SB
11B	116677.9	8/13-9:30	8/14-7:00	116674.2	8/16-8:00	116674.3					SB
12A	116888.8	8/14-14:00	8/16-8:00	116888.6	8/16-15:30	116888.7					SB
12B	117052.6	8/14-14:00	8/16-8:00	117052.4	8/16-15:30	117052.4					SB
13A											
13B											
14A											
14B											

Sample Pre-Test Tare Sheet: ☐ Probes☐ Filters☒ O-RingsDate/Time In Desiccator: 4/17/18-12:00 Balance ID#: 107 Audit Weight ID# / Weight(mg): 109B/200mg

Sample ID	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials	Project/Run #
1A	4/17/18-14:00	3550.0	4/23/18-9:00	3550.1	-	-	-	-	SB	18-409 #1
1B		3561.0	↓	3561.2	-	-	-	-	SB	↓
2A		3547.2	6/20/18-11:15	3550.6	6/22/18-12:10	3550.5	-	-	SB	18-414 #1
2B		3565.8		3569.2		3569.2	-	-	SB	↓
3A		3574.7		3578.0		3577.9	-	-	SB	18-414 #2
3B		3563.0		3566.3		3566.2	-	-	SB	↓
4A		3587.9		3591.4		3591.4	-	-	SB	18-414 #3
4B		3576.4		3579.5		3579.5	-	-	SB	↓
5A		3525.8		3528.9	7/11/18-8:00	3529.0	-	-	SB	18-415 #1
5B		3529.4		3532.7	↓	3532.8	-	-	SB	18-415 #1
6A		3442.3		3455.9	7/31/18-2:00	3457.0	8/1/18-13:00	3457.1	SB	18-424 #1 R.D
6B		3549.1		3552.2		3553.1		3553.1	SB	18-424 #1 R.D
7A		3569.6		3572.5		3573.7		3573.5	SB	18-424 #1
7B		3516.8		3520.0		3521.1		3521.1	SB	18-424 #1
8A	7/31/18-2:00	3550.3	8/1/18-13:00	3550.1	-	-	-	-	SB	18-424 #2
8B		3583.6		3583.7	-	-	-	-	SB	18-424 #2
9A		3580.2		3580.3	-	-	-	-	SB	18-424 #3
9B		3522.9		3523.0	-	-	-	-	SB	18-424 #3
10A		3430.4		3430.5	-	-	-	-	SB	18-424 #4
10B		3569.1		3569.2	-	-	-	-	SB	18-424 #4
11A		3414.7	8/10/18-9:45	3414.9	-	-	-	-	SB	18-424 #5
11B		4227.1	8/10/18-9:45	4227.2	-	-	-	-	SB	18-424 #5
12A		3395.3	8/14/18-7:00	3395.4	-	-	-	-	SB	18-424 #6
12B		3423.5	8/14/18-7:00	3423.5	-	-	-	-	SB	18-424 #6
13A										
13B										
14A										
14B										

Sample Post-Test Analysis Sheet: ☐ Probes☐ Filters☒ O-RingsBalance ID#: 107 Audit Weight ID# / Weight (mg): _____

Sample ID	Tare (mg)	Date/ Time in Desiccator	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Tech. Initials
1A	3550.1	4/23-16:45	4/25-8:45	3550.8	4/27-9:00	3550.8					JB
1B	3561.2	↓	↓	3562.1	↓	3562.1					JB
2A	3550.5	6/25-11:30	6/26-13:00	3552.1	6/27-10:00	3551.5	6/28-7:00	3551.6	-	-	JB
2B	3569.2	6/25-11:30	6/26-13:00	3570.0	6/27-10:00	3569.7	6/28-7:00	3569.6	-	-	JB
3A	3577.9	6/26-20:00	6/28-7:00	3578.4	6/29-6:30	3578.5	-	-	-	-	JB
3B	3566.2	6/26-20:00	6/28-7:00	3567.3	6/29-6:30	3567.3	-	-	-	-	JB
4A	3591.4	6/27-14:00	6/29-6:30	3591.7	6/29-16:00	3591.3	-	-	-	-	JB
4B	3579.5	6/27-14:00	6/29-6:30	3580.0	6/29-16:00	3580.1	-	-	-	-	JB
5A	3529.0	7/11-15:30	7/13-8:30	3530.2	7/16-8:30	3530.2	-	-	-	-	JB
5B	3532.8	7/11-15:30	7/13-8:30	3534.1	7/16-8:30	3533.9	-	-	-	-	JB
6A	3457.1										JB
6B	3553.1										JB
7A	3573.5	8/8-16:15	8/10-10:00	3573.5	8/12-21:20	3573.6					JB
7B	3521.1	8/8-16:15	8/10-10:00	3521.9	8/12-21:20	3521.8					JB
8A	3550.1	8/9-10:45	8/12-21:20	3551.1	8/13-9:00	3551.0					JB
8B	3583.7	8/9-10:45	↓	3584.5	↓	3584.7					JB
9A	3580.3	8/9-16:00	↓	3581.1	↓	3581.2					JB
9B	3523.0	8/9-16:00	↓	3530.0	↓	3523.9					JB
10A	3430.5	8/10-14:15	↓	3431.1	↓	3431.1					JB
10B	3569.2	8/10-14:15	↓	3570.2	↓	3570.1					JB
11A	3414.9	8/13-9:30	8/14/18-7:00	3416.1	8/16-8:00	3416.0					JB
11B	4227.2	8/13-9:30	8/14/18-7:00	4228.3	8/16-8:00	4228.4					JB
12A	3395.4	8/14-14:00	8/16-8:00	3397.2	8/16-15:30	3397.4					JB
12B	3423.5	8/14-14:00	8/16-8:00	3424.9	8/16-15:30	3424.8					JB
13A											
13B											
14A											
14B											

EPA Method 28R Weighted Average Emissions

Client: Pacific Energy
 Stove Model: Vista LE
 Test Dates: 8/8/18 - 8/14/18
 Job Number: 18-424

Signature/Date: 

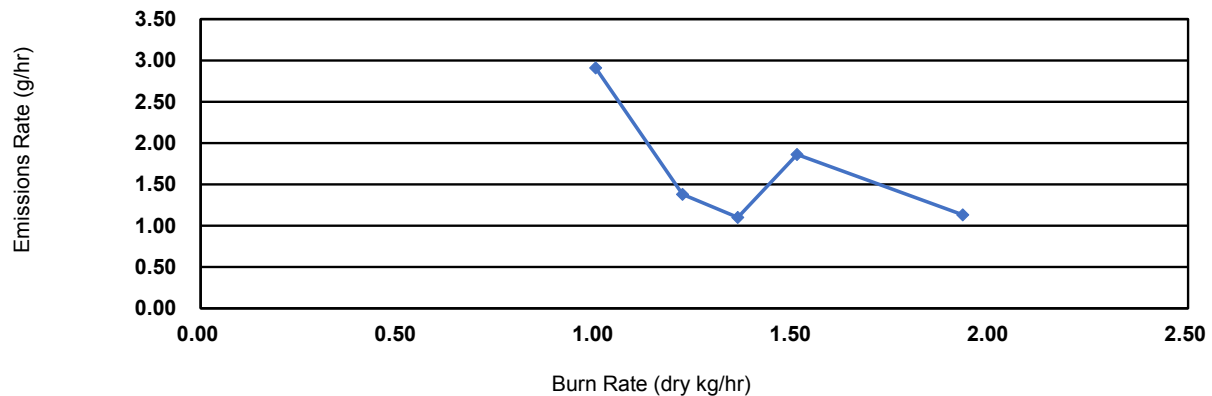
8/16/2018

Weighted Average Particulate Emissions (g/hr):	1.9
Weighted Average HHV Efficiency (%):	72.3%
Weighted Average LHV Efficiency (%):	78.2%
Average CO Emissions (g/min):	1.4

Individual Run Summaries

Run Number:	1	Run Number:	5
Burn Rate (dry kg/hr):	1.00	Burn Rate (dry kg/hr):	1.22
Emissions Rate (g/hr):	2.91	Emissions Rate (g/hr):	1.38
HHV Efficiency (%):	73.0%	HHV Efficiency (%):	74.6%
LHV Efficiency (%):	78.9%	LHV Efficiency (%):	80.7%
Weighting Percentage (%):	36.72%	Weighting Percentage (%):	18.55%
Run Number:	4	Run Number:	2
Burn Rate (dry kg/hr):	1.36	Burn Rate (dry kg/hr):	1.51
Emissions Rate (g/hr):	1.10	Emissions Rate (g/hr):	1.86
HHV Efficiency (%):	74.1%	HHV Efficiency (%):	73.9%
LHV Efficiency (%):	80.1%	LHV Efficiency (%):	79.8%
Weighting Percentage (%):	12.95%	Weighting Percentage (%):	15.73%
Run Number:	3		
Burn Rate (dry kg/hr):	1.93		
Emissions Rate (g/hr):	1.13		
HHV Efficiency (%):	65.0%		
LHV Efficiency (%):	70.3%		
Weighting Percentage (%):	16.05%		

Emission Rate vs Burn Rate Plot





QUALITY CONTROL SERVICES

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PFS Teco
 11785 SE Hwy 212 STE#305
 Clackamas, OR 97015

Report Number: DIRI01A05026180111

A2LA ACCREDITED **CERTIFICATE OF CALIBRATION WITH DATA**

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Rice Lake	IQ+355E-2A x 1000	A05026	N/A	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	1	QC033	1/11/18	6/27/17	6/2018

FUNCTIONAL CHECKS

SHIFT TEST	LINEARITY	REPEATABILITY	ENVIRONMENTAL CONDITIONS
Test Wt: 250 Tol: 1	Test Wt: HB44 Tol: HB44	Test Wt: 100 Tol: 1	
As-Found: Pass: ☒ Fail: ☐	As-Found: Pass: ☒ Fail: ☐	As-Found: Pass: ☒ Fail: ☐	☐ Good ☒ Fair ☐ Poor
As-Left: Pass: ☒ Fail: ☐	As-Left: Pass: ☒ Fail: ☐	As-Left: Pass: ☒ Fail: ☐	Temperature: 17.7°C

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
1000	1000.1	1000.1	0.5
700	700.3	700.3	0.5
500	499.8	499.8	0.5
300	300.0	300.0	0.5
100	100.0	100.0	0.5
50	50.0	50.0	0.5

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Avoirdupois Cast W	Rice Lake	25 and 50lb	PWO990-CA	11/24/17	11/2019	20172265

Permanent Information Concerning this Equipment:

2000lbs platform. Has a custom pan.

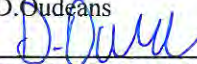
Comments/Information Concerning this Calibration

1/18 RH = 58.5

Report prepared/reviewed by: 

Date: 1-11-18

Technician: D. Oudeans

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.



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PFS Teco
11785 SE Hwy 212 STE#305
Clackamas, OR 97015

Report Number: DIRI0182484A0912013i180613

A2LA ACCREDITED **CERTIFICATE OF CALIBRATION WITH DATA**

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Digiweigh	DWP12i 400x.01	82484A0912013i	#050	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	0.01	QC033	6/13/18	1/11/18	12/2018

FUNCTIONAL CHECKS

SHIFT TEST	LINEARITY	REPEATABILITY	ENVIRONMENTAL CONDITIONS
Test Wt: 50 Tol: 0.05	Test Wt: HB44 Tol: HB44	Test Wt: 50 Tol: 0.01	
As-Found: Pass: ☒ Fail: ☐	As-Found: Pass: ☒ Fail: ☐	As-Found: Pass: ☒ Fail: ☐	☐ ☒ ☐ Good Fair Poor
As-Left: Pass: ☒ Fail: ☐	As-Left: Pass: ☒ Fail: ☐	As-Left: Pass: ☒ Fail: ☐	Temperature: 22.2°C

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
400	399.98	399.98	0.058
300	300.00	300.00	0.058
200	200.00	200.00	0.058
100	100.00	100.00	0.012
50	50.00	50.00	0.012
20	20.00	20.00	0.012

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Avoirdupois Cast W	Rice Lake	25 and 50lb	PWO990-CA	11/24/17	11/2019	20172265
Weight Set	Rice Lake	.001 to 10lb	PW0990	9/23/16	9/2018	20161896

Permanent Information Concerning this Equipment:

6 month calibration cycle. Relative humidity= 56%.

Comments/Information Concerning this Calibration

Report prepared/reviewed by: Jake C

Date: 6/13/18

Technician: J. Colacchio

Signature: [Signature]

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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.

Dry Gas Meter Calibration

Meter Manufacturer: Apex
 Model: XC-60-ED
 Lab ID #: 053
 Serial #: 1902130
 Calibration Date: 6/13/2018
 Calibration Expiration: 12/13/2018
 Barometric Pressure: 29.84 in. Hg



Reference Standard DGM	
Manufacturer:	Apex
Model:	SK25DA
Lab ID#:	047
Serial #:	1101001
Calibration Expiration Date:	3/5/2019
Calibration γ Factor:	0.998

Unit Under Test Previous Calibration	
Date	1/10/2018
γ Factor:	0.995
Allowable Deviation ($\pm 5\%$):	0.04975
Actual Deviation:	0.01
Result:	PASS

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	144.977	146.222	201.016
Standard DGM Temperature ($^{\circ}\text{F}$)	73.2	73.0	72.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	5.194	5.278	7.307
DGM Temperature ($^{\circ}\text{F}$)	84.0	90.0	94.0
DGM Pressure (in H_2O)	2.10	2.58	1.4
Time (min)	36.0	32.0	60.0
Net Volume for Standard DGM (ft^3)	5.120	5.164	7.099
Net Volume for DGM (ft^3)	5.194	5.278	7.307

Dry Gas Meter γ Factor	0.999	1.001	1.006
γ Factor Deviation From Average	0.999	1.001	1.006

Average Gas Meter γ Factor

1.002

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{\text{std}} \times (\gamma_{\text{std}}) \times (P_{\text{bar}} + P_{\text{std}}/13.6) \times (T_{\text{DGM}} + 460)] / [V_{\text{DGM}} \times (T_{\text{std}} + 460) \times (P_{\text{bar}} + P_{\text{DGM}}/13.6)]$

Standard Reference Meter is calibrated to NIST traceable standards. Uncertainty of measurement is $\pm 0.5\%$.

Dry Gas Meter Calibration

Meter Manufacturer: Apex
 Model: XC-60-ED
 Lab ID #: 054
 Serial #: 1902133
 Calibration Date: 6/13/2018
 Calibration Expiration: 12/13/2018
 Barometric Pressure: 29.84 in. Hg



Reference Standard DGM	
Manufacturer:	Apex
Model:	SK25DA
Lab ID#:	047
Serial #:	1101001
Calibration Expiration Date:	3/5/2019
Calibration γ Factor:	0.998

Unit Under Test Previous Calibration	
Date	1/11/2018
γ Factor:	1.000
Allowable Deviation ($\pm 5\%$):	0.05
Actual Deviation:	0.00
Result:	PASS

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	158.715	148.505	236.136
Standard DGM Temperature ($^{\circ}\text{F}$)	72.5	73.2	73.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	5.777	5.426	8.616
DGM Temperature ($^{\circ}\text{F}$)	93.5	94.0	90.0
DGM Pressure (in H_2O)	2.50	2.00	1.5
Time (min)	37.0	38.5	71.5
Net Volume for Standard DGM (ft^3)	5.605	5.244	8.339
Net Volume for DGM (ft^3)	5.777	5.426	8.616
Dry Gas Meter γ Factor	1.000	0.997	0.993
γ Factor Deviation From Average	1.000	0.997	0.993

Average Gas Meter γ Factor

0.997

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{\text{std}} \times (\gamma_{\text{std}}) \times (P_{\text{bar}} + P_{\text{std}}/13.6) \times (T_{\text{DGM}} + 460)] / [V_{\text{DGM}} \times (T_{\text{std}} + 460) \times (P_{\text{bar}} + P_{\text{DGM}}/13.6)]$

Standard Reference Meter is calibrated to NIST traceable standards. Uncertainty of measurement is $\pm 0.5\%$.

Dry Gas Meter Calibration

Meter Manufacturer: Apex
 Model: Apex-AK-600
 Lab ID #: 055
 Serial #: 810016
 Calibration Date: 6/15/2018
 Calibration Expiration: 6/15/2019
 Barometric Pressure: 29.83 in. Hg



Reference Standard DGM	
Manufacturer:	Apex
Model:	SK25DA
Lab ID#:	047
Serial #:	1101001
Calibration Expiration Date:	3/5/2019
Calibration γ Factor:	0.998

Unit Under Test Previous Calibration	
Date	1/18/2017
γ Factor:	0.997
Allowable Deviation ($\pm 5\%$):	0.04985
Actual Deviation:	0.00
Result:	PASS

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	145.479	148.058	143.802
Standard DGM Temperature ($^{\circ}\text{F}$)	71.0	71.0	71.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	5.146	5.254	5.114
DGM Temperature ($^{\circ}\text{F}$)	75.0	76.5	77.5
DGM Pressure (in H_2O)	1.80	1.80	1.8
Time (min)			
Net Volume for Standard DGM (ft^3)	5.138	5.229	5.078
Net Volume for DGM (ft^3)	5.146	5.254	5.114

Dry Gas Meter γ Factor	0.999	0.999	0.999
γ Factor Deviation From Average	0.999	0.999	0.999

Average Gas Meter γ Factor

0.999

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{\text{std}} \times (\gamma_{\text{std}}) \times (P_{\text{bar}} + P_{\text{std}}/13.6) \times (T_{\text{DGM}} + 460)] / [V_{\text{DGM}} \times (T_{\text{std}} + 460) \times (P_{\text{bar}} + P_{\text{DGM}}/13.6)]$

Standard Reference Meter is calibrated to NIST traceable standards. Uncertainty of measurement is $\pm 0.5\%$.



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Report of Calibration

Firm: Dirigo Laboratories
Address: 11785 SE Hwy 212, Ste 305
City/State/Zip: Clackamas, OR 97015

Test Completed: 03/21/17
Submitted By: John Steiner
Traceable Number: 20170468

Test Item: 200mg and 100mg Individual Weights
Serial No.: Listed in Table

Manufacturer: Troemner

<u>Material</u>	<u>Assumed Density</u>	<u>Range</u>	<u>Tolerance Class</u>
Stainless Steel	7.95 g/cm ³	200mg & 100mg	ASTM Class 1

Method and Traceability

The procedure used for this calibration is NIST IR 6969 SOP 4 Double Substitution Weighing Design. Standards used for comparison are traceable to the National Institute of Standards and Technology (reports on file) and are part of a comprehensive measurement assurance program for ensuring continued accuracy and traceability within the level of uncertainty reported. The Traceable Number listed above is Traceable to National Standards through an unbroken chain of comparison each having stated uncertainties.

Standards Used:

100g to 1mg Working Standards Were Calibrated: 03/03/17 Due: 03/31/18 Standards ID: 723318

Mass Comparators Used: MET-05

Tested by: D. Thompson

Conventional Mass: "The conventional value of the result of weighing a body in air is equal to the mass of a standard, of conventionally chosen density, at a conventionally chosen temperature, which balances this body at this reference temperature in air of conventionally chosen density. International Recommendation 33 (OIML IR 33 1973, 1979). "Conventional Value of the Result of Weighing in Air" (Previously known as "Apparent Mass vs. 8.0g/cm³).

Uncertainty Statement: The uncertainty conforms to the ISO Guide to the Expressions of Uncertainty in Measurement. Uncertainty as reported is based on a coverage factor $k=2$ for an approximate 95 percent level of uncertainty. Uncertainty components include the standard deviation of the process, the uncertainty of the standard used, an uncertainty component associated with the potential drift of the standard used, and the estimated uncertainty related to measuring and determining the air buoyancy effect.

Conventional Mass Values are listed on page 2 of this report.

page 1 of 2

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 03/21/17

Signature David S. Thompson

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Member: National Conference of Standards Laboratories and Weights & Measures



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Report of Calibration

Firm: Dirigo Laboratories
Address: 11785 SE Hwy 212, Ste 305
City/State/Zip: Clackamas, OR 97015

Test Completed: 03/21/17
Submitted By: John Steiner
Traceable Number: 20170468

Test Item: 200mg and 100mg Individual Weights
Serial No.: Listed in Table

Manufacturer: Troemner

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
21.967	753.44	49.44

Conventional Mass Value

Nominal Value	As Found grams	As Found Correction* (mg)	Uncertainty (mg)	Tolerance (mg)
200mg SN 1000101395	0.2000061	0.0061	0.0026	0.01
100mg SN 1000126267	0.1000046	0.0046	0.0028	0.01

*Correction is the difference between the conventional mass value of a weight and its nominal value.

Comments: These weights were new from the manufacturer and were within ASTM Class 1 tolerances As Found. No adjustments or changes were made so As Found values should be considered to be As Left values.

Accredited by the American Association for Laboratory Accreditation (A2LA) under Calibration Laboratory Code 115953 and Certificate Number 1550.01. This laboratory meets the requirements of ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration.

page 2 of 2

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 03/21/17

Signature David S. Thompson



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Report of Calibration

Firm: Dirigo Laboratories
Address: 11785 SE Hwy 212, Ste 305
City/State/Zip: Clackamas, OR 97015

Test Completed: 01/15/16
Purchase Order: 1001
Traceable Number: 20152489

Test Item: 20lb and 10lb Individual Grip Handle Weights
Serial No.: Listed in Table

Manufacturer: Unknown

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
21.448	760.64	44.58

Conventional Mass Value

Nominal Value	As Found pounds	As Found Correction* (mg)	Uncertainty (mg)	Tolerance (mg)
20lb #098	19.9995450	-206.4	6.4	910
10lb #097	10.0006510	295.3	5.1	450
10lb #051	10.0003421	155.2	5.1	450

*Correction is the difference between the conventional mass value of a weight and its nominal value.

Comments: These weights were received in good condition and were within NIST Handbook 105-1 Class F tolerances As Found. No adjustments or changes were made so As Found values should be considered to be As Left values.

Accredited by the American Association for Laboratory Accreditation (A2LA) under Calibration Laboratory Code 115953 and Certificate Number 1550.01. This laboratory meets the requirements of ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration.

page 2 of 2

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 01/15/16

Signature David S. Thompson



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PFS Teco
 11785 SE Hwy 212 STE#305
 Clackamas, OR 97015

Report Number: DIRI0134307497180613

A2LA ACCREDITED **CERTIFICATE OF CALIBRATION WITH DATA**

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Balance	Sartorius	ENTRIS224-1S	34307497	#107	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
g	0.0001	QC012	6/13/18	1/11/18	12/2018

FUNCTIONAL CHECKS

ECCENTRICITY		LINEARITY		STANDARD DEVIATION			ENVIRONMENTAL CONDITIONS
Test Wt:	Tol:	Test Wt:	Tol:	Test Wt:	Tol:		
100	0.0003	50 x 4	0.0002	100	0.0001		☐ ☒ ☐
As-Found:		As-Found:		1.100.0000	5.100.0001	9.100.0001	Good Fair Poor
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	2.100.0000	6.100.0001	10.100.0001	
As-Left:		As-Left:		3.100.0000	7.100.0001	Result	Temperature: 22.8°C
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	4.100.0000	8.100.0001	0.00005	

A2LA ACCREDITED SECTION OF REPORT

Standard	As-Found	As-Left	Expanded Uncertainty
200	199.9980	200.0000	0.00015
100	99.9991	100.0000	0.00015
50	49.9995	50.0001	0.00015
20	19.9998	20.0000	0.00015
1	1.0000	1.0000	0.00015
0.1	0.1000	0.1000	0.00015

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	Rice Lake	20 kg to 1mg	2831W	1/3/18	1/2019	20152429

Permanent Information Concerning this Equipment:

6 month calibration cycle. Relative humidity= 47%

Comments/Info Concerning this Calibration:

6/13/18: Adjusted span.

Report prepared/reviewed by: Jake C

Date: 6/13/18

Technician: J. Colacchio

Signature: [Signature]

THIS CERTIFICATE SHALL NOT BE REPRODUCED 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 and readability 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. Calibrations comply with ISO/IEC 17025 and ANSI/Z540-1-1994 quality standards.

NIST Traceable Calibration Report



Reference Number: 1200788
PO Number: JSTEINERT013118

PFS-TECO
11785 SE Highway 212
Suite 305

Clackamas, OR 97015 United States

Manufacturer: Dwyer Instruments Inc.
Model Number: 471
Description: Air Velocity, Digital Thermo Anemometer
Asset Number: #095
Serial Number: #095
Procedure: DS Universal Speed/Time/Temperature

Calibration Date: 02/14/2018
Calibration Due Date: 02/14/2019
Condition As Found: Limited In Tol See Comments
Condition As Left: Limited See Comments

Remarks:

NIST-traceable calibration performed on the unit referenced above in accordance with customer requirements, published specifications and the lab's standard operating procedures. No adjustments were made to the unit.

This calibration is considered limited due to the requested test range.

Standards Utilized

Asset No.	Manufacturer	Model No.	Description	Cal. Date	Due Date
CP105979	Kanomax	X5602	Air Velocity, Wind Tunnel, Open Jet	01/06/2018	01/31/2019
CP144554	Fluke Corporation	1551A EX	Temperature, Stik Thermometer	01/08/2018	01/31/2019

Calibration Data

FUNCTION TESTED	Nominal Value	As Found	Out of Tol	As Left	Out of Tol	CALIBRATION TOLERANCE
Speed Accuracy Air Velocity	50 ft/min	43		Same		35 to 65 ft/min [EMU 1.3 ft/min][TUR 12:1]
Speed Accuracy Air Velocity	100 ft/min	90		Same		85 to 115 ft/min [EMU 1.5 ft/min][TUR 9.8:1]
Speed Accuracy Air Velocity	150 ft/min	140		Same		135 to 165 ft/min [EMU 1.8 ft/min][TUR 8.3:1]
Speed Accuracy Air Velocity	200 ft/min	192		Same		185 to 215 ft/min [EMU 2.1 ft/min][TUR 7.1:1]
Speed Accuracy Air Velocity	250 ft/min	240		Same		235 to 265 ft/min [EMU 2.4 ft/min][TUR 6.2:1]
Speed Accuracy Air Velocity	300 ft/min	288		Same		285 to 315 ft/min [EMU 2.7 ft/min][TUR 5.6:1]
Speed Accuracy Air Velocity	400 ft/min	395		Same		385 to 415 ft/min [EMU 3.3 ft/min][TUR 4.5:1]
Speed Accuracy Air Velocity	500 ft/min	485		Same		485 to 515 ft/min [EMU 3.9 ft/min][TUR 3.8:1]
Temperature Accuracy	72.0 °F	71.9		Same		70.0 to 74.0 °F [EMU 0.11 °F][TUR 18:1]

Temperature: 23° C
Humidity: 20% RH
Rpt. No.: 1375092

Calibration Performed By:				Quality Reviewer:	
Mathews, Rich	314	Metrologist	847-327-5314	Szplit, Tony	02/14/2018
Name	ID #	Title	Phone	Name	Date

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Model 1430 Microtector® Electronic Point Gage

Installation and Operating Instructions



Model 1430 Microtector® Portable Electronic Point Gage combines modern, solid-state integrated circuit electronics with a time-proven point gage manometer to provide fast, accurate pressure measurements.

SPECIFICATIONS AND FEATURES

- Accurate and repeatable to $\pm .00025$ inches water column
- Pressure range: 0 - 2" w.c., positive, negative, or differential pressures
- Non-toxic and inexpensive gage fluid consists of distilled water mixed with a small amount of fluorescein green color concentrate
- Convenient, portable, lightweight and self-contained, the unit requires no external power connections and is operated by a 1.5 volt penlight cell
- A.C. detector current eliminates point plating, fouling and erosion
- Micrometers are manufactured in accordance with ASME B89.1.13-2001, and are traceable to a standard at the National Institute of Standards and Technology

- Three-point mounting, dual leveling adjustment, and circular level vial assure rapid setup
- Durablock® precision-machined acrylic plastic gage body
- Sensitive 0 - 50 microamp D.C. meter acts as a detector and also indicates battery and probe condition
- Heavy 2" thick steel base plate provides steady mounting
- Top-quality glass epoxy circuit board and solid-state, integrated circuit electronics
- Electronic enclosure of tough, molded styrene acrylonitrile provides maximum protection to components yet allows easy access to battery compartment
- Rugged sheet steel cover and carrying case protects the entire unit when not in use
- Accessories included are (2) 3-foot lengths Tygon® tubing, (2) 1/8" pipe thread adapters and 3/4 oz. bottle of fluorescein green color concentrate with wetting agent

Maximum pressure: 100 psig with optional pipe thread connections.

Tygon® is a registered trademark of Saint-Gobain Corporation

DWYER INSTRUMENTS, INC.

P.O. BOX 373

MICHIGAN CITY, INDIANA 46361, U.S.A

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Praxair
5700 South Alameda Street
Los Angeles, CA 90058
Tel: (323) 585-2154 Fax: (714) 542-6689
PGVPID: F22017

DocNumber: 000104677

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information:

PXPKG TUALATIN OR H
10450 SW TUALATIN SHERWOOD
TUALATIN OR 97062

Praxair Order Number: 70187071
Customer P. O. Number
Customer Reference Number:

Fill Date: 1/24/2017
Part Number: NI CD17CO8E-AS
Lot Number: 109702413
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure & Volume: 2000 psig 140 cu. ft.

Certified Concentration:

Expiration Date:	2/22/2025	NIST Traceable
Cylinder Number:	CC144992	Analytical Uncertainty:
17.06 %	CARBON DIOXIDE	± 0.3 %
4.25 %	CARBON MONOXIDE	± 0.6 %
17.02 %	OXYGEN	± 0.1 %
Balance	NITROGEN	

Certification Information: Certification Date: 2/22/2017 Term: 96 Months Expiration Date: 2/22/2025

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Do Not Use this Standard if Pressure is less than 100 PSIG.

CO2 responses have been corrected for O2 effect. O2 responses have been corrected for CO2 interference.

Analytical Data: (R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component: CARBON DIOXIDE

Requested Concentration 17 %
Certified Concentration 17.06 %
Instrument Used Horiba VIA-510 S/N 20C194WK
Analytical Method NDIR
Last Multipoint Calibration 2/10/2017

First Analysis Data: Date: 2/22/2017
Z: 0 R: 20.01 C: 17.04 Conc: 17.049
R: 20.01 Z: 0 C: 17.05 Conc: 17.059
Z: 0 C: 17.05 R: 20.01 Conc: 17.059
UOM: % Mean Test Assay: 17.055 %

Reference Standard Type GMIS
Ref Std Cylinder # SA10234
Ref Std Conc 20.02%
Ref Std Traceable to SRM # RGM#CC28
SRM Sample # N/A
SRM Cylinder # RGM#CC28033

Second Analysis Data: Date:
Z: 0 R: 0 C: 0 Conc: 0
R: 0 Z: 0 C: 0 Conc: 0
Z: 0 C: 0 R: 0 Conc: 0
UOM: % Mean Test Assay: 0 %

2. Component: CARBON MONOXIDE

Requested Concentration 4.25 %
Certified Concentration 4.25 %
Instrument Used Horiba VIA-510 S/N UB9UCSYX
Analytical Method NDIR
Last Multipoint Calibration 2/10/2017

First Analysis Data: Date: 2/22/2017
Z: 0 R: 4 C: 4.3 Conc: 4.253
R: 4 Z: 0 C: 4.3 Conc: 4.253
Z: 0 C: 4.3 R: 4.01 Conc: 4.253
UOM: % Mean Test Assay: 4.253 %

Reference Standard Type GMIS
Ref Std Cylinder # CC257812
Ref Std Conc 3.96%
Ref Std Traceable to SRM # 2641a
SRM Sample # 59-C-02
SRM Cylinder # FF13690

Second Analysis Data: Date:
Z: 0 R: 0 C: 0 Conc: 0
R: 0 Z: 0 C: 0 Conc: 0
Z: 0 C: 0 R: 0 Conc: 0
UOM: % Mean Test Assay: 0 %

DocNumber: 000104677

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

3. Component: OXYGEN

Requested Concentration 17 %
 Certified Concentration 17.02 %
 Instrument Used OXYMAT SE
 Analytical Method PARAMAGNETIC
 Last Multipoint Calibration 2/5/2017

First Analysis Data: Date: 2/22/2017
 Z: 0 R: 19.74 C: 17.01 Conc: 17.016
 R: 19.72 Z: 0 C: 17.01 Conc: 17.016
 Z: 0 C: 17.03 R: 19.74 Conc: 17.036
 UOM: % Mean Test Assay: 17.022 %

Analyzed by:

Ying Yu

Reference Standard Type GMIS
 Ref. Std. Cylinder # CC112100
 Ref. Std. Conc. 19.74 %
 Ref. Std. Traceable to SRM # 2659a
 SRM Sample # 71-E-19
 SRM Cylinder # FF22331

Second Analysis Data:

Date:
 Z: 0 R: 0 C: 0 Conc: 0
 R: 0 Z: 0 C: 0 Conc: 0
 Z: 0 C: 0 R: 0 Conc: 0
 UOM: % Mean Test Assay: 0 %

Certified by:

Nassim Haddad



Praxair
5700 South Alameda Street
Los Angeles, CA 90058
Tel: (323) 585-2154 Fax: (714) 542-6689
PGVPID: F22016

DocNumber: 000101815

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information:

PRAXAIR PKG VANCOUVER WA
603 SE VICTORY AVE BLDG 46 S
VANCOUVER WA 98661

Praxair Order Number: 70157889
Customer P. O. Number:
Customer Reference Number:

Fill Date: 11/28/2016
Part Number: NI CD10CO33E-AS
Lot Number: 109633301
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure & Volume: 2000 psig 140 cu ft

Certified Concentration:

Expiration Date:	12/15/2024	NIST Traceable
Cylinder Number:	CC332147	Analytical Uncertainty:
10.02 %	CARBON DIOXIDE	± 0.4 %
2.52 %	CARBON MONOXIDE	± 0.5 %
10.51 %	OXYGEN	± 0.2 %
Balance	NITROGEN	

Certification Information: Certification Date: 12/15/2016 Term: 96 Months Expiration Date: 12/15/2024

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Do Not Use this Standard if Pressure is less than 100 PSIG.

O2 responses have been corrected for CO2 interference. CO2 responses have been corrected for O2 effect.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component: CARBON DIOXIDE

Requested Concentration: 10 %
Certified Concentration: 10.02 %
Instrument Used: Horiba VIA-510 S/N 20C194WK
Analytical Method: NDIR
Last Multipoint Calibration: 12/12/2016

First Analysis Data: Date: 12/15/2016
Z: 0 R: 13.98 C: 10.01 Conc: 10.017
R: 13.99 Z: 0 C: 10.01 Conc: 10.017
Z: 0 C: 10.01 R: 13.97 Conc: 10.017
UOM: % Mean Test Assay: 10.017 %

Reference Standard Type: GMIS
Ref Std Cylinder #: CC283552
Ref Std Conc: 13.99 %
Ref Std Traceable to SRM #: 1675b
SRM Sample #: 6-F-51
SRM Cylinder #: CAL014538

Second Analysis Data: Date:
Z: 0 R: 0 C: 0 Conc: 0
R: 0 Z: 0 C: 0 Conc: 0
Z: 0 C: 0 R: 0 Conc: 0
UOM: % Mean Test Assay: 0 %

2. Component: CARBON MONOXIDE

Requested Concentration: 2.5 %
Certified Concentration: 2.52 %
Instrument Used: Horiba VIA-510 S/N UB9UCSYX
Analytical Method: NDIR
Last Multipoint Calibration: 11/18/2016

First Analysis Data: Date: 11/15/2016
Z: 0 R: 3.97 C: 2.52 Conc: 2.516
R: 3.96 Z: 0 C: 2.53 Conc: 2.526
Z: 0 C: 2.52 R: 3.97 Conc: 2.516
UOM: % Mean Test Assay: 2.519 %

Reference Standard Type: GMIS
Ref Std Cylinder #: CC257812
Ref Std Conc: 3.96 %
Ref Std Traceable to SRM #: 2641a
SRM Sample #: 59-C-02
SRM Cylinder #: FF13690

Second Analysis Data: Date:
Z: 0 R: 0 C: 0 Conc: 0
R: 0 Z: 0 C: 0 Conc: 0
Z: 0 C: 0 R: 0 Conc: 0
UOM: % Mean Test Assay: 0 %

Report and Certificate of Calibration

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CALIBRATION CERTIFICATION



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1-800-356-4662
CL-108

www.Cal-Cert.com

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14 Inverness Drive East, Ste B-128
Englewood, CO 80112
1-800-983-7832
CL-157



Calibration
Laboratory

Report #: 2260-28789-46 **Customer PO#:**
Customer Name: PFS TECO
Customer Address: 11785 Southeast Highway 212
City: Clackamas **State:** OR **Zip:** 97015
Contact: John Steinert
Service Address: 6709 Southeast Lake Road Milwaukie, OR 97222

Calibration Standards

10-RH/00192 Comark Thermohygrometer S/N 6217150049 Cal Date 11/17/17 Due Date 11/30/18 Vendor Cal-Cert REPORT # 1573-C-01
10-SR1/00515 SPI Steel Rule S/N 00515 Cal Date 3/21/17 Due Date 3/21/18 Vendor Cal-Cert REPORT# 59499-C-07

Instrument Data

Calibration Date:	January 25, 2018	Reference:	Manufacturer's Spec
Calibration Due Date:	January 25, 2019	Cal-Cert Procedure:	CP-115
Calibration Frequency:	12 Months	Indicating System:	Scaling
Manufacturer:	Dewalt	Temperature:	71 °F
Type:	Tape Measure	Humidity:	29% RH
Model Number:	DWHT33372	Asset #:	#090
Serial #:	#1 TAPE	Service Location:	Cal-Cert Lab
Capacity:	192 Inches	As Found:	Pass
		As Left:	Pass

Instrument Range:	192.000 Inches	Range Resolution:	0.0625 Inches
	Calibration Standard	As Found Reading	Verification Reading #1
			Verification Reading #2
	0.000	0.000	0.000
	0.063	0.063	0.063
	1.000	1.000	1.000
	12.000	12.000	12.000
	48.000	48.000	48.000
	96.000	96.000	96.000
	192.000	192.000	192.000

Expanded Uncertainty ± 0.07217 Inches

Remarks:

We sincerely thank you for your business. Please call us at 1-800-356-4662 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by the International Accreditation Service, Inc. (IAS) under Calibration Laboratory Code CL-108 & CL-157.
IAS is recognized under the ILAC mutual recognition agreement (MRA).

This certificate is hereby issued that the above instrument was tested for accuracy with calibrated standards traceable to the National Institute of Standards and Technology (NIST). The information provided on this form complies with the data gathering and reporting requirements of ISO/IEC 17025 and ANSI/NCCL Z540.3, and meets the requirements of all applicable references and Cal-Cert procedures listed above. Any stated measurement uncertainty includes the uncertainty of the Calibration standards used, combined with the uncertainty of the measurement process using the RSS method with a k=2 for an approximate 95% level of confidence. The calibration process meets or exceeds a ratio of 4:1 unless otherwise stated.
All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

This report shall not be reproduced except in full, without written approval from Cal-Cert

Service Engineer: TYSON MORAN
Technical Manager: MARSHALL DOYLE

Date: January 25, 2018
Signature: *M Doyle*

Report and Certificate of Calibration

CAL-CERT
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Englewood, CO 80112
1-800-983-7832
CL-157



ACCREDITED
Calibration
Laboratory

Report #: 2260-28781-66
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212
City: Clackamas
Contact: John Steinert
Service Address: 6709 SE Lake Road, Milwaukie, OR 97222

Customer PO#:
State: OR
Zip: 97015

Calibration Standards

10-RH/00192 Comark Thermohygrometer S/N 6217150049 Cal Date: 11/17/17 Due Date: 11/30/18 Vendor: CC REPORT # 1573-C-01
L-GB-0/00397 Mitutoyo 83 Piece Gage Block Set S/N 0509020 Cal Date: 9/8/16 Due Date: 9/30/18 Vendor: American Gage REPORT # 83181-2-354224

Instrument Data

Calibration Date:	January 23, 2018	Reference:	NAVAIR 17-20MD-07
Calibration Due Date:	January 23, 2019	Cal-Cert Procedure:	CP-008
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	General	Temperature:	72 °F
Type:	Digital Caliper	Humidity:	31% RH
Model Number:	147	Asset #:	#092
Serial #:	#092	Service Location:	Cal-Cert Lab
Capacity:	6 Inches	As Found:	PASS
Resolution:	0.0005 Inches	As Left:	PASS

Instrument Range:	6 Inches	Range Resolution:	0.0005 Inches
--------------------------	----------	--------------------------	---------------

Outside Jaws / Linearity				
Calibration Standard Inches	As Found Inches	As Left Reading 1 Inches	As Left Reading 2 Inches	Tolerance ± Inches
0.0000	0.0000	0.0000	0.0000	0.0000
0.0500	0.0500	0.0500	0.0500	0.0010
0.3000	0.3000	0.3000	0.3005	0.0010
0.6000	0.6000	0.6000	0.6000	0.0010
1.2000	1.2005	1.2005	1.2000	0.0010
2.4000	2.4000	2.4000	2.4005	0.0010
3.5000	3.5000	3.5000	3.5000	0.0010
5.0000	5.0000	5.0000	5.0000	0.0010
6.0000	6.0000	6.0000	6.0000	0.0010

Expanded Uncertainty ± 0.00129 Inches

Verifications (for information only)			
	Target	Measured	Tolerance ±
Resolution Check	0.10050	0.10050	N/A
Depth	1.000	1.00000	N/A
Step	1.000	1.00000	N/A
Inside Jaws	1.000	1.00000	N/A
Inspections			
Jaws Parallel			Acceptable

Remarks:

We sincerely thank you for your business. Please call us at 1-800-356-4662 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by the International Accreditation Service, Inc. (IAS) under Calibration Laboratory Code CL-108 & CL-157.
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Any stated measurement uncertainty includes the uncertainty of the Calibration standards used, combined with the uncertainty of the measurement process using the RSS method with a k=2 for an approximate 95% level of confidence. The calibration process meets or exceeds a ratio of 4:1 unless otherwise stated.

All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

This report shall not be reproduced except in full, without written approval from Cal-Cert.

Service Engineer: NICOLAS ILLA

Date: January 23, 2018

Technical Manager: MARSHALL DOYLE

Signature:

Mr Doyle

Caliper CF-008-01

Revision 13

6/29/2017

J-2000

owner's manual



DELMHORST[®]
INSTRUMENT CO.
WHEN ACCURACY IS THE POINT.[™]

**IMPORTANT:
THESE INSTRUCTIONS ARE TO
REMAIN WITH THE HOMEOWNER**

**PACIFIC
ENERGY**

SERIAL #

SAFETY NOTICE

If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area.

Meets the Environmental Protection Agency's 2020 Particulate Emission Standards (Crib Wood).



OPERATING AND INSTALLATION INSTRUCTIONS



**MODEL(s): VISTA LE,
VISTA CLASSIC LE**

Visit www.pacificenergy.net for the most recent version of this manual

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WARNING



HOT GLASS WILL CAUSE BURNS.

DO NOT TOUCH GLASS UNTIL COOLED.

NEVER ALLOW CHILDREN TO TOUCH GLASS.

STATE of CALIFORNIA

WARNING: this product can expose you to chemicals including ceramic fibers, which are known to the state of California to cause cancer, and to carbon monoxide, which is known to the state of California to cause birth defects or other reproductive harm.

For more information go to www.p65warnings.ca.gov.

**This warning is applicable to all
PACIFIC ENERGY FIREPLACE PRODUCTS**

PLEASE SAVE THESE INSTRUCTIONS

NOTE: WE STRONGLY RECOMMEND THAT SMOKE AND CARBON MONOXIDE DETECTORS BE INSTALLED IN THE AREA WHERE THE HEATER IS TO BE INSTALLED.

If smoke detectors have been previously installed, you may notice that they are operating more frequently. This may be due to curing of stove paint or fumes caused by accidentally leaving the fire door open. Do not disconnect the detectors.

SAFETY NOTICE: If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area.

Please read this entire manual before you install and use your new room heater. Failure to follow instructions may result in property damage, bodily injury, or even death.

Experience will give you the right settings for proper combustion and efficient burning. Remember the correct air inlet setting is affected by variables such as type of wood, outside temperature, chimney size and weather conditions. With practice, you will become proficient in operating your heater and will obtain the performance for which it was designed.

Rating Label

PLEASE SAVE THESE INSTRUCTIONS

This manual describes the installation and operation of the Pacific Energy, VISTA LE or VISTA CLASSIC LE Freestanding wood heater.

SAFETY NOTICE: If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area.

Please read this entire manual before you install and use your new room heater. Failure to follow instructions may result in property damage, bodily injury, or even death.

This heater meets the 2020 U.S. Environmental Protection Agency's crib wood emission limits for wood heaters sold after May 15, 2020 using Method 28R.

Model VISTA LE / VISTA CLASSIC LE: 1.9 g/hr..

Under specific test conditions this heater has been shown to deliver heat at rates ranging from 13,500 to 23,200Btu/hr.

Efficiency and BTU Output

EPA Certified Emissions	1.9 grams per hour
LHV Tested Efficiency 1	78%
HHV Tested Efficiency 2	72%
EPA BTU Output 3	13,494 to 23,186 btu/hr.
Maximum Wood Length	18 inches
Ideal Wood Length	16 inches
Fuel	Seasoned Cord wood

1 Weighted Average Lower Heating Value (LHV) efficiency as tested using CSA B415 Performance testing of solid-fuel-burning heating appliances. LHV assumes the moisture is already in a vapour state so there is no loss of energy

2 Weighted Average Higher Heating Value (HHV) efficiency as tested using CSA B415 Performance testing of solid-fuel-burning heating appliances. HHV includes the energy required to vaporize the water in the fuel

3 The range of BTU outputs is based on efficiency using CSA B415 Performance testing of solid-fuel-burning heating appliances and burn rates from the low and high EPA tests using Douglas Fir dimensional lumber.

[illegible]

CAUTION: 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.

Instruct all members of your family on the safe operation of the heater. Ensure they have enough knowledge of the entire system if they are expected to operate it. Stress the section on chimney fires and the importance of following the steps outlined "In Case of Chimney Fire".

Chimney Smoke and Creosote Formation

When wood is burned slowly, it produces tar and other organic vapours, which combine with expelled moisture to form creosote. The creosote vapours 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 connector and chimney should be inspected periodically (at least once every two months) during the heating season to determine if a creosote buildup has occurred. If creosote has accumulated (3 mm. or more), it should be removed to reduce the risk of a chimney fire.

1. Highest smoke densities and emissions occur when a large amount of wood is added to a bed of hot coals and the air inlet is closed. The heated wood generates smoke, but without ample air, the smoke cannot burn. Smoke-free, clean burning requires small fuel loads, two or three logs at a time or 1/4 to 1/2 of fuel load and leaving the air inlet relatively wide open, especially during the first 10 to 30 minutes after each loading, when most of the smoke generating reactions are occurring. After 30 minutes or so, the air inlet can be turned down substantially without excessive smoke generation. Wood coals create very little creosote-producing smoke.
2. The cooler the surface over which the wood smoke is passing, the more creosote will be condensed. Wet or green wood contributes significantly to creosote formation as the excess moisture that is boiled off cools the fire, making it difficult for the tars and gases to ignite, thus creating dense smoke and poor combustion. This moisture-laden smoke cools the chimney, compounding the problem by offering the smoke the ideal place to condense.

In summary, a certain amount of creosote is inevitable. Regular inspection and cleaning is the solution. The use of dry, seasoned wood and ample combustion air will help to minimize annoying smoke emissions and creosote buildup.

Chimney Fires

The dangerous side effect of excessive creosote buildup is a chimney fire. This causes much higher than normal temperatures in the chimney and on its exterior surfaces. Temperatures inside the chimney can exceed 2000°F (1100°C). Ignition of nearby or touching combustible material is more likely during a chimney fire. Proper clearances are critical to prevent damage during such a fire.

Chimney fires are easy to detect; they usually involve one or more of the following:

- Flames and sparks shooting out of the top of the chimney
- A roaring sound
- Vibration of the chimney

To Avoid a Chimney Fire

1. Burn wood cleanly. Do not burn wet wood or turn down the unit too quickly after loading.
2. Do not let creosote build up to a point where a chimney fire is possible.
3. Do not have fires in the heater that may ignite chimney fires. These are excessively hot fires, such as when burning household trash, cardboard, Christmas tree limbs, or even ordinary fuel wood; (e.g. with a full load on a hot bed of coals and with the air inlet wide open for more time than is needed to completely char a fresh fuel load.)
4. The Chimney and connector pipe should be inspected /cleaned periodically.

In Case of a Chimney Fire

1. Prepare to evacuate to ensure everyone's safety. Have a well understood plan of action for evacuation. Have a place outside where everyone is to meet.
 2. Close air inlet on stove.
 3. Call local fire department. Have a fire extinguisher handy. Contact your local municipal or provincial fire authority for further information on how to handle a chimney fire. It is most important that you have a clearly understood plan on how to handle a chimney fire.
 4. After the chimney fire is out, the chimney must be cleaned and checked for stress and cracks before starting another fire. Also check combustibles around the chimney and the roof.
- The services of a certified installer/Chimney Sweep (from one of the associations listed below), is strongly recommended to inspect and service your Chimney system
NFI (National Fireplace Institute®) in the United States,
CSIA (Chimney Safety Institute of America) in the United States and Canada,
WETT (Wood Energy Technology Transfer) in Canada or
APC (Association des Professionnels du Chauffage) in Quebec

Curing of the Paint Finish

To achieve the best finish, the paint on your stove must be baked on. When burning your stove for the first 2-3 times it is very important that the room be well ventilated. Open all windows and doors. Smoke and fumes caused by the curing process may cause discomfort to some individuals.

- Follow the procedures on the information sheet included with your stove from STOVE BRIGHT (Forrest Paint).

WARNING: Never use chemicals or any other volatile liquid to start a fire. Do not burn garbage, or flammable fluids such as gasoline, naphtha, or engine oil.

Operation

CAUTION: Hot while in operation. Keep children, clothing and furniture away. Contact may cause skin burns.

WARNING: Always keep loading door closed when burning. This heater is not designed for open door burning.

WARNING: No alteration or modification of the combustion air control assembly is permitted. Any tampering will void warranty and could be very hazardous.

WARNING: Do not use grates or andirons to elevate the fuel. Burn directly on the fire bricks. Replace broken or missing bricks. Failure to do so may create a hazardous condition.

Wood Selection

This heater is designed to burn natural wood only. Higher efficiency and lower emissions generally result when burning air-dried seasoned hardwoods, as compared to softwoods or to green or freshly cut hardwoods.

Wood should be properly air dried (seasoned) for six months or more. Wet or undried wood will cause the fire to smoulder and produce large amounts of smoke and creosote. Wet wood also produces very little heat and tends to go out often. Wood should be stored under cover away from open flame or heat sources.

DO NOT BURN :

• Salt water wood *	• Treated wood
• Wet or green wood	• Coal/charcoal
• Garbage*	• Solvents
• Lawn clippings/yard waste	• Unseasoned wood
• Railroad ties	• Manure or animal remains
• Materials containing rubber, including tires	• Materials containing plastic
• Construction or demolition debris	• Materials containing asbestos
• Waste petroleum products, paints, paint thinners, or asphalt products	• Paper products, cardboard, plywood, or particleboard.

*** These materials contain chlorides which will rapidly destroy metal surfaces and void warranty.**

Burning these materials may result in the release of toxic fumes or render the heater ineffective and cause smoke.

Do not burn anything but wood. Other fuels, e.g. Charcoal, can produce large amounts of carbon monoxide, a tasteless, odourless gas that can kill. Under no circumstances should you attempt to barbecue in this heater.

The prohibition against burning these materials does not prohibit the use of fire starters made from paper, cardboard, saw dust, wax and similar substances for the purpose of starting a fire in an affected wood heater.

How to Test Your Wood

Add a large piece of wood to the stove when it has a good large bed of coals. It is dry if it is burning on more than one side within one minute. It is damp if it turns black and lights within three minutes. If it sizzles, hisses and blackens without igniting in five minutes it is too wet and should not be burnt

Lighting a fire

WARNING: Never use chemicals or any other volatile liquid to start a fire.

1. Adjust air control to "High" position (all the way to the left) and open door.
2. Place crumpled newspaper in the centre of the heater and crisscross with several pieces of dry kindling. Add a few small pieces of dry wood on top.
3. Ignite the paper and leave the door ajar approximately 1/2"(13mm) - 1"(25mm) until the wood kindling is fully engulfed in flame.
4. After the kindling is fully engulfed add a few small logs. Close door.
5. Begin normal operation after a good coal base exists and wood has charred.

Normal Operation

WARNING: 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 the operating instructions in this manual.

1. Set air control to a desired setting. If smoke pours down across the glass (waterfall effect) this indicates you have shut the control down too soon or you are using too low a setting. The wide range control panel makes finding the desired setting for your application easy. As every home's heating needs vary (i.e. Insulation, windows, climate, etc.) The proper setting can only be found by trial and error and should be noted for future burns.
 2. To refuel, adjust air control to high, and give the fire time to brighten. Open the door slowly, this will prevent back puffing.
 3. Use wood of different shape, diameter and length (up to 18"(457mm)). Load your wood endwise and try to place the logs so that the air can flow between them. Always use dry wood.
 4. Do not load fuel to a height or in such a manner that would be hazardous when opening the door.
 5. For extended or overnight burns, unsplit logs are preferred. Remember to char the wood completely on maximum setting before adjusting air control for overnight burn.
- Burn wood only, dry and well seasoned. The denser or heavier the wood when dry, the greater its heat value. This is why hardwoods are generally preferred. Green or wet wood will cause a rapid buildup of creosote. If you feel it is necessary to burn wet or unseasoned wood, do so only with the air inlet set open enough to maintain a good strong fire and fairly high chimney temperatures. Do not attempt to burn overnight using green wood or wet wood. Wet wood can cause up to 25% drop in heater output, as well as contributing significantly to creosote buildup.

DO NOT OVER FIRE THIS HEATER: Attempts to achieve heat output rates that exceed heater design specifications can result in permanent damage to the heater and chimney. A glowing red, top or vent pipe are indications of over firing. Failure to rectify an over firing condition can be hazardous and may void the manufacturer's warranty.

Restarting After Extended or Overnight Burns

1. Open door and rake hot embers towards the front of the heater. Add a couple of dry, split logs on top of embers, close door.
2. Adjust air control to high and in just a few minutes, logs should begin burning.
3. After wood has charred, reset air control to desired setting.
4. To achieve maximum firing rate, set control to high "H". Do not use this setting other than for starting or preheating fresh fuel loads.

Proper Draft

1. Draft is the force which moves air from the appliance up through the chimney. The amount of draft in your chimney depends on the length of the chimney, local geography, nearby obstructions and other factors.
2. Too much draft may cause excessive temperatures in the appliance. An uncontrollable burn or a glowing red stove part or chimney indicates excessive draft.
3. Inadequate draft may cause back puffing into the room and plugging of the chimney. Smoke leaking into the room through appliance and chimney connector joints indicates inadequate draft.

Remember the correct air inlet setting is affected by variables such as type of wood, outside temperature, chimney size and weather conditions.

Ash Removal

Caution: Ashes are to be removed only when the heater is cold. Whenever ashes get 3"(76mm) to 4"(102mm) deep in your firebox, and when fire has burned down and cooled, remove excess ashes. Leave an ash bed approximately 1" (25 mm) deep on the firebox bottom to help maintain a hot charcoal bed.

Ash Cleanout system (optional on VISTA LE):

The ash dump handle is located under the ash lip on the left hand side. To operate ash dump, pull handle out 1/2"(13mm) and turn clockwise. This will unlock the ash dump and allow it to open. Hold handle open while pulling ashes into the opening. Avoid large embers as these still contain heat value. Release handle and push in to lock. Ensure ash dump door is properly engaged. Fill the cavity with the remaining ash level with the firebox floor. Lift and pull out ash pan and discard ashes into metal container. Replace ash pan and ensure it is seated properly.

Do not burn with ash dump door open. Doing so will create a hazardous condition. Always leave about 1"(25mm) of ash when cleaning.

Disposal of Ashes

Ashes should be placed in a metal container with a tight fitting lid. The closed container of ashes should be placed on a non-combustible 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 closed container until all cinders have thoroughly cooled. Other waste should not be placed in this container.

Maintenance

WARNING: Never use chemicals or any other volatile liquid to start a fire. Do not burn garbage, or flammable fluids such as gasoline, naphtha, or engine oil.

WARNING: ONLY USE MATERIALS SUPPLIED BY MANUFACTURER WHEN DOING MAINTENANCE OR REPLACEMENTS.

1. If glass becomes darkened through slow burning or poor wood, it can readily be cleaned with fireplace glass cleaner when stove is cold. Never scrape with an object that might scratch the glass. The type and amount of deposit on the glass is a good indication of the flue pipe and chimney buildup. A light brown dusty deposit that is easily wiped off usually indicates good combustion and dry, well-seasoned wood and therefore relatively clean pipes and chimney. On the other hand, a black greasy deposit that is difficult to remove is a result of wet and green wood and too slow a burning rate. This heavy deposit is building up at least as quickly in the chimney.
2. **DOOR GASKETS** - The gasket used by Pacific Energy (3/4"(22mm) Firm Density fiberglass rope) requires only light pressure to seal. This will prolong seal life. It is important that the door seal be maintained in good condition. Periodically inspect seals and replace if necessary. Follow the instructions included in the DR31.WDGKIT kit, obtainable from your nearest Pacific Energy dealer.
3. **DOOR GLASS** - Do not slam loading door or otherwise impact glass. When closing door, make sure that no logs protrude to impact the glass. If the glass gets cracked or broken, it must be replaced before using the stove. Replacement glass can be obtained from your dealer. Use 10-1/2"(266mm) x 16-1/2"(419mm) x 5 mm. Ceramic glass only. **Do not substitute with any other type.**
 - To remove broken glass, undo the four retaining screws and remove clamps and frame, noting position for re-assembly. Remove all particles of glass. Be careful as they are very sharp. Install new glass complete with gasket. Replace frame, clamps and screws.

CAUTION:

- Do not overtighten, tighten screws very carefully
 - Do not clean glass when hot
 - Do not use abrasive cleaners on glass
4. The area where boost combustion air enters the firebox must be kept clear of excessive ash buildup which will block air flow. This area is at the front of the firebox.
 5. Do not store wood within heater installation clearances, or within the space required for fuel loading and ash removal. Keep the area around the heater clean and free of loose combustibles, furniture, newspapers, etc.
 6. If the plated door requires cleaning, use mild soap and water only. Use of abrasive cleaners will void warranty.
 7. Establish a routine for the fuel, wood burning and firing technique. Check daily for creosote buildup until experience shows how often you need to clean to be safe.
 8. Be aware that the hotter the fire, the less creosote is deposited. Weekly cleaning may be necessary in mild weather, even though monthly cleaning is usually enough in the coldest months when burning rates are higher. When wood is burned slowly, it produces tar and other organic vapours, which combine with expelled

Maintenance Checks

Check the following parts for damage such as cracks, excessive corrosion, burned out sections and excessive warping: (See website for descriptions and more detail)

Weekly:

- Firebrick - Visual, for cracking.
- Door Gasket - sagging, placement, damage.

Monthly

- Brick rail tabs and brick rails.
- Air riser tube in the back of the firebox.
- Back side of airwash chamber.
- Baffle locking pin.
- Boost tube cover.
- Baffle Tubes

When Cleaning the Chimney System:

- Top baffle board/blanket.
- Baffle.
- Top heat shield and mounting bolt.
- Baffle Gasket.
- Brick Rails.
- Manifold.

Blower:

- The blower should be cleaned out a minimum every six months by using a vacuum on the grill openings in the back and bottom of the blower casing to remove any dust and debris.

Baffle:

- Some warping of the baffle is normal(up to 1/4" or .65cm). Replace if the baffle has permanent warping greater than this or has cracking or breakage.
- Please contact your Dealer if you experience any of the damage listed above. Continuing to operate your stove with broken parts can accelerate damage to other parts and may void your warranty

Baffle / Tube Removal

Chimney connector pipe should be disconnected from stove to clean and inspect. Only if this is not possible should you remove baffle assembly.

DO NOT OPERATE WITH BAFFLE ASSEMBLY, TUBES OR INSULATION REMOVED.

Baffle Removal

1. Slide the Ceramic Board located above the tubes towards the front of the stove. Remove retaining pin at the back of the firebox, just under the baffle.
2. Lift the Baffle up to disconnect from the Baffle supply tube.
3. Move the Baffle to one side then tilt it sideways to drop down and remove from firebox. You may need to remove the opposite side brick rail to allow the Baffle to drop down. - To remove the Brick Rail, remove the brick directly under it then lift the rail up and inward to clear the locating pins
4. Inspect the gasket between baffle and supply tube. If necessary, replace with gasket (prt#80000365) available from your Pacific Energy dealer.
5. Re-install baffle assembly in reverse order. The two side pieces of blanket insulation must be tight against the side rails. The Ceramic Board on top of the tubes must be pushed back tight against the Baffle.

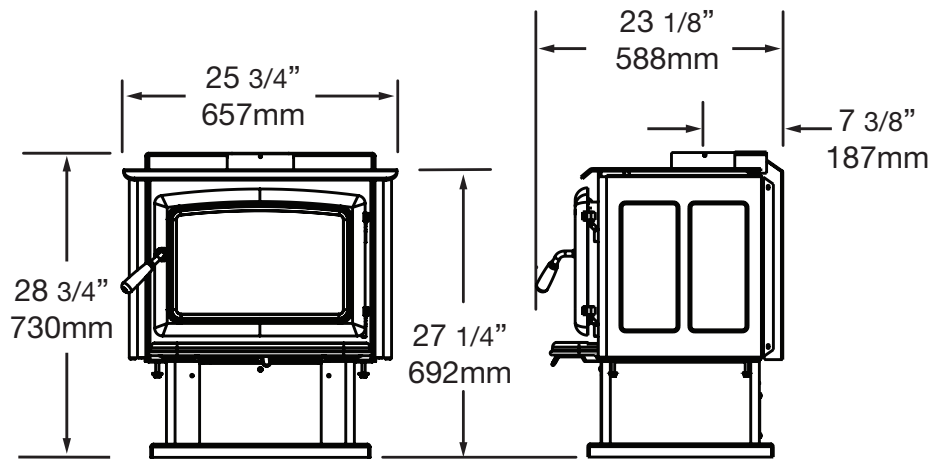
Tube / Baffle Board Removal

1. With a set of vise-grips, grasp the front baffle tube on the right, slightly away from the baffle air assembly. While squeezing tightly, use a hammer to hit the pliers and pull the tube to the right to disengage the tube from the hole on the left. Allow the tube to hang freely from the hole on the right.
2. Repeat step #1 for rear baffle tube.
3. Grasp the front edge of the baffle board and pull forward. Guide the board down and through the door opening. **Caution - Baffle Board material is very fragile.**

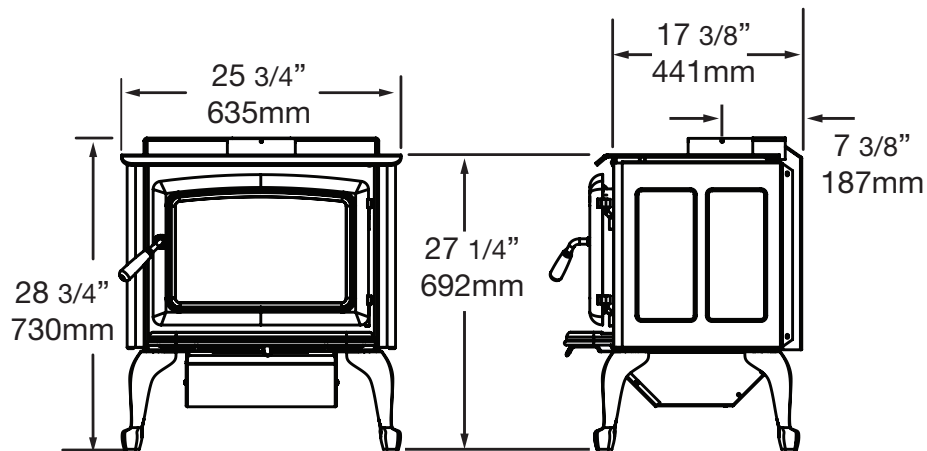
Installation

1. With the holes facing down/forward and the notch to the left side, insert a baffle tube into the hole in the baffle air channel on the right at an angle and then raise and insert into the opposite hole on the left side baffle air assembly.
2. With a set of vise-grips, grasp the baffle tube on the left, slightly away from the baffle air assembly. While squeezing tightly, use a hammer to hit the pliers and push the tube to the left to engage the tube in the hole on the left.
3. With the rear tube installed, Insert the baffle board above the tube, between the tube and the side hold down tabs.
4. Repeat steps #1 & #2 with the remaining baffle tube, being careful not to damage the board.
5. Slide the baffle board back until the lower edge is tight against the baffle.

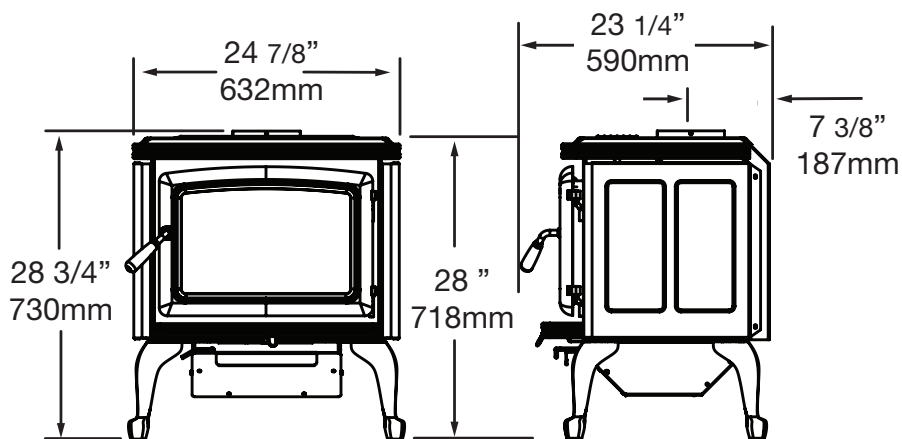
Dimensions



VISTA LE - Pedestal



VISTA LE- Leg



VISTA CLASSIC LE

Figure 1: VISTA LE dimensions.

Crate Removal

1. Carefully remove the crate top and supports.
2. Remove plastic cover.
3. On Leg units, remove the stove from it's supports by loosening the nuts holding the support to the unit

Assembly - Legs (Leg Model)

1. With the unit on its back, Insert the leg around the first nut and between the Leg Adapter flange and the washer and second nut.
2. Using the guides cast into the tops of the leg, align the guides into the notches in the Ash Box mounting flanges.
3. Tighten the bolts down.

Assembly - Optional Ash Cleanout

Pedestal Model

1. Remove the Ash Drawer Front Cover Plate by removing the center screw(1) and lifting up to dis-engage the bottom tab.
2. Remove the Knock-out in the top left corner of the opening
3. Install the Ash Dump mechanism, following the instructions on the next page.
4. Install the new Ash Pan into the Pedestal.

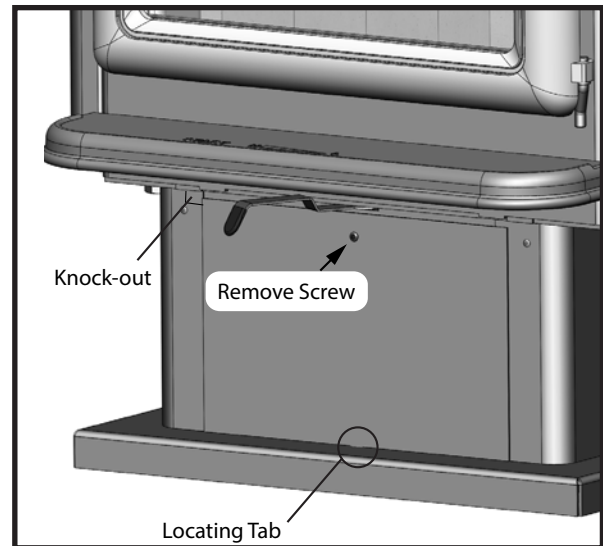


Figure 2: Ped Cover removal.

Leg Model

1. Remove the two screws holding the Leg Ash Box front cover (located on either side). Remove the cover
2. Remove the Knock-out in the top left corner of the opening
3. Install the Ash Dump mechanism, following the instructions.
4. Install the new Ash Pan into the Leg Ash Box.

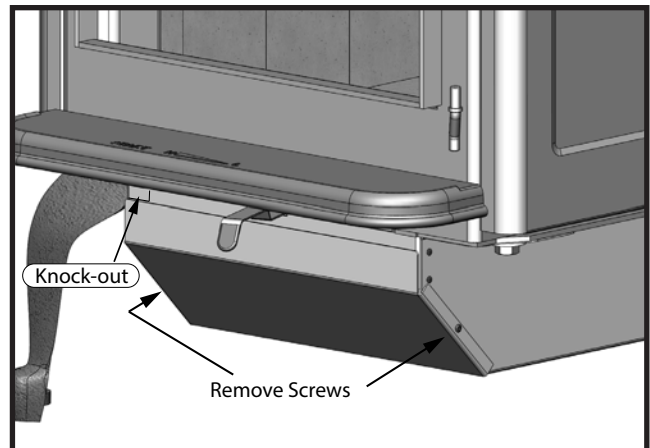


Figure 3: Leg Ash Cover removal.

Ash Dump Installation

1. Remove the Ash Cleanout hole cover plate and gasket, located under the stove. Discard the cover plate.

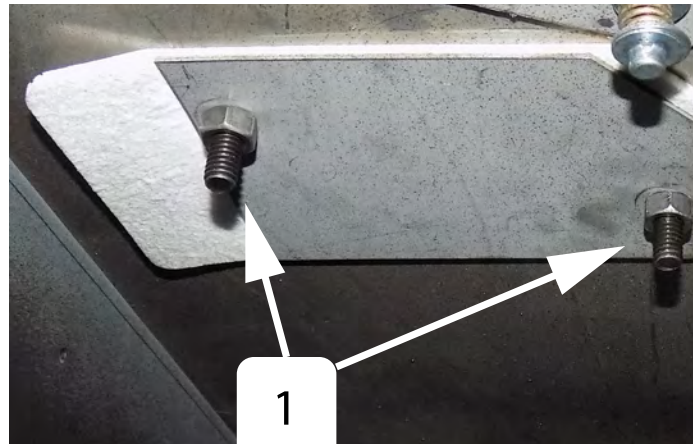


Figure 4: Cover Plate removal

2. Place the provided gasket(s) around the upper tube portion of the new Ash Dump mechanism, as per the drawing.

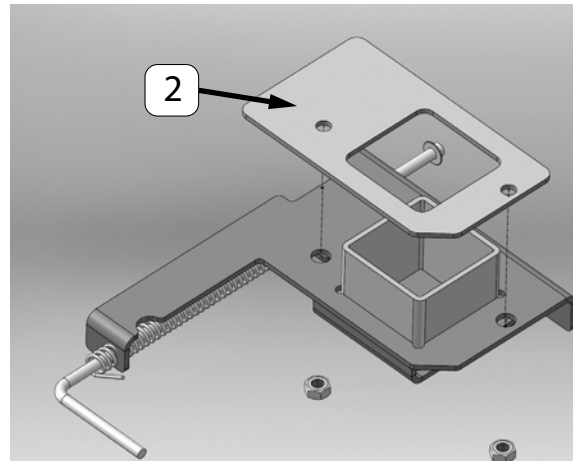


Figure 5: Ash Cleanout Gasket.

3. Insert The Ash Dump mechanism with gasket from underneath the firebox bottom up into the open hole and over the two bolts hanging down. - The release handle should be facing forward and on the left.
4. Re-attach the nuts onto the carriage bolts. And tighten to gently compress the gasket.

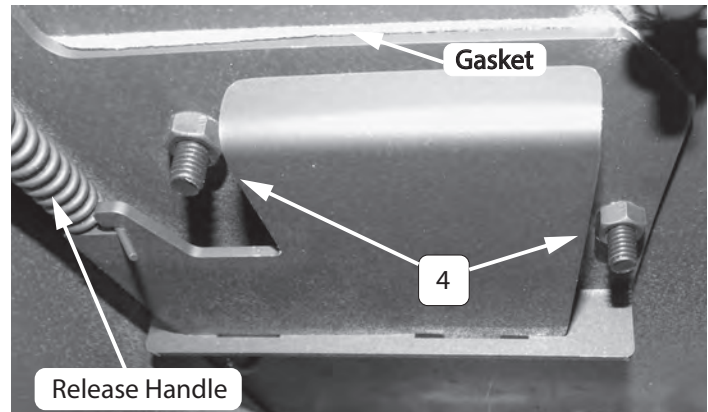


Figure 6: Under side of bolted ash Cleanout.

Floor Protector

The stove may be installed on a combustible floor, provided noncombustible ember protection is used. This protection must extend as follows:

In USA: 16" (406 mm) to the front and 8" (203 mm) to the sides of the fuel loading door opening. See Figure #4, below. This protection is also required under the chimney connector and 2" (51 mm) beyond each side.

U.S.A. Only

Minimum Width - 33 3/8" (850mm)
Minimum Overall Depth - 35" (890mm)

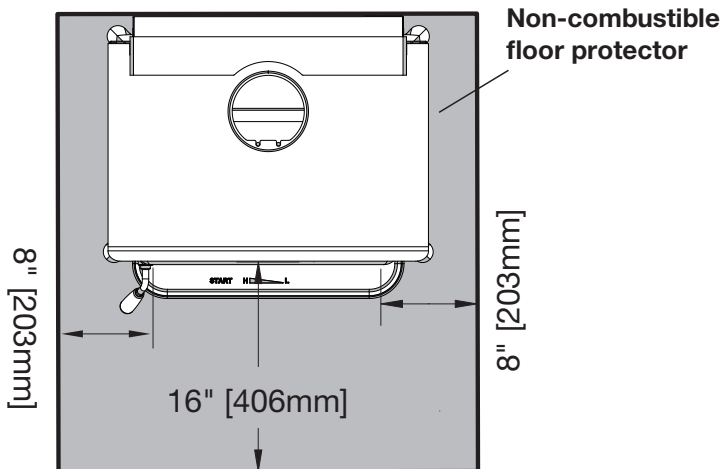


Figure 7: VISTA LE Floor protector - USA only.

In Canada: 18" (457 mm) on the firing side and 8" (203 mm) to the other sides.

CANADA Only

Minimum Width - 40 3/4" (1.035m)
Minimum Overall Depth - 45" (1.14 mm)

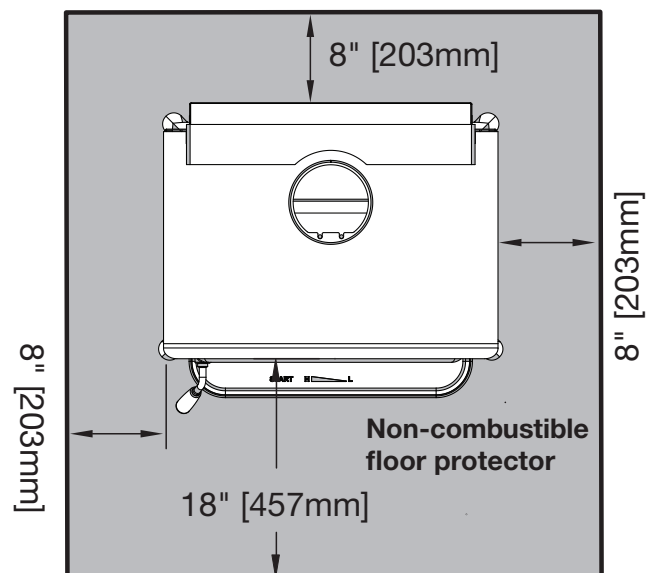


Figure 8: VISTA LE Floor protector - CAN only.

Residential Installation

Clearances:

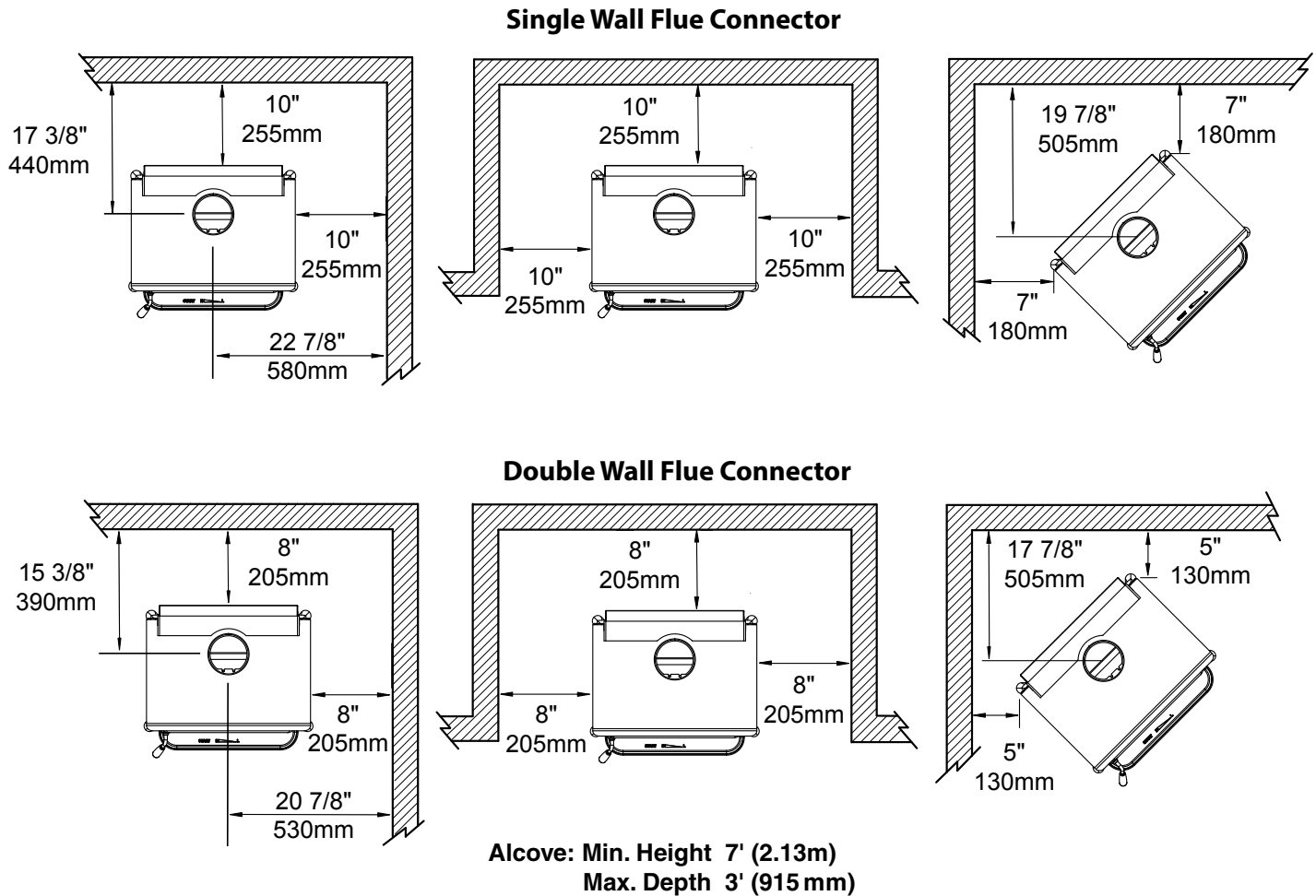


Figure 9: VISTA LE Minimum clearances.

Clearances may be reduced with various heat shielding/insulating materials. Consult CSA B365 or NFPA 211 and local fire codes and authorities for approval. For close clearances, use a listed double-wall connector.

NOTE: local/national codes or regulations may override some guidelines in this manual

We recommend that our products be installed and/or serviced by professionals who are certified by a "Qualified agency";

**NFI (National Fireplace Institute®) in the United States,
CSIA (Chimney Safety Institute of America) in the United States and Canada,
WETT (Wood Energy Technology Transfer) in Canada or
APC (Association des Professionnels du Chauffage) in Quebec**

Warning: Under no circumstances is this heater to be installed in a makeshift or "temporary" manner. It may be fired only after the following conditions have been met.

DO NOT ATTEMPT TO CONNECT THIS HEATER TO ANY AIR DISTRIBUTION DUCT.

Outside combustion air or fresh air into the room may be required in your area, consult local building codes (see Combustion Air section).

Chimney and Connector

- The chimney system must be a ULC-S629 or UL-130HT listed Stainless chimney or a Masonry chimney suitable for use with solid fuel, that is lined, in good condition and meets fire and building codes.
- The chimney flue size should be the same as the stove outlet (6 inches) for optimal performance. Reducing or increasing the flue size may adversely affect stove performance.
- Chimney flue exit is to be 3 feet (1 m.) above roof and two feet (0.6 m.) above highest projection within 10 feet (3 m.) horizontally.
- The installation must meet all local codes.
- Do not connect this unit to a chimney flue serving another appliance. Minimum system height is 15 feet (4.6 m.) (measured from base of appliance).

BOTH CHIMNEY SYSTEM AND CONNECTOR MUST BE LISTED TO:

**IN CANADA - ULC S-641 LISTED for double wall connector and ULC-S629 LISTED CHIMNEY,
IN USA - UL-103 HT LISTED CONNECTOR AND CHIMNEY**

When using a Double-Wall Connector

- Use a listed double-wall connector.
- If a listed chimney and double-wall connector are to be connected to the stove, install all components as per the chimney/connector manufacturer's installation requirements.

When using a Single-Wall (smoke pipe) Connector

The single wall pipe section must be:

- If you are using smoke pipe/chimney connector in conjunction with the listed chimney system, consult local/national fire or building codes for connector installation. Follow the chimney manufacturer's complete instructions for the installation of the chimney system.
- As short and straight as possible, use six inch diameter, 24 gauge black pipe that is clean and in new condition.
- Installed with the crimped or male ends pointing down. (This will carry any liquid creosote or condensation back into the stove) and secured at every joint and collar with 3 sheet metal screws.
- The chimney connector shall not pass through an attic, roof space, closet or similar concealed space, floor, or ceiling. Where passage through a wall, or partition of combustible material is desired, the installation shall conform to CAN/CSA-B365, Installation Code for Solid-Fuel-Burning Appliances and Equipment or NFPA 211 Standard for Chimneys, Fireplaces, Vents and Solid-Fuel Burning Appliances.

Installation Procedure

1. Select the position for your wood stove based on the clearances diagram. Position the floor protection and stove.
2. Mark the position for the hole in the ceiling and roof by using a string and plumb-bob hanging over the exact center of the stoves flue pipe.
3. Check that the intended location will not interfere with floor joists, ceiling joists or rafters before proceeding further. Adjust if necessary and reconfirm the clearance's from the stove to combustibles.
4. Carefully follow the directions of the listed chimney for installation of the chimney system from the ceiling through to the rain cap. This may include framing in holes etc.
5. Start installing smoke pipe / chimney connector, slip the crimped edge of the pipe inside the stove collar. Use holes provided in collar to secure pipe with two screws.
6. Install the remaining lengths of pipe one on top of the other up to the finished height of the chimney and using the manufacturers approved adapter, secure to each other. A slip section can make this easier.

Combustion Air

Intake or combustion air can be supplied to the stove in one of two ways. Consult your local building code or CAN/CSA-B365, Installation Code for Solid-Fuel-Burning Appliances and Equipment before proceeding.

Outside air supply - (Necessary for mobile home installation, optional for residential installation.)

To draw **outside air through the floor** - This hole must get its air from a ventilated crawl space or be extended with duct to the outdoors (see Figure #3, Page 7). The use of outside combustion air for residential installation requires the unit to be secured to the structure to prevent dislodging of the air duct.

- **Leg Model:** Cut or drill a hole in the floor, (large enough to fit 4" metal flex venting) behind the ash box enclosure. Once the stove is in place, attach the 4" Intake Starter to the Ash Box Enclosure. Connect to the floor with the 4"(100mm) i.d. metal flex pipe.
- **Pedestal Model:** Cut or drill a 4" (100mm) diameter hole in the floor anywhere inside the perimeter of the pedestal base. Cover the hole with a 4" x 4" (100 mm x 100 mm) rodent screen and staple/nail in place. Leave the cover over the hole on the back of the Pedestal. Place the stove over the hole.

To draw **outside air from behind the stove**, Use a 4"(100mm) Air intake. Cut or drill the recommended size hole through a wall behind the unit.

- Install the 4" Intake Starter over the hole in the rear of the Ash Box enclosure. Attach metal flex between the starter and the Air Intake.
- Pedestal Model: Remove the cover plate from the rear of the pedestal and install the cover plate over the hole located under the Pedestal. Install the 4" Intake Starter over the hole in the rear. Attach metal flex between the starter and the wall inlet.

Room air supply - The stove will draw its air from the room through the opening in the Ash Box Enclosure and into the firebox intake.

Note: The living space around the heater must be well ventilated with good air circulation. Anything that may cause a negative pressure can cause gases or fumes to be pulled into the living area. During extremely cold weather, and especially when burning at very slow rates, the upper parts of the exposed chimney may ice up, partially blocking the flue gases. If blockage occurs, flue gases may enter the living space.

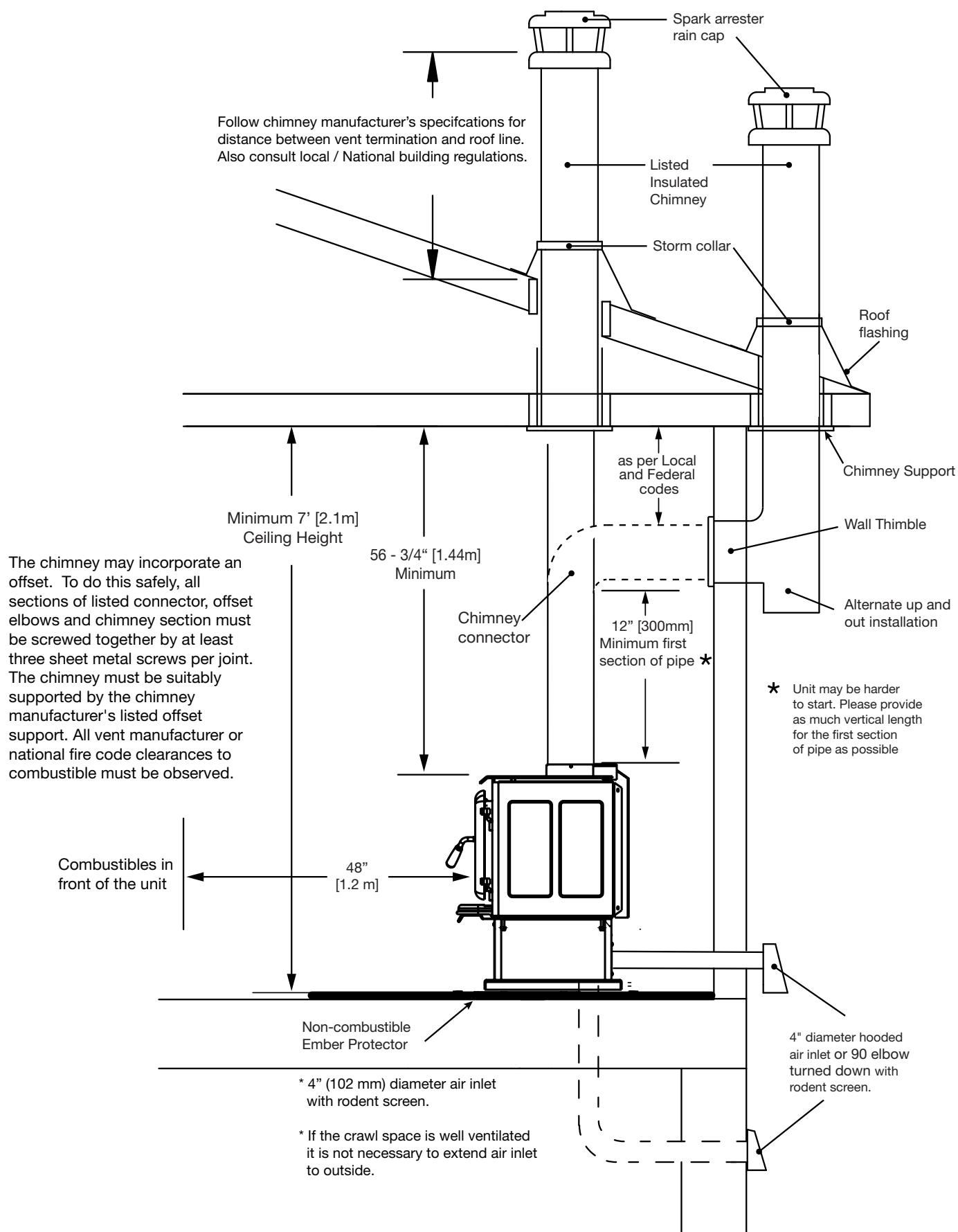


Figure 10: VISTA LE residential venting.

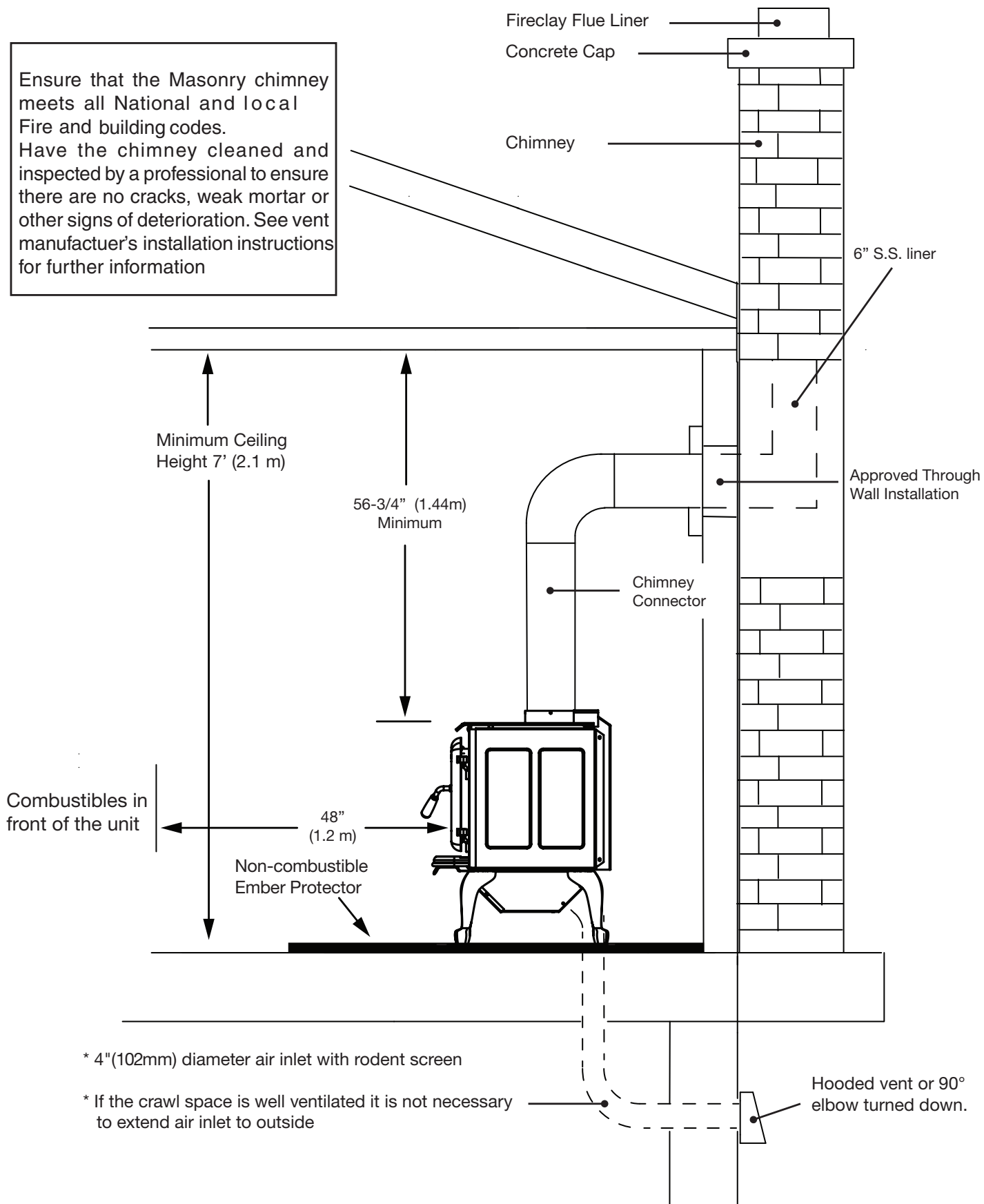


Figure 11: VISTA LE Venting to a masonry chimney.

Through Wall Installations (as per NFPA 211-2013)

ATTENTION: VAPOUR BARRIER MUST BE MAINTAINED WHEREVER CHIMNEY OR OTHER COMPONENTS PENETRATE TO THE EXTERIOR OF THE STRUCTURE. SEE LOCAL BUILDING CODES FOR PROPER AND APPROVED METHODS OF MAINTAINING VAPOUR BARRIER.

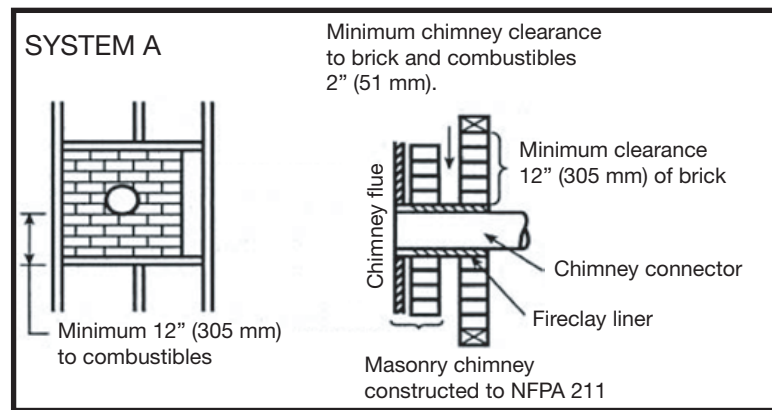


Figure 12: System A.ai
Minimum Clearance 12 in. (305mm) to combustibles

System A. Minimum 3.5 in. (90 mm) thick brick masonry wall framed into combustible wall with a minimum of 12 in. (305 mm) brick separation from clay liner to combustibles. Fireclay liner (ASTM C 315, Standard Specifications for Clay Fire Linings, or equivalent), minimum 5/8 in. (16 mm) wall thickness, shall run from outer surface of brick wall to, but not beyond, the inner surface of chimney flue liner and shall be firmly cemented in place.

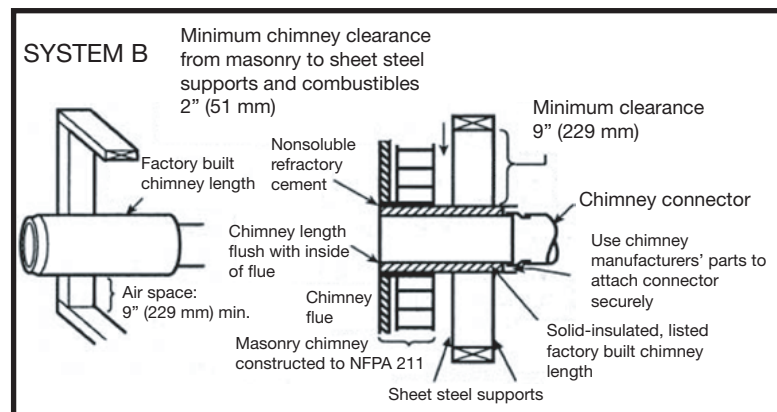


Figure 13: System B.ai

Minimum Clearance 9 in. (229mm) to combustibles

System B. Solid-Insulated, listed factory-built chimney length of the same inside diameter as the chimney connector and having 1 in. (25.4 mm) or more of insulation with a minimum 9 in. (229 mm) air space between the outer wall of the chimney length and combustibles.

The inner end of the chimney length shall be flush with the inside of the masonry chimney flue and shall be sealed to the flue and to the brick masonry penetration with non-water-soluble refractory cement. Supports shall be securely fastened to wall surfaces on all sides.

Fasteners between supports and the chimney length shall not penetrate the chimney liner.

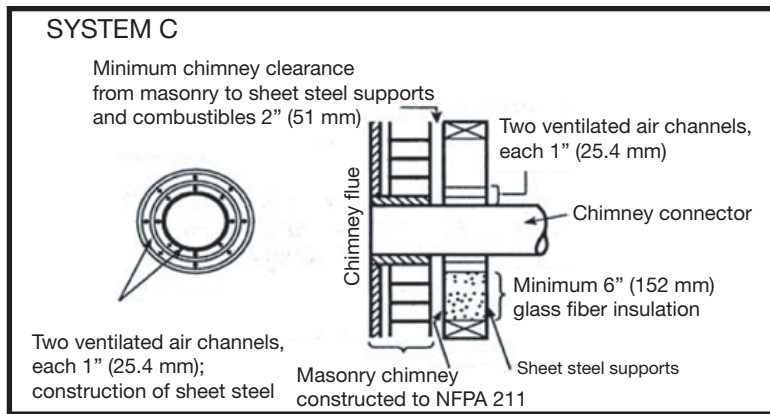


Figure 14: System C.ai

Minimum Clearance: 6 in. (152mm) to combustibles

System C. Sheet steel chimney connector, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, with a ventilated thimble, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, having two 1 in. (25.4 mm) air channels, separated from combustibles by a minimum of 6 in. (152 mm) of glass fiber insulation. Opening shall be covered, and thimble supported with a sheet steel support, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

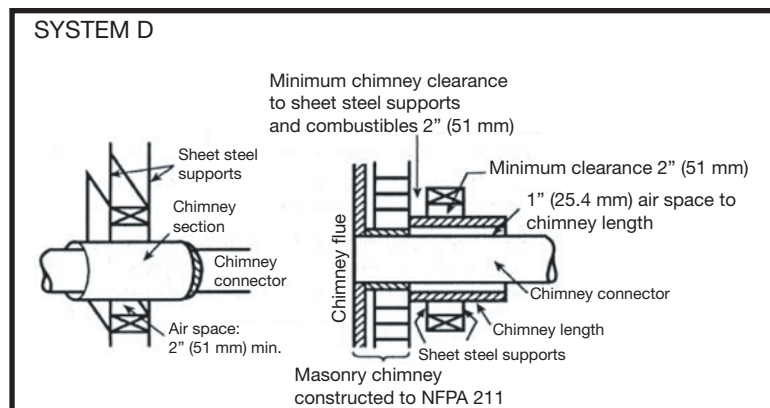


Figure 15: System D.ai

Minimum Clearance: 2 in. (51mm) to combustibles

System D. Solid-Insulated, listed factory-built chimney length with an inside diameter 2 in. (51 mm) larger than the chimney connector and having 1 in. (25.4mm) or more of insulation, serving as a pass-through for a single-wall sheet steel chimney connector of minimum 24 gauge [0.024 in. (0.61 mm)] thickness, with a minimum 2 in. (51 mm) air space between the outer wall of chimney section and combustibles.

Minimum length of chimney section shall be 12 in. (305 mm). Chimney section concentric with and spaced 1 in. (25.4 mm) away from connector by means of sheet steel support plates on both ends of chimney section. Opening shall be covered, and chimney section supported on both sides with sheet steel supports of minimum 24 gauge [0.024 in. (0.61 mm)] thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

Mobile Home Installation

Warning: Under no circumstances is this heater to be installed in a makeshift or "temporary" manner. It may be fired only after the following conditions have been met.

- **DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.**
- **DO NOT INSTALL IN A SLEEPING ROOM.**
- **CAUTION: THE STRUCTURAL INTEGRITY OF THE MOBILE HOME FLOOR, WALL AND CEILING/ ROOF MUST BE MAINTAINED.**
- Attach the stove to the floor using two 1/4" x 2" or longer lag screws through holes in the legs or the Pedestal base.
- Outside air supply must be used for Mobile Home installations - see .pg.16
- The services of a competent or certified installer, (certified by the Wood Energy Technical Training program (WETT) - in Canada, Hearth Education Foundation (HEARTH) - in U.S.A.,) are strongly recommended.

Clearances

This heater must be installed with listed double-wall connector and compatible ULC-S629 or UL-103HT listed chimney system, see page 18.

Clearances to combustible surfaces and materials are shown. See picture below.

Consult local fire codes and authorities for approval.

NOTE: Install all components to the connector or chimney manufacturer's installation requirements. Consult your chimney supplier/manufacturer for installation advice.

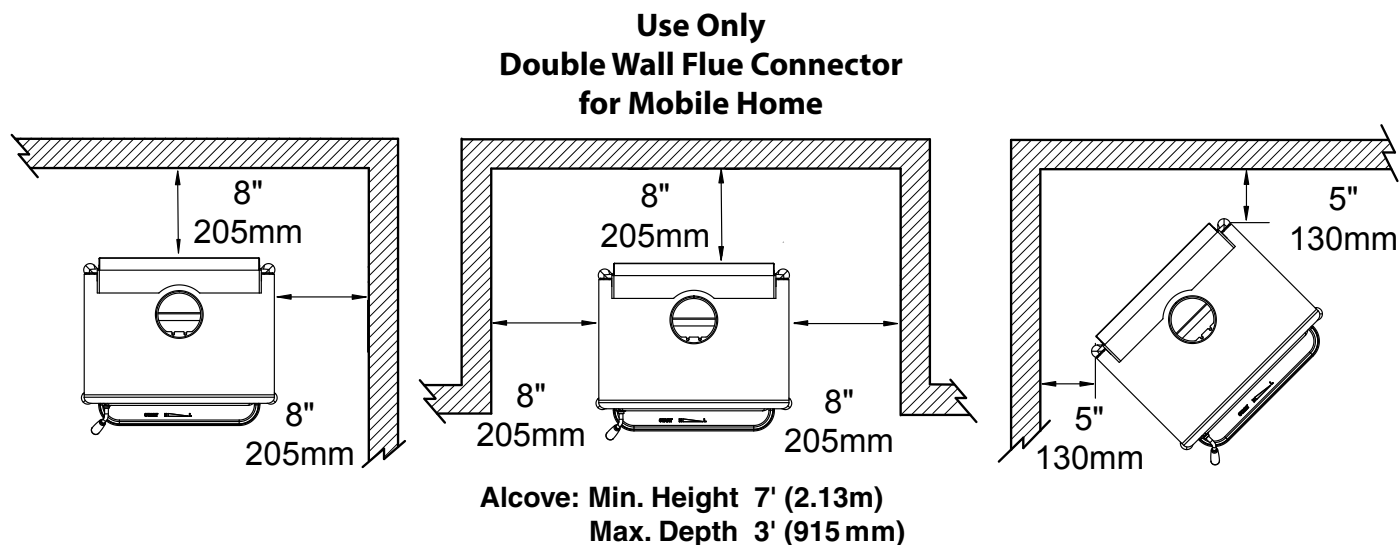


Figure 16: VISTA LE Mobile Home Clearances.

Optional Blower

The optional blower kit Part #: WODC.BLOWB is equipped with a three prong power cord and may be installed at any time. Follow the installation instructions supplied with the kit. Route power supply cord away from heater.

Electrical rating: 115 volts AC-1.02 amps.
Fan output rating: 140 CFM

Blower Operation

Proper blower speed matched with air control setting will ensure peak performance from your stove. Operate as follows:

- Air control set to "L" (low), operate blower speed control on "Low".
- Air control set between "L" and "H" (low and high), operate blower speed control at desired setting.

Automatic: To operate the blower automatically, set the rocker switch on the side of the fan housing to "Auto" and set the speed control to your desired setting. This will allow the fan to turn on as the stove heats up to operating temperature. It will also shut the blower off after the fire has gone out and the unit has cooled to below a useful heat output range.

Manual: To manually operate the blower, set the rocker switch to "Man" and set the speed control to your desired setting. This will bypass the temperature sensing device and allow full control of the blower. Switching from "Auto" to "Man" or selecting speed may be done anytime.

Note: The Blower will not shut off until it is manually turned off.

Firebrick Installation

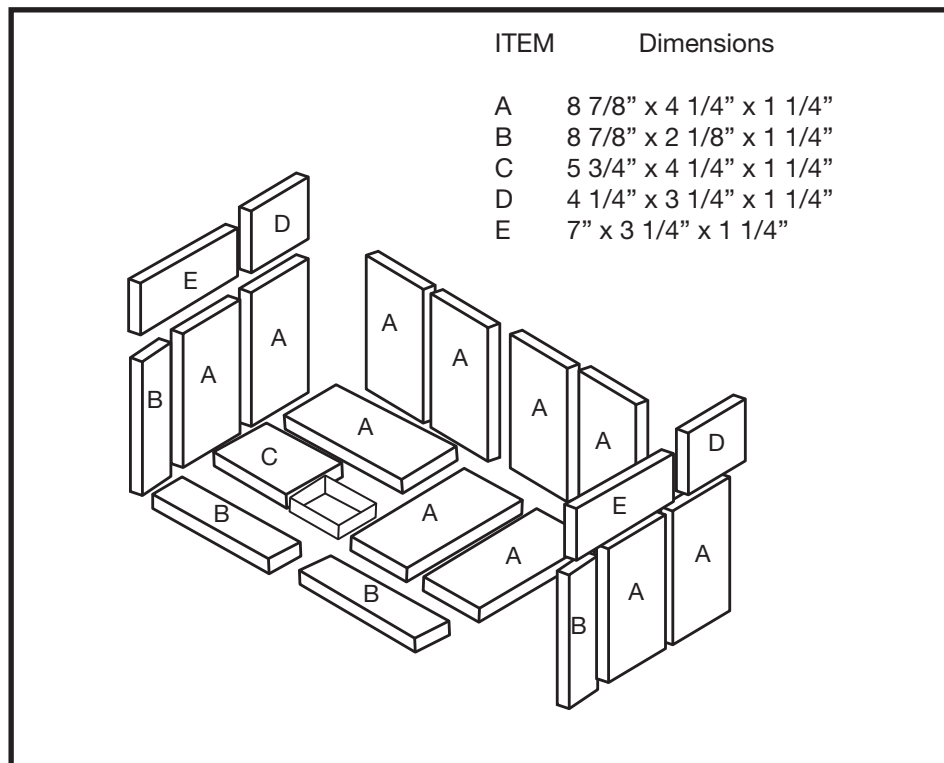


Figure 17: Neo 1.6 LE Firebrick layout.

Begin firebrick installation with the rear wall.

1. Stand one "A" firebrick vertically behind the tab located on the brick rail. Slide the firebrick toward the center of the rear wall (Figure 18).
2. Slide a 2nd "A" firebrick underneath the tab on the brick rail (Figure 19).

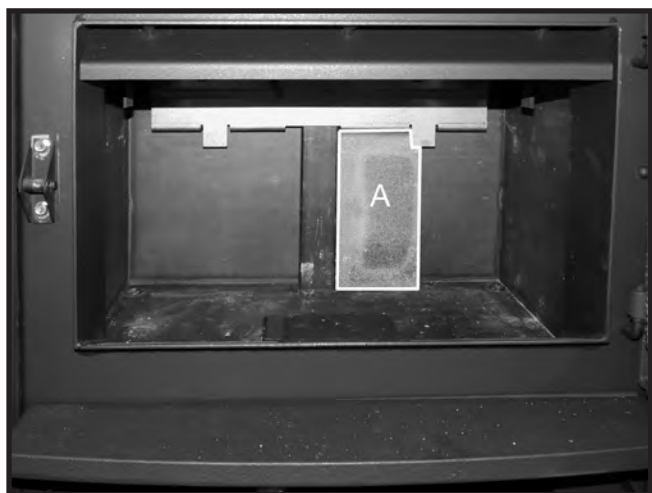


Figure 18: Installing the 1st of the rear wall firebricks.

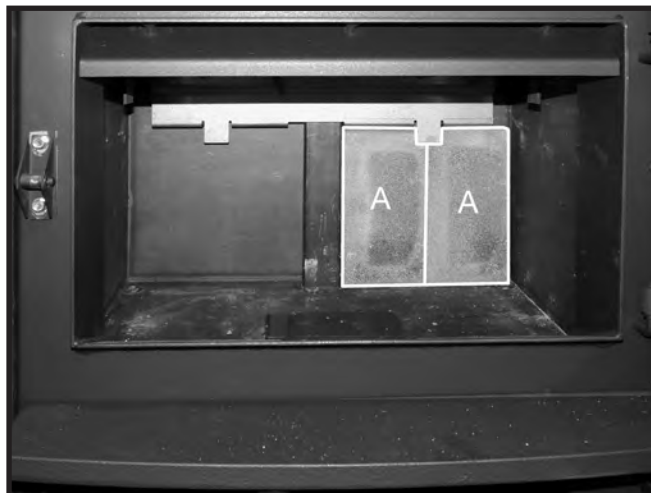


Figure 19: Installing the 2nd rear wall firebricks.

3. Repeat steps 1 & 2 for the placement of the other "A" firebricks on the rear wall (Figure 20).
4. For the side walls: Stand an "A" firebrick against the side wall and up against the rear wall firebrick (Figure 21).

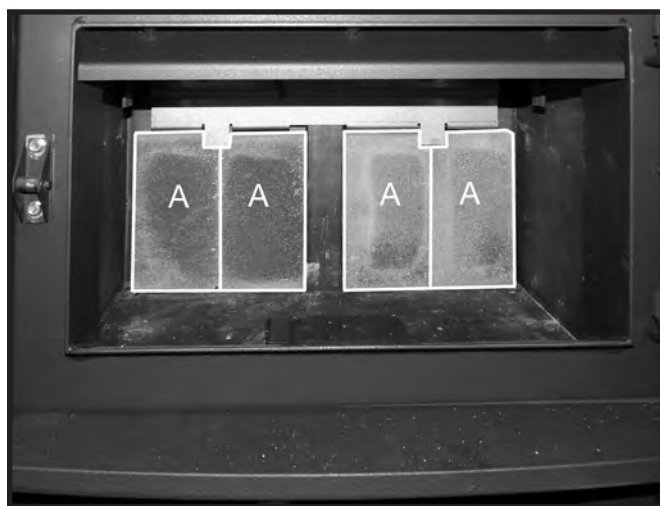


Figure 20: Remaining rear wall firebricks in place.

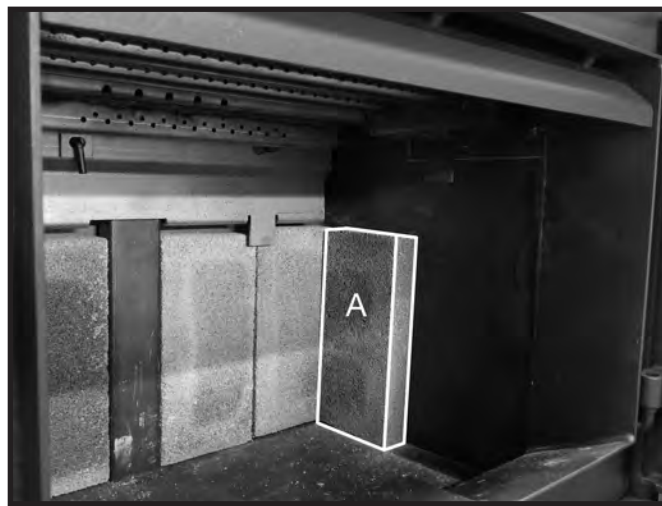


Figure 21: 1st side wall brick in place.

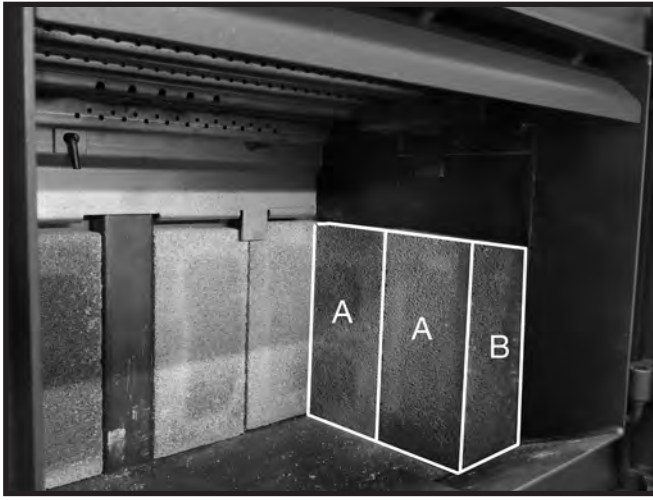


Figure 22: Lower side wall firebricks in place.

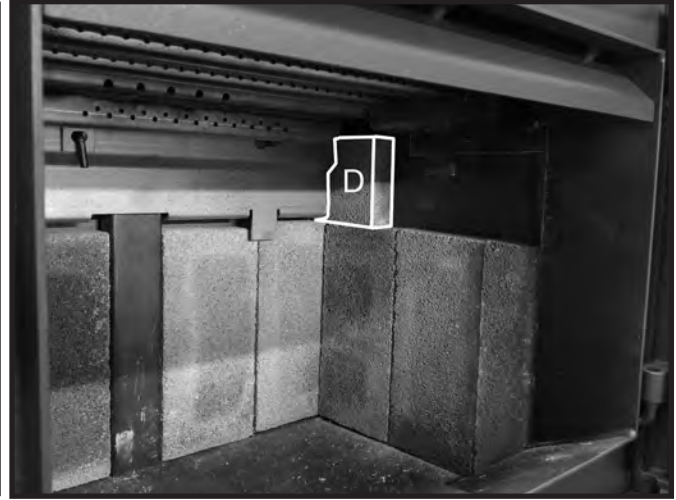


Figure 23: Small side wall firebrick in position.

5. Stand another "A" brick beside the first one followed by a narrow "B" firebrick (Figure 22).
6. Place a "D" firebrick on top of the previously placed "A" firebricks and slide this firebrick back toward the rear wall making sure that this firebrick tucks in behind the brick rail (Figure 23).
7. Slide an "E" firebrick under the side wall brick rail tab and rest on top of the three previously placed side wall firebricks (Figure 24). Repeat steps 4-7 on the other side (Figure 25).

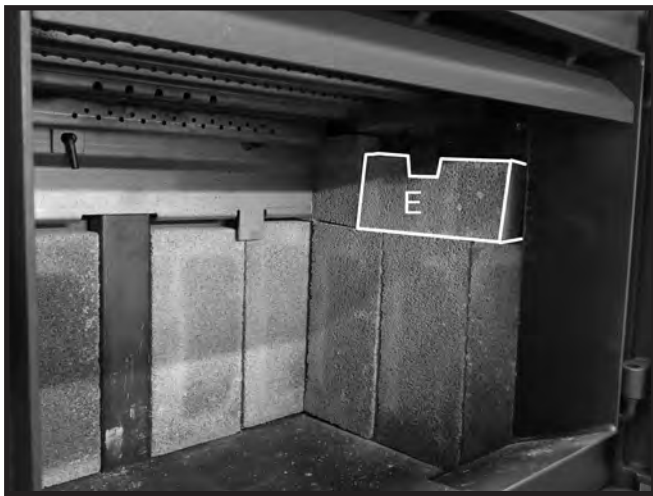


Figure 24: Final side wall firebrick in position.



Figure 25: Firebox floor with ash dump.

8. Units with Ash Dump installed:
 - Place two "A" firebricks on the firebox floor as shown in (Figure 26).
 - Place a third "A" firebrick against the rear wall as shown in (Figure 27).
 - Place the "C" firebrick so that it sits beside the ash dump, against the lefthand side wall and the "A" firebrick located directly behind the ash dump (Figure 28).
9. Units without Ash Dump installed:
 - Place 4 "A" firebricks on the firebox floor as shown in. Push brick to the back of the firebox.

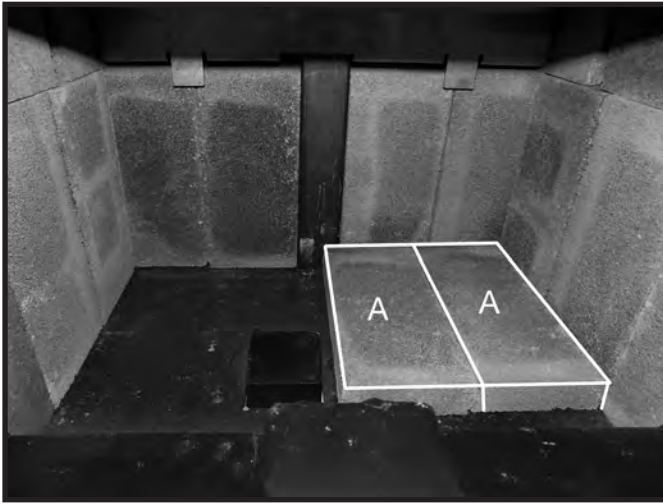


Figure 26: First two floor bricks in place.

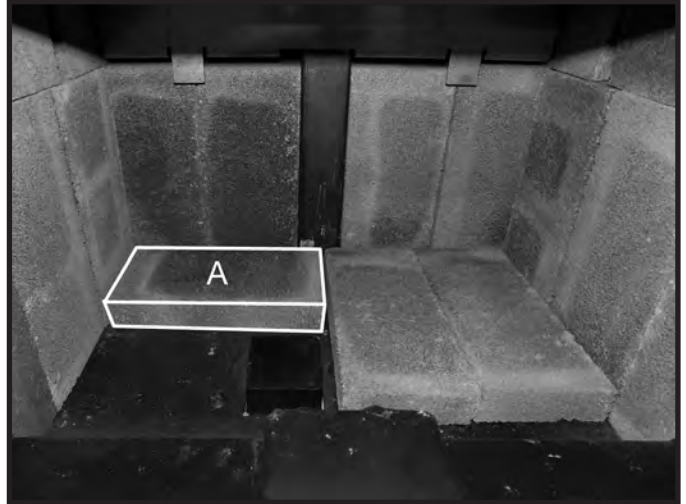


Figure 27: Third floor brick in place.

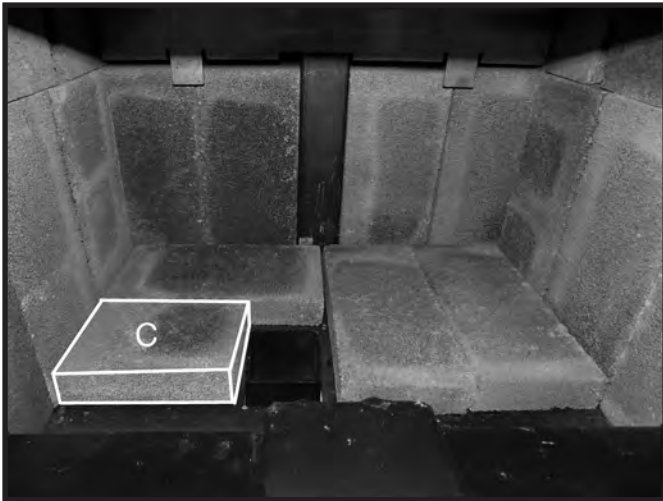


Figure 28: Fourth floor brick in place.

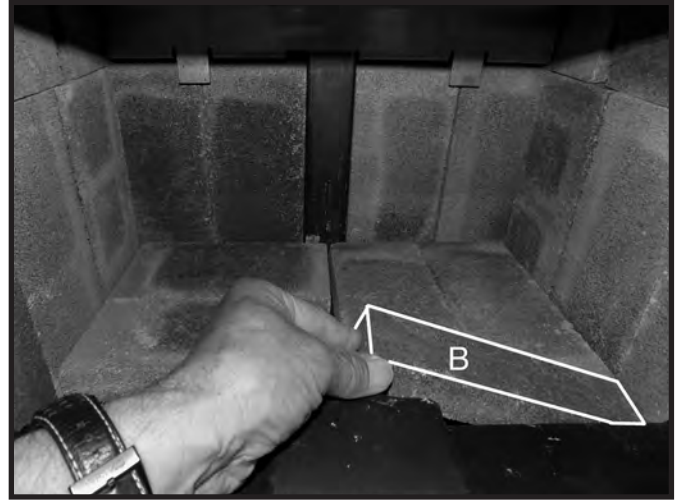


Figure 29: Narrow floor brick being positioned.

10. Place the two remaining "B" firebricks in front of the other floor firebricks to complete firebrick installation (Figure 28 and Figure 29).

Note: there will be one brick left over.

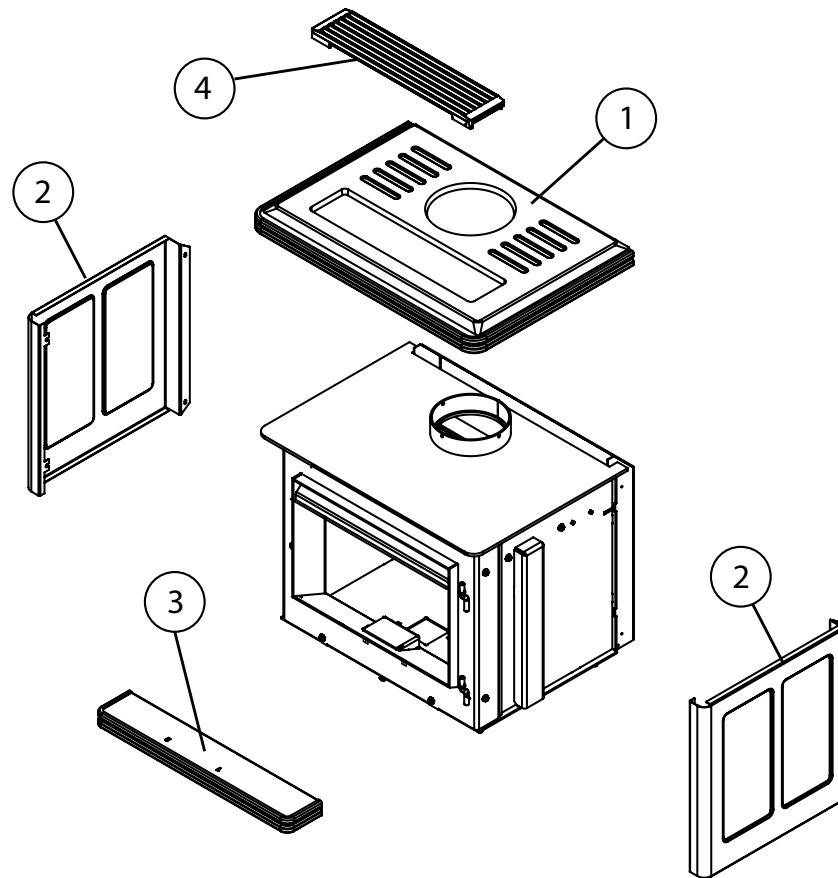


Figure 30: Final narrow brick in place.

Trouble Shooting

Problem	Cause	Cure
Excessive Creosote Build-up	1) Wood is too wet 2) Turning down air control too soon 3) Draft too low	- Use dry wood - Do not turn down until: a) there is a good bed of coals b) the wood is charred - Chimney plugged or restricted, check flue - Improper chimney height and/or diameter - Provide outside air for combustion - Check draft in chimney and system, alter as needed.
Glass is Dirty	1) See 1, 2, and 3 above 2) Door Gasket leakage	- Replace gasket - Check door latch
Low Heat Output	1) Wood may be wet 2) Fire too small 3) Draft too low	- Check wood and use drier wood if required. - Build a larger fire - Open draft control to increase burn rate. - Chimney plugged or restricted Inspect and clean
Won't Burn Overnight	1) Air control set too high 2) Not enough wood 3) Draft too high	- Set control lower - Unsplit wood is preferred for overnight burns - Excessive chimney height and/or diameter, see page 11
Stove Won't Burn	1) Combustion air supply is blocked	- Check outside air supply for obstructions - Check that room air cover is removed. - Chimney plugged or restricted Inspect and clean

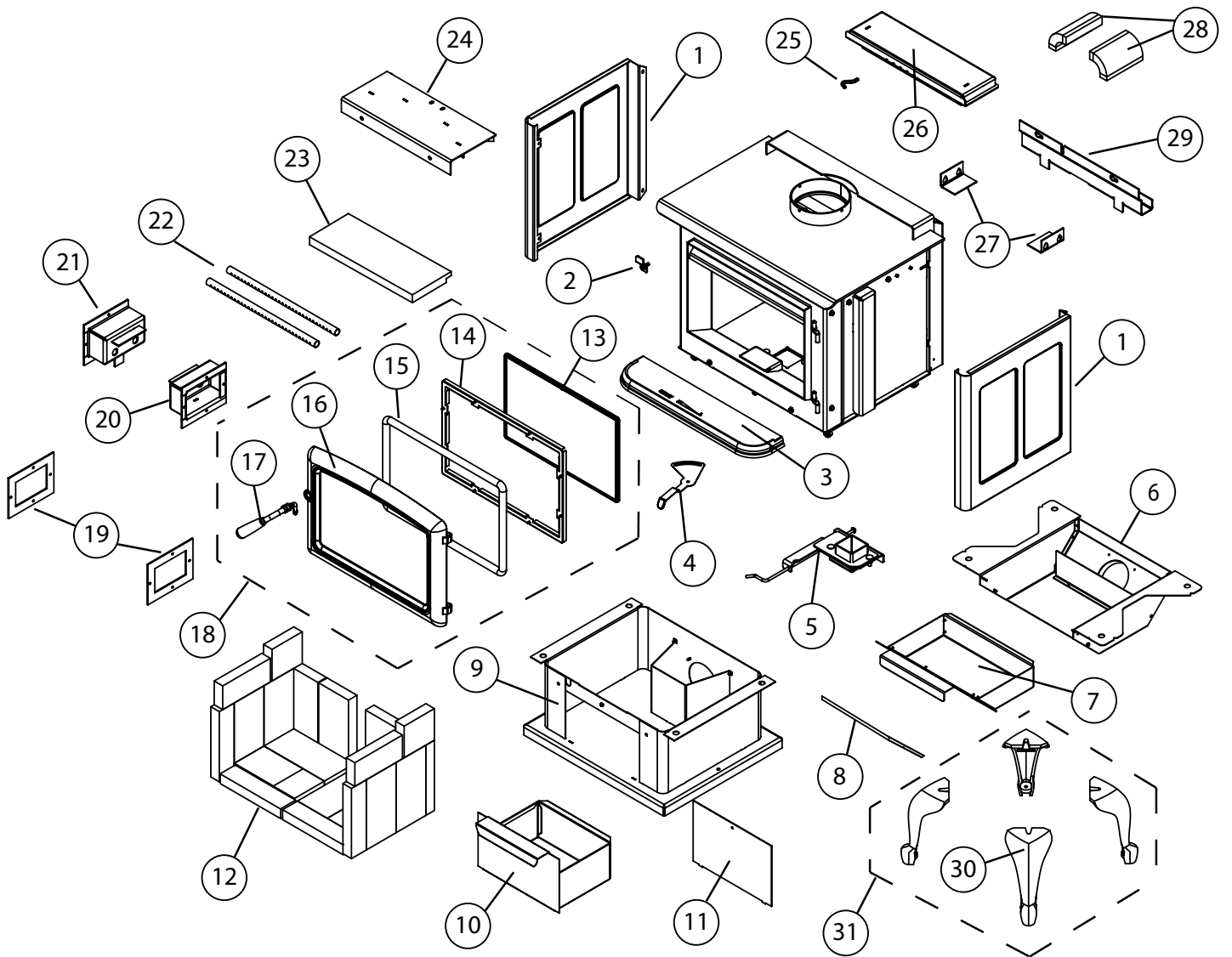
Replacement Parts - VISTA CLASSIC LE



CLASSIC ONLY ENAMEL PARTS:

1..... Top, Ebony Black.....	80002397
..... Top, Ivory	80002398
..... Top, Sunset Red	80002399
2..... Side, Ebony Black	80002400
..... Side, Ivory.....	80002401
..... Side, Sunset Red.....	80002402
3..... Ash Shelf, Ebony Black	80001000
..... Ash Shelf, Ivory.....	80000342
..... Ash Shelf, Sunset Red.....	80001005
4..... Casting, Trivet, Met Black.....	11260005
..... Casting, Trivet, Nickel.....	11260006

(WHEN ORDERING, INCLUDE PART NUMBER WITH DESCRIPTION)



Replacement Parts - VISTA LE

ITEM	DESCRIPTION	PART NO.
1.....	Side shield, left or right.....	80002386
2.....	Door catch, Vista LE.....	80002387
3.....	Ashlip (c/w hardware).....	80000018
4.....	Air Control, Primary.....	80002215
5.....	Ash dump assembly.....	80001793
6.....	Ash drawer enclosure.....	80002388
7.....	Ash box (leg model).....	80002389
8.....	Ash Drawer Enclosure Cover.....	80002390
9.....	Pedestal.....	80002391
10.....	Ash box (pedestal model).....	80002392
11.....	Pedestal front cover assembly.....	80002393
12.....	Firebrick, NEO 1.6 LE / Vista LE (set).....	80002355
13.....	Glass(c/w Tape), NEO 1.6.....	80000220
14.....	Glass Retainer, NEO 1.6 / Vista LE.....	80002356
15.....	Gasket, Door, NEO 1.6/ Vista LE.....	80000670
16.....	Casting, Door, Vista LE, Black.....	80002394
.....	Casting, Door, Vista LE, Nickel.....	80002395
.....	Casting, Door, Vista LE, Brushed Nickel.....	80002396
17.....	Door handle assembly.....	80000660
18.....	Door Assembly, Met Black.....	11190026
.....	Door Assembly, Nickel.....	11190025
.....	Door Assembly, Brushed Nickel.....	11190024
19.....	Tube Air Box Gasket, NEO 1.6 LE / Vista LE.....	80002359
20.....	Tube Air Box (RHS), NEO 1.6 LE / Vista LE.....	80002365
21.....	Tube Air Box (LHS), NEO 1.6 LE / Vista LE.....	80002358
22.....	Tubes, NEO 1.6 LE /Vista LE (set of 2).....	80002364
23.....	Baffle Board, NEO 1.6LE / Vista LE.....	80002357
24.....	Flame Shield, NEO 1.6 LE / Vista LE,.....	80002360
25.....	Baffle, Pin, (10pc).....	80000364
26.....	Baffle, NEO 1.6 LE / Vista LE.....	80002361
27.....	Brick Rail Set, Left/Right, NEO 1.6 LE / Vista LE.....	80002363
28.....	Baffle Blanket (set), NEO 1.6 LE / Vista LE.....	80002362
29.....	Rear Brick Rail, NEO 1.6.....	80001723
30.....	Casting, Leg, Black.....	80000148
.....	Casting, Leg, Nickel.....	80000783
.....	Casting, Leg, Brushed Nickel.....	80000147
31.....	Legs, (4pc kit), Black.....	11130006
.....	Legs, (4pc kit), Nickel.....	11130007
.....	Legs, (4pc kit), Brushed Nickel.....	11130004

All parts may be ordered from your nearest Pacific Energy dealer. Contact Pacific Energy for the location of the dealer nearest you.

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PACIFIC ENERGY FIREPLACE PRODUCTS LTD.

2975 Allenby Rd., Duncan, B.C. V9L 6V8

Web site: <http://www.pacificenergy.net>

For additional technical support, please contact your dealer

**IMPORTANT:
THESE INSTRUCTIONS ARE TO
REMAIN WITH THE HOMEOWNER**

**PACIFIC
ENERGY**

SERIAL #

SAFETY NOTICE

If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area.

Meets the Environmental Protection Agency's 2020 Particulate Emission Standards (Crib Wood).



OPERATING AND INSTALLATION INSTRUCTIONS



**MODEL:
NEOSTONE 1.6 LE**

Visit www.pacificenergy.net for the most recent version of this manual

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PLEASE SAVE THESE INSTRUCTIONS

NOTE: WE STRONGLY RECOMMEND THAT SMOKE AND CARBON MONOXIDE DETECTORS BE INSTALLED IN THE AREA WHERE THE HEATER IS TO BE INSTALLED.

If smoke detectors have been previously installed, you may notice that they are operating more frequently. This may be due to curing of stove paint or fumes caused by accidentally leaving the fire door open. Do not disconnect the detectors.

SAFETY NOTICE: If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in you area.

Please read this entire manual before you install and use your new room heater. Failure to follow instructions may result in property damage, bodily injury, or even death.

Experience will give you the right settings for proper combustion and efficient burning. Remember the correct air inlet setting is affected by variables such as type of wood, outside temperature, chimney size and weather conditions. With practice, you will become proficient in operating your heater and will obtain the performance for which it was designed.

PLEASE SAVE THESE INSTRUCTIONS

This manual describes the installation and operation of the Pacific Energy, NEO 1.6 LE Freestanding wood heater.

SAFETY NOTICE: If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area.

Please read this entire manual before you install and use your new room heater. Failure to follow instructions may result in property damage, bodily injury, or even death.

This heater meets the 2020 U.S. Environmental Protection Agency's crib wood emission limits for wood heaters sold after May 15, 2020 using Method 28R.

Model NEO 1.6 LE: 1.9 g/hr..

Under specific test conditions this heater has been shown to deliver heat at rates ranging from:

XX,XXX to XX,XXXBtu/hr.

Efficiency and BTU Output

EPA Certified Emissions	1.9 grams per hour
LHV Tested Efficiency 1	78.2%
HHV Tested Efficiency 2	72.3%
EPA BTU Output 3	XXXXX btu/hr.
Peak BTU/Hr. Output 4	XX,X00 btu/hr.
Maximum Wood Length	18 inches
Ideal Wood Length	17 inches
Fuel	Seasoned Cord wood

1 Weighted Average Lower Heating Value (LHV) efficiency as tested using CSA B415 Performance testing of solid-fuel-burning heating appliances. LHV assumes the moisture is already in a vapour state so there is no loss of energy

2 Weighted Average Higher Heating Value (HHV) efficiency as tested using CSA B415 Performance testing of solid-fuel-burning heating appliances. HHV includes the energy required to vaporize the water in the fuel

3 The range of BTU outputs is based on efficiency using CSA B415 Performance testing of solid-fuel-burning heating appliances and burn rates from the low and high EPA tests using Douglas Fir dimensional lumber.

4 The Peak BTU/hr. is based on efficiency using CSA B415 Performance testing of solid-fuel-burning heating appliances, the Maximum one hour High burn rate from the High Burn EPA test and the BTU content of cord wood (8600 btu/lb).

[illegible]

CAUTION: 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.

Instruct all members of your family on the safe operation of the heater. Ensure they have enough knowledge of the entire system if they are expected to operate it. Stress the section on chimney fires and the importance of following the steps outlined "In Case of Chimney Fire".

Chimney Smoke and Creosote Formation

When wood is burned slowly, it produces tar and other organic vapours, which combine with expelled moisture to form creosote. The creosote vapours 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 connector and chimney should be inspected periodically (at least once every two months) during the heating season to determine if a creosote buildup has occurred. If creosote has accumulated (3 mm. or more), it should be removed to reduce the risk of a chimney fire.

1. Highest smoke densities and emissions occur when a large amount of wood is added to a bed of hot coals and the air inlet is closed. The heated wood generates smoke, but without ample air, the smoke cannot burn. Smoke-free, clean burning requires small fuel loads, two or three logs at a time or 1/4 to 1/2 of fuel load and leaving the air inlet relatively wide open, especially during the first 10 to 30 minutes after each loading, when most of the smoke generating reactions are occurring. After 30 minutes or so, the air inlet can be turned down substantially without excessive smoke generation. Wood coals create very little creosote-producing smoke.
2. The cooler the surface over which the wood smoke is passing, the more creosote will be condensed. Wet or green wood contributes significantly to creosote formation as the excess moisture that is boiled off cools the fire, making it difficult for the tars and gases to ignite, thus creating dense smoke and poor combustion. This moisture-laden smoke cools the chimney, compounding the problem by offering the smoke the ideal place to condense.

In summary, a certain amount of creosote is inevitable. Regular inspection and cleaning is the solution. The use of dry, seasoned wood and ample combustion air will help to minimize annoying smoke emissions and creosote buildup.

Chimney Fires

The dangerous side effect of excessive creosote buildup is a chimney fire. This causes much higher than normal temperatures in the chimney and on its exterior surfaces. Temperatures inside the chimney can exceed 2000°F (1100°C). Ignition of nearby or touching combustible material is more likely during a chimney fire. Proper clearances are critical to prevent damage during such a fire.

Chimney fires are easy to detect; they usually involve one or more of the following:

- Flames and sparks shooting out of the top of the chimney
- A roaring sound
- Vibration of the chimney

To Avoid a Chimney Fire

1. Burn wood cleanly. Do not burn wet wood or turn down the unit too quickly after loading.
2. Do not let creosote build up to a point where a chimney fire is possible.
3. Do not have fires in the heater that may ignite chimney fires. These are excessively hot fires, such as when burning household trash, cardboard, Christmas tree limbs, or even ordinary fuel wood; (e.g. with a full load on a hot bed of coals and with the air inlet wide open for more time than is needed to completely char a fresh fuel load.)
4. The Chimney and connector pipe should be inspected /cleaned periodically.

In Case of a Chimney Fire

1. Prepare to evacuate to ensure everyone's safety. Have a well understood plan of action for evacuation. Have a place outside where everyone is to meet.
 2. Close air inlet on stove.
 3. Call local fire department. Have a fire extinguisher handy. Contact your local municipal or provincial fire authority for further information on how to handle a chimney fire. It is most important that you have a clearly understood plan on how to handle a chimney fire.
 4. After the chimney fire is out, the chimney must be cleaned and checked for stress and cracks before starting another fire. Also check combustibles around the chimney and the roof.
- The services of a competent or certified installer, (certified by the Wood Energy Technical Training program (WETT) - in Canada, Hearth Education Foundation (HEARTH) - in U.S.A.,) are strongly recommended.

Curing of the Paint Finish

To achieve the best finish, the paint on your stove must be baked on. When burning your stove for the first 2-3 times it is very important that the room be well ventilated. Open all windows and doors. Smoke and fumes caused by the curing process may cause discomfort to some individuals.

WARNING: Never use chemicals or any other volatile liquid to start a fire. Do not burn garbage, or flammable fluids such as gasoline, naphtha, or engine oil.

Operation

CAUTION: Hot while in operation. Keep children, clothing and furniture away. Contact may cause skin burns.

WARNING: Always keep loading door closed when burning. This heater is not designed for open door burning.

WARNING: No alteration or modification of the combustion air control assembly is permitted. Any tampering will void warranty and could be very hazardous.

WARNING: Do not use grates or andirons to elevate the fuel. Burn directly on the fire bricks. Replace broken or missing bricks. Failure to do so may create a hazardous condition.

Wood Selection

This heater is designed to burn natural wood only. Higher efficiency and lower emissions generally result when burning air-dried seasoned hardwoods, as compared to softwoods or to green or freshly cut hardwoods.

Wood should be properly air dried (seasoned) for six months or more. Wet or undried wood will cause the fire to smoulder and produce large amounts of smoke and creosote. Wet wood also produces very little heat and tends to go out often. Wood should be stored under cover away from open flame or heat sources.

DO NOT BURN :

• Salt water wood *	• Treated wood
• Wet or green wood	• Coal/charcoal
• Garbage*	• Solvents
• Lawn clippings/yard waste	• Unseasoned wood
• Railroad ties	• Manure or animal remains
• Materials containing rubber, including tires	• Materials containing plastic
• Construction or demolition debris	• Materials containing asbestos
• Waste petroleum products, paints, paint thinners, or asphalt products	• Paper products, cardboard, plywood, or particleboard.

*** These materials contain chlorides which will rapidly destroy metal surfaces and void warranty.**

Burning these materials may result in the release of toxic fumes or render the heater ineffective and cause smoke.

Do not burn anything but wood. Other fuels, e.g. Charcoal, can produce large amounts of carbon monoxide, a tasteless, odourless gas that can kill. Under no circumstances should you attempt to barbecue in this heater.

The prohibition against burning these materials does not prohibit the use of fire starters made from paper, cardboard, saw dust, wax and similar substances for the purpose of starting a fire in an affected wood heater.

How to Test Your Wood

Add a large piece of wood to the stove when it has a good large bed of coals. It is dry if it is burning on more than one side within one minute. It is damp if it turns black and lights within three minutes. If it sizzles, hisses and blackens without igniting in five minutes it is too wet and should not be burnt

Lighting a fire

WARNING: Never use chemicals or any other volatile liquid to start a fire.

1. Adjust air control to "High" position (all the way to the left) and open door.
2. Place crumpled newspaper in the centre of the heater and crisscross with several pieces of dry kindling. Add a few small pieces of dry wood on top.
3. Ignite the paper and leave the door ajar approximately 1/2"(13mm) - 1"(25mm) until the wood kindling is fully engulfed in flame.
4. After the kindling is fully engulfed add a few small logs. Close door.
5. Begin normal operation after a good coal base exists and wood has charred.

Normal Operation

WARNING: 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 the operating instructions in this manual.

1. Set air control to a desired setting. If smoke pours down across the glass (waterfall effect) this indicates you have shut the control down too soon or you are using too low a setting. The wide range control panel makes finding the desired setting for your application easy. As every home's heating needs vary (i.e. Insulation, windows, climate, etc.) The proper setting can only be found by trial and error and should be noted for future burns.
 2. To refuel, adjust air control to high, and give the fire time to brighten. Open the door slowly, this will prevent back puffing.
 3. Use wood of different shape, diameter and length (up to 18"(457mm)). Load your wood endwise and try to place the logs so that the air can flow between them. Always use dry wood.
 4. Do not load fuel to a height or in such a manner that would be hazardous when opening the door.
 5. For extended or overnight burns, unsplit logs are preferred. Remember to char the wood completely on maximum setting before adjusting air control for overnight burn.
- Burn wood only, dry and well seasoned. The denser or heavier the wood when dry, the greater its heat value. This is why hardwoods are generally preferred. Green or wet wood will cause a rapid buildup of creosote. If you feel it is necessary to burn wet or unseasoned wood, do so only with the air inlet set open enough to maintain a good strong fire and fairly high chimney temperatures. Do not attempt to burn overnight using green wood or wet wood. Wet wood can cause up to 25% drop in heater output, as well as contributing significantly to creosote buildup.

DO NOT OVER FIRE THIS HEATER: Attempts to achieve heat output rates that exceed heater design specifications can result in permanent damage to the heater and chimney. A glowing red, top or vent pipe are indications of over firing. Failure to rectify an over firing condition can be hazardous and may void the manufacturer's warranty.

Restarting After Extended or Overnight Burns

1. Open door and rake hot embers towards the front of the heater. Add a couple of dry, split logs on top of embers, close door.
2. Adjust air control to high and in just a few minutes, logs should begin burning.
3. After wood has charred, reset air control to desired setting.
4. To achieve maximum firing rate, set control to high "H". Do not use this setting other than for starting or preheating fresh fuel loads.

Proper Draft

1. Draft is the force which moves air from the appliance up through the chimney. The amount of draft in your chimney depends on the length of the chimney, local geography, nearby obstructions and other factors.
2. Too much draft may cause excessive temperatures in the appliance. An uncontrollable burn or a glowing red stove part or chimney indicates excessive draft.
3. Inadequate draft may cause back puffing into the room and plugging of the chimney. Smoke leaking into the room through appliance and chimney connector joints indicates inadequate draft.

Remember the correct air inlet setting is affected by variables such as type of wood, outside temperature, chimney size and weather conditions.

Ash Removal

Caution: Ashes are to be removed only when the heater is cold. Whenever ashes get 3"(76mm) to 4"(102mm) deep in your firebox, and when fire has burned down and cooled, remove excess ashes. Leave an ash bed approximately 1" (25 mm) deep on the firebox bottom to help maintain a hot charcoal bed.

Ash Cleanout system (optional):

The ash dump handle is located under the ash lip on the left hand side. To operate ash dump, pull handle out 1/2"(13mm) and turn clockwise. This will unlock the ash dump and allow it to open. Hold handle open while pulling ashes into the opening. Avoid large embers as these still contain heat value. Release handle and push in to lock. Ensure ash dump door is properly engaged. Fill the cavity with the remaining ash level with the firebox floor. Lift and pull out ash pan and discard ashes into metal container. Replace ash pan and ensure it is seated properly.

Do not burn with ash dump door open. Doing so will create a hazardous condition. Always leave about 1"(25mm) of ash when cleaning.

Disposal of Ashes

Ashes should be placed in a metal container with a tight fitting lid. The closed container of ashes should be placed on a non-combustible 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 closed container until all cinders have thoroughly cooled. Other waste should not be placed in this container.

Maintenance

WARNING: Never use chemicals or any other volatile liquid to start a fire. Do not burn garbage, or flammable fluids such as gasoline, naphtha, or engine oil.

WARNING: ONLY USE MATERIALS SUPPLIED BY MANUFACTURER WHEN DOING MAINTENANCE OR REPLACEMENTS.

1. If glass becomes darkened through slow burning or poor wood, it can readily be cleaned with fireplace glass cleaner when stove is cold. Never scrape with an object that might scratch the glass. The type and amount of deposit on the glass is a good indication of the flue pipe and chimney buildup. A light brown dusty deposit that is easily wiped off usually indicates good combustion and dry, well-seasoned wood and therefore relatively clean pipes and chimney. On the other hand, a black greasy deposit that is difficult to remove is a result of wet and green wood and too slow a burning rate. This heavy deposit is building up at least as quickly in the chimney.
2. **DOOR GASKETS** - The gasket used by Pacific Energy (7/8"(22mm) medium density fiberglass rope) requires only light pressure to seal. This will prolong seal life. It is important that the door seal be maintained in good condition. Periodically inspect seals and replace if necessary. Follow the instructions included in the DR31.WDGKIT kit, obtainable from your nearest Pacific Energy dealer.
3. **DOOR GLASS** - Do not slam loading door or otherwise impact glass. When closing door, make sure that no logs protrude to impact the glass. If the glass gets cracked or broken, it must be replaced before using the stove. Replacement glass can be obtained from your dealer. Use 8-13/16"(224mm) x 15-1/4"(387mm) x 5 mm. Ceramic glass only. **Do not substitute with any other type.**
- To remove broken glass, undo the four retaining screws and remove clamps and frame, noting position for re-assembly. Remove all particles of glass. Be careful as they are very sharp. Install new glass complete with gasket. Replace frame, clamps and screws.

CAUTION:

- Do not overtighten, tighten screws very carefully
 - Do not clean glass when hot
 - Do not use abrasive cleaners on glass
4. The area where boost combustion air enters the firebox must be kept clear of excessive ash buildup which will block air flow. This area is at the front of the firebox.
 5. Do not store wood within heater installation clearances, or within the space required for fuel loading and ash removal. Keep the area around the heater clean and free of loose combustibles, furniture, newspapers, etc.
 6. If the plated door requires cleaning, use mild soap and water only. Use of abrasive cleaners will void warranty.
 7. Establish a routine for the fuel, wood burning and firing technique. Check daily for creosote buildup until experience shows how often you need to clean to be safe.
 8. Be aware that the hotter the fire, the less creosote is deposited. Weekly cleaning may be necessary in mild weather, even though monthly cleaning is usually enough in the coldest months when burning rates are higher. When wood is burned slowly, it produces tar and other organic vapours, which combine with expelled

Maintenance Checks

Check the following parts for damage such as cracks, excessive corrosion, burned out sections and excessive warping: (See website for descriptions and more detail)

Weekly:

- Firebrick - Visual, for cracking.
- Door Gasket - sagging, placement, damage.

Monthly

- Brick rail tabs and brick rails.
- Air riser tube in the back of the firebox.
- Back side of airwash chamber.
- Baffle locking pin.
- Boost tube cover.

When Cleaning the Chimney System:

- Top baffle board/blanket.
- Baffle.
- Top heat shield and mounting bolt.
- Baffle Gasket.
- Brick Rails.
- Manifold.

Blower:

- The blower should be cleaned out a minimum every six months by using a vacuum on the grill openings in the back and bottom of the blower casing to remove any dust and debris.

Baffle:

- Some warping of the baffle is normal(up to 1/4" or .65cm). Replace if the baffle has permanent warping greater than this or has cracking or breakage.
- Please contact your Dealer if you experience any of the damage listed above. Continuing to operate your stove with broken parts can accelerate damage to other parts and may void your warranty

Baffle Removal

Chimney connector pipe should be disconnected from stove to clean and inspect. Only if this is not possible should you remove baffle assembly.

DO NOT OPERATE WITH BAFFLE ASSEMBLY OR INSULATION REMOVED.

Removal

Remove retaining pin at the back of the firebox, just under the baffle. Lift baffle up and pull forward to disconnect from the supply tube. Tilt baffle sideways to drop down and remove from firebox. Inspect gasket between baffle and supply tube. If necessary, replace with gasket #139.5 available from your Pacific Energy dealer. Re-install baffle assembly in reverse order. The two side pieces of insulation must be tight against the side rails.

Dimensions

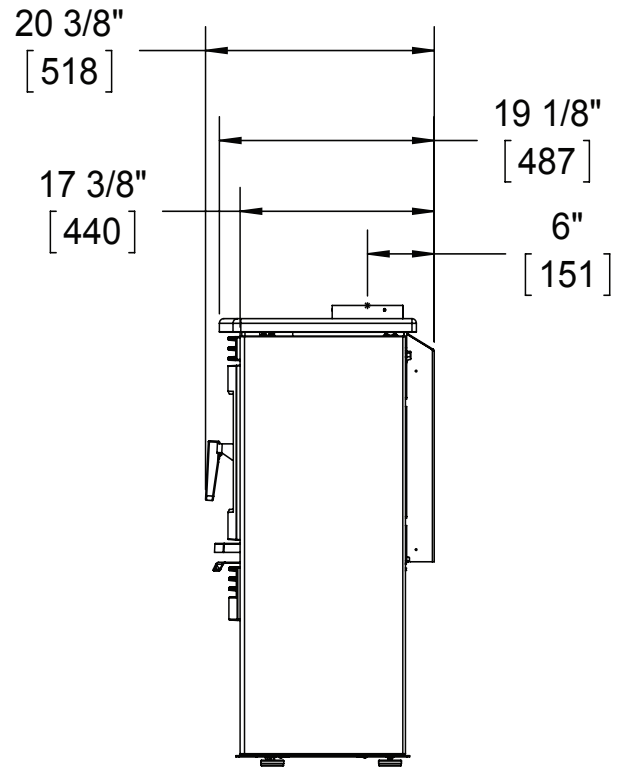
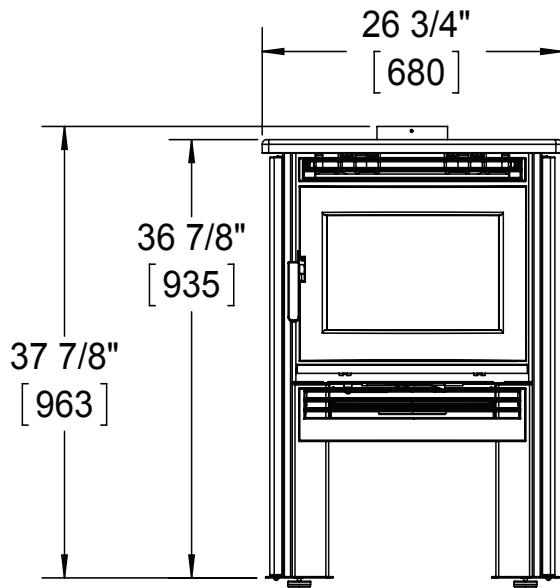


Figure 1: NE16.CLBODYA DIMS.AI

Crate Removal

1. Carefully remove the crate top and supports.
2. Remove plastic cover.
3. Using a 7/16" wrench, remove lag bolts that secure stove body to bottom pallet.

Assembly - Soapstone Panels

NOTE: We strongly recommended that two people are used to remove or install the Soapstone Top and Side Panels due to the weight of the pieces.

Soapstone can be easily scratched and damaged. Please be very careful when removing or installing the Top and/or Side Panel pieces and place pieces on a non-marking soft surface.

1. Leaving the crate with a long narrow side down, carefully remove the long slats. using clean gloves (with rubber grip) carefully lift a long, side pieces at each end, from the crate.
 2. Remove the screws in the Side Panel Mounting Brackets. "Figure 2: side panel mounting brackets."
 3. Gently place the Soapstone Side Panel (the edge with the larger corner radius to the front) near the Base. Lift the Panel up and engage the holes in the panel onto the pins in the Base."Figure 3: NEOSTone side panel to Pins."
- Note: There are holes on both ends of the panel to allow for right or left side installation. The holes are offset front to back, if the panel does not sit flush with the metal edging on the front then flip panel so that the larger radius is to the front.

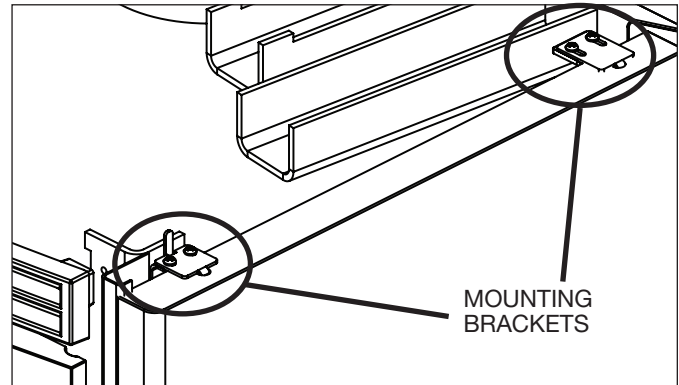


Figure 3: side panel mounting brackets.

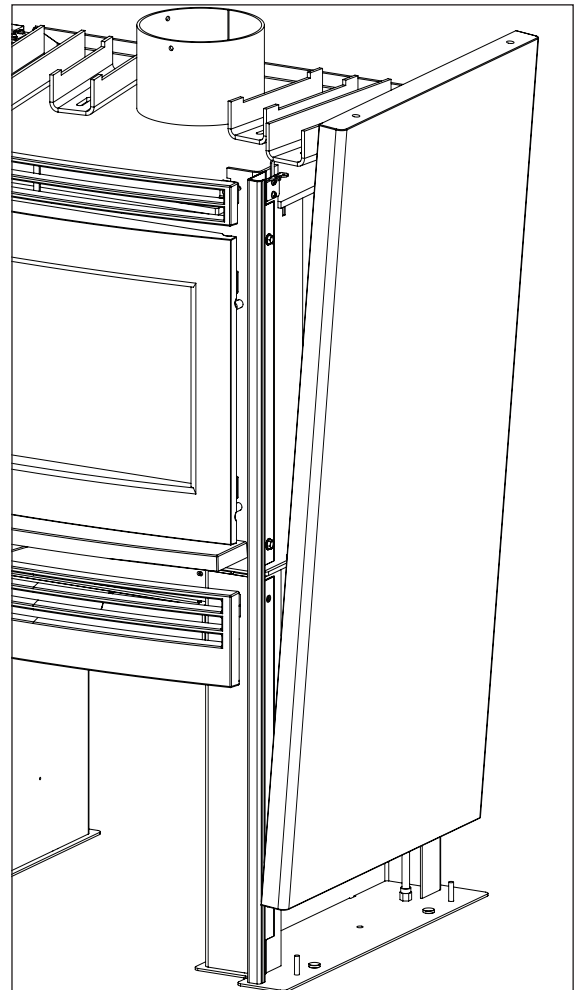


Figure 2: NEOSTone side panel to Pins.

4. While supporting the side panel, Install the Mounting Brackets with the pin placed into the holes in the panels. Install the screws, securing the front and rear Mounting Brackets to the top face of the Soapstone Side Panel. Fig. #3
5. Repeat the procedures 2 thru 5 for the other side. Do Not let the crate fall/drop after removing the sides.

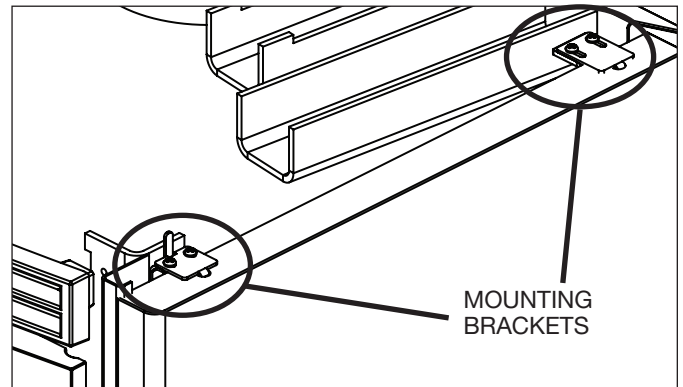
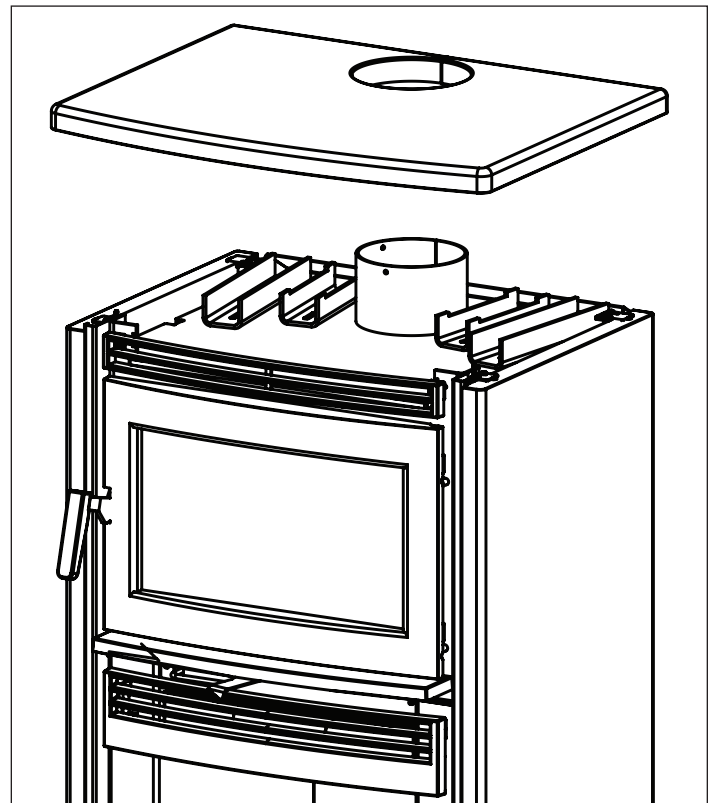


Figure 4: side panel mounting brackets.

6. Lift the Top piece up over the flue collar and the pins at the front corners. Gently lower the top onto the pins and center the opening around the flue collar.



Floor Protector

The stove may be installed on a combustible floor provided noncombustible ember protection is used. This protection must extend as follows:

In USA: 16" (406 mm) to the front and 8" (203 mm) to the sides of the fuel loading door opening. See Figure #4, below. This protection is also required under the chimney connector and 2" (51 mm) beyond each side.

U.S.A. Only

Minimum Width - 33 3/8" (848mm)
Minimum Overall Depth - 32 3/4" (832mm)

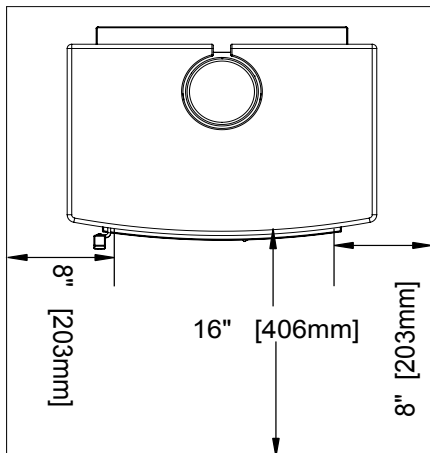


Figure 5: NEO16 NEOSTONE FLOOR PROTECTOR USA.

In Canada: 18" (457 mm) on the firing side and 8" (203 mm) to the other sides.

Canada Only

Minimum Width - 42 3/4" (1.09m)
Minimum Overall Depth - 45 1/8" (1.12m)

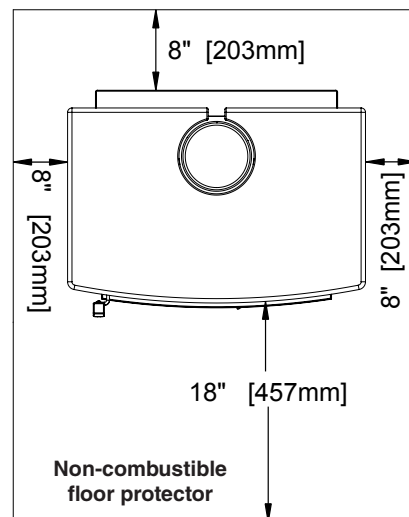


Figure 6: NEO16 NEOSTONE FLOOR PROTECTOR CAN.

Residential Installation

Clearances:

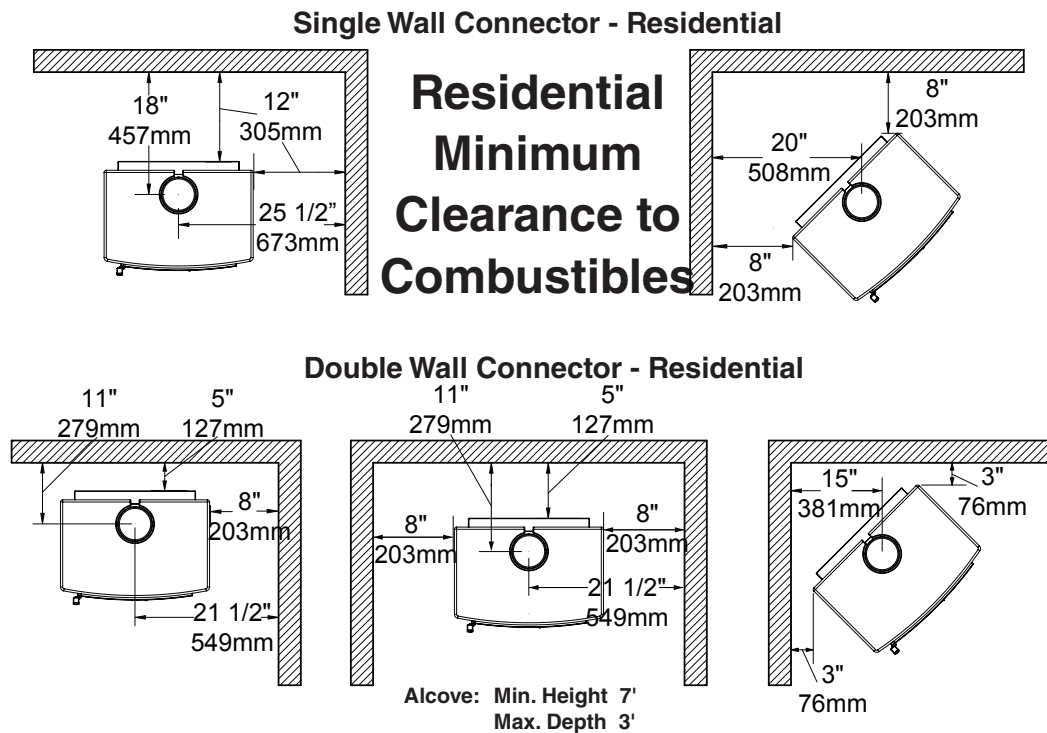


Figure 7: Neo16 NEOSTONE residential clearances.

Clearances may be reduced with various heat shielding/insulating materials. Consult CSA B365 or NFPA 211 and local fire codes and authorities for approval. For close clearances, use a listed double-wall connector.

NOTE: local/national codes or regulations may override some guidelines in this manual

We recommend that our products be installed and/or serviced by professionals who are certified by a "Qualified agency";

**NFI (National Fireplace Institute®) in the United States,
CSIA (Chimney Safety Institute of America) in the United States and Canada,
WETT (Wood Energy Technology Transfer) in Canada or
APC (Association des Professionnels du Chauffage) in Quebec**



Warning: Under no circumstances is this heater to be installed in a makeshift or "temporary" manner. It may be fired only after the following conditions have been met.

DO NOT ATTEMPT TO CONNECT THIS HEATER TO ANY AIR DISTRIBUTION DUCT.

Outside combustion air or fresh air into the room may be required in your area, consult local building codes (see Combustion Air section).

Chimney and Connector

- The chimney system must be a ULC-S629 or UL-130HT listed Stainless chimney or a Masonry chimney suitable for use with solid fuel, that is lined, in good condition and meets fire and building codes.
- The chimney flue size should be the same as the stove outlet (6 inches) for optimal performance. Reducing or increasing the flue size may adversely affect stove performance.
- Chimney flue exit is to be 3 feet (1 m.) above roof and two feet (0.6 m.) above highest projection within 10 feet (3 m.) horizontally.
- The installation must meet all local codes.
- Do not connect this unit to a chimney flue serving another appliance. Minimum system height is 15 feet (4.6 m.) (measured from base of appliance).

BOTH CHIMNEY SYSTEM AND CONNECTOR MUST BE LISTED TO:

**IN CANADA - ULC S-641 LISTED for double wall connector and ULC-S629 LISTED CHIMNEY,
IN USA - UL-103 HT LISTED CONNECTOR AND CHIMNEY**

When using a Double-Wall Connector

- Use a listed double-wall connector.
- If a listed chimney and double-wall connector are to be connected to the stove, install all components as per the chimney/connector manufacturer's installation requirements.

When using a Single-Wall (smoke pipe) Connector

The single wall pipe section must be:

- If you are using smoke pipe/chimney connector in conjunction with the listed chimney system, consult local/national fire or building codes for connector installation. Follow the chimney manufacturer's complete instructions for the installation of the chimney system.
- As short and straight as possible, use six inch diameter, 24 gauge black pipe that is clean and in new condition.
- Installed with the crimped or male ends pointing down. (This will carry any liquid creosote or condensation back into the stove) and secured at every joint and collar with 3 sheet metal screws.
- The chimney connector shall not pass through an attic, roof space, closet or similar concealed space, floor, or ceiling. Where passage through a wall, or partition of combustible material is desired, the installation shall conform to CAN/CSA-B365, Installation Code for Solid-Fuel-Burning Appliances and Equipment or NFPA 211 Standard for Chimneys, Fireplaces, Vents and Solid-Fuel Burning Appliances.

Installation Procedure

1. Select the position for your wood stove based on the clearances diagram. Position the floor protection and stove.
2. Mark the position for the hole in the ceiling and roof by using a string and plumb-bob hanging over the exact center of the stoves flue pipe.
3. Check that the intended location will not interfere with floor joists, ceiling joists or rafters before proceeding further. Adjust if necessary and reconfirm the clearance's from the stove to combustibles.
4. Carefully follow the directions of the listed chimney for installation of the chimney system from the ceiling through to the rain cap. This may include framing in holes etc.
5. Start installing smoke pipe / chimney connector, slip the crimped edge of the pipe inside the stove collar. Use holes provided in collar to secure pipe with two screws.
6. Install the remaining lengths of pipe one on top of the other up to the finished height of the chimney and using the manufacturers approved adapter, secure to each other. A slip section can make this easier.

Combustion Air

Intake or combustion air can be supplied to the stove in one of two ways. Consult your local building code or CAN/CSA-B365, Installation Code for Solid-Fuel-Burning Appliances and Equipment before proceeding.

Outside air supply - (Necessary for mobile home installation, optional for residential installation.)

To draw **outside air through the floor** - This hole must get its air from a ventilated crawl space or be extended with duct to the outdoors (see Figure #3, Page 7). The use of outside combustion air for residential installation requires the unit to be secured to the structure to prevent dislodging of the air duct.

To draw **outside air from behind the stove**, Use a 4"(100mm) Air intake. Cut or drill the recommended size hole through a wall behind the unit.

- Install the 4" Intake Starter over the hole in the rear of the Ash Box enclosure. Attach metal flex between the starter and the Air Intake.

Room air supply - The stove will draw its air from the room through the opening in the Ash Box Enclosure and into the firebox intake.

Note: The living space around the heater must be well ventilated with good air circulation. Anything that may cause a negative pressure can cause gases or fumes to be pulled into the living area. During extremely cold weather, and especially when burning at very slow rates, the upper parts of the exposed chimney may ice up, partially blocking the flue gases. If blockage occurs, flue gases may enter the living space.

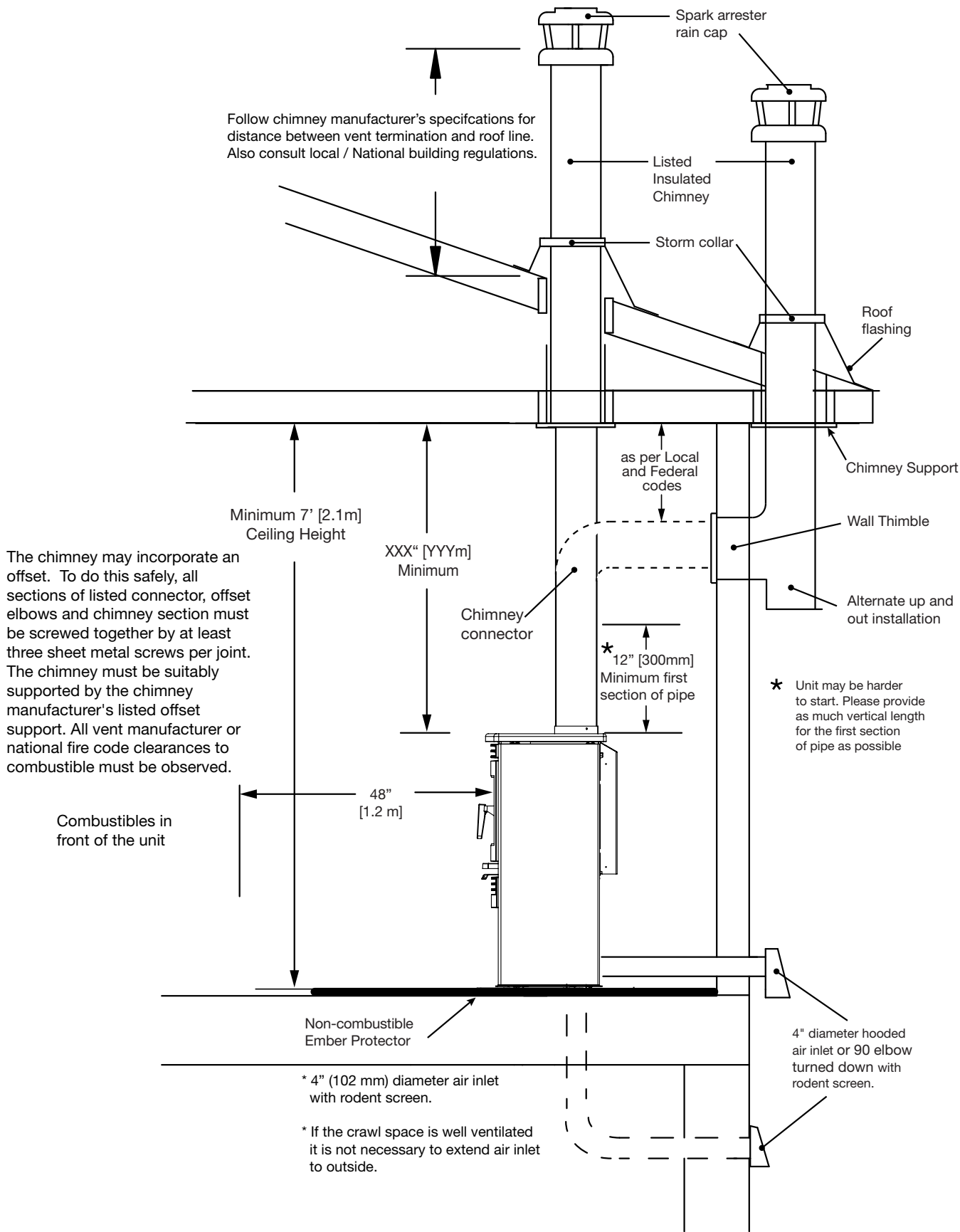


Figure 8: NEOSTONE 1.6 LE venting.

Ensure that the Masonry chimney meets all National and local Fire and building codes. Have the chimney cleaned and inspected by a professional to ensure there are no cracks, weak mortar or other signs of deterioration. See vent manufacturer's installation instructions for further information

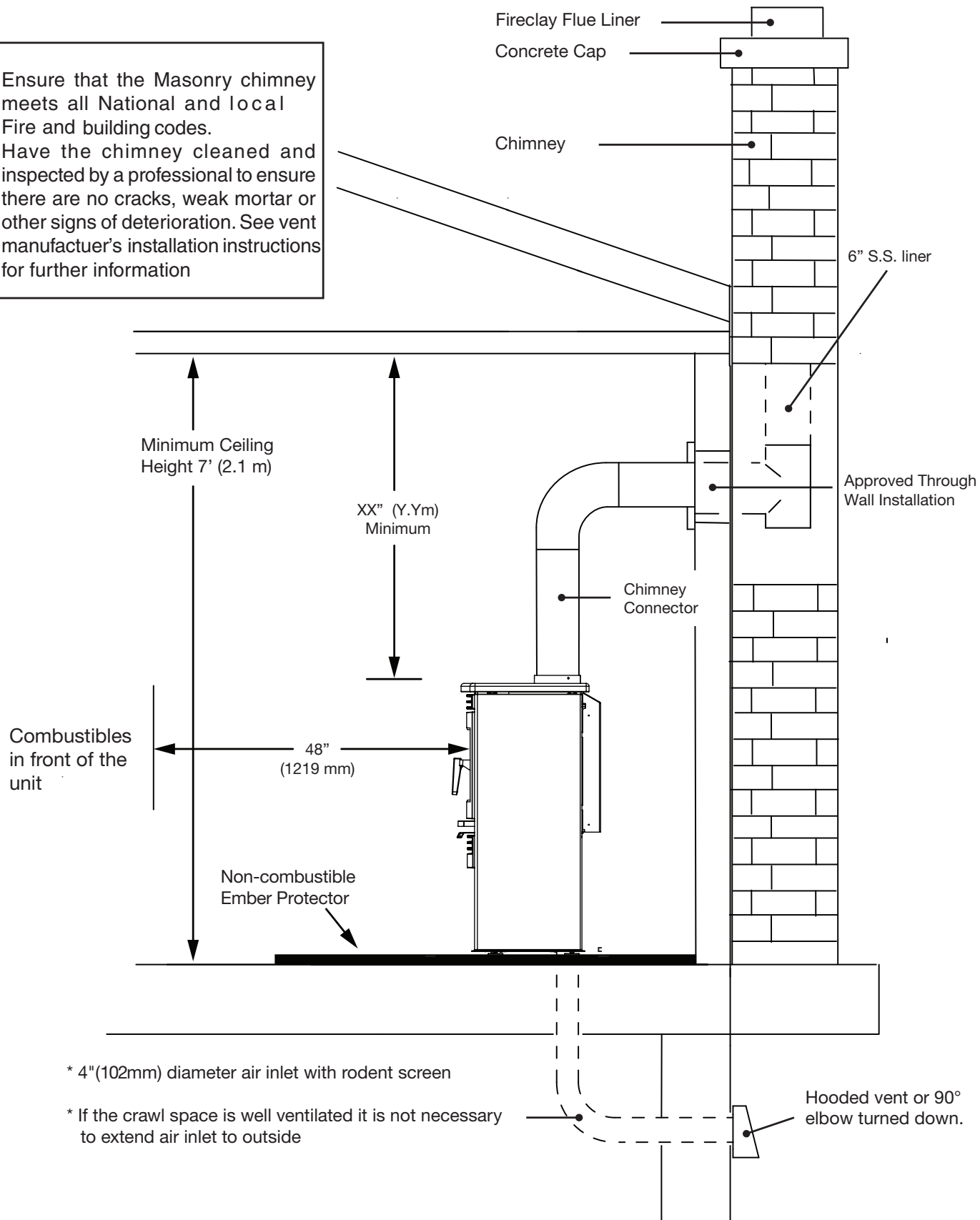


Figure 9: NEOSTONE 1.6 LE Venting into a masonry chimney.

Through Wall Installations (as per NFPA 211-2013)

ATTENTION: VAPOUR BARRIER MUST BE MAINTAINED WHEREVER CHIMNEY OR OTHER COMPONENTS PENETRATE TO THE EXTERIOR OF THE STRUCTURE. SEE LOCAL BUILDING CODES FOR PROPER AND APPROVED METHODS OF MAINTAINING VAPOUR BARRIER.

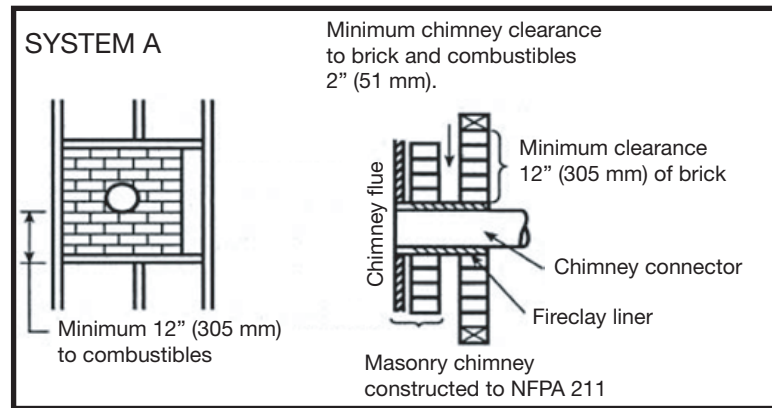


Figure 10: System A.ai
Minimum Clearance 12 in. (305mm) to combustibles

System A. Minimum 3.5 in. (90 mm) thick brick masonry wall framed into combustible wall with a minimum of 12 in. (305 mm) brick separation from clay liner to combustibles. Fireclay liner (ASTM C 315, Standard Specifications for Clay Fire Linings, or equivalent), minimum 5/8 in. (16 mm) wall thickness, shall run from outer surface of brick wall to, but not beyond, the inner surface of chimney flue liner and shall be firmly cemented in place.

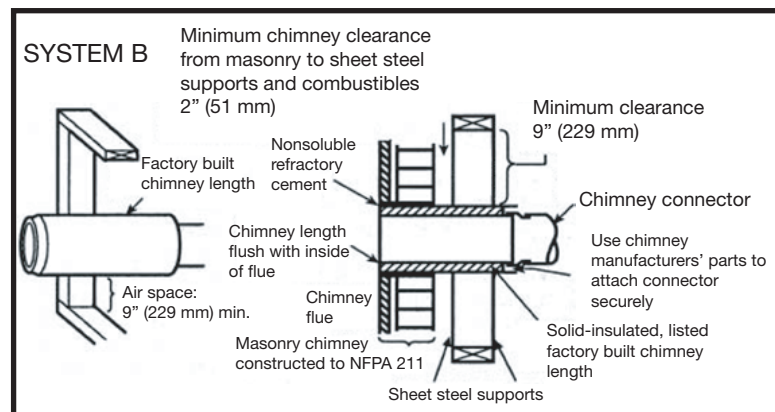


Figure 11: System B.ai

Minimum Clearance 9 in. (229mm) to combustibles

System B. Solid-Insulated, listed factory-built chimney length of the same inside diameter as the chimney connector and having 1 in. (25.4 mm) or more of insulation with a minimum 9 in. (229 mm) air space between the outer wall of the chimney length and combustibles.

The inner end of the chimney length shall be flush with the inside of the masonry chimney flue and shall be sealed to the flue and to the brick masonry penetration with non-water-soluble refractory cement. Supports shall be securely fastened to wall surfaces on all sides.

Fasteners between supports and the chimney length shall not penetrate the chimney liner.

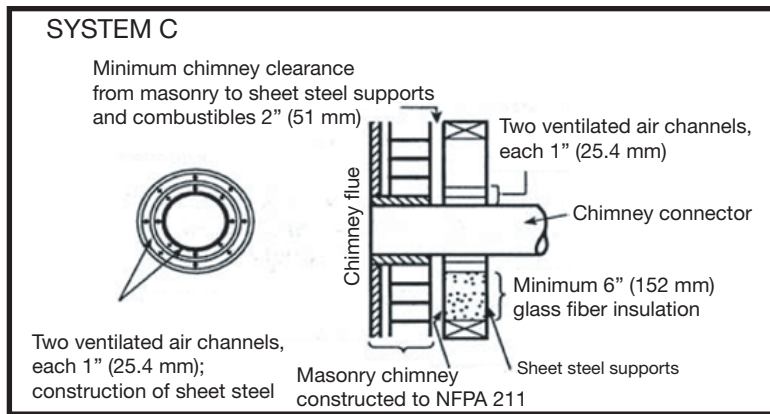


Figure 12: System C.ai

Minimum Clearance: 6 in. (152mm) to combustibles

System C. Sheet steel chimney connector, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, with a ventilated thimble, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, having two 1 in. (25.4 mm) air channels, separated from combustibles by a minimum of 6 in. (152 mm) of glass fiber insulation. Opening shall be covered, and thimble supported with a sheet steel support, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

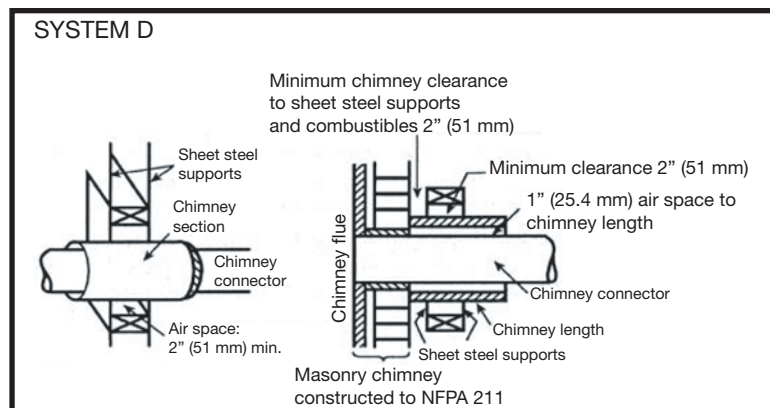


Figure 13: System D.ai

Minimum Clearance: 2 in. (51mm) to combustibles

System D. Solid-Insulated, listed factory-built chimney length with an inside diameter 2 in. (51 mm) larger than the chimney connector and having 1 in. (25.4mm) or more of insulation, serving as a pass-through for a single-wall sheet steel chimney connector of minimum 24 gauge [0.024 in. (0.61 mm)] thickness, with a minimum 2 in. (51 mm) air space between the outer wall of chimney section and combustibles.

Minimum length of chimney section shall be 12 in. (305 mm). Chimney section concentric with and spaced 1 in. (25.4 mm) away from connector by means of sheet steel support plates on both ends of chimney section. Opening shall be covered, and chimney section supported on both sides with sheet steel supports of minimum 24 gauge [0.024 in. (0.61 mm)] thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

Mobile Home Installation

Warning: Under no circumstances is this heater to be installed in a makeshift or "temporary" manner. It may be fired only after the following conditions have been met.

- **DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.**
- **DO NOT INSTALL IN A SLEEPING ROOM.**
- **CAUTION: THE STRUCTURAL INTEGRITY OF THE MOBILE HOME FLOOR, WALL AND CEILING/ ROOF MUST BE MAINTAINED.**
- Attach the stove to the floor using two 1/4" x 2" or longer lag screws through holes in the legs or the Pedestal base.
- Outside air supply must be used for Mobile Home installations - see .pg.16
- The services of a competent or certified installer, (certified by the Wood Energy Technical Training program (WETT) - in Canada, Hearth Education Foundation (HEARTH) - in U.S.A.,) are strongly recommended.

Clearances

This heater must be installed with listed double-wall connector and compatible ULC-S629 or UL-103HT listed chimney system, see page 17.

Clearances to combustible surfaces and materials are shown. See picture below.

Consult local fire codes and authorities for approval.

NOTE: Install all components to the connector or chimney manufacturer's installation requirements. Consult your chimney supplier/manufacturer for installation advice.

Double Wall Connector - Mobile Home

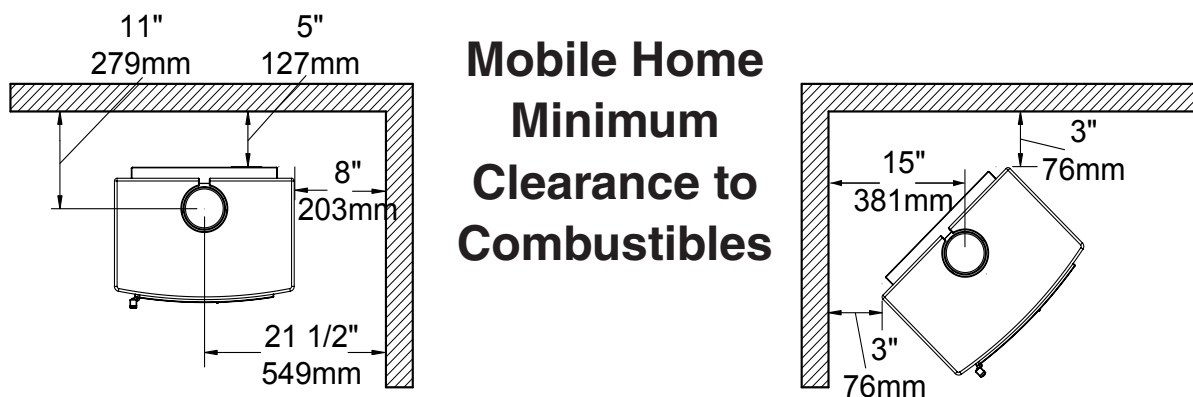


Figure 14: NEO16 NEOSTONE mobile home CLEARANCES.

Optional Blower

The optional blower kit (Part #: 11140001) is equipped with a three prong power cord and may be installed at any time. Follow the installation instructions supplied with the kit. Route power supply cord away from heater.

Electrical rating: 115 volts AC-1.02 amps.

Fan output rating: 140 CFM

Blower Operation

Proper blower speed matched with air control setting will ensure peak performance from your stove. Operate as follows:

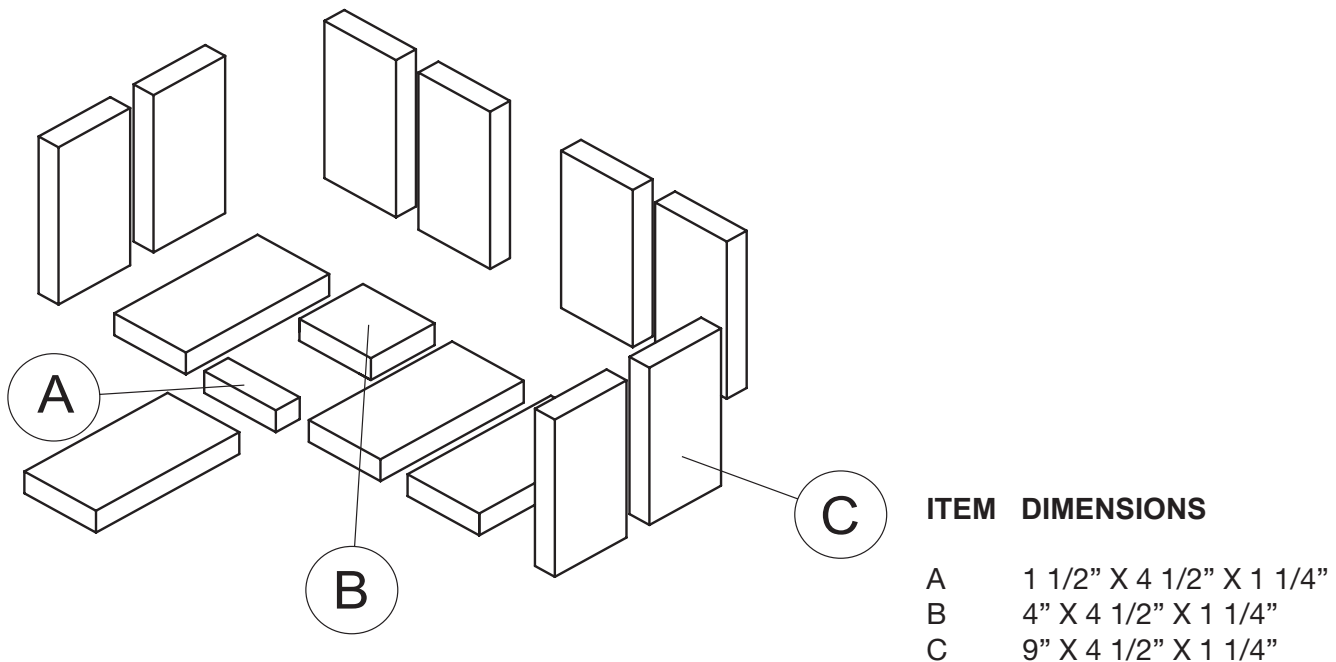
- Air control set to "L" (low), operate blower speed control on "Low".
- Air control set between "L" and "H" (low and high), operate blower speed control at desired setting.

Automatic: To operate the blower automatically, set the rocker switch on the side of the fan housing to "Auto" and set the speed control to your desired setting. This will allow the fan to turn on as the stove heats up to operating temperature. It will also shut the blower off after the fire has gone out and the unit has cooled to below a useful heat output range.

Manual: To manually operate the blower, set the rocker switch to "Man" and set the speed control to your desired setting. This will bypass the temperature sensing device and allow full control of the blower. Switching from "Auto" to "Man" or selecting speed may be done anytime.

Note: The Blower will not shut off until it is manually turned off.

Firebrick Installation



Firebrick Installation Con't

1. Install the floor firebricks; For units **without an Ash Dump** use full size "D" bricks See "Figure 19: Floor layout without ash dump." on page 24. For unit **with the Ash Dump** installed, 2 small bricks ("A & B" in Fig 20) will used on either end of the ash dump in addition to the regular sized "D" bricks used in the rest of the installation.

There is one exception. Brick "C" is a shorter brick than the "D" bricks. "C" brick fits up against the Baffle Tube on the rear wall of the firebox and is used in units with or without an ash dump.

2. The firebricks for the side walls are next. The sides use "D" bricks. The bricks will stand on top of the floor bricks and will stand on their ends. They will be held in place by two tabs per wall. Install the end bricks first followed by the two center bricks.

3. The rear wall is last. The rear bricks also stand on end and will stand on top of the floor bricks.

Trouble Shooting

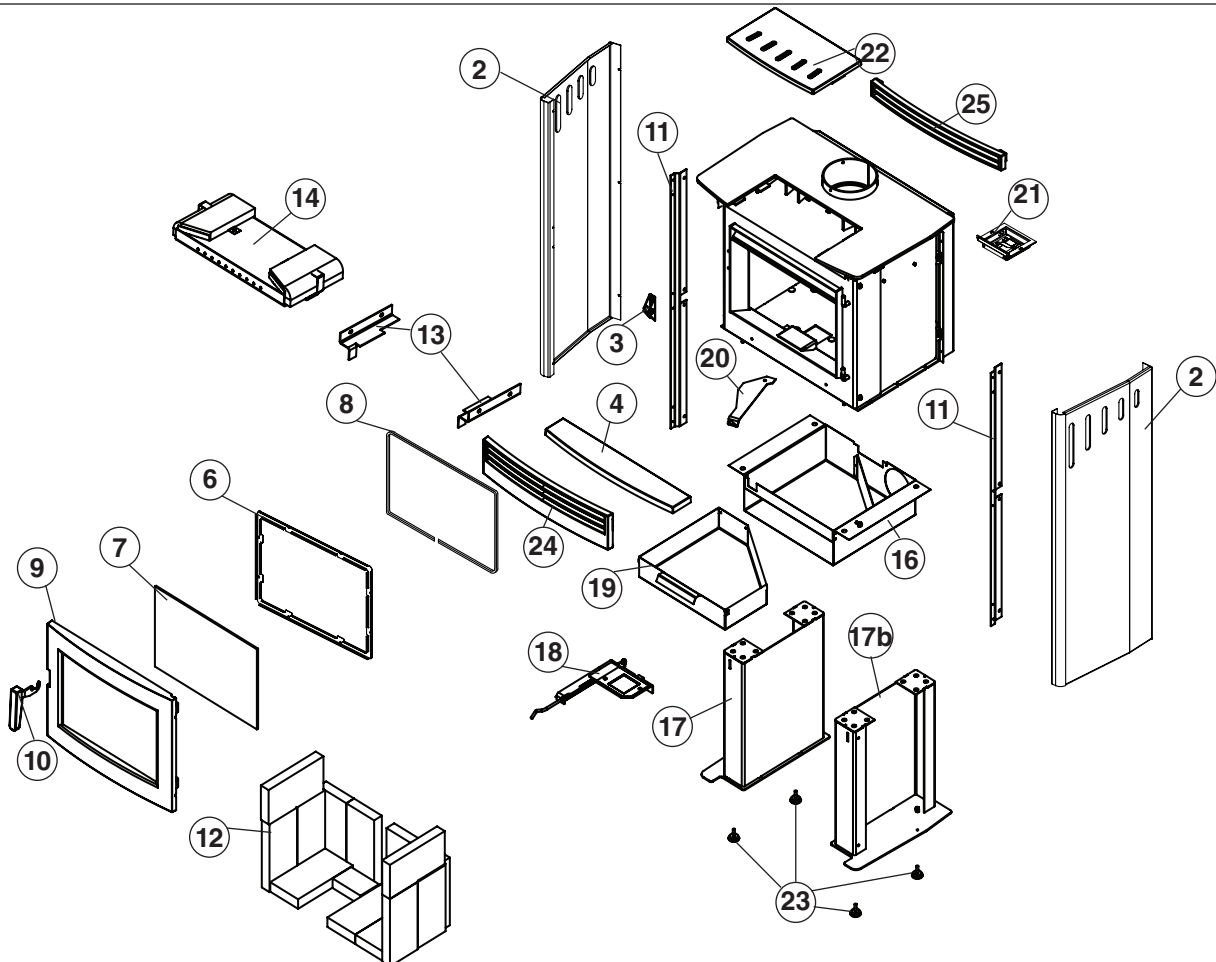
Problem	Cause	Cure
Excessive Creosote Build-up	1) Wood is too wet 2) Turning down air control too soon 3) Draft too low	- Use dry wood - Do not turn down until: a) there is a good bed of coals b) the wood is charred - Chimney plugged or restricted, check flue - Improper chimney height and/or diameter - Provide outside air for combustion - Check draft in chimney and system, alter as needed.
Glass is Dirty	1) See 1, 2, and 3 above 2) Door Gasket leakage	- Replace gasket - Check door latch
Low Heat Output	1) Wood may be wet 2) Fire too small 3) Draft too low	- Check wood and use drier wood if required. - Build a larger fire - Open draft control to increase burn rate. - Chimney plugged or restricted Inspect and clean
Won't Burn Overnight	1) Air control set too high 2) Not enough wood 3) Draft too high	- Set control lower - Unsplit wood is preferred for overnight burns - Excessive chimney height and/or diameter, see page 11
Stove Won't Burn	1) Combustion air supply is blocked	- Check outside air supply for obstructions - Check that room air cover is removed. - Chimney plugged or restricted Inspect and clean

Replacement Parts - NEO 1.6 LE

(WHEN ORDERING, INCLUDE PART NUMBER WITH DESCRIPTION)

ITEM	DESCRIPTION	PART NO.	ITEM	DESCRIPTION	PART NO.
1....	Soapstone Panel Set.....	????	16...	Right Support, Black	NE16.78125
2....	Door Catch	NE16.7825	17...	Ash Dump Assembly	NE16.7857
3....	Ash Lip	NE16.5037701	18...	Ash Drawer.....	NE16.78352
4....	Gasket Guide/Glass Retainer.....	NE16.7818	19...	Air Shutter Assembly	NE16.7826
5....	Replacement Glass (c/w Tape)....	NE16.5034700	20...	Secondary Air Control Assembly	NE16.7833
6....	Door Gasket Kit	WODC.DG58	21...	Levelling Feet (4pcs.)	NE16.5049765
7....	Door Casting, Black.....	NE16.5037700	22...	Lower Grill Assy.	NE16.5037703
8....	Door Handle Assembly	NE16.7817	23...	Upper Grill	NE16.5037702
9....	Side Panel Spacer.....	7103.10-A	24...	Outside Air Pipe Shield.....	NE16.7872
10...	Firebrick Set	NE16.BRIC	25...	Soapstone Hardware Pack	NE16.STHRDWR
11 ...	Brick Rail, Left/Right.....	NE16.RAILSET			
12...	Replacement Baffle Kit.....	NE16.BAFKIT			
13...	Baffle Pin	SSER.125001			
14...	Ash System	NE16.LGADA			
15...	Left Support, Black.....	NE16.78115			

All parts may be ordered from your nearest Pacific Energy dealer. Contact Pacific Energy for the location of the dealer nearest you.





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PACIFIC ENERGY FIREPLACE PRODUCTS LTD.

2975 Allenby Rd., Duncan, B.C. V9L 6V8

Web site: <http://www.pacificenergy.net>

For additional technical support, please contact your dealer

**IMPORTANT:
THESE INSTRUCTIONS ARE TO
REMAIN WITH THE HOMEOWNER**

**PACIFIC
ENERGY**

SERIAL #

SAFETY NOTICE

If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area.

Meets the Environmental Protection Agency's 2020 Particulate Emission Standards (Crib Wood).



OPERATING AND INSTALLATION INSTRUCTIONS



**MODEL(s): VISTA LE,
VISTA CLASSIC LE**

Visit www.pacificenergy.net for the most recent version of this manual

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PLEASE SAVE THESE INSTRUCTIONS

NOTE: WE STRONGLY RECOMMEND THAT SMOKE AND CARBON MONOXIDE DETECTORS BE INSTALLED IN THE AREA WHERE THE HEATER IS TO BE INSTALLED.

If smoke detectors have been previously installed, you may notice that they are operating more frequently. This may be due to curing of stove paint or fumes caused by accidentally leaving the fire door open. Do not disconnect the detectors.

SAFETY NOTICE: If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in you area.

Please read this entire manual before you install and use your new room heater. Failure to follow instructions may result in property damage, bodily injury, or even death.

Experience will give you the right settings for proper combustion and efficient burning. Remember the correct air inlet setting is affected by variables such as type of wood, outside temperature, chimney size and weather conditions. With practice, you will become proficient in operating your heater and will obtain the performance for which it was designed.

Rating Label

PLEASE SAVE THESE INSTRUCTIONS

This manual describes the installation and operation of the Pacific Energy, VISTA LE or VISTA CLASSIC LE Freestanding wood heater.

SAFETY NOTICE: If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area.

Please read this entire manual before you install and use your new room heater. Failure to follow instructions may result in property damage, bodily injury, or even death.

This heater meets the 2020 U.S. Environmental Protection Agency's crib wood emission limits for wood heaters sold after May 15, 2020 using Method 28R.

Model VISTA LE / VISTA CLASSIC LE: 1.9 g/hr..

Under specific test conditions this heater has been shown to deliver heat at rates ranging from 12,500 to 38,200Btu/hr.

Efficiency and BTU Output

EPA Certified Emissions	1.9 grams per hour
LHV Tested Efficiency 1	78.2%
HHV Tested Efficiency 2	72.3%
EPA BTU Output 3	XXXXX btu/hr.
Peak BTU/Hr. Output 4	XX,X00 btu/hr.
Maximum Wood Length	18 inches
Ideal Wood Length	17 inches
Fuel	Seasoned Cord wood

1 Weighted Average Lower Heating Value (LHV) efficiency as tested using CSA B415 Performance testing of solid-fuel-burning heating appliances. LHV assumes the moisture is already in a vapour state so there is no loss of energy

2 Weighted Average Higher Heating Value (HHV) efficiency as tested using CSA B415 Performance testing of solid-fuel-burning heating appliances. HHV includes the energy required to vaporize the water in the fuel

3 The range of BTU outputs is based on efficiency using CSA B415 Performance testing of solid-fuel-burning heating appliances and burn rates from the low and high EPA tests using Douglas Fir dimensional lumber.

4 The Peak BTU/hr. is based on efficiency using CSA B415 Performance testing of solid-fuel-burning heating appliances, the Maximum one hour High burn rate from the High Burn EPA test and the BTU content of cord wood (8600 btu/lb).

UL
LISTED

UL
CLASSIFIED

UL
EVALUATED

UL
RECOGNIZED

UL
TESTED

UL
INSPECTED

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CAUTION: 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.

Instruct all members of your family on the safe operation of the heater. Ensure they have enough knowledge of the entire system if they are expected to operate it. Stress the section on chimney fires and the importance of following the steps outlined "In Case of Chimney Fire".

Chimney Smoke and Creosote Formation

When wood is burned slowly, it produces tar and other organic vapours, which combine with expelled moisture to form creosote. The creosote vapours 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 connector and chimney should be inspected periodically (at least once every two months) during the heating season to determine if a creosote buildup has occurred. If creosote has accumulated (3 mm. or more), it should be removed to reduce the risk of a chimney fire.

1. Highest smoke densities and emissions occur when a large amount of wood is added to a bed of hot coals and the air inlet is closed. The heated wood generates smoke, but without ample air, the smoke cannot burn. Smoke-free, clean burning requires small fuel loads, two or three logs at a time or 1/4 to 1/2 of fuel load and leaving the air inlet relatively wide open, especially during the first 10 to 30 minutes after each loading, when most of the smoke generating reactions are occurring. After 30 minutes or so, the air inlet can be turned down substantially without excessive smoke generation. Wood coals create very little creosote-producing smoke.
2. The cooler the surface over which the wood smoke is passing, the more creosote will be condensed. Wet or green wood contributes significantly to creosote formation as the excess moisture that is boiled off cools the fire, making it difficult for the tars and gases to ignite, thus creating dense smoke and poor combustion. This moisture-laden smoke cools the chimney, compounding the problem by offering the smoke the ideal place to condense.

In summary, a certain amount of creosote is inevitable. Regular inspection and cleaning is the solution. The use of dry, seasoned wood and ample combustion air will help to minimize annoying smoke emissions and creosote buildup.

Chimney Fires

The dangerous side effect of excessive creosote buildup is a chimney fire. This causes much higher than normal temperatures in the chimney and on its exterior surfaces. Temperatures inside the chimney can exceed 2000°F (1100°C). Ignition of nearby or touching combustible material is more likely during a chimney fire. Proper clearances are critical to prevent damage during such a fire.

Chimney fires are easy to detect; they usually involve one or more of the following:

- Flames and sparks shooting out of the top of the chimney
- A roaring sound
- Vibration of the chimney

To Avoid a Chimney Fire

1. Burn wood cleanly. Do not burn wet wood or turn down the unit too quickly after loading.
2. Do not let creosote build up to a point where a chimney fire is possible.
3. Do not have fires in the heater that may ignite chimney fires. These are excessively hot fires, such as when burning household trash, cardboard, Christmas tree limbs, or even ordinary fuel wood; (e.g. with a full load on a hot bed of coals and with the air inlet wide open for more time than is needed to completely char a fresh fuel load.)
4. The Chimney and connector pipe should be inspected /cleaned periodically.

In Case of a Chimney Fire

1. Prepare to evacuate to ensure everyone's safety. Have a well understood plan of action for evacuation. Have a place outside where everyone is to meet.
 2. Close air inlet on stove.
 3. Call local fire department. Have a fire extinguisher handy. Contact your local municipal or provincial fire authority for further information on how to handle a chimney fire. It is most important that you have a clearly understood plan on how to handle a chimney fire.
 4. After the chimney fire is out, the chimney must be cleaned and checked for stress and cracks before starting another fire. Also check combustibles around the chimney and the roof.
- The services of a competent or certified installer, (certified by the Wood Energy Technical Training program (WETT) - in Canada, Hearth Education Foundation (HEARTH) - in U.S.A.,) are strongly recommended.

Curing of the Paint Finish

To achieve the best finish, the paint on your stove must be baked on. When burning your stove for the first 2-3 times it is very important that the room be well ventilated. Open all windows and doors. Smoke and fumes caused by the curing process may cause discomfort to some individuals.

WARNING: Never use chemicals or any other volatile liquid to start a fire. Do not burn garbage, or flammable fluids such as gasoline, naphtha, or engine oil.

Operation

CAUTION: Hot while in operation. Keep children, clothing and furniture away. Contact may cause skin burns.

WARNING: Always keep loading door closed when burning. This heater is not designed for open door burning.

WARNING: No alteration or modification of the combustion air control assembly is permitted. Any tampering will void warranty and could be very hazardous.

WARNING: Do not use grates or andirons to elevate the fuel. Burn directly on the fire bricks. Replace broken or missing bricks. Failure to do so may create a hazardous condition.

Wood Selection

This heater is designed to burn natural wood only. Higher efficiency and lower emissions generally result when burning air-dried seasoned hardwoods, as compared to softwoods or to green or freshly cut hardwoods.

Wood should be properly air dried (seasoned) for six months or more. Wet or undried wood will cause the fire to smoulder and produce large amounts of smoke and creosote. Wet wood also produces very little heat and tends to go out often. Wood should be stored under cover away from open flame or heat sources.

DO NOT BURN :

• Salt water wood *	• Treated wood
• Wet or green wood	• Coal/charcoal
• Garbage*	• Solvents
• Lawn clippings/yard waste	• Unseasoned wood
• Railroad ties	• Manure or animal remains
• Materials containing rubber, including tires	• Materials containing plastic
• Construction or demolition debris	• Materials containing asbestos
• Waste petroleum products, paints, paint thinners, or asphalt products	• Paper products, cardboard, plywood, or particleboard.

*** These materials contain chlorides which will rapidly destroy metal surfaces and void warranty.**

Burning these materials may result in the release of toxic fumes or render the heater ineffective and cause smoke.

Do not burn anything but wood. Other fuels, e.g. Charcoal, can produce large amounts of carbon monoxide, a tasteless, odourless gas that can kill. Under no circumstances should you attempt to barbecue in this heater.

The prohibition against burning these materials does not prohibit the use of fire starters made from paper, cardboard, saw dust, wax and similar substances for the purpose of starting a fire in an affected wood heater.

How to Test Your Wood

Add a large piece of wood to the stove when it has a good large bed of coals. It is dry if it is burning on more than one side within one minute. It is damp if it turns black and lights within three minutes. If it sizzles, hisses and blackens without igniting in five minutes it is too wet and should not be burnt

Lighting a fire

WARNING: Never use chemicals or any other volatile liquid to start a fire.

1. Adjust air control to "High" position (all the way to the left) and open door.
2. Place crumpled newspaper in the centre of the heater and crisscross with several pieces of dry kindling. Add a few small pieces of dry wood on top.
3. Ignite the paper and leave the door ajar approximately 1/2"(13mm) - 1"(25mm) until the wood kindling is fully engulfed in flame.
4. After the kindling is fully engulfed add a few small logs. Close door.
5. Begin normal operation after a good coal base exists and wood has charred.

Normal Operation

WARNING: 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 the operating instructions in this manual.

1. Set air control to a desired setting. If smoke pours down across the glass (waterfall effect) this indicates you have shut the control down too soon or you are using too low a setting. The wide range control panel makes finding the desired setting for your application easy. As every home's heating needs vary (i.e. Insulation, windows, climate, etc.) The proper setting can only be found by trial and error and should be noted for future burns.
 2. To refuel, adjust air control to high, and give the fire time to brighten. Open the door slowly, this will prevent back puffing.
 3. Use wood of different shape, diameter and length (up to 18"(457mm)). Load your wood endwise and try to place the logs so that the air can flow between them. Always use dry wood.
 4. Do not load fuel to a height or in such a manner that would be hazardous when opening the door.
 5. For extended or overnight burns, unsplit logs are preferred. Remember to char the wood completely on maximum setting before adjusting air control for overnight burn.
- Burn wood only, dry and well seasoned. The denser or heavier the wood when dry, the greater its heat value. This is why hardwoods are generally preferred. Green or wet wood will cause a rapid buildup of creosote. If you feel it is necessary to burn wet or unseasoned wood, do so only with the air inlet set open enough to maintain a good strong fire and fairly high chimney temperatures. Do not attempt to burn overnight using green wood or wet wood. Wet wood can cause up to 25% drop in heater output, as well as contributing significantly to creosote buildup.

DO NOT OVER FIRE THIS HEATER: Attempts to achieve heat output rates that exceed heater design specifications can result in permanent damage to the heater and chimney. A glowing red, top or vent pipe are indications of over firing. Failure to rectify an over firing condition can be hazardous and may void the manufacturer's warranty.

Restarting After Extended or Overnight Burns

1. Open door and rake hot embers towards the front of the heater. Add a couple of dry, split logs on top of embers, close door.
2. Adjust air control to high and in just a few minutes, logs should begin burning.
3. After wood has charred, reset air control to desired setting.
4. To achieve maximum firing rate, set control to high "H". Do not use this setting other than for starting or preheating fresh fuel loads.

Proper Draft

1. Draft is the force which moves air from the appliance up through the chimney. The amount of draft in your chimney depends on the length of the chimney, local geography, nearby obstructions and other factors.
2. Too much draft may cause excessive temperatures in the appliance. An uncontrollable burn or a glowing red stove part or chimney indicates excessive draft.
3. Inadequate draft may cause back puffing into the room and plugging of the chimney. Smoke leaking into the room through appliance and chimney connector joints indicates inadequate draft.

Remember the correct air inlet setting is affected by variables such as type of wood, outside temperature, chimney size and weather conditions.

Ash Removal

Caution: Ashes are to be removed only when the heater is cold. Whenever ashes get 3"(76mm) to 4"(102mm) deep in your firebox, and when fire has burned down and cooled, remove excess ashes. Leave an ash bed approximately 1" (25 mm) deep on the firebox bottom to help maintain a hot charcoal bed.

Ash Cleanout system (optional):

The ash dump handle is located under the ash lip on the left hand side. To operate ash dump, pull handle out 1/2"(13mm) and turn clockwise. This will unlock the ash dump and allow it to open. Hold handle open while pulling ashes into the opening. Avoid large embers as these still contain heat value. Release handle and push in to lock. Ensure ash dump door is properly engaged. Fill the cavity with the remaining ash level with the firebox floor. Lift and pull out ash pan and discard ashes into metal container. Replace ash pan and ensure it is seated properly.

Do not burn with ash dump door open. Doing so will create a hazardous condition. Always leave about 1"(25mm) of ash when cleaning.

Disposal of Ashes

Ashes should be placed in a metal container with a tight fitting lid. The closed container of ashes should be placed on a non-combustible 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 closed container until all cinders have thoroughly cooled. Other waste should not be placed in this container.

Maintenance

WARNING: Never use chemicals or any other volatile liquid to start a fire. Do not burn garbage, or flammable fluids such as gasoline, naphtha, or engine oil.

WARNING: ONLY USE MATERIALS SUPPLIED BY MANUFACTURER WHEN DOING MAINTENANCE OR REPLACEMENTS.

1. If glass becomes darkened through slow burning or poor wood, it can readily be cleaned with fireplace glass cleaner when stove is cold. Never scrape with an object that might scratch the glass. The type and amount of deposit on the glass is a good indication of the flue pipe and chimney buildup. A light brown dusty deposit that is easily wiped off usually indicates good combustion and dry, well-seasoned wood and therefore relatively clean pipes and chimney. On the other hand, a black greasy deposit that is difficult to remove is a result of wet and green wood and too slow a burning rate. This heavy deposit is building up at least as quickly in the chimney.
2. **DOOR GASKETS** - The gasket used by Pacific Energy (7/8"(22mm) medium density fiberglass rope) requires only light pressure to seal. This will prolong seal life. It is important that the door seal be maintained in good condition. Periodically inspect seals and replace if necessary. Follow the instructions included in the DR31.WDGKIT kit, obtainable from your nearest Pacific Energy dealer.
3. **DOOR GLASS** - Do not slam loading door or otherwise impact glass. When closing door, make sure that no logs protrude to impact the glass. If the glass gets cracked or broken, it must be replaced before using the stove. Replacement glass can be obtained from your dealer. Use 8-13/16"(224mm) x 15-1/4"(387mm) x 5 mm. Ceramic glass only. **Do not substitute with any other type.**
- To remove broken glass, undo the four retaining screws and remove clamps and frame, noting position for re-assembly. Remove all particles of glass. Be careful as they are very sharp. Install new glass complete with gasket. Replace frame, clamps and screws.

CAUTION:

- Do not overtighten, tighten screws very carefully
 - Do not clean glass when hot
 - Do not use abrasive cleaners on glass
4. The area where boost combustion air enters the firebox must be kept clear of excessive ash buildup which will block air flow. This area is at the front of the firebox.
 5. Do not store wood within heater installation clearances, or within the space required for fuel loading and ash removal. Keep the area around the heater clean and free of loose combustibles, furniture, newspapers, etc.
 6. If the plated door requires cleaning, use mild soap and water only. Use of abrasive cleaners will void warranty.
 7. Establish a routine for the fuel, wood burning and firing technique. Check daily for creosote buildup until experience shows how often you need to clean to be safe.
 8. Be aware that the hotter the fire, the less creosote is deposited. Weekly cleaning may be necessary in mild weather, even though monthly cleaning is usually enough in the coldest months when burning rates are higher. When wood is burned slowly, it produces tar and other organic vapours, which combine with expelled

Maintenance Checks

Check the following parts for damage such as cracks, excessive corrosion, burned out sections and excessive warping: (See website for descriptions and more detail)

Weekly:

- Firebrick - Visual, for cracking.
- Door Gasket - sagging, placement, damage.

Monthly

- Brick rail tabs and brick rails.
- Air riser tube in the back of the firebox.
- Back side of airwash chamber.
- Baffle locking pin.
- Boost tube cover.

When Cleaning the Chimney System:

- Top baffle board/blanket.
- Baffle.
- Top heat shield and mounting bolt.
- Baffle Gasket.
- Brick Rails.
- Manifold.

Blower:

- The blower should be cleaned out a minimum every six months by using a vacuum on the grill openings in the back and bottom of the blower casing to remove any dust and debris.

Baffle:

- Some warping of the baffle is normal(up to 1/4" or .65cm). Replace if the baffle has permanent warping greater than this or has cracking or breakage.
- Please contact your Dealer if you experience any of the damage listed above. Continuing to operate your stove with broken parts can accelerate damage to other parts and may void your warranty

Baffle Removal

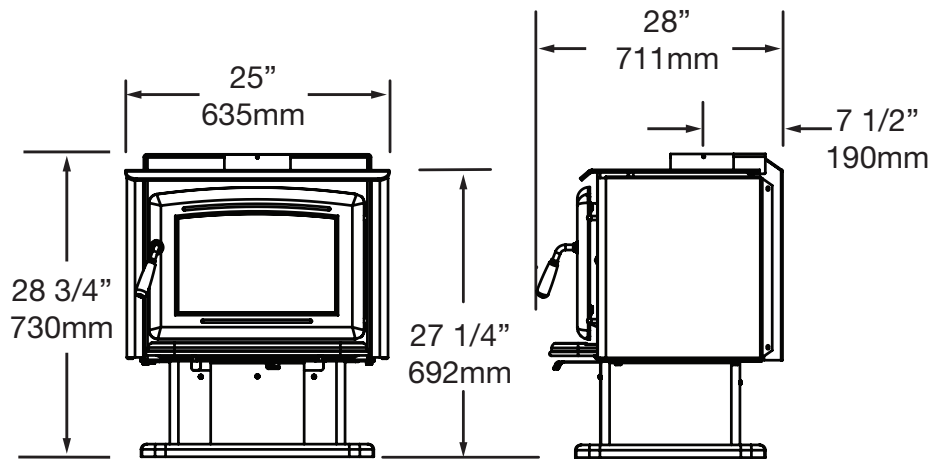
Chimney connector pipe should be disconnected from stove to clean and inspect. Only if this is not possible should you remove baffle assembly.

DO NOT OPERATE WITH BAFFLE ASSEMBLY OR INSULATION REMOVED.

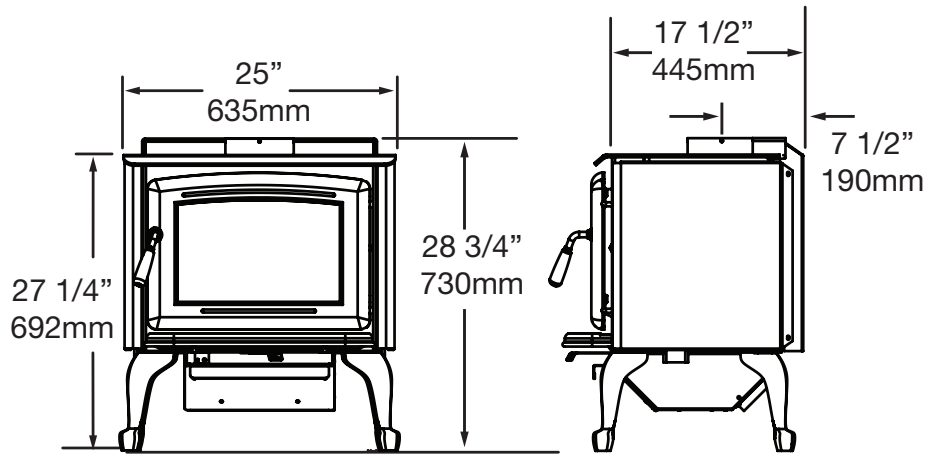
Removal

Remove retaining pin at the back of the firebox, just under the baffle. Lift baffle up and pull forward to disconnect from the supply tube. Tilt baffle sideways to drop down and remove from firebox. Inspect gasket between baffle and supply tube. If necessary, replace with gasket #139.5 available from your Pacific Energy dealer. Re-install baffle assembly in reverse order. The two side pieces of insulation must be tight against the side rails.

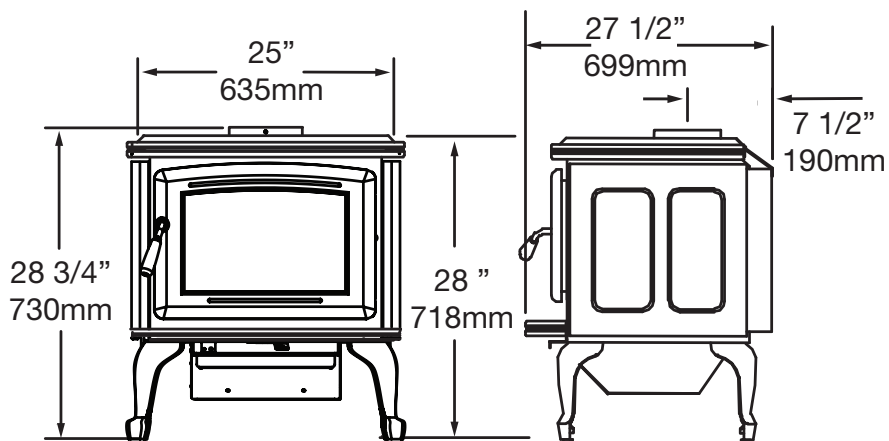
Dimensions



VISTA LE - Pedestal



VISTA LE- Leg



VISTA CLASSIC LE

Figure 1: VISTA LE dimensions.

Crate Removal

1. Carefully remove the crate top and supports.
2. Remove plastic cover.
3. Using a 7/16" wrench, remove lag bolts that secure stove body to bottom pallet.

Assembly - Legs (Leg Model)

1. Loosen the four bolts holding the Ash Box to the firebox bottom.
2. Insert the legs between the Ash Box flange and the washers.
3. Using the guides cast into the tops of the leg, align the guides into the notches in the Ash Box mounting flanges.
4. Tighten the bolts down.

Assembly - Optional Ash Cleanout

Pedestal Model

1. Remove the Ash Drawer Front Cover Plate by removing the center screw(1) and lifting up to disengage the bottom tab.
2. Remove the two screws (2) holding the Pedestal Brace. Remove the brace
3. Install the Ash Dump mechanism, following the instructions.
4. Break off the corner tab of the Pedestal Brace with pliers. See "Figure 3: Ped Brace knockout." on page 12
5. Re-install the Pedestal Brace with the notched corner to the top left. Install the new Ash Pan into the Pedestal.

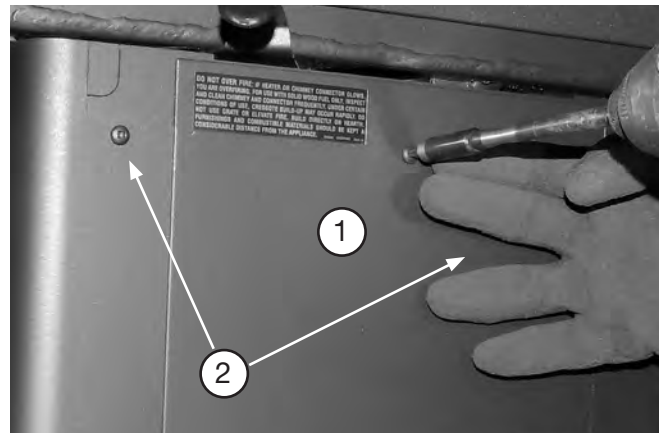


Figure 2: Ped front cover removal.

Leg Model

1. Remove the two screws holding the Leg Ash Box Brace (2). Remove the brace
2. Install the Ash Dump mechanism, following the instructions.
3. Break off the corner tab of the Pedestal Brace with pliers See "Figure 3: Ped Brace knockout." on page 12
4. Re-install the Leg Ash Box Brace with the notched corner to the top left. Install the new Ash Pan into the Leg Ash Box.

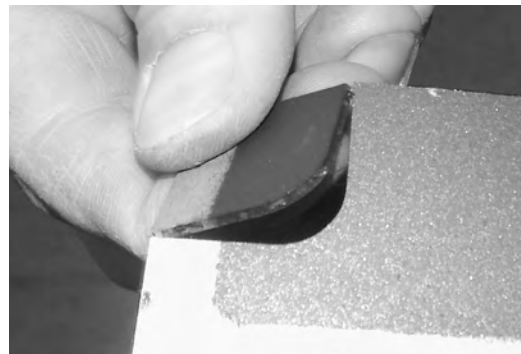


Figure 3: Ped Brace knockout.

Ash Dump Installation

1. Remove the Ash Cleanout hole cover plate and gasket, located under the stove. Discard the cover plate.

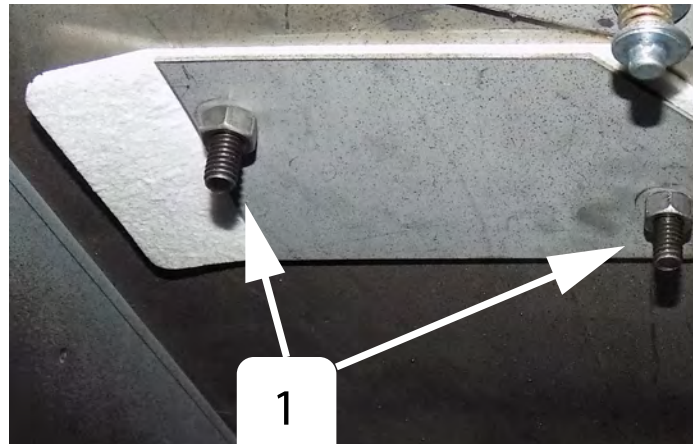


Figure 4: Cover Plate removal

2. Place the provided gasket(s) around the upper tube portion of the new Ash Dump mechanism, as per the drawing.

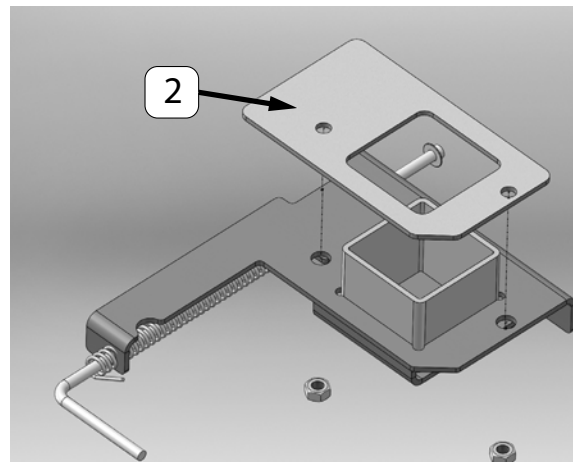


Figure 5: Ash Cleanout Gasket.

3. Insert The Ash Dump mechanism with gasket from underneath the firebox bottom up into the open hole and over the two bolts hanging down. - The release handle should be facing forward and on the left.
4. Re-attach the nuts onto the carriage bolts. And tighten to gently compress the gasket.

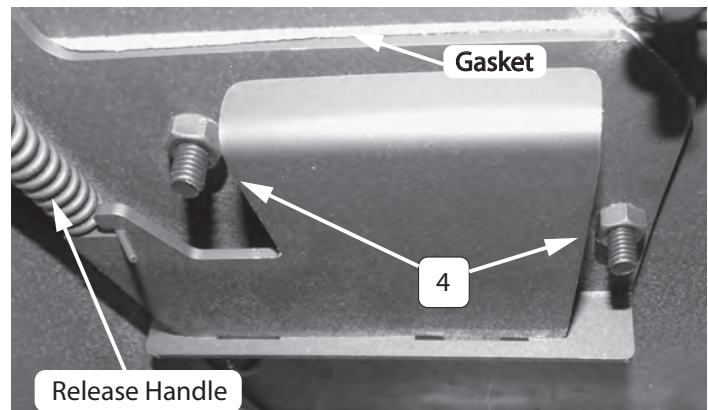


Figure 6: Under side of bolted ash Cleanout.

Floor Protector

The stove may be installed on a combustible floor provided noncombustible ember protection is used. This protection must extend as follows:

In USA: 16" (406 mm) to the front and 8" (203 mm) to the sides of the fuel loading door opening. See Figure #4, below. This protection is also required under the chimney connector and 2" (51 mm) beyond each side.

U.S.A. Only

Minimum Width - 33 1/2" (850mm)

Minimum Overall Depth - 35 1/2" (895mm)

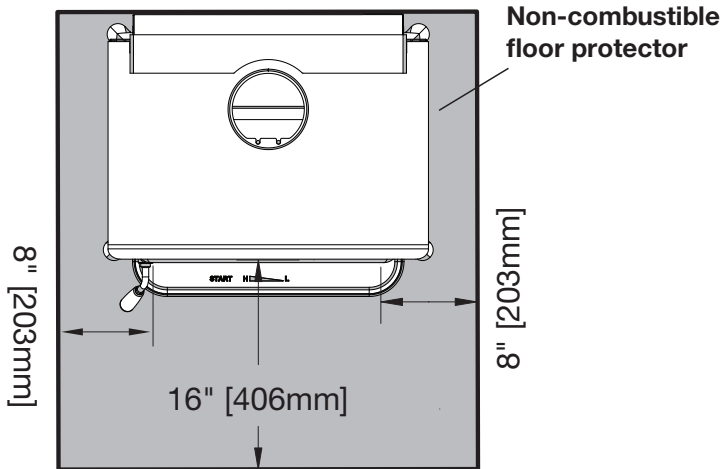
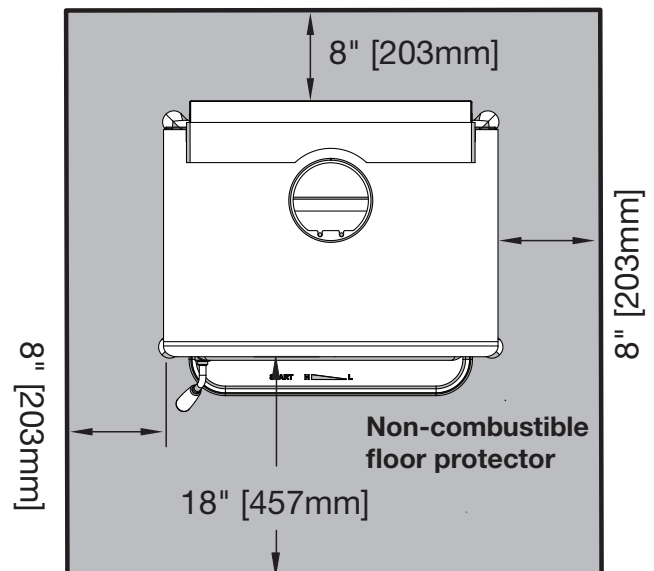


Figure 7: VISTA LE Floor protector - USA only.

CANADA Only

Minimum Width - 40 3/4" (1.035m)

Minimum Overall Depth - 45 1/8" (1.146m)



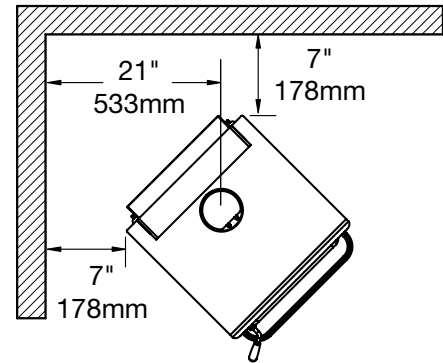
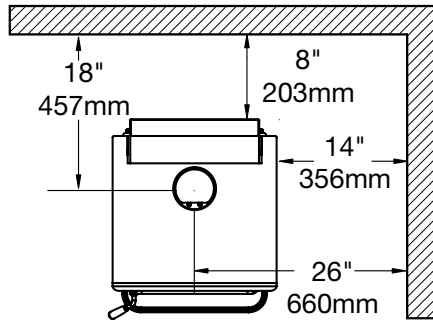
In Canada: 18" (457 mm) on the firing side and 8" (203 mm) to the other sides.

Figure 8: VISTA LE Floor protector - CAN only.

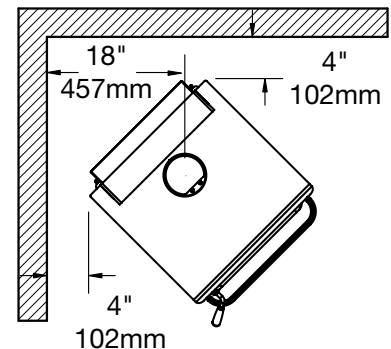
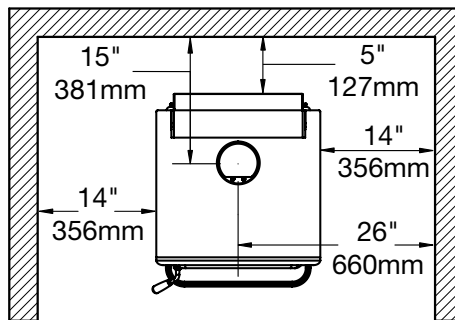
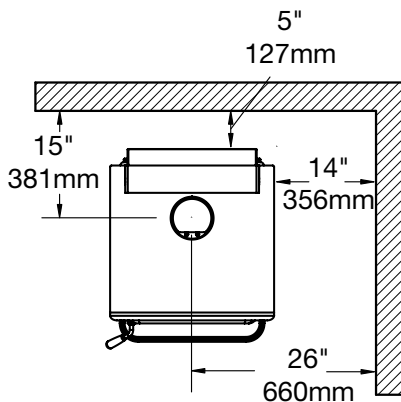
Residential Installation

Clearances:

Single Wall Connector - Residential



Double Wall Connector - Residential



**Alcove: Min. Height 7' (2.13m)
Max. Depth 3' (915mm)**

Clearances may be reduced with various heat shielding/insulating materials. Consult CSA B365 or NFPA 211 and local fire codes and authorities for approval. For close clearances, use a listed double-wall connector.

NOTE: local/national codes or regulations may override some guidelines in this manual

We recommend that our products be installed and/or serviced by professionals who are certified by a "Qualified agency";

**NFI (National Fireplace Institute®) in the United States,
CSIA (Chimney Safety Institute of America) in the United States and Canada,
WETT (Wood Energy Technology Transfer) in Canada or
APC (Association des Professionnels du Chauffage) in Quebec**



Warning: Under no circumstances is this heater to be installed in a makeshift or "temporary" manner. It may be fired only after the following conditions have been met.

DO NOT ATTEMPT TO CONNECT THIS HEATER TO ANY AIR DISTRIBUTION DUCT.

Outside combustion air or fresh air into the room may be required in your area, consult local building codes (see Combustion Air section).

Chimney and Connector

- The chimney system must be a ULC-S629 or UL-130HT listed Stainless chimney or a Masonry chimney suitable for use with solid fuel, that is lined, in good condition and meets fire and building codes.
- The chimney flue size should be the same as the stove outlet (6 inches) for optimal performance. Reducing or increasing the flue size may adversely affect stove performance.
- Chimney flue exit is to be 3 feet (1 m.) above roof and two feet (0.6 m.) above highest projection within 10 feet (3 m.) horizontally.
- The installation must meet all local codes.
- Do not connect this unit to a chimney flue serving another appliance. Minimum system height is 15 feet (4.6 m.) (measured from base of appliance).

BOTH CHIMNEY SYSTEM AND CONNECTOR MUST BE LISTED TO:

**IN CANADA - ULC S-641 LISTED for double wall connector and ULC-S629 LISTED CHIMNEY,
IN USA - UL-103 HT LISTED CONNECTOR AND CHIMNEY**

When using a Double-Wall Connector

- Use a listed double-wall connector.
- If a listed chimney and double-wall connector are to be connected to the stove, install all components as per the chimney/connector manufacturer's installation requirements.

When using a Single-Wall (smoke pipe) Connector

The single wall pipe section must be:

- If you are using smoke pipe/chimney connector in conjunction with the listed chimney system, consult local/national fire or building codes for connector installation. Follow the chimney manufacturer's complete instructions for the installation of the chimney system.
- As short and straight as possible, use six inch diameter, 24 gauge black pipe that is clean and in new condition.
- Installed with the crimped or male ends pointing down. (This will carry any liquid creosote or condensation back into the stove) and secured at every joint and collar with 3 sheet metal screws.
- The chimney connector shall not pass through an attic, roof space, closet or similar concealed space, floor, or ceiling. Where passage through a wall, or partition of combustible material is desired, the installation shall conform to CAN/CSA-B365, Installation Code for Solid-Fuel-Burning Appliances and Equipment or NFPA 211 Standard for Chimneys, Fireplaces, Vents and Solid-Fuel Burning Appliances.

Installation Procedure

1. Select the position for your wood stove based on the clearances diagram. Position the floor protection and stove.
2. Mark the position for the hole in the ceiling and roof by using a string and plumb-bob hanging over the exact center of the stoves flue pipe.
3. Check that the intended location will not interfere with floor joists, ceiling joists or rafters before proceeding further. Adjust if necessary and reconfirm the clearance's from the stove to combustibles.
4. Carefully follow the directions of the listed chimney for installation of the chimney system from the ceiling through to the rain cap. This may include framing in holes etc.
5. Start installing smoke pipe / chimney connector, slip the crimped edge of the pipe inside the stove collar. Use holes provided in collar to secure pipe with two screws.
6. Install the remaining lengths of pipe one on top of the other up to the finished height of the chimney and using the manufacturers approved adapter, secure to each other. A slip section can make this easier.

Combustion Air

Intake or combustion air can be supplied to the stove in one of two ways. Consult your local building code or CAN/CSA-B365, Installation Code for Solid-Fuel-Burning Appliances and Equipment before proceeding.

Outside air supply - (Necessary for mobile home installation, optional for residential installation.)

To draw **outside air through the floor** - This hole must get its air from a ventilated crawl space or be extended with duct to the outdoors (see Figure #3, Page 7). The use of outside combustion air for residential installation requires the unit to be secured to the structure to prevent dislodging of the air duct.

- **Leg Model:** Cut or drill a hole in the floor, (large enough to fit 4" metal flex venting) behind the ash box enclosure. Once the stove is in place, attach the 4" Intake Starter to the Ash Box Enclosure. Connect to the floor with the 4"(100mm) i.d. metal flex pipe.
- **Pedestal Model:** Cut or drill a 4" (100mm) diameter hole in the floor anywhere inside the perimeter of the pedestal base. Cover the hole with a 4" x 4" (100 mm x 100 mm) rodent screen and staple/nail in place. Leave the cover over the hole on the back of the Pedestal. Place the stove over the hole.

To draw **outside air from behind the stove**, Use a 4"(100mm) Air intake. Cut or drill the recommended size hole through a wall behind the unit.

- Install the 4" Intake Starter over the hole in the rear of the Ash Box enclosure. Attach metal flex between the starter and the Air Intake.
- Pedestal Model: Remove the cover plate from the rear of the pedestal and install the cover plate over the hole located under the Pedestal. Install the 4" Intake Starter over the hole in the rear. Attach metal flex between the starter and the wall inlet.

Room air supply - The stove will draw its air from the room through the opening in the Ash Box Enclosure and into the firebox intake.

Note: The living space around the heater must be well ventilated with good air circulation. Anything that may cause a negative pressure can cause gases or fumes to be pulled into the living area. During extremely cold weather, and especially when burning at very slow rates, the upper parts of the exposed chimney may ice up, partially blocking the flue gases. If blockage occurs, flue gases may enter the living space.

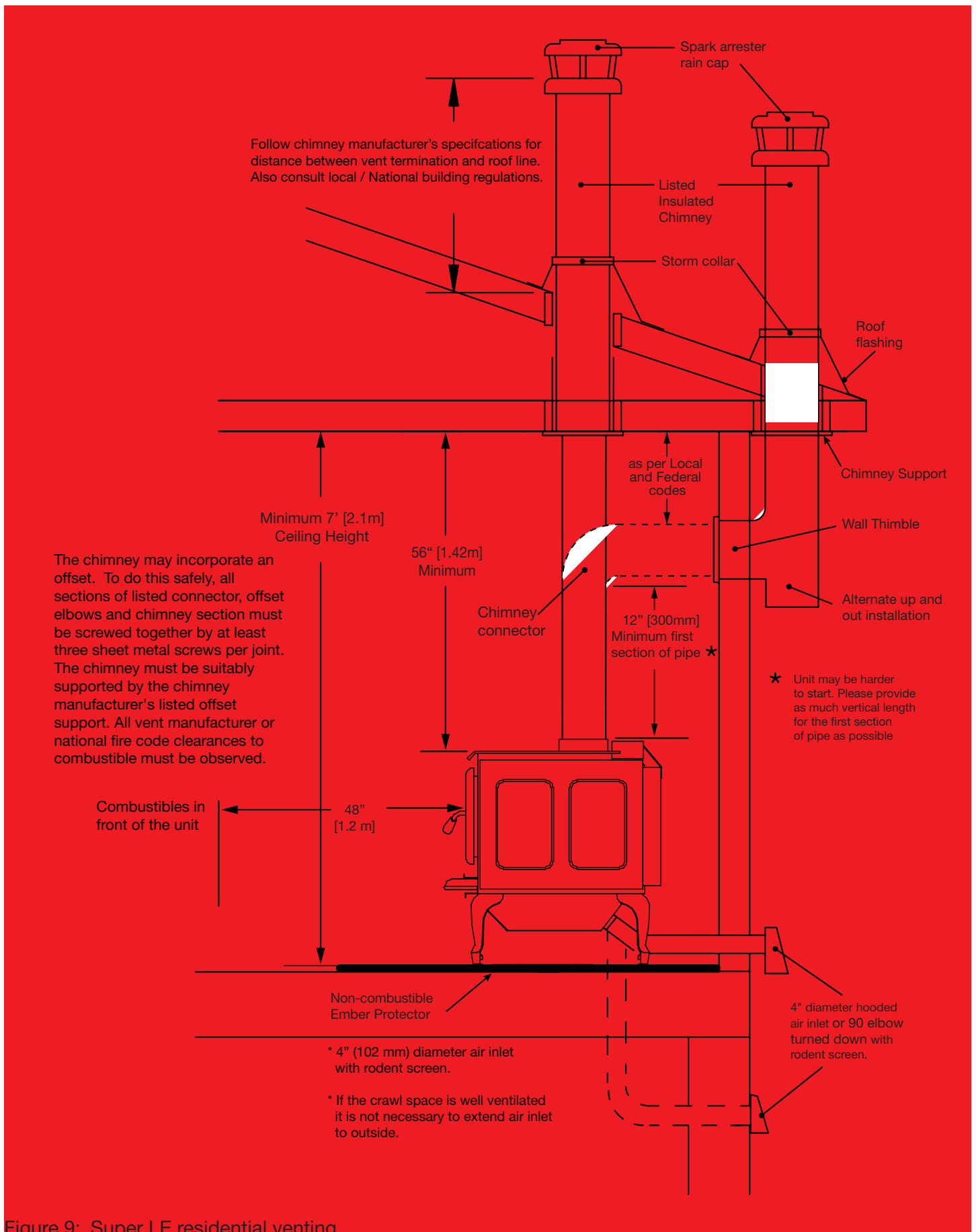


Figure 9: Super LE residential venting.

Ensure that the Masonry chimney meets all National and local Fire and building codes. Have the chimney cleaned and inspected by a professional to ensure there are no cracks, weak mortar or other signs of deterioration. See vent manufacturer's installation instructions for further information

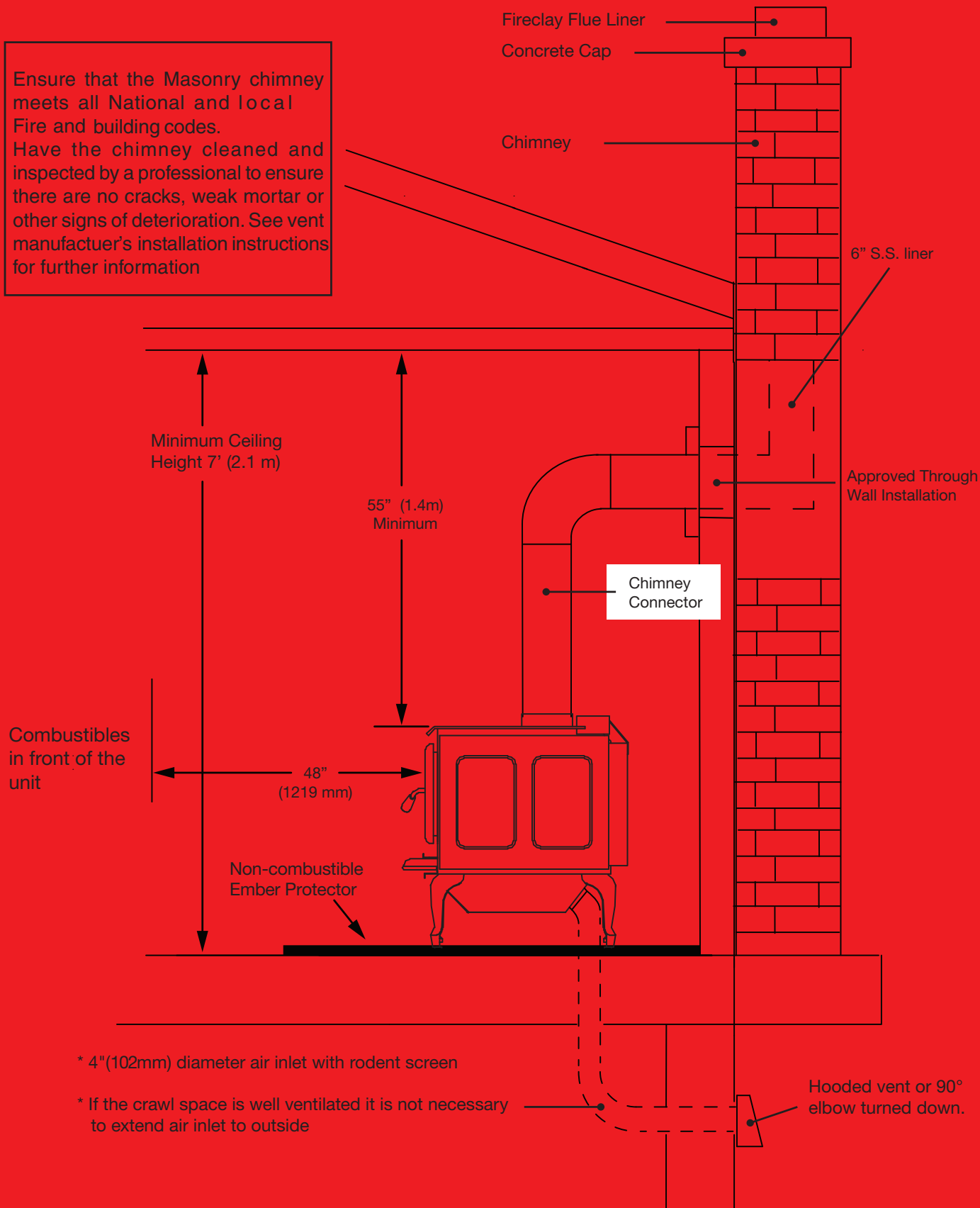


Figure 10: Super LE Venting to a masonry chimney.

Through Wall Installations (as per NFPA 211-2013)

ATTENTION: VAPOUR BARRIER MUST BE MAINTAINED WHEREVER CHIMNEY OR OTHER COMPONENTS PENETRATE TO THE EXTERIOR OF THE STRUCTURE. SEE LOCAL BUILDING CODES FOR PROPER AND APPROVED METHODS OF MAINTAINING VAPOUR BARRIER.

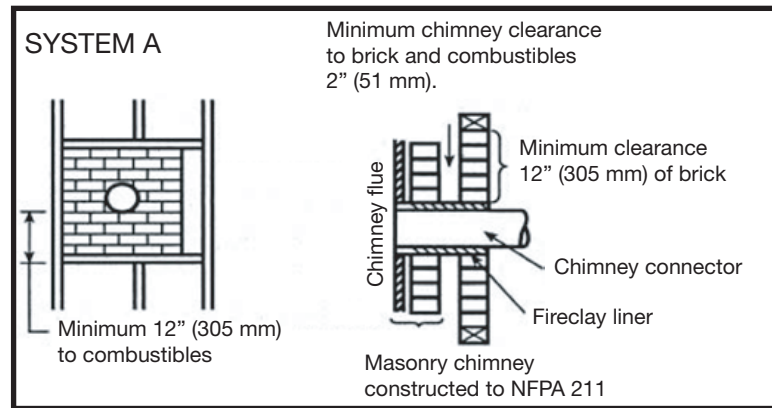


Figure 11: System A.ai
Minimum Clearance 12 in. (305mm) to combustibles

System A. Minimum 3.5 in. (90 mm) thick brick masonry wall framed into combustible wall with a minimum of 12 in. (305 mm) brick separation from clay liner to combustibles. Fireclay liner (ASTM C 315, Standard Specifications for Clay Fire Linings, or equivalent), minimum 5/8 in. (16 mm) wall thickness, shall run from outer surface of brick wall to, but not beyond, the inner surface of chimney flue liner and shall be firmly cemented in place.

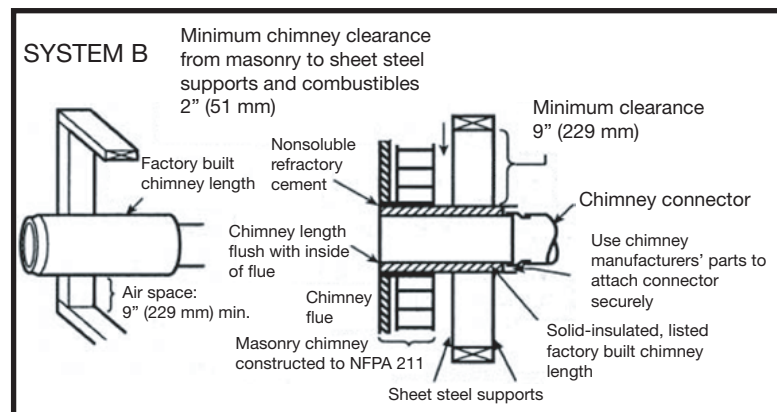


Figure 12: System B.ai
Minimum Clearance 9 in. (229mm) to combustibles

System B. Solid-Insulated, listed factory-built chimney length of the same inside diameter as the chimney connector and having 1 in. (25.4 mm) or more of insulation with a minimum 9 in. (229 mm) air space between the outer wall of the chimney length and combustibles.

The inner end of the chimney length shall be flush with the inside of the masonry chimney flue and shall be sealed to the flue and to the brick masonry penetration with non-water-soluble refractory cement. Supports shall be securely fastened to wall surfaces on all sides.

Fasteners between supports and the chimney length shall not penetrate the chimney liner.

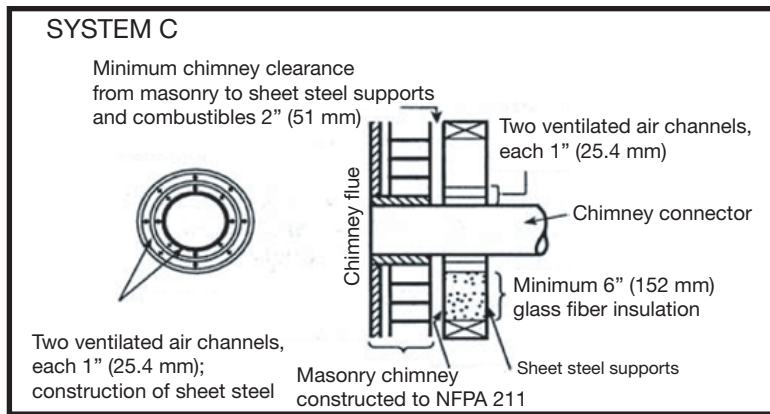


Figure 13: System C.ai

Minimum Clearance: 6 in. (152mm) to combustibles

System C. Sheet steel chimney connector, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, with a ventilated thimble, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, having two 1 in. (25.4 mm) air channels, separated from combustibles by a minimum of 6 in. (152 mm) of glass fiber insulation. Opening shall be covered, and thimble supported with a sheet steel support, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

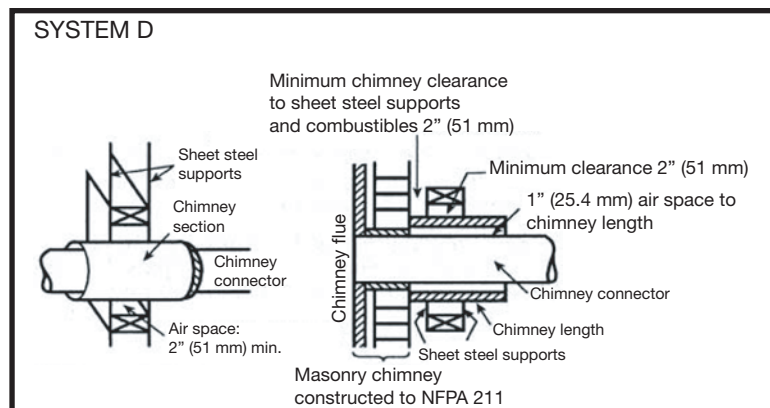


Figure 14: System D.ai

Minimum Clearance: 2 in. (51mm) to combustibles

System D. Solid-Insulated, listed factory-built chimney length with an inside diameter 2 in. (51 mm) larger than the chimney connector and having 1 in. (25.4mm) or more of insulation, serving as a pass-through for a single-wall sheet steel chimney connector of minimum 24 gauge [0.024 in. (0.61 mm)] thickness, with a minimum 2 in. (51 mm) air space between the outer wall of chimney section and combustibles.

Minimum length of chimney section shall be 12 in. (305 mm). Chimney section concentric with and spaced 1 in. (25.4 mm) away from connector by means of sheet steel support plates on both ends of chimney section. Opening shall be covered, and chimney section supported on both sides with sheet steel supports of minimum 24 gauge [0.024 in. (0.61 mm)] thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

Mobile Home Installation

Warning: Under no circumstances is this heater to be installed in a makeshift or "temporary" manner. It may be fired only after the following conditions have been met.

- **DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.**
- **DO NOT INSTALL IN A SLEEPING ROOM.**
- **CAUTION: THE STRUCTURAL INTEGRITY OF THE MOBILE HOME FLOOR, WALL AND CEILING/ ROOF MUST BE MAINTAINED.**
- Attach the stove to the floor using two 1/4" x 2" or longer lag screws through holes in the legs or the Pedestal base.
- Outside air supply must be used for Mobile Home installations - see .pg.16
- The services of a competent or certified installer, (certified by the Wood Energy Technical Training program (WETT) - in Canada, Hearth Education Foundation (HEARTH) - in U.S.A.,) are strongly recommended.

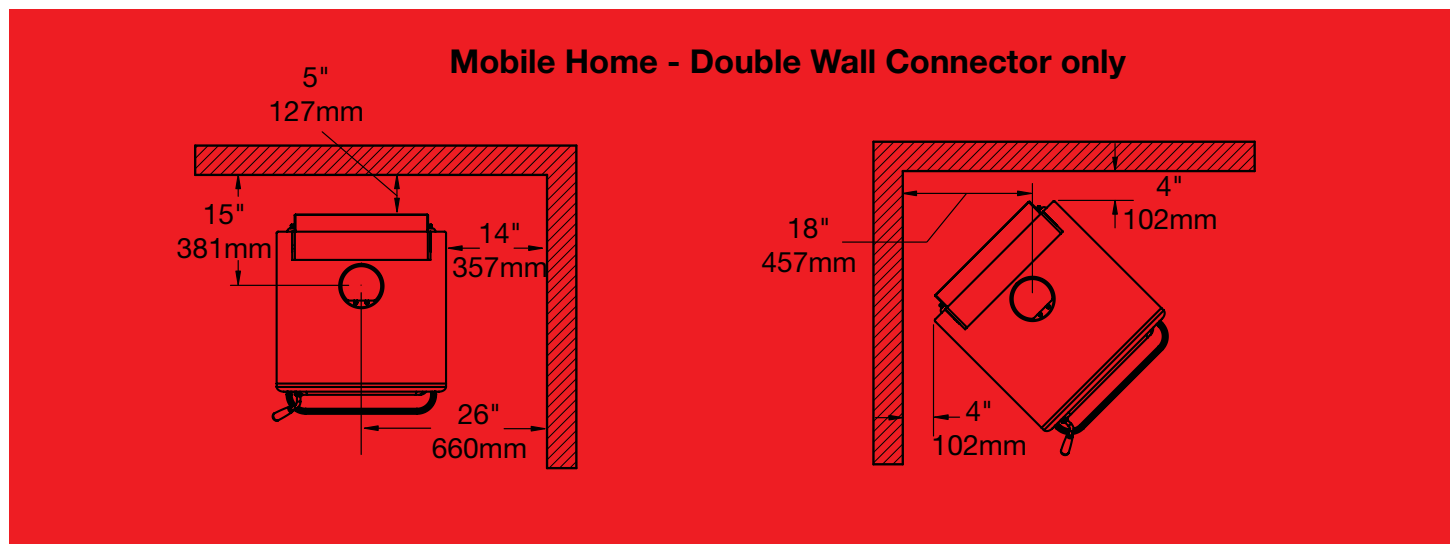
Clearances

This heater must be installed with listed double-wall connector and compatible ULC-S629 or UL-103HT listed chimney system, see page 17.

Clearances to combustible surfaces and materials are shown. See picture below.

Consult local fire codes and authorities for approval.

NOTE: Install all components to the connector or chimney manufacturer's installation requirements. Consult your chimney supplier/manufacturer for installation advice.



Optional Blower

The optional blower kit Part #: WODC.BLOWB is equipped with a three prong power cord and may be installed at any time. Follow the installation instructions supplied with the kit. Route power supply cord away from heater.

Electrical rating: 115 volts AC-1.02 amps.
Fan output rating: 140 CFM

Blower Operation

Proper blower speed matched with air control setting will ensure peak performance from your stove. Operate as follows:

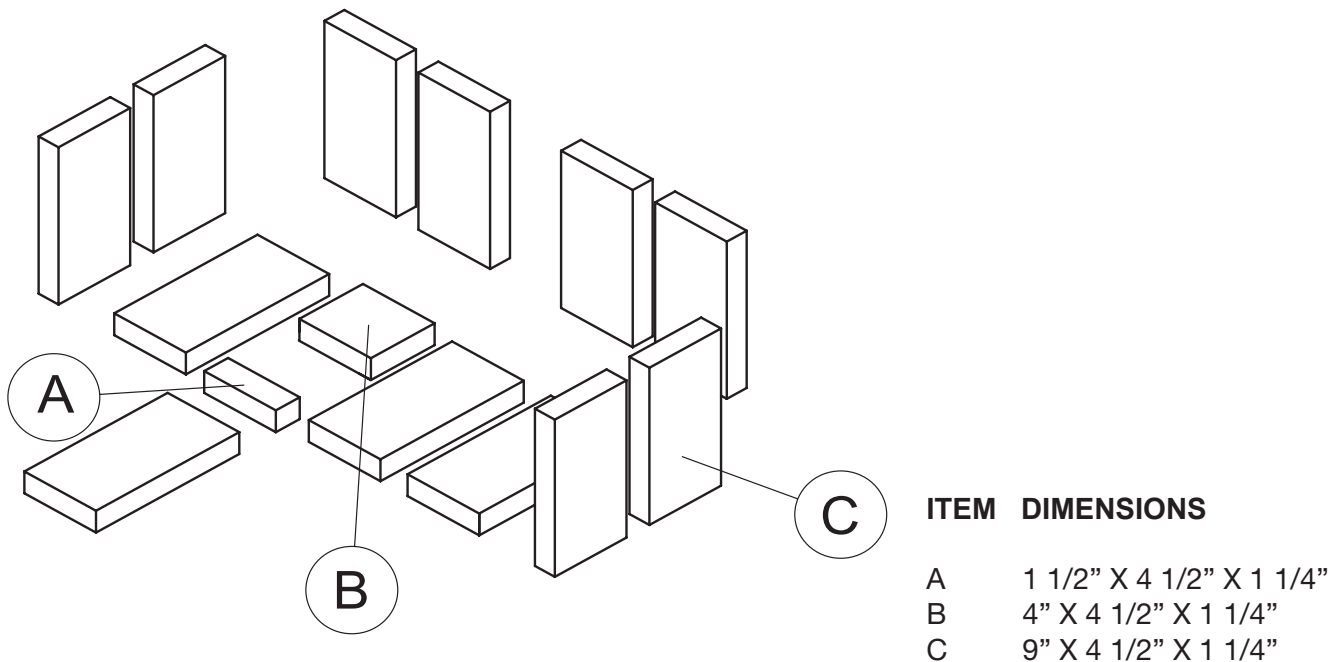
- Air control set to "L" (low), operate blower speed control on "Low".
- Air control set between "L" and "H" (low and high), operate blower speed control at desired setting.

Automatic: To operate the blower automatically, set the rocker switch on the side of the fan housing to "Auto" and set the speed control to your desired setting. This will allow the fan to turn on as the stove heats up to operating temperature. It will also shut the blower off after the fire has gone out and the unit has cooled to below a useful heat output range.

Manual: To manually operate the blower, set the rocker switch to "Man" and set the speed control to your desired setting. This will bypass the temperature sensing device and allow full control of the blower. Switching from "Auto" to "Man" or selecting speed may be done anytime.

Note: The Blower will not shut off until it is manually turned off.

Firebrick Installation



Firebrick Installation Con't

1. Install the floor firebricks; For units **without an Ash Dump** use full size "D" bricks See "Figure 19: Floor layout without ash dump." on page 24. For unit **with the Ash Dump** installed, 2 small bricks ("A & B" in Fig 20) will be used on either end of the ash dump in addition to the regular sized "D" bricks used in the rest of the installation.

There is one exception. Brick "C" is a shorter brick than the "D" bricks. "C" brick fits up against the Baffle Tube on the rear wall of the firebox and is used in units with or without an ash dump.

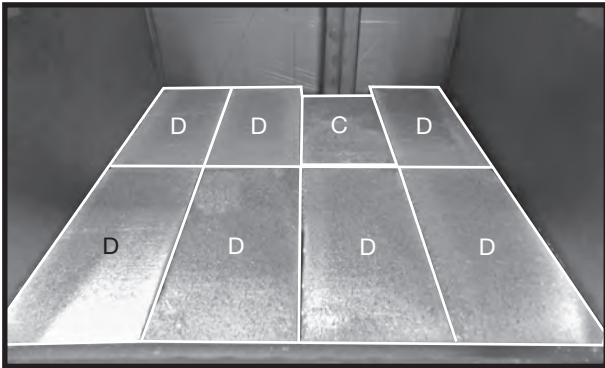


Figure 18: Floor layout without ash dump.

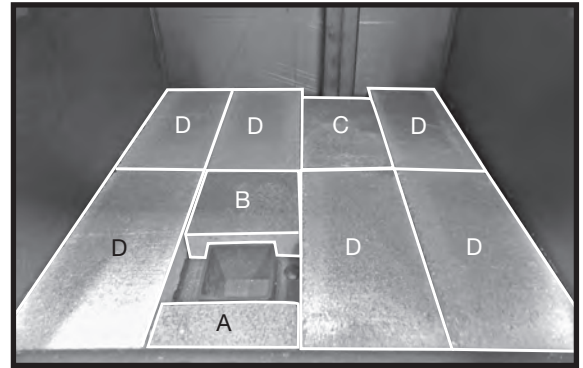


Figure 19: Firebricks on floor.

2. The firebricks for the side walls are next. The sides use "D" bricks. The bricks will stand on top of the floor bricks and will stand on their ends. They will be held in place by two tabs per wall. Install the end bricks first followed by the two center bricks.

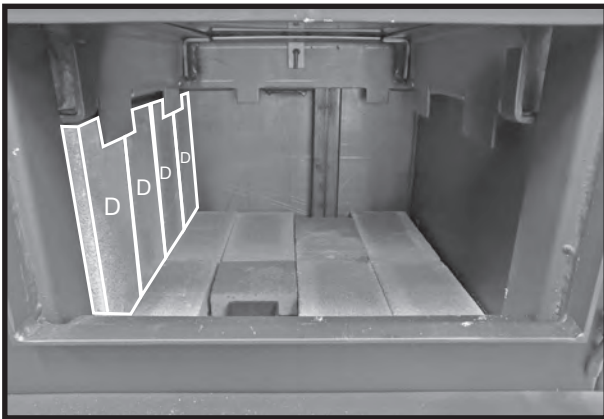


Figure 15: Left wall bricks in place.

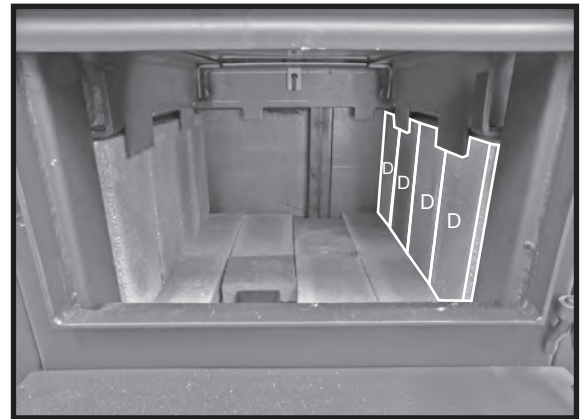


Figure 16: Bricks on right side wall in place.

3. The rear wall is last. The rear bricks also stand on end and will stand on top of the floor bricks.

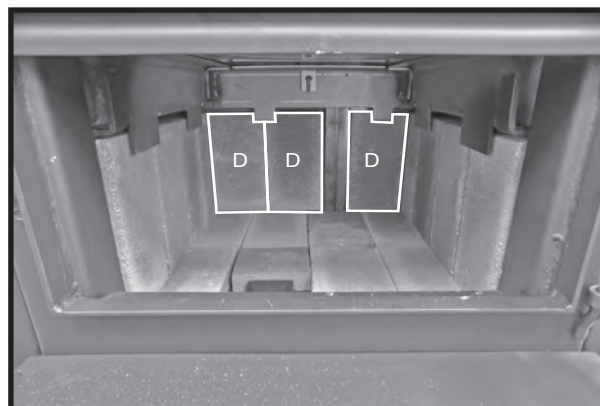


Figure 17: Rear wall firebrick installation complete.

Trouble Shooting

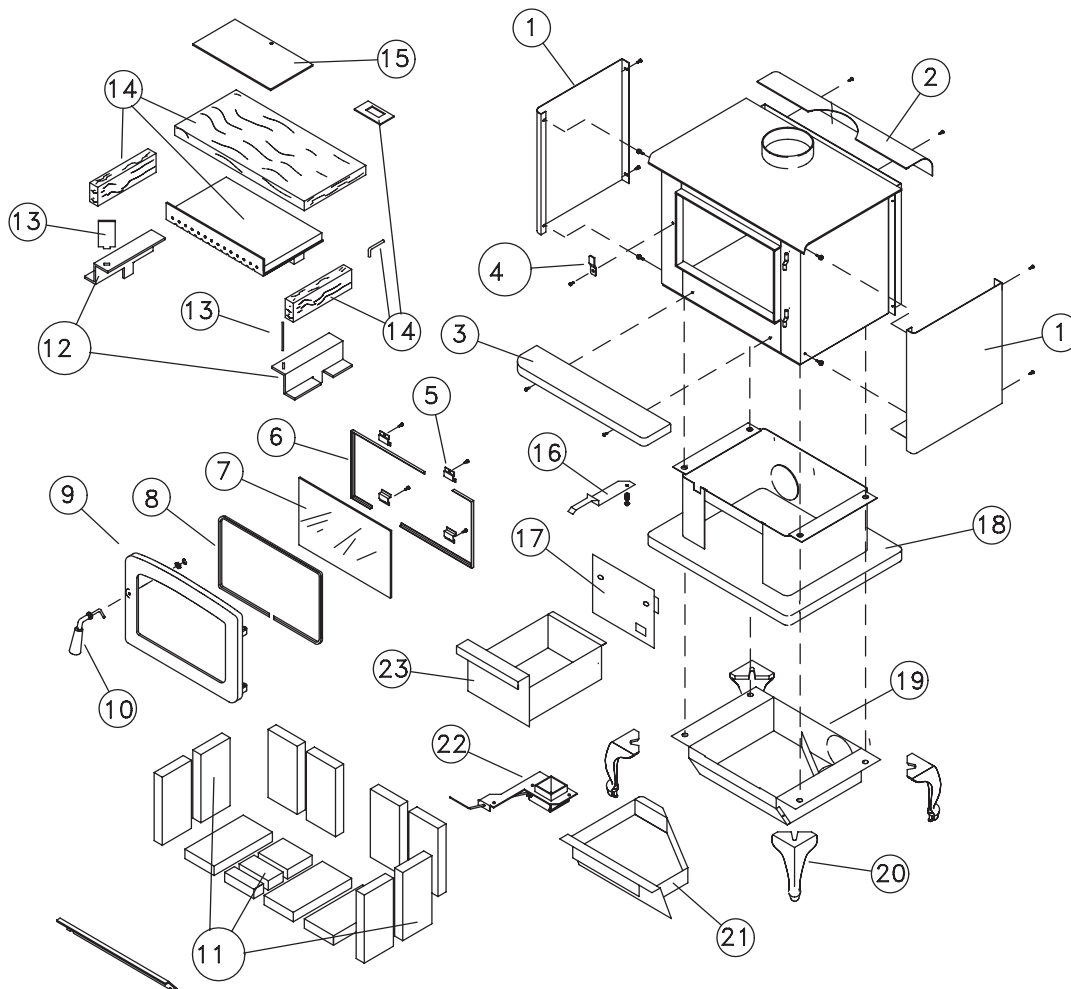
Problem	Cause	Cure
Excessive Creosote Build-up	1) Wood is too wet 2) Turning down air control too soon 3) Draft too low	- Use dry wood - Do not turn down until: a) there is a good bed of coals b) the wood is charred - Chimney plugged or restricted, check flue - Improper chimney height and/or diameter - Provide outside air for combustion - Check draft in chimney and system, alter as needed.
Glass is Dirty	1) See 1, 2, and 3 above 2) Door Gasket leakage	- Replace gasket - Check door latch
Low Heat Output	1) Wood may be wet 2) Fire too small 3) Draft too low	- Check wood and use drier wood if required. - Build a larger fire - Open draft control to increase burn rate. - Chimney plugged or restricted Inspect and clean
Won't Burn Overnight	1) Air control set too high 2) Not enough wood 3) Draft too high	- Set control lower - Unsplit wood is preferred for overnight burns - Excessive chimney height and/or diameter, see page 11
Stove Won't Burn	1) Combustion air supply is blocked	- Check outside air supply for obstructions - Check that room air cover is removed. - Chimney plugged or restricted Inspect and clean

Replacement Parts - VISTA LE

(WHEN ORDERING, INCLUDE PART NUMBER WITH DESCRIPTION)

ITEM	DESCRIPTION	PART NO.	ITEM	DESCRIPTION	PART NO.
1.....	Side shield, left or right.....	VIST.2201	18.....	Pedestal	VIST.2205WELD
2.....	Top deflector	VIST.2229	19.....	Ash drawer enclosure.....	VIST.2219
3.....	Ashlip (c/w hardware).....	ALIP.5037473MB	20.....	Leg, Black.....	CAST.LEGST
4.....	Door catch.....	WODC.1461		Leg, Gold.....	CAST.LEGGLD
5.....	Glass clamp set(4 pc.)	SSE.1425		Leg, Nikel	CAST.LEGNI
6.....	Glass bar set (2 pc.).....	DR16.212501		Leg, Brushed Nikel.....	CAST.LEGBNA
7.....	Replacement glass(c/w Tape)	DR16.208201	21.....	Ash box (leg model)	VIST.2220
8.....	Door gasket kit	DR31.WDGKIT	22.....	Ash dump assembly	WODC.2261
9.....	Door Casting, Black.....	CAST.16ST	23.....	Ash box (pedestal model).....	WODC.4316
.....	Door Casting, Gold.....	CAST.16GD			
.....	Door casting, Nikel.....	CAST.16NI			
.....	Door casting, Brushed Nikel.....	CAST.16BNI			
10.....	Door handle assembly.....	WODC.4147C			
11.....	Firebrick set.....	BRIC.VISTA			
12.....	Brick rail set.....	VIST.RAILSET			
13.....	Rail extensions 2 pc.	VIST .RAILEXT			
14.....	Baffle kit.....	VIST.BAFKIT			
15.....	Flame shield (c/w nut & bolt).....	VIST.2115			
16.....	Air shutter assembly	VIST.4531			
17.....	Pedestal front cover assembly.....	SSE.2075			

All parts may be ordered from your nearest Pacific Energy deale . Contact Pacific Energy for the location of the dealer nearest you.

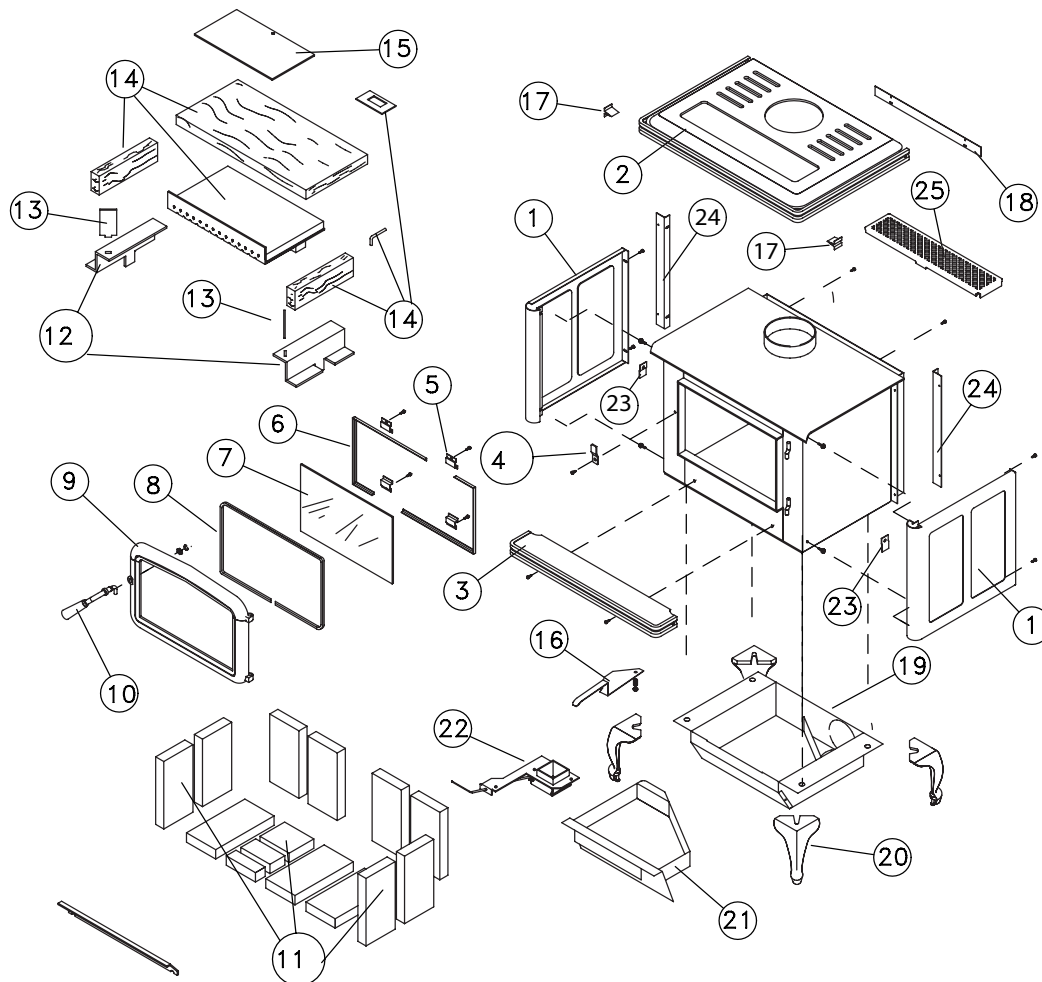


Replacement Parts - VISTA CLASSIC LE

(WHEN ORDERING, INCLUDE PART NUMBER WITH DESCRIPTION)

ITEM	DESCRIPTION	PART NO.	ITEM	DESCRIPTION	PART NO.
1.....	Vista Classic side shield, L/R	VISC.2251	19....	Ash drawer enclosure	VIST.2219
2.....	Vista Classic top	VISC.2240	20.....	Leg, Black.....	CAST.LEGST
3.....	Vista Classic ashlip.....	ALIP.2264xx		Leg, Gold.....	CAST.LEGGLD
4.....	Door catch.....	WODC.1461		Leg, Nickel	CAST.LEGNI
5.....	Glass clamp set(4 pc.)	SSEK.1425		Leg, Brushed Nickel.....	CAST.LEGBNA
6.....	Glass bar set (2 pc.).....	DR16.212501	21....	Ash box.....	VIST.2220
7.....	Replacement glass(c/w Tape)	DR16.208201	22....	Ash dump assembly	WODC.2261
8.....	Door gasket kit	DR31.WDGKIT	23....	Vista Classic side shield clip.....	2252
9.....	Door Casting, Black.....	CAST.16ST	24....	Vista Classic side shield bracket	2253
.....	Door Casting, Gold.....	CAST.16GD	25....	Vista Classic Trivet, Gold	VISC.CTGDA
.....	Door casting, Nickel.....	CAST.16NI		Vista Classic Trivet, Nickel.....	VISC.CTNIA
.....	Door casting, Brushed Nickel.....	CAST.16BNI		Vista Classic TRivet, BLack.....	VISC.CTBKA
10.....	Door handle assembly.....	WODC.4147C			
11.....	Firebrick set.....	BRIC.VISTA			
12.....	Brick rail set.....	VIST.RAILSET			
13.....	Rail extensions 2 pc.	VIST .RAILEXT			
14.....	Baffle kit.....	VIST.BAFKIT			
15.....	Flame shield (c/w nut & bolt).....	VIST.2115			
16.....	Air shutter assembly	VIST.4531			
17....	Vista Classic top clip.....	2242.001			
18....	Vista Classic top bracket.....	2243			

All parts may be ordered from your nearest Pacific Energy dealer . Contact Pacific Energy for the location of the dealer nearest you.



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