
Hearth & Home Technologies

Project # 21-661

Model: Expedition-I

AKA: Gifford-CB, Gifford-BM

Type: Single Burn Rate Wood-Fired
Heater

June 18, 2021

Revised: August 3, 2021

**ASTM E2780 – 10
Standard Test Method for
Determining Particulate Matter
Emissions from Wood Heaters**

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Revision Summary

Date: June 18, 2021 – Original Issue

Date: August 3, 2021 – The following revisions were made per request from the EPA:

- The owner's manual was edited to include information on replacement parts. See pages 23-30 of owner's manual in Appendix B (pages 134-141 in Non-CBI report).

- The pre-conditioning test data in Appendix A was revised to include fuel moisture information, see page 20 of Non-CBI Test Report.

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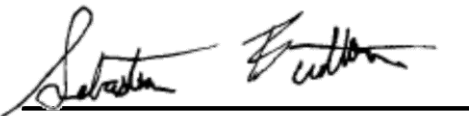
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Affidavit

PFS-TECO was contracted by Hearth & Home Technologies to provide testing services for the Expedition-I Wood-Fired Room Heater per ASTM E2780, *Standard Test Method for Determining Particulate Matter Emissions from Wood Heaters*. All testing and associated procedures were conducted at PFS-TECO's Hearth Products laboratory beginning on 5/13/2021 and ending on 5/13/2021. The laboratory is located at 11785 SE Hwy 212, Clackamas OR 97015. Testing procedures followed ASTM E2780. 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", and ISO 17025:2005 "Requirements for Testing Laboratories." PFS-TECO is also accredited 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.

A handwritten signature in black ink, appearing to read "Sebastian Button", written over a solid black horizontal line.

Sebastian Button, Laboratory Supervisor

Introduction

Hearth & Home Technologies of Halifax, PA contracted with PFS-TECO to perform EPA certification testing on the model Expedition-I Wood-Fired Room Heater. All testing was performed at PFS-TECO's Portland Laboratory in Clackamas, OR. All testing was performed by Sebastian Button.

Notes

- Prior to start of testing, 50 hours of conditioning was performed by the manufacturer in accordance with ASTM E2780.
- Prior to start of testing, the dilution tunnel was cleaned with a steel brush.
- A 1st hour emissions sample train was pulled for all test runs.
- The blower assembly on this appliance is integral to the design and not provided optionally, therefore no fan confirmation test was performed.
- A total of 2 test runs were completed. Test runs were performed in accordance with ASTM E2780 for a single burn rate appliance. See the Run Narrative section for further detail on each run.

Wood Heater Identification and Testing

- Appliance Tested: ***Expedition-I***
- Serial Number: ***Un-serialized Prototype – PFS Tracking Number 100***
- Manufacturer: ***Hearth & Home Technologies***
- Catalyst: ***No***
- Variable Burn Rate: ***No***
- Heat exchange blower: ***Integral***
- Type: ***Wood Stove***
- Style: ***Insert***
- Testing Period – Start: ***Thursday, May 13, 2021***
Finish: ***Thursday, May 13, 2021***
- Test Location: ***PFS-TECO***
11785 SE Hwy 212, Suite 305
Clackamas, OR 97015
- Elevation: ***~131 Feet above sea level***
- Test Technician(s): ***Sebastian Button***
- Observers: ***Bud Fongeallaz of HHT***

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
189	Mettler Toledo 3'x3' floor scale w/digital weight indicator
132	Digiweigh DWP-440 Platform Scale
129	APEX XC-50-DIR Digital Emissions Sampling Box A
130	APEX XC-50-DIR Digital Emissions Sampling Box B
187	California Analytical ZRE CO ₂ /CO/O ₂ IR ANALYZER
064	Digital Barometer
109A/B	Troemner 100mg/200mg Audit Weights
107	Sartorius Analytical Balance
051	10 lb audit weight
148	Dewalt Tape Measure
095	Anemometer
111	Microtector
115	Delmhorst Wood Moisture Meter
SA18857	Gas Analyzer Calibration Span Gas
91005049	Gas Analyzer Calibration Mid Gas

Results

The average emissions rate for the 2 run test series was measured to be **1.9 g/hr** with a Higher Heating Value efficiency of **65%**. The average CO emission rate for the 2 tests was **2.54 g/min**. The HHT model Expedition-I Expedition-I Wood-Fired Room Heater meets the 2020 crib wood PM emission standard of ≤ 2.0 g/hr per CFR 40 part 60, §60.532 (c).

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

Summary Table

	<i>Run 1</i>	<i>Run 2</i>
Date	5/13/2021	5/13/2021
Run Number	1	2
Emission Rate (g/hr)	1.64	2.12
Burn Rate (kg/hr)	2.29	1.99
Heat Output (Btu/hr)	27,361	23,747
Overall Efficiency (% HHV)	64.3%	64.9%
CO Emissions (g/MJ Output)	5.53	5.80
CO Emissions (g/kg Dry Fuel)	70.46	74.49
CO Emissions (g/min)	2.66	2.42
Emissions Rate – First Hour (g/hr)	2.18	3.30
Particulate emission average of 2 test runs: 1.9 grams per hour.		
Weighted average HHV efficiency of 2 test runs: 65%.		
Average CO emissions of 2 test runs: 2.54 g/min.		

Test Run Narrative

Run 1

Run 1 was performed on 5/13/2021, in accordance with the procedures specified in ASTM E2780 for a single burn rate appliance. The total test time was 94 minutes. The particulate emissions rate for the test was 1.64 g/hr, the burn rate was 2.29 kg/hr with an HHV efficiency of 64.3%. The Train A sample assembly 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 2

Run 2 was performed on 5/13/2021, in accordance with the procedures specified in ASTM E2780 for a single burn rate appliance. The total test time was 112 minutes. The particulate emissions rate for the test was 2.12 g/hr, the burn rate was 1.99 kg/hr with an HHV efficiency of 64.9. The Train A sample assembly 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.

The average burn rate for the two test runs is 2.14 kg/hr, with each test run differing from the average by 7.0%, which meets the requirement for single burn heaters in ASTM E2780 X1.4.2.

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	75	78.8	43.1	36.7	30.00	9.35	9.50	21.6	94
2	79	80.8	30.5	30.1	29.92	9.55	9.77	21.6	112

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.

	Pre-Burn Air Setting	Test Run Air and Fan Settings
Run 1	Automatic Combustion Control (ACC) Activated upon fuel loading, fan on high	Automatic Combustion Control (ACC) Activated upon fuel loading, fan on high
Run 2	Automatic Combustion Control (ACC) Activated upon fuel loading, fan on high	Automatic Combustion Control (ACC) Activated upon fuel loading, fan on high

Appliance Description

Model(s): Expedition-I

Appliance Type: Single Burn Rate Wood-Fired Room Heater

Additional Models: This model series is also offered under the Vermont Casting Branding as the Gifford-CB and Gifford-BM. These models utilize the same basic design with respect to performance and emissions controls. All models listed are presumed to have the same emissions performance as the test specimen provided for certification testing.

Firebox Volume: 1.45 ft³

Air Introduction System: Primary and secondary air enter the appliance through fixed openings on either side of the bottom of the appliance. The primary air is channeled towards the front of the firebox and down to an air wash over the loading door, while the secondary air is channeled up the sides and is orificed into a series of 3 stainless steel secondary air tubes. Start-up air is activated by the Automatic Combustion Control (ACC), which is meant to be activated during fuel loading. A gated orifice allows air to enter the front air channel in the bottom of the firebox, through two orifices directed at the coal bed. The ACC is controlled by a timer mechanism which slowly closes off the air supply.

Baffles: The secondary air tubes are covered by a ceramic baffle board, which is insulated by a ceramic fiber blanket.

Refractory Insulation: The firebox is lined with 1.25" thick firebrick.

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

Catalytic Combustor: N/A

Fan: The Expedition-I is equipped with a convection fan attached to the lower front of the appliance.

Appliance Dimensions

Expedition-I Unit Dimensions

Height	Width	Depth	Firebox Volume
19"	26.5"	16"	1.45 ft ³

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

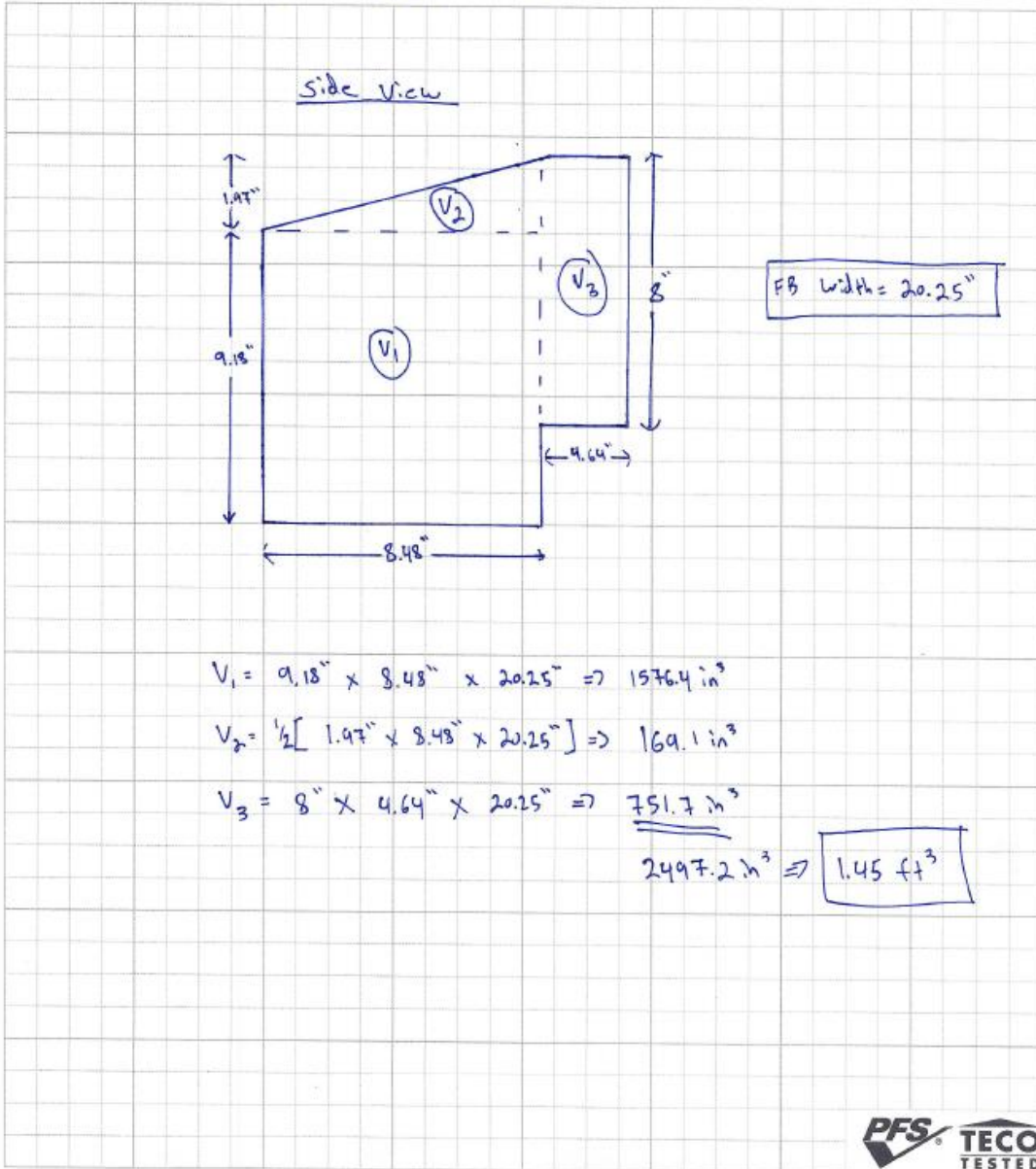
Firebox Volume



An Employee-Owned Company • PFS Corporation d/b/a PFS TECO

PROJECT: HHT Expedition - I

DATE: _____



Appliance Front



Appliance Left



Appliance Right



Appliance Rear



Test Fuel Properties

Test fuel used was dimensional Douglas fir lumber in 2" x 4" (nominal). Test fuel was air dried to the specified moisture range of 19-25% dry basis. A typical fuel load is pictured below:

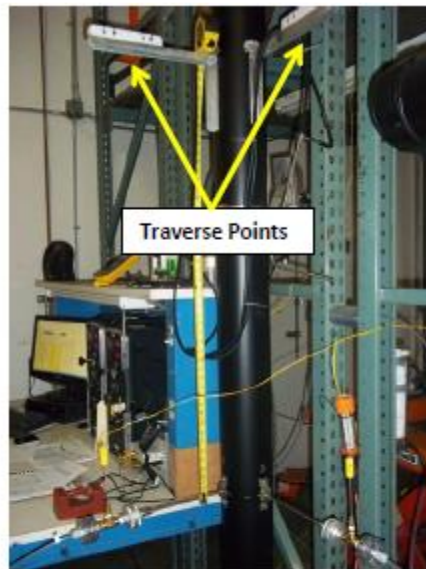
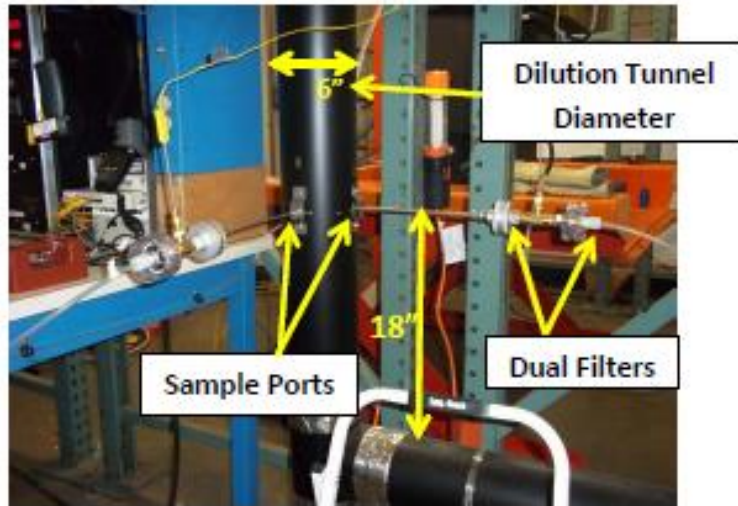
Typical Fuel Load



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 12 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: 352 Mountain House Road, Halifax, PA 17032, 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 IN ACCORDANCE WITH REQUIREMENTS 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 Alternate Test Method Approval

Appendix B – Labels and Manuals

Appendix C – Equipment Calibration Records

Appendix D – Design Drawings (CBI Report Only)

Appendix E – Manufacturer QAP (CBI Report Only)

Pre-Conditioning Data

Client: HHT	Job #: 21-661
Model: Expedition/Gifford	Tracking #:
Date(s): 2/22/21 – 3/18/21	Technician: Bud Fongeallaz

Elapsed Time (hrs)	Flue (°F)	Catalyst Exit (°F)	Notes: Indicate initial air setting and any changes in in setting during conditioning, as well as weight and average moisture content of all fuel additions.
0	584	N/A	Added 9.6 lbs single burn rate. Moisture 18.825%
1	785	N/A	
2	456	N/A	
3	522	N/A	Added 9.8lbs single burn rate. Moisture 20.9%
4	978	N/A	
5	745	N/A	Added 10.0lbs single burn rate. Moisture 20.825%
6	796	N/A	
7	801	N/A	Added 9.9lbs single burn rate. Moisture 20.2%
8	756	N/A	
9	322	N/A	
10	704	N/A	Added 9.7lbs single burn rate. Moisture 20.075%
11	441	N/A	
12	855	N/A	Added 10.2lbs single burn rate. Moisture 18.65%
13	946	N/A	
14	786	N/A	
15	655	N/A	
16	420	N/A	
17	568	N/A	Added 9.6lbs single burn rate. Moisture 21.25%
18	952	N/A	
19	770	N/A	
20	400	N/A	
21	587	N/A	Added 10.5lbs single burn rate. Moisture 18.575%
22	678	N/A	
23	922	N/A	Added 8.1lbs single burn rate. Moisture 19.175%
24	798	N/A	
25	654	N/A	Added 10.4lbs single burn rate. Moisture 20.05%
26	826	N/A	
27	563	N/A	
28	372	N/A	
29	630	N/A	Added 11.3lbs single burn rate. Moisture 18.25%
30	964	N/A	
31	780	N/A	Added 8.8lbs single burn rate. Moisture 19.2%
32	411	N/A	
33	630	N/A	Added 10.0lbs single burn rate. Moisture 22.575%
34	982	N/A	
35	700	N/A	Added 7.7lbs single burn rate. Moisture 21.875%
36	436	N/A	
37	503	N/A	Added 11.4lbs single burn rate. Moisture 22.125%
38	944	N/A	
39	660	N/A	
40	400	N/A	
41	560	N/A	Added 9.6lbs single burn rate. Moisture 19.475%
42	901	N/A	
43	803	N/A	Added 9.9lbs single burn rate. Moisture 17.925%
44	498	N/A	
45	612	N/A	Added 11.7lbs single burn rate. Moisture 20.125%
46	906	N/A	
47	741	N/A	Added 8.8lbs single burn rate. Moisture 22.225%
48	502	N/A	
49	311	N/A	
50	632	N/A	Added 8.4lbs single burn rate. Moisture 17.675%

Expedition-I Burn Instructions

Firebox Volume – 1.45 ft³

Nominal Fuel Length ~ 17"

Fuel Configuration – Four 2x4's, 4 spacers on all pieces

Kindling Fire

Light approximately 7 lbs of kindling fuel with torch, push in ACC when closing door.

Preburn Fire

Once kindling has burned down to ~2 pounds and there is no more active flame, load preburn fuel. Preburn should consist of two 17" pieces loaded parallel to door with five or six 9" pieces loaded perpendicularly on top. Total preburn fuel weight should be about the same weight at the test fuel load. Once fuel is loaded, close door immediately, activate ACC, turn fan onto high. You should be in coal bed range right at the hour mark.

Test Fire

Level coal bed, ensuring Lower Primary Air Orifices are clear. Activate ACC prior to loading, once fuel is loaded keep door cracked for 80-90 seconds then close. Fan on High, test length is ~90 minutes.

**WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515**



Run 1 Data Summary

Client:	HHT
Model:	Expedition 1
Job #:	21-661
Tracking #:	100
Test Date:	5/13/2021

A handwritten signature in black ink, appearing to read "Sebastian E. ...", is written over a horizontal line.

Techician Signature

6/14/2021

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: HHT

Model: Expedition 1

Run #: 1

Job #: 21-661

Tracking #: 100

Technician: SJB

Date: 5/13/2021

Burn Rate (kg/hr):	2.29
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	16.689	21.640	21.758	13.634
Average Gas Velocity in Dilution Tunnel (ft/sec)	8.7			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	22571.5			
Average Gas Meter Temperature (°F)	78.6	81.8	80.4	79.3
Total Sample Volume (dscf)	16.562	21.300	21.395	13.481
Average Tunnel Temperature (°F)	102.4			
Total Time of Test (min)	94			
Total Particulate Catch (mg)	0.0	1.7	1.4	1.3
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000798	0.0000654	0.0000964
Total PM Emissions (g)	0.00	2.82	2.31	2.18
Particulate Emission Rate (g/hr)	0.00	1.80	1.48	2.18
Emissions Factor (g/kg)	-	0.79	0.65	-
Difference from Average Total Particulate Emissions (g)	-	0.25	0.25	-
Difference from Average Total Particulate Emissions (%)	-	9.9%	9.9%	-
Difference from Average Emissions Factor (g/kg)	-	0.07	0.07	-

Final Average Results	
Total Particulate Emissions (g)	2.57
Particulate Emission Rate (g/hr)	1.64
Emissions Factor (g/kg)	0.72
HHV Efficiency (%)	64.3%
LHV Efficiency (%)	69.5%
CO Emissions (g/min)	2.66

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	89.2	OK
Face Velocity	< 30 ft/min	12.8	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min: 75 / Max: 79.7	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	46.8	OK

B415.1 Efficiency Results

Manufacturer: HHT
Model: Expedition 1
Date: 05/13/21
Run: 1
Control #: 21-661
Test Duration: 94
Output Category: 4

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	64.3%	69.5%
Combustion Efficiency	95.0%	95.0%
Heat Transfer Efficiency	67.6%	73.1%

Output Rate (kJ/h)	28,844	27,361	(Btu/h)
Burn Rate (kg/h)	2.27	4.99	(lb/h)
Input (kJ/h)	44,887	42,580	(Btu/h)

Test Load Weight (dry kg)	3.55	7.82	dry lb
MC wet (%)	17.73		
MC dry (%)	21.55		
Particulate (g)	2.57		
CO (g)	250		
Test Duration (h)	1.57		

Emissions	Particulate	CO
g/MJ Output	0.06	5.53
g/kg Dry Fuel	0.72	70.46
g/h	1.64	159.65
g/min	0.03	2.66
lb/MM Btu Output	0.13	12.86

Air/Fuel Ratio (A/F)	13.14
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	17.00	23.8				
2x4	17.00	23.2				
2x4	9.00	19.9				
2x4	9.00	19.7				
2x4	9.00	23.3				
2x4	9.00	19.9				
2x4	9.00	20.5				
2x4	9.00	22.2				
Total Fuel Weight (lbs):		9.35	Average Moisture (%DB):		21.6	

Firebox Volume (ft³): 1.45
 Total 2x4 Crib Weight, with spacers (lbs): 9.50
 Total 4x4 Crib Weight, with spacers (lbs): 0.00
 Total Wet Fuel Weight, with spacers (lbs): 9.50

Coal Bed Range (20-25%):
 Min (lbs): 1.90
 Max (lbs): 2.38

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	17.00	1.81	19.3	19.8	18.5	1.52
2x4	17.00	1.81	24.5	23.8	23.1	1.46
2x4	17.00	1.85	23.8	24.5	22.4	1.50
2x4	17.00	1.95	19.4	18.9	20.6	1.63
Total Dry Weight, no spacers (lbs):						6.11
Total Dry Weight, with spacers (lbs):						7.90

Spacer Moisture Readings (%DB)						
19.2	19.9	15.9	11.5			
19.7	11.3	11.1	16.8			
18.7	12.5	22.1	16.6			
11.4	16.1	16.2	12.8			

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	29.6	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.55	OK
2x4 Fuel Mix	35 - 65 % of total weight	N/A	N/A

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: HHT	Job #: 21-661
Model: Expedition 1	Tracking #: 100
Run #: 1	Technician: SJB
Test Start Time: 12:03	Date: 5/13/2021

Total Sampling Time (min): 94		Pre-Test	Post Test	Avg.
Recording Interval (min): 1		Barometric Pressure (in. Hg): 30.01	29.99	30.00
Meter Box γ Factor: 1.003 (A)		Relative Humidity (%): 43.1	36.7	
Meter Box γ Factor: 0.999 (B)		Room Air Velocity (ft/min): 0	0	
Meter Box γ Factor: 1.010 (Ambient)		Scale Audit (lbs): 10.0	10.0	
		Ambient Sample Volume: 16.689 ft ³		

Induced Draft Check (in. H₂O): **0**
 Smoke Capture Check (%): **100%**
 Date Flue Pipe Last Cleaned: **5/13/2021**

Sample Train Post-Test Leak Checks

(A)	0.001	cfm @	-5 in. Hg
(B)	0.000	cfm @	-5 in. Hg
(Ambient)	0.001	cfm @	-5 in. Hg

DILUTION TUNNEL FLOW

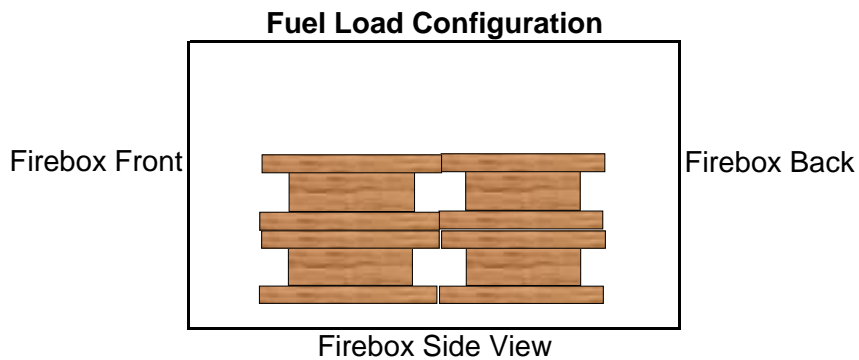
Traverse Data

Point	dP (in H ₂ O)	Temp (°F)
1	0.012	101
2	0.018	101
3	0.020	101
4	0.020	101
5	0.018	101
6	0.012	101
7	0.012	101
8	0.014	101
9	0.020	101
10	0.020	101
11	0.018	101
12	0.010	101
Center	0.020	101

Dilution Tunnel H ₂ O:	2.00	percent
Tunnel Diameter:	12	inches
Pitot Tube Cp:	0.99	[unitless]
Dilution Tunnel MW(dry):	29.00	lb/lb-mole
Dilution Tunnel MW(wet):	28.78	lb/lb-mole
Tunnel Area:	0.7854	ft ²
V _{strav} :	8.61	ft/sec
V _{scent} :	9.65	ft/sec
F _p :	0.893	[ratio]
Initial Tunnel Flow:	375.4	scf/min

Static Pressure: **-0.062** in. H₂O

TEST FUEL PROPERTIES



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)	21.6

WOODSTOVE PREBURN DATA - ASTM E2780

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Recording Interval (min): 1
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							Flue	Ambient
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average			
0	11.2	-0.080	274	245	259	335	174	257.3	426	74	
1	11.1	-0.090	278	247	257	330	178	257.7	483	74	
2	10.9	-0.090	280	250	254	336	180	260.0	537	75	
3	10.7	-0.090	282	251	250	351	182	263.3	570	75	
4	10.5	-0.090	283	251	248	366	184	266.3	602	75	
5	10.3	-0.090	283	251	246	383	185	269.5	615	75	
6	10.1	-0.090	284	251	244	394	186	271.7	620	75	
7	9.9	-0.100	284	250	244	407	186	274.1	623	75	
8	9.7	-0.100	284	249	244	414	186	275.4	633	75	
9	9.5	-0.100	284	248	245	424	186	277.6	631	75	
10	9.3	-0.090	284	247	247	435	187	280.0	625	75	
11	9.2	-0.090	284	247	250	438	187	281.1	617	75	
12	9.0	-0.090	285	247	253	440	187	282.2	612	74	
13	8.8	-0.090	287	246	256	438	187	282.6	609	73	
14	8.7	-0.090	287	246	258	441	186	283.8	607	73	
15	8.5	-0.100	288	246	261	440	186	284.1	609	73	
16	8.3	-0.090	288	245	264	445	186	285.5	612	73	
17	8.1	-0.100	289	245	267	446	186	286.5	620	72	
18	8.0	-0.100	289	244	270	448	186	287.6	621	73	
19	7.8	-0.100	290	244	273	451	186	288.9	620	72	
20	7.6	-0.100	291	244	277	451	186	289.7	616	72	
21	7.4	-0.100	292	245	279	453	186	291.1	616	72	
22	7.3	-0.100	293	245	283	452	187	291.9	622	71	
23	7.1	-0.100	294	246	285	455	187	293.4	630	72	
24	6.9	-0.100	295	247	288	456	187	294.6	636	72	
25	6.7	-0.100	297	248	291	463	188	297.1	641	72	
26	6.5	-0.100	298	249	293	466	188	298.6	642	72	
27	6.4	-0.100	299	250	295	469	189	300.4	643	72	
28	6.2	-0.100	301	251	298	474	189	302.7	643	72	
29	6.0	-0.100	303	253	300	474	190	303.9	643	72	
30	5.8	-0.100	304	255	302	481	190	306.4	645	71	
31	5.7	-0.100	306	257	304	486	191	308.8	645	72	
32	5.5	-0.100	308	259	306	489	192	310.7	644	71	
33	5.3	-0.100	310	262	308	492	193	312.7	642	72	
34	5.1	-0.100	312	264	310	495	193	314.9	642	72	
35	5.0	-0.100	314	267	312	497	194	317.0	643	72	
36	4.8	-0.100	317	270	304	505	195	318.2	642	72	
37	4.7	-0.100	320	273	310	505	195	320.6	631	72	
38	4.5	-0.100	322	276	312	509	196	323.0	624	72	
39	4.4	-0.090	325	279	315	506	197	324.4	613	71	
40	4.2	-0.090	328	282	314	505	197	325.2	608	72	
41	4.1	-0.090	330	286	315	503	198	326.5	603	72	
42	4.0	-0.090	333	290	322	498	199	328.3	601	72	
43	3.8	-0.090	336	293	323	501	199	330.5	598	72	
44	3.7	-0.090	338	296	325	497	200	331.3	597	72	

WOODSTOVE PREBURN DATA - ASTM E2780

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Recording Interval (min): 1
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							Flue	Ambient
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average			
45	3.6	-0.090	341	300	326	495	201	332.5	595	72	
46	3.4	-0.090	344	304	326	495	202	333.9	593	72	
47	3.3	-0.090	346	307	325	493	203	334.7	589	72	
48	3.2	-0.090	349	311	329	491	203	336.6	581	72	
49	3.1	-0.090	351	315	332	490	204	338.3	576	72	
50	3.0	-0.090	354	319	336	487	205	340.3	565	72	
51	2.9	-0.090	356	323	339	485	206	341.8	552	72	
52	2.8	-0.090	359	326	344	477	206	342.6	538	72	
53	2.7	-0.080	361	330	347	473	207	343.6	530	72	
54	2.6	-0.080	363	333	347	467	207	343.4	517	72	
55	2.6	-0.080	364	337	346	458	208	342.6	503	73	
56	2.5	-0.080	365	339	345	450	209	341.6	492	73	
57	2.5	-0.080	367	342	342	443	210	340.5	473	74	
58	2.4	-0.080	368	345	338	431	211	338.8	456	74	
59	2.4	-0.070	370	348	335	419	211	336.6	443	74	
60	2.3	-0.070	372	351	330	410	212	335.1	432	75	

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: HHTJob #: 21-661Model: Expedition 1Tracking #: 100Run #: 1Technician: SJBDate: 5/13/2021

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		0.019	1.03	74	-2		9.5		101	420	73	75
1	0.223	0.223	0.018	1.99	74	-2	105	9.4	-0.08	110	405	76	75
2	0.452	0.229	0.019	1.97	74	-2	104	9.3	-0.18	102	462	77	75
3	0.682	0.230	0.019	1.97	74	-2	104	9.1	-0.15	101	516	77	75
4	0.912	0.230	0.019	1.96	74	-2	104	8.9	-0.2	102	579	78	75
5	1.139	0.227	0.018	1.94	75	-2	106	8.7	-0.21	103	623	78	76
6	1.367	0.228	0.019	1.94	75	-2	104	8.5	-0.23	105	662	79	76
7	1.596	0.229	0.019	1.94	75	-2	104	8.2	-0.27	107	690	80	76
8	1.822	0.226	0.020	1.93	75	-2	100	7.9	-0.26	108	716	80	76
9	2.049	0.227	0.019	1.93	75	-2	104	7.7	-0.28	111	749	81	76
10	2.277	0.228	0.019	1.93	75	-2	104	7.4	-0.24	112	770	82	76
11	2.503	0.226	0.019	1.92	75	-2	103	7.2	-0.21	113	798	82	76
12	2.729	0.226	0.019	1.92	76	-2	103	6.9	-0.26	113	785	83	77
13	2.956	0.227	0.019	1.92	76	-2	104	6.7	-0.25	114	811	83	77
14	3.183	0.227	0.019	1.92	76	-2	104	6.5	-0.24	117	849	84	77
15	3.408	0.225	0.019	1.91	76	-2	103	6.2	-0.24	119	875	85	77
16	3.633	0.225	0.019	1.91	77	-2	103	6.0	-0.26	119	862	85	77
17	3.859	0.226	0.020	1.90	77	-2	101	5.7	-0.25	118	837	85	77
18	4.085	0.226	0.020	1.91	77	-2	101	5.5	-0.25	118	825	86	78
19	4.310	0.225	0.020	1.91	77	-2	100	5.2	-0.24	118	816	86	78
20	4.535	0.225	0.019	1.90	78	-2	103	5.0	-0.23	117	806	87	78
21	4.760	0.225	0.020	1.90	78	-2	100	4.7	-0.24	117	797	87	78
22	4.986	0.226	0.019	1.90	78	-2	103	4.5	-0.22	118	798	87	78
23	5.211	0.225	0.020	1.91	78	-2	100	4.3	-0.22	117	789	87	78
24	5.436	0.225	0.019	1.90	78	-2	103	4.1	-0.22	117	781	88	78
25	5.660	0.224	0.020	1.90	79	-2	99	3.9	-0.21	117	779	88	78
26	5.885	0.225	0.020	1.90	79	-2	100	3.7	-0.2	117	778	88	78
27	6.111	0.226	0.020	1.90	79	-2	100	3.5	-0.21	117	781	88	79
28	6.336	0.225	0.020	1.90	79	-2	100	3.3	-0.19	117	775	88	79
29	6.560	0.224	0.020	1.89	79	-2	99	3.1	-0.19	117	769	89	79
30	6.784	0.224	0.019	1.89	80	-2	102	2.9	-0.19	116	768	89	79
31	7.008	0.224	0.020	1.88	80	-2	99	2.7	-0.18	116	764	89	79

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: HHTJob #: 21-661Model: Expedition 1Tracking #: 100Run #: 1Technician: SJBDate: 5/13/2021

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
32	7.233	0.225	0.020	1.88	80	-2	99	2.5	-0.18	115	758	89	79
33	7.458	0.225	0.020	1.88	80	-2	99	2.4	-0.18	115	751	89	79
34	7.682	0.224	0.020	1.88	81	-2	99	2.2	-0.16	115	742	89	79
35	7.905	0.223	0.020	1.87	81	-2	98	2.0	-0.16	114	722	89	80
36	8.131	0.226	0.020	1.94	81	-2	100	1.9	-0.14	113	703	89	80
37	8.360	0.229	0.020	1.94	81	-2	101	1.8	-0.12	112	680	89	79
38	8.589	0.229	0.020	1.94	81	-2	101	1.7	-0.11	111	657	89	79
39	8.816	0.227	0.021	1.94	81	-2	97	1.6	-0.09	109	639	89	79
40	9.046	0.230	0.020	1.94	81	-2	101	1.5	-0.09	108	616	89	80
41	9.274	0.228	0.020	1.95	81	-2	100	1.4	-0.07	107	590	89	80
42	9.502	0.228	0.020	1.94	82	-2	100	1.4	-0.06	106	562	88	80
43	9.732	0.230	0.020	1.94	82	-2	100	1.3	-0.04	105	537	88	80
44	9.959	0.227	0.020	1.94	82	-2	99	1.3	-0.04	104	516	88	79
45	10.189	0.230	0.021	1.94	82	-2	98	1.2	-0.03	102	498	88	80
46	10.419	0.230	0.021	1.95	82	-2	98	1.2	-0.03	102	482	88	80
47	10.647	0.228	0.021	1.94	83	-2	97	1.2	-0.03	101	468	88	80
48	10.877	0.230	0.020	1.95	83	-2	100	1.2	-0.03	100	456	87	80
49	11.106	0.229	0.021	1.95	83	-2	97	1.1	-0.03	100	447	87	80
50	11.335	0.229	0.020	1.95	83	-2	99	1.1	-0.02	99	439	87	80
51	11.565	0.230	0.021	1.95	83	-2	97	1.1	-0.03	99	430	87	80
52	11.794	0.229	0.021	1.95	84	-2	97	1.0	-0.03	98	424	87	80
53	12.024	0.230	0.021	1.95	84	-2	97	1.0	-0.02	97	419	87	80
54	12.254	0.230	0.020	1.95	84	-2	99	1.0	-0.02	97	414	87	80
55	12.483	0.229	0.020	1.95	84	-2	99	1.0	-0.04	97	408	86	80
56	12.714	0.231	0.020	1.95	84	-2	100	0.9	-0.02	96	403	86	80
57	12.943	0.229	0.022	1.96	84	-2	94	0.9	-0.03	96	399	86	80
58	13.173	0.230	0.021	1.96	84	-2	97	0.9	-0.03	95	395	86	80
59	13.404	0.231	0.021	1.96	84	-2	97	0.9	-0.03	95	391	86	79
60	13.634	0.230	0.020	1.96	84	-2	99	0.8	-0.03	95	389	86	79
61	13.873	0.239	0.020	2.02	84	-2	103	0.8	-0.02	95	388	79	80
62	14.109	0.236	0.021	2.02	85	-2	99	0.8	-0.03	95	386	79	79
63	14.343	0.234	0.020	2.02	85	-2	101	0.8	-0.02	94	383	80	80

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: HHTJob #: 21-661Model: Expedition 1Tracking #: 100Run #: 1Technician: SJBDate: 5/13/2021

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
64	14.578	0.235	0.020	2.02	85	-2	101	0.7	-0.02	94	380	80	79
65	14.814	0.236	0.021	2.02	85	-2	99	0.7	-0.03	93	377	80	80
66	15.048	0.234	0.020	2.02	85	-2	101	0.7	-0.02	94	374	80	80
67	15.284	0.236	0.020	2.02	85	-2	101	0.7	-0.02	94	371	80	80
68	15.518	0.234	0.020	2.03	86	-2	100	0.6	-0.03	93	368	80	79
69	15.753	0.235	0.020	2.02	86	-2	101	0.6	-0.03	93	366	81	79
70	15.989	0.236	0.020	2.02	86	-2	101	0.6	-0.03	93	365	81	80
71	16.223	0.234	0.021	2.02	86	-2	98	0.6	-0.02	93	362	81	80
72	16.459	0.236	0.021	2.02	86	-2	99	0.5	-0.02	92	361	81	80
73	16.694	0.235	0.021	2.02	86	-2	98	0.5	-0.03	92	359	81	80
74	16.928	0.234	0.021	2.02	86	-2	98	0.5	-0.02	92	357	81	79
75	17.165	0.237	0.021	2.02	87	-2	99	0.5	-0.02	92	356	81	79
76	17.399	0.234	0.020	2.02	87	-2	100	0.4	-0.03	92	354	82	79
77	17.634	0.235	0.021	2.02	87	-2	98	0.4	-0.02	92	352	82	79
78	17.870	0.236	0.021	2.03	87	-2	98	0.4	-0.03	91	351	82	79
79	18.105	0.235	0.021	2.02	87	-2	98	0.4	-0.02	91	348	82	79
80	18.341	0.236	0.021	2.02	87	-2	98	0.3	-0.03	91	348	82	79
81	18.576	0.235	0.021	2.02	87	-2	98	0.3	-0.01	91	346	82	79
82	18.811	0.235	0.020	2.02	87	-2	100	0.3	-0.03	91	343	82	79
83	19.048	0.237	0.021	2.03	87	-2	99	0.3	-0.03	91	343	82	79
84	19.283	0.235	0.021	2.02	87	-2	98	0.2	-0.02	91	342	82	79
85	19.518	0.235	0.021	2.02	87	-2	98	0.2	-0.03	91	340	82	79
86	19.755	0.237	0.021	2.03	87	-2	99	0.2	-0.03	91	338	82	80
87	19.990	0.235	0.021	2.03	87	-2	98	0.2	-0.02	90	336	82	79
88	20.225	0.235	0.021	2.03	87	-2	98	0.1	-0.03	90	335	82	79
89	20.462	0.237	0.021	2.03	87	-2	99	0.1	-0.02	90	332	82	79
90	20.696	0.234	0.021	2.02	87	-2	98	0.1	-0.02	90	331	82	79
91	20.932	0.236	0.021	2.02	87	-2	98	0.1	-0.03	90	328	82	79
92	21.169	0.237	0.021	2.03	87	-2	99	0.0	-0.02	90	326	82	79
93	21.403	0.234	0.021	2.03	86	-2	98	0.0	-0.01	90	325	82	78
94	21.640	0.237	0.021	2.03	87	-2	99	0.0	-0.03	90	324	82	79
Avg/Tot	21.640	0.230	0.020	1.95	82	-2.00	100			102	534	84	78.6

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

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		1.07	74	-2		75	-0.070	1.97	0.30
1	0.231	0.231	2.10	74	-2	108	76	-0.080	1.33	0.25
2	0.464	0.233	2.09	74	-2	105	77	-0.080	6.24	0.51
3	0.694	0.230	2.08	74	-2	103	77	-0.090	9.02	0.35
4	0.924	0.230	2.08	74	-2	103	77	-0.090	11.48	0.28
5	1.155	0.231	2.08	74	-2	107	78	-0.100	12.08	0.37
6	1.383	0.228	2.06	75	-2	103	79	-0.100	12.81	0.78
7	1.613	0.230	2.07	75	-2	104	79	-0.100	13.18	1.03
8	1.843	0.230	2.07	75	-2	101	80	-0.100	13.61	1.20
9	2.070	0.227	2.05	75	-2	103	80	-0.110	14.32	1.11
10	2.298	0.228	2.05	75	-2	103	81	-0.110	14.43	0.96
11	2.527	0.229	2.05	75	-2	104	81	-0.110	14.94	0.84
12	2.755	0.228	2.05	76	-2	103	82	-0.110	14.48	0.78
13	2.981	0.226	2.04	76	-2	102	82	-0.110	14.98	0.76
14	3.209	0.228	2.04	76	-2	103	83	-0.110	15.82	0.51
15	3.437	0.228	2.04	76	-2	104	84	-0.110	16.46	0.25
16	3.664	0.227	2.04	77	-2	103	84	-0.110	16.24	0.31
17	3.890	0.226	2.03	77	-2	100	85	-0.110	15.29	0.61
18	4.116	0.226	2.03	77	-2	100	85	-0.110	14.99	0.76
19	4.343	0.227	2.03	78	-2	100	86	-0.110	14.93	0.78
20	4.570	0.227	2.03	78	-2	103	86	-0.110	14.86	0.68
21	4.797	0.227	2.03	78	-2	100	86	-0.110	14.49	0.86
22	5.022	0.225	2.03	78	-2	102	87	-0.110	14.63	0.86
23	5.247	0.225	2.03	79	-2	99	87	-0.110	14.44	0.91
24	5.474	0.227	2.02	79	-2	103	88	-0.100	14.34	0.90
25	5.700	0.226	2.02	79	-2	99	88	-0.110	14.31	0.96
26	5.926	0.226	2.02	79	-2	99	88	-0.100	14.27	0.98
27	6.152	0.226	2.02	80	-2	99	89	-0.100	14.27	0.98
28	6.376	0.224	2.02	80	-2	98	89	-0.100	14.09	0.98
29	6.601	0.225	2.01	80	-2	99	89	-0.100	13.96	1.03
30	6.826	0.225	2.01	80	-2	101	89	-0.100	14.07	0.84
31	7.052	0.226	2.01	81	-2	99	89	-0.100	14.01	0.81

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

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 (%)
32	7.277	0.225	2.00	81	-2	99	89	-0.100	13.95	0.88
33	7.501	0.224	2.00	81	-2	98	89	-0.100	13.80	0.87
34	7.725	0.224	2.00	81	-2	98	89	-0.100	13.52	0.94
35	7.949	0.224	1.99	81	-2	98	89	-0.100	13.08	0.76
36	8.177	0.228	2.11	81	-2	100	89	-0.100	12.56	0.50
37	8.412	0.235	2.12	81	-2	103	89	-0.100	11.63	0.22
38	8.644	0.232	2.12	81	-2	101	88	-0.090	10.88	0.19
39	8.879	0.235	2.12	82	-2	100	88	-0.090	10.53	0.16
40	9.111	0.232	2.11	82	-2	101	88	-0.090	9.78	0.10
41	9.346	0.235	2.12	82	-2	102	89	-0.090	8.88	0.05
42	9.578	0.232	2.12	82	-2	101	88	-0.080	7.76	0.07
43	9.813	0.235	2.12	82	-2	102	88	-0.080	6.88	0.11
44	10.045	0.232	2.12	82	-2	100	88	-0.080	6.45	0.15
45	10.280	0.235	2.12	82	-2	99	88	-0.080	6.33	0.18
46	10.512	0.232	2.12	82	-2	98	88	-0.070	6.12	0.23
47	10.747	0.235	2.12	82	-2	99	88	-0.070	5.92	0.29
48	10.980	0.233	2.12	82	-2	101	88	-0.070	5.84	0.31
49	11.215	0.235	2.13	82	-2	99	88	-0.070	5.79	0.34
50	11.448	0.233	2.11	82	-2	100	88	-0.070	5.77	0.37
51	11.682	0.234	2.11	82	-2	98	88	-0.070	5.69	0.40
52	11.914	0.232	2.11	82	-2	97	88	-0.070	5.72	0.41
53	12.149	0.235	2.11	82	-2	99	88	-0.070	5.67	0.43
54	12.381	0.232	2.11	82	-2	100	88	-0.070	5.67	0.45
55	12.615	0.234	2.12	82	-2	101	87	-0.070	5.61	0.46
56	12.848	0.233	2.12	82	-2	100	87	-0.060	5.58	0.49
57	13.082	0.234	2.12	82	-2	96	87	-0.060	5.54	0.50
58	13.315	0.233	2.12	82	-2	98	87	-0.060	5.51	0.53
59	13.549	0.234	2.12	82	-2	98	87	-0.060	5.79	0.49
60	13.782	0.233	2.12	82	-2	100	87	-0.060	5.77	0.48
61	14.017	0.235	2.12	82	-2	101	87	-0.060	5.77	0.48
62	14.249	0.232	2.12	82	-2	97	87	-0.060	5.69	0.50
63	14.484	0.235	2.12	83	-2	101	87	-0.060	5.53	0.55

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

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 (%)
64	14.717	0.233	2.12	83	-2	100	87	-0.060	5.45	0.59
65	14.952	0.235	2.12	82	-2	98	87	-0.060	5.32	0.63
66	15.185	0.233	2.12	82	-2	100	87	-0.060	5.26	0.64
67	15.420	0.235	2.12	82	-2	101	87	-0.060	5.26	0.65
68	15.653	0.233	2.12	82	-2	100	87	-0.060	5.20	0.67
69	15.888	0.235	2.12	82	-2	101	87	-0.060	5.17	0.68
70	16.121	0.233	2.12	83	-2	100	87	-0.060	5.20	0.70
71	16.357	0.236	2.12	83	-2	99	87	-0.060	5.16	0.69
72	16.590	0.233	2.12	83	-2	97	86	-0.060	5.26	0.65
73	16.826	0.236	2.12	83	-2	99	86	-0.060	5.22	0.67
74	17.059	0.233	2.12	83	-2	97	86	-0.060	5.19	0.69
75	17.295	0.236	2.12	83	-2	99	86	-0.060	5.12	0.68
76	17.529	0.234	2.13	83	-2	100	86	-0.060	5.01	0.74
77	17.763	0.234	2.12	83	-2	98	86	-0.060	4.97	0.75
78	17.998	0.235	2.12	83	-2	98	86	-0.060	4.95	0.75
79	18.232	0.234	2.13	83	-2	98	86	-0.060	4.91	0.79
80	18.468	0.236	2.13	83	-2	98	86	-0.060	4.88	0.81
81	18.701	0.233	2.13	83	-2	97	86	-0.060	4.84	0.84
82	18.937	0.236	2.13	83	-2	101	86	-0.050	4.79	0.86
83	19.171	0.234	2.12	83	-2	98	86	-0.050	4.73	0.91
84	19.407	0.236	2.13	83	-2	98	86	-0.050	4.73	0.91
85	19.641	0.234	2.13	83	-2	98	86	-0.050	4.70	0.93
86	19.877	0.236	2.13	83	-2	98	86	-0.050	4.62	0.96
87	20.111	0.234	2.13	83	-2	97	86	-0.050	4.58	0.98
88	20.346	0.235	2.13	83	-2	98	85	-0.050	4.56	1.01
89	20.582	0.236	2.13	83	-2	98	85	-0.050	4.52	1.02
90	20.816	0.234	2.13	83	-2	97	85	-0.050	4.46	1.05
91	21.053	0.237	2.13	83	-2	99	85	-0.050	4.39	1.08
92	21.287	0.234	2.13	83	-2	98	85	-0.050	4.38	1.09
93	21.524	0.237	2.13	82	-2	99	85	-0.050	4.37	1.07
94	21.758	0.234	2.14	82	-2	98	85	-0.050	4.28	1.11
Avg/Tot	21.758	0.231	2.08	80	-2.00	100	86	-0.079	8.64	0.65

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

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 (%)

WOODSTOVE SURFACE TEMPERATURE DATA

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Stove ΔT: 47

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	377	356	325	393	215	333.3	N/A
1	382	362	322	379	218	332.7	N/A
2	384	363	317	364	218	329.0	N/A
3	383	363	312	362	218	327.4	N/A
4	380	362	306	375	218	328.2	N/A
5	377	361	301	387	218	328.5	N/A
6	373	358	296	411	217	330.9	N/A
7	369	355	293	433	216	333.2	N/A
8	364	352	289	456	216	335.5	N/A
9	360	349	286	478	215	337.4	N/A
10	356	345	284	499	214	339.5	N/A
11	352	342	282	518	212	341.3	N/A
12	349	338	281	534	211	342.5	N/A
13	345	335	278	552	210	344.1	N/A
14	342	333	279	560	209	344.5	N/A
15	340	330	278	573	208	345.8	N/A
16	338	328	276	585	207	346.5	N/A
17	336	327	274	595	206	347.3	N/A
18	335	325	275	599	205	347.6	N/A
19	334	324	274	603	204	347.6	N/A
20	333	323	280	611	203	349.8	N/A
21	333	323	286	615	202	351.6	N/A
22	333	322	284	619	201	351.8	N/A
23	333	322	289	620	200	352.9	N/A
24	334	323	293	626	199	354.9	N/A
25	335	323	294	622	199	354.6	N/A
26	336	324	302	627	198	357.4	N/A
27	337	325	304	627	198	358.1	N/A
28	339	326	310	630	197	360.2	N/A
29	340	327	310	630	197	360.7	N/A
30	342	329	313	632	196	362.5	N/A
31	344	331	320	634	196	365.1	N/A
32	346	333	321	640	196	367.0	N/A
33	349	335	324	636	196	368.0	N/A
34	352	338	328	638	195	370.1	N/A
35	355	340	335	638	195	372.5	N/A
36	358	343	337	634	195	373.3	N/A
37	361	346	340	627	195	373.8	N/A
38	366	350	336	617	195	372.5	N/A
39	369	353	329	608	195	371.0	N/A
40	373	357	335	597	196	371.7	N/A
41	378	361	340	584	196	371.7	N/A
42	382	365	335	570	197	369.9	N/A
43	386	369	346	549	197	369.5	N/A
44	391	374	345	529	198	367.1	N/A
45	395	378	342	514	198	365.4	N/A
46	398	382	340	499	198	363.3	N/A
47	401	385	336	478	198	359.7	N/A

WOODSTOVE SURFACE TEMPERATURE DATA

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Stove ΔT: 47

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
48	403	389	333	463	198	357.3	N/A
49	405	391	330	451	198	354.9	N/A
50	407	392	326	433	198	351.2	N/A
51	408	394	295	424	198	343.8	N/A
52	409	396	307	412	198	344.4	N/A
53	409	397	319	403	198	345.0	N/A
54	410	399	316	393	198	342.9	N/A
55	409	399	313	386	198	340.9	N/A
56	409	400	310	379	197	339.0	N/A
57	408	401	308	369	197	336.6	N/A
58	406	399	305	364	197	334.4	N/A
59	403	400	303	358	197	332.2	N/A
60	403	400	301	355	197	330.9	N/A
61	402	400	299	350	196	329.3	N/A
62	402	399	297	347	196	328.0	N/A
63	402	398	295	342	195	326.5	N/A
64	402	398	294	336	195	324.9	N/A
65	403	396	292	337	195	324.5	N/A
66	402	396	291	331	194	322.7	N/A
67	401	395	289	328	194	321.4	N/A
68	401	395	287	323	193	319.9	N/A
69	399	393	286	320	193	318.3	N/A
70	399	393	285	318	192	317.2	N/A
71	398	392	283	316	192	316.2	N/A
72	397	391	282	313	192	314.7	N/A
73	396	388	280	309	191	313.0	N/A
74	394	388	279	307	191	311.9	N/A
75	394	388	277	303	190	310.4	N/A
76	393	387	276	304	190	309.6	N/A
77	392	386	274	301	189	308.2	N/A
78	390	385	273	299	189	307.0	N/A
79	388	383	271	296	189	305.2	N/A
80	387	382	270	293	188	304.1	N/A
81	386	382	268	293	188	303.5	N/A
82	385	380	267	291	188	302.0	N/A
83	384	379	265	289	187	300.9	N/A
84	382	378	264	286	187	299.6	N/A
85	382	377	263	284	187	298.4	N/A
86	379	375	262	283	186	297.0	N/A
87	376	373	261	281	186	295.3	N/A
88	374	373	259	281	186	294.4	N/A
89	372	371	258	280	186	293.1	N/A
90	370	369	257	277	185	291.6	N/A
91	368	368	255	275	185	290.2	N/A
92	367	366	254	274	185	289.1	N/A
93	365	365	253	272	184	287.7	N/A
94	364	363	252	270	184	286.5	N/A
Average	375	365	296	442	198	335	N/A

LAB SAMPLE DATA - ASTM E2515

Client: HHT
 Model: Expedition 1
 Run #: 1

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

	Sample ID	Tare, mg	Total, mg	Final, mg	Catch, mg
Train A Filters - 1st hr	G0033	120.4	241.4	242.4	1.0
	G0034	121.0			
Train A Probe - 1st hr	17A	116808.6	116808.6	116808.7	0.1
Train A O-Rings - 1st hr	17A	3612.5	3612.5	3612.7	0.2
Train A Filters - Remainder	G0035	119.0	239.7	239.8	0.1
	G0036	120.7			
Train A Probe- Remainder	17B	117138.5	117138.5	117138.6	0.1
Train A O-Rings - Remainder	17B	3569.0	3569.0	3569.2	0.2
Train B Filters	G0038	120.3	241.4	242.5	1.1
	G0039	121.1			
Train B Probe	18B	117328.6	117328.6	117328.7	0.1
Train B O-Rings	18B	3367.5	3367.5	3367.7	0.2
Background Filter	G0040	120.3	120.3	120.3	0.0

Placed in Dessicator on:	5/13/21 - 14:00
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Train A Filters - 1st hr	242.4	5/14 14:20	242.4	5/17 9:09		
Train A Probe - 1st hr	116808.7	5/14 14:21	116808.7	5/17 9:10		
Train A O-Rings - 1st hr	3612.7	5/14 14:22	3612.7	5/17 9:11		
Train A Filters - Remainder	239.9	5/14 14:20	239.8	5/17 9:09		
Train A Probe - Remainder	117138.6	5/14 14:21	117138.6	5/17 9:10		
Train A O-Rings - Remainder	3569.1	5/14 14:22	3569.2	5/17 9:11		
Train B Filters	242.7	5/14 14:21	242.5	5/17 9:10		
Train B Probe	117328.6	5/14 14:22	117328.7	5/17 9:11		
Train B O-Rings	3367.6	5/14 14:22	3367.7	5/17 9:11		
Background Filter	120.3	5/14 14:21	120.3	5/17 9:10		

1st hour Sub-Total, mg:	1.3
Remainder Sub-Total, mg:	0.4
Train 1 Aggregate, mg:	1.7
Train 2 Aggregate, mg:	1.4
Ambient Aggregate, mg:	0.0

ASTM E2780 Wood Heater Run Sheets

Client: HHT Job Number: 21-661 Tracking #: 100
 Model: Expedition 1 Run Number: 1 Test Date: 5/13/2021

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): N/A – Single Burn Rate
 Targeted Burn Category: N/A – Single Burn Rate

Preburn Notes

Time	Notes
10:30 11:01 12:01	Ignited kindling fire (7.5 lbs), fan on high. @ 2.0 lbs of kindling remaining, loaded pre-burn test fuel, activated ACC. @ 2.3 lbs, leveled coal bed and zeroed scale in preparation of fuel loading.

Test Notes

Test Burn Start Time: 12:03 Test Fuel Loaded by: 45 seconds
 Door Closed: 80 seconds Air Control Set at: 0 seconds
 Other Loading Notes: N/A

Time	Notes
0 min 60 min 94 min	Loaded test fuel, activated ACC, fan on high. Changed 1 st hour filter train. End of test

Test Burn End Time: 13:37

Flue Gas Concentration Measurement

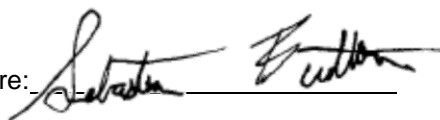
Calibration Gas Values: Span Gas CO₂ (%): 17.14 CO (%): 4.3
 Mid Gas CO₂ (%): 9.90 CO (%): 2.47

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	11:07	11:12	11:09	See Run #2 Notes		
CO ₂	0.00	10.04	17.14	N/A	N/A	N/A
CO	0.00	2.452	4.299	N/A	N/A	N/A

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

Technician Signature: _____



Date: 5/13/21

ASTM E2780 Wood Heater Run Sheets

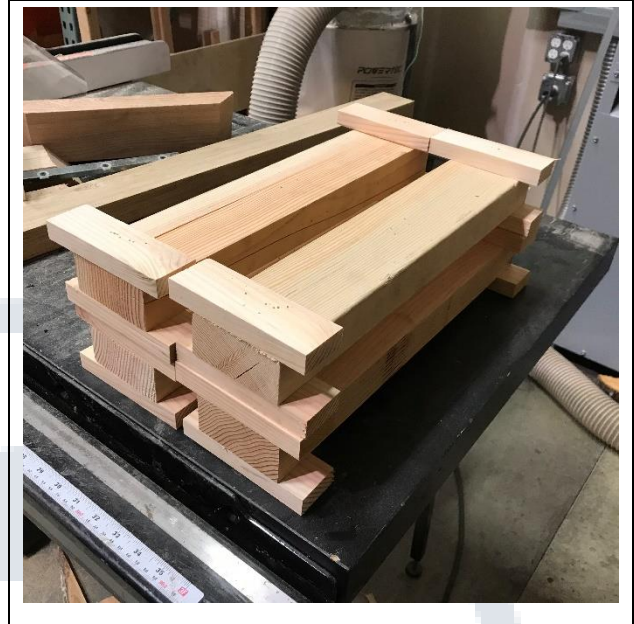
Client: HHT
Model: Expedition 1

Job Number: 21-661
Run Number: 1

Tracking #: 100
Test Date: 5/13/2021



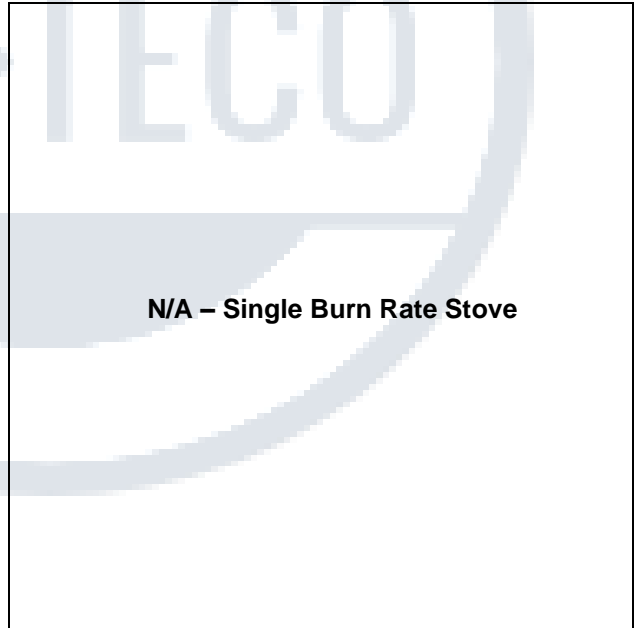
Test Fuel Side View



Test Fuel Iso View



Test Fuel Loaded in Stove



N/A - Single Burn Rate Stove

Air Setting

Technician Signature: *Sebastian E. Sutton*

Date: 5/13/21

**WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515**



Run 2 Data Summary

Client:	HHT
Model:	Expedition 1
Job #:	21-661
Tracking #:	100
Test Date:	5/13/2021

A handwritten signature in black ink, appearing to read "Sebastian Euteneier".

Technician Signature

6/14/2021

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: HHT

Model: Expedition 1

Run #: 2

Job #: 21-661

Tracking #: 100

Technician: SJB

Date: 5/13/2021

Burn Rate (kg/hr):	1.99
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	20.158	25.164	24.448	13.379
Average Gas Velocity in Dilution Tunnel (ft/sec)	8.7			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	22761.5			
Average Gas Meter Temperature (°F)	79.6	86.3	83.1	83.6
Total Sample Volume (dscf)	19.910	24.494	23.840	13.086
Average Tunnel Temperature (°F)	102.2			
Total Time of Test (min)	112			
Total Particulate Catch (mg)	0.0	2.1	2.4	1.9
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000857	0.0001007	0.0001452
Total PM Emissions (g)	0.00	3.64	4.28	3.30
Particulate Emission Rate (g/hr)	0.00	1.95	2.29	3.30
Emissions Factor (g/kg)	-	0.98	1.15	-
Difference from Average Total Particulate Emissions (g)	-	0.32	0.32	-
Difference from Average Total Particulate Emissions (%)	-	8.0%	8.0%	-
Difference from Average Emissions Factor (g/kg)	-	0.09	0.09	-

Final Average Results	
Total Particulate Emissions (g)	3.96
Particulate Emission Rate (g/hr)	2.12
Emissions Factor (g/kg)	1.07
HHV Efficiency (%)	64.9%
LHV Efficiency (%)	70.1%
CO Emissions (g/min)	2.42

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	89.3	OK
Face Velocity	< 30 ft/min	12.6	OK
Leakage Rate	Less than 4% of average sample rate	0.002 cfm	OK
Ambient Temp	55-90 °F	Min: 78.4 / 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	37.6	OK

B415.1 Efficiency Results

Manufacturer: HHT
Model: Expedition 1
Date: 05/13/21
Run: 2
Control #: 21-661
Test Duration: 112
Output Category: 4

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	64.9%	70.1%
Combustion Efficiency	94.8%	94.8%
Heat Transfer Efficiency	68.4%	74.0%

Output Rate (kJ/h)	25,033	23,747	(Btu/h)
Burn Rate (kg/h)	1.95	4.29	(lb/h)
Input (kJ/h)	38,584	36,601	(Btu/h)

Test Load Weight (dry kg)	3.64	8.01	dry lb
MC wet (%)	17.73		
MC dry (%)	21.55		
Particulate (g)	3.96		
CO (g)	271		
Test Duration (h)	1.87		

Emissions	Particulate	CO
g/MJ Output	0.08	5.80
g/kg Dry Fuel	1.09	74.49
g/h	2.12	145.09
g/min	0.04	2.42
lb/MM Btu Output	0.20	13.47

Air/Fuel Ratio (A/F)	14.95
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: HHT
 Model: Expedition 1
 Run #: 2

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	17.00	24.6				
2x4	17.00	19.7				
2x4	9.00	19.4				
2x4	9.00	23.5				
2x4	9.00	22.8				
2x4	9.00	21.9				
2x4	9.00	19.8				
2x4	9.00	21.8				
Total Fuel Weight (lbs):		9.55	Average Moisture (%DB):		21.7	

Firebox Volume (ft³): 1.45
 Total 2x4 Crib Weight, with spacers (lbs): 9.77
 Total 4x4 Crib Weight, with spacers (lbs): 0.00
 Total Wet Fuel Weight, with spacers (lbs): 9.77

Coal Bed Range (20-25%):
 Min (lbs): 1.95
 Max (lbs): 2.44

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	17.00	2.01	22.3	24.8	23.9	1.63
2x4	17.00	1.94	20.2	19.5	19.1	1.62
2x4	17.00	1.98	21.7	18.9	22.0	1.64
2x4	17.00	1.90	23.8	19.7	22.7	1.56
Total Dry Weight, no spacers (lbs):						6.44
Total Dry Weight, with spacers (lbs):						8.17

Spacer Moisture Readings (%DB)						
9.7	22.4	21.8	12.4			
13.5	12.8	8.5	16.8			
7.8	9.1	7.8	9.8			
9.4	13.4	9.6	10.1			

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)	6.74	OK
2x4 Fuel Mix	35 - 65 % of total weight	N/A	N/A

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: **HHT**
 Model: **Expedition 1**
 Run #: **2**
 Test Start Time: **15:59**

Job #: **21-661**
 Tracking #: **100**
 Technician: **SJB**
 Date: **5/13/2021**

Total Sampling Time (min): **112**
 Recording Interval (min): **1**

Meter Box γ Factor: **1.003** (A)
 Meter Box γ Factor: **0.999** (B)
 Meter Box γ Factor: **1.010** (Ambient)

Induced Draft Check (in. H₂O): **0**
 Smoke Capture Check (%): **100%**
 Date Flue Pipe Last Cleaned: **5/13/2021**

	Pre-Test	Post Test	Avg.
Barometric Pressure (in. Hg)	29.93	29.90	29.92
Relative Humidity (%)	30.5	30.1	
Room Air Velocity (ft/min)	0	0	
Scale Audit (lbs)	10.0	10.0	
Ambient Sample Volume:	20.158 ft ³		

Sample Train Post-Test Leak Checks

(A)	0.002	cfm @	-5 in. Hg
(B)	0.001	cfm @	-5 in. Hg
(Ambient)	0.001	cfm @	-5 in. Hg

DILUTION TUNNEL FLOW

Traverse Data

Point	dP (in H ₂ O)	Temp (°F)
1	0.012	101
2	0.018	101
3	0.020	101
4	0.020	101
5	0.018	101
6	0.012	101
7	0.012	101
8	0.014	101
9	0.020	101
10	0.020	101
11	0.018	101
12	0.010	101
Center	0.020	101

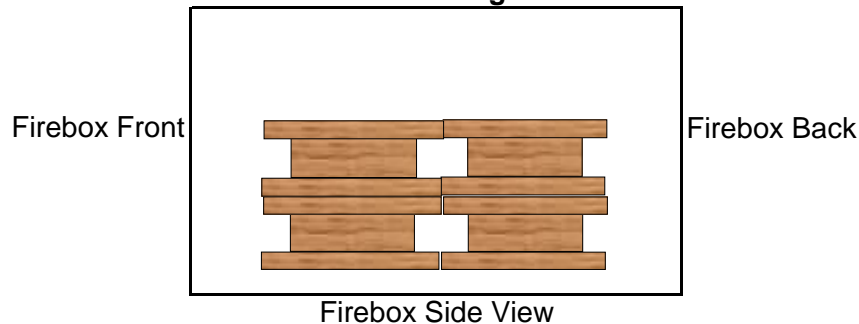
Dilution Tunnel H₂O: **2.00** percent
 Tunnel Diameter: **12** inches
 Pitot Tube Cp: **0.99** [unitless]
 Dilution Tunnel MW(dry): **29.00** lb/lb-mole
 Dilution Tunnel MW(wet): **28.78** lb/lb-mole
 Tunnel Area: **0.7854** ft²

V_{strav} : **8.62** ft/sec
 V_{scent} : **9.66** ft/sec
 F_p : **0.893** [ratio]
 Initial Tunnel Flow: **374.8** scf/min

Static Pressure: **-0.062** in. H₂O

TEST FUEL PROPERTIES

Fuel Load Configuration



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)	21.6

WOODSTOVE PREBURN DATA - ASTM E2780

Client: HHT
 Model: Expedition 1
 Run #: 2

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Recording Interval (min): 1
 Run Time (min): 78

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							Flue	Ambient
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average			
0	11.5	-0.080	327	293	222	408	169	283.7	509	77	
1	11.3	-0.090	331	297	211	404	171	282.7	558	77	
2	11.2	-0.090	334	300	209	411	173	285.4	603	76	
3	11.0	-0.100	336	303	202	425	175	288.1	637	77	
4	10.8	-0.100	336	304	200	441	177	291.5	652	76	
5	10.6	-0.100	336	305	198	453	178	293.9	660	76	
6	10.4	-0.100	334	306	197	464	178	295.9	668	77	
7	10.1	-0.100	333	305	196	476	179	297.6	676	76	
8	10.0	-0.100	332	304	195	490	179	299.9	673	76	
9	9.8	-0.100	330	304	195	491	179	299.8	665	77	
10	9.6	-0.100	329	303	196	498	179	301.0	656	77	
11	9.4	-0.100	328	303	197	498	179	301.0	654	77	
12	9.2	-0.090	327	302	199	497	180	300.8	649	76	
13	9.0	-0.090	326	302	201	493	180	300.2	640	76	
14	8.8	-0.090	324	301	203	495	180	300.7	633	77	
15	8.7	-0.090	324	301	206	489	181	300.1	622	77	
16	8.5	-0.090	323	300	208	484	181	299.5	614	77	
17	8.3	-0.090	323	301	211	481	182	299.5	612	77	
18	8.2	-0.090	322	301	213	476	182	298.8	612	77	
19	8.0	-0.090	322	302	215	471	183	298.4	610	77	
20	7.8	-0.090	321	302	217	473	183	299.3	612	77	
21	7.7	-0.090	321	302	219	470	184	299.2	611	77	
22	7.5	-0.090	321	302	221	467	184	299.0	610	77	
23	7.3	-0.090	321	302	223	468	184	299.7	608	77	
24	7.2	-0.090	320	303	224	467	185	299.7	608	77	
25	7.0	-0.090	320	304	226	466	185	300.0	609	77	
26	6.8	-0.090	321	305	227	467	186	301.1	612	77	
27	6.7	-0.090	320	305	228	468	186	301.5	611	78	
28	6.5	-0.090	321	306	229	469	187	302.3	611	77	
29	6.4	-0.090	322	307	231	471	187	303.7	613	78	
30	6.2	-0.090	323	308	231	470	188	303.9	613	78	
31	6.1	-0.090	325	309	230	473	188	304.9	616	77	
32	5.9	-0.090	326	311	235	474	188	306.8	619	77	
33	5.8	-0.090	328	312	234	475	189	307.7	620	78	
34	5.6	-0.090	329	314	235	479	189	309.1	621	77	
35	5.5	-0.090	331	315	235	482	190	310.4	623	77	
36	5.3	-0.090	332	317	236	481	190	311.2	622	77	
37	5.2	-0.090	332	318	235	484	191	312.1	619	78	
38	5.0	-0.090	333	320	242	489	192	314.9	618	78	
39	4.9	-0.090	333	321	242	492	193	316.1	618	78	
40	4.8	-0.090	334	323	241	489	193	316.1	615	78	
41	4.6	-0.090	336	325	248	493	194	319.2	611	78	
42	4.5	-0.090	338	327	250	494	195	320.7	608	79	
43	4.4	-0.090	340	329	252	492	195	321.5	605	79	
44	4.3	-0.090	342	332	253	493	196	323.2	603	79	

WOODSTOVE PREBURN DATA - ASTM E2780

Client: HHT
 Model: Expedition 1
 Run #: 2

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Recording Interval (min): 1
 Run Time (min): 78

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							Flue	Ambient
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average			
45	4.1	-0.090	344	335	254	494	197	324.8	595	79	
46	4.0	-0.090	346	338	255	490	198	325.3	590	79	
47	3.9	-0.090	348	341	256	489	198	326.5	585	79	
48	3.8	-0.090	350	343	258	489	199	327.7	581	79	
49	3.6	-0.090	352	346	258	487	200	328.6	574	79	
50	3.5	-0.090	354	349	259	487	201	330.0	569	80	
51	3.5	-0.080	357	352	260	483	202	330.7	566	79	
52	3.4	-0.080	358	355	261	481	202	331.5	560	79	
53	3.3	-0.080	361	357	262	478	203	332.2	546	80	
54	3.2	-0.080	364	361	263	470	204	332.2	530	80	
55	3.2	-0.080	367	363	263	466	205	332.6	512	80	
56	3.1	-0.080	368	366	264	456	206	332.0	494	80	
57	3.1	-0.080	370	368	284	447	206	335.2	478	80	
58	3.0	-0.070	372	370	317	436	207	340.5	467	79	
59	3.0	-0.070	374	373	301	425	208	336.0	456	80	
60	2.9	-0.070	376	375	270	414	209	328.6	447	80	
61	2.9	-0.070	377	376	330	404	209	339.4	438	80	
62	2.9	-0.070	379	378	328	397	210	338.5	430	80	
63	2.8	-0.070	381	379	326	388	211	337.0	421	80	
64	2.8	-0.070	382	381	324	381	212	336.0	414	80	
65	2.8	-0.070	384	381	321	373	213	334.4	407	80	
66	2.8	-0.070	385	383	319	366	214	333.2	401	80	
67	2.7	-0.060	386	383	316	357	214	331.3	395	80	
68	2.7	-0.060	386	385	314	350	215	329.8	389	80	
69	2.7	-0.060	387	386	312	345	216	328.8	385	80	
70	2.6	-0.060	388	387	309	338	216	327.5	381	79	
71	2.6	-0.060	389	388	306	334	217	326.6	377	79	
72	2.6	-0.060	389	389	304	330	217	325.8	374	79	
73	2.6	-0.060	390	389	302	324	218	324.6	370	79	
74	2.5	-0.060	391	390	299	318	218	323.1	367	79	
75	2.5	-0.060	391	390	297	313	218	321.6	364	79	
76	2.5	-0.060	391	391	295	312	218	321.2	363	79	
77	2.5	-0.060	391	390	293	310	218	320.3	361	79	
78	2.4	-0.060	391	391	291	304	219	319.2	360	79	

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: HHTJob #: 21-661Model: Expedition 1Tracking #: 100Run #: 2Technician: SJBDate: 5/13/2021

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	0.002		0.020	0.98	81	-3		9.7		98	356	78	79
1	0.231	0.229	0.020	1.94	81	-3	105	9.7	-0.06	106	369	80	79
2	0.459	0.228	0.020	1.92	81	-3	104	9.5	-0.18	103	454	80	79
3	0.687	0.228	0.020	1.91	81	-3	104	9.4	-0.14	100	436	80	79
4	0.913	0.226	0.021	1.90	81	-3	100	9.2	-0.16	101	485	81	79
5	1.138	0.225	0.020	1.90	81	-3	102	9.1	-0.15	101	504	81	79
6	1.364	0.226	0.020	1.90	81	-3	103	8.8	-0.21	103	566	81	79
7	1.590	0.226	0.020	1.89	81	-3	103	8.6	-0.2	105	605	82	78
8	1.815	0.225	0.020	1.89	81	-3	103	8.4	-0.21	107	635	82	79
9	2.038	0.223	0.020	1.88	81	-3	102	8.2	-0.24	109	657	83	79
10	2.263	0.225	0.021	1.88	81	-3	101	7.9	-0.26	110	671	83	79
11	2.487	0.224	0.020	1.88	81	-3	103	7.7	-0.26	111	682	84	79
12	2.712	0.225	0.020	1.87	81	-3	103	7.4	-0.26	111	688	84	79
13	2.936	0.224	0.020	1.87	81	-3	103	7.2	-0.25	112	691	85	79
14	3.159	0.223	0.020	1.87	82	-3	102	6.9	-0.26	113	697	85	79
15	3.382	0.223	0.020	1.87	82	-3	102	6.7	-0.23	113	701	85	79
16	3.604	0.222	0.020	1.86	82	-3	102	6.4	-0.24	114	708	86	79
17	3.827	0.223	0.020	1.86	82	-3	102	6.2	-0.23	114	710	86	79
18	4.051	0.224	0.020	1.86	82	-3	103	6.0	-0.22	114	708	86	79
19	4.274	0.223	0.021	1.86	82	-3	100	5.8	-0.21	114	707	86	79
20	4.497	0.223	0.020	1.86	82	-3	102	5.6	-0.21	114	705	87	79
21	4.720	0.223	0.021	1.86	82	-3	100	5.3	-0.22	114	700	87	79
22	4.943	0.223	0.020	1.86	82	-3	102	5.1	-0.2	114	695	87	79
23	5.165	0.222	0.021	1.86	83	-3	99	4.9	-0.2	114	696	87	79
24	5.386	0.221	0.020	1.86	83	-3	101	4.7	-0.2	114	697	88	79
25	5.609	0.223	0.020	1.85	83	-3	102	4.6	-0.19	114	698	88	79
26	5.831	0.222	0.020	1.85	83	-3	102	4.3	-0.21	114	701	88	79
27	6.054	0.223	0.020	1.85	83	-3	102	4.2	-0.19	115	701	88	79
28	6.276	0.222	0.021	1.85	83	-3	99	4.0	-0.19	115	701	88	79
29	6.498	0.222	0.021	1.85	83	-3	99	3.8	-0.17	115	699	88	79
30	6.721	0.223	0.021	1.85	84	-3	100	3.6	-0.16	114	698	88	79
31	6.943	0.222	0.021	1.85	84	-3	99	3.4	-0.19	114	694	89	79

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: HHTJob #: 21-661Model: Expedition 1Tracking #: 100Run #: 2Technician: SJBDate: 5/13/2021

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
32	7.166	0.223	0.021	1.84	84	-3	100	3.3	-0.17	114	691	89	79
33	7.388	0.222	0.021	1.85	84	-3	99	3.1	-0.17	114	690	89	79
34	7.609	0.221	0.021	1.85	84	-3	99	2.9	-0.16	114	692	89	79
35	7.830	0.221	0.021	1.85	84	-3	99	2.8	-0.17	114	693	89	79
36	8.052	0.222	0.020	1.84	84	-3	102	2.6	-0.17	114	694	88	79
37	8.274	0.222	0.021	1.84	85	-3	99	2.5	-0.15	114	689	87	79
38	8.495	0.221	0.021	1.84	85	-3	99	2.3	-0.15	113	678	87	79
39	8.717	0.222	0.021	1.84	85	-3	99	2.2	-0.12	113	661	87	79
40	8.939	0.222	0.020	1.84	85	-3	101	2.1	-0.11	112	641	87	79
41	9.161	0.222	0.021	1.84	85	-3	99	2.0	-0.1	111	623	87	80
42	9.383	0.222	0.021	1.85	85	-3	99	1.9	-0.1	110	598	86	79
43	9.605	0.222	0.021	1.84	85	-3	98	1.8	-0.08	109	579	86	79
44	9.827	0.222	0.021	1.85	85	-3	98	1.7	-0.07	108	559	86	79
45	10.049	0.222	0.021	1.85	85	-3	98	1.7	-0.06	107	539	86	79
46	10.271	0.222	0.021	1.85	86	-3	98	1.6	-0.06	106	521	86	80
47	10.493	0.222	0.021	1.85	86	-3	98	1.6	-0.05	105	502	85	79
48	10.714	0.221	0.021	1.84	86	-3	98	1.5	-0.04	105	488	85	80
49	10.935	0.221	0.021	1.84	86	-3	98	1.5	-0.03	104	475	85	79
50	11.158	0.223	0.021	1.84	86	-3	98	1.4	-0.04	103	462	85	80
51	11.380	0.222	0.021	1.84	86	-3	98	1.4	-0.02	103	451	85	79
52	11.602	0.222	0.021	1.84	86	-3	98	1.4	-0.02	102	440	85	79
53	11.825	0.223	0.021	1.85	86	-3	98	1.4	-0.03	101	430	84	79
54	12.047	0.222	0.021	1.84	86	-3	98	1.3	-0.03	101	423	84	79
55	12.270	0.223	0.021	1.85	86	-3	98	1.3	-0.03	100	416	84	79
56	12.492	0.222	0.021	1.85	87	-3	97	1.3	-0.02	100	410	84	79
57	12.715	0.223	0.021	1.85	87	-3	98	1.3	-0.02	99	406	84	79
58	12.937	0.222	0.021	1.86	87	-3	97	1.2	-0.03	99	399	84	79
59	13.159	0.222	0.021	1.85	87	-3	97	1.2	-0.03	99	395	84	80
60	13.381	0.222	0.021	1.85	87	-3	97	1.2	-0.03	99	391	84	79
61	13.616	0.235	0.021	1.90	87	-3	103	1.2	-0.03	98	388	82	80
62	13.842	0.226	0.021	1.90	87	-3	99	1.1	-0.02	98	386	82	79
63	14.067	0.225	0.021	1.90	87	-3	98	1.1	-0.03	98	382	82	79

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: HHTJob #: 21-661Model: Expedition 1Tracking #: 100Run #: 2Technician: SJBDate: 5/13/2021

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
64	14.293	0.226	0.021	1.89	87	-3	99	1.1	-0.01	97	379	82	79
65	14.520	0.227	0.021	1.90	87	-3	99	1.1	-0.02	97	377	82	79
66	14.746	0.226	0.021	1.90	87	-3	99	1.0	-0.03	97	374	82	79
67	14.972	0.226	0.021	1.90	87	-3	99	1.0	-0.03	97	373	82	79
68	15.198	0.226	0.021	1.90	87	-3	99	1.0	-0.03	96	371	82	79
69	15.425	0.227	0.020	1.90	88	-3	102	1.0	-0.02	96	369	82	79
70	15.651	0.226	0.021	1.90	88	-3	99	0.9	-0.03	96	368	82	79
71	15.877	0.226	0.021	1.90	88	-3	99	0.9	-0.03	96	366	82	79
72	16.104	0.227	0.021	1.91	88	-3	99	0.9	-0.02	96	365	83	79
73	16.331	0.227	0.020	1.90	88	-3	101	0.9	-0.03	96	363	83	79
74	16.556	0.225	0.020	1.90	88	-3	101	0.8	-0.02	96	362	83	79
75	16.783	0.227	0.021	1.90	88	-3	99	0.8	-0.03	96	361	83	80
76	17.010	0.227	0.020	1.90	89	-3	101	0.8	-0.03	96	359	83	80
77	17.237	0.227	0.020	1.90	89	-3	101	0.8	-0.02	95	358	83	80
78	17.462	0.225	0.020	1.90	89	-3	100	0.7	-0.02	95	357	83	80
79	17.689	0.227	0.020	1.90	89	-3	101	0.7	-0.02	95	354	83	80
80	17.916	0.227	0.020	1.91	89	-3	101	0.7	-0.02	95	353	83	80
81	18.143	0.227	0.020	1.90	89	-3	101	0.7	-0.03	95	353	84	80
82	18.368	0.225	0.020	1.90	89	-3	100	0.6	-0.02	95	351	84	80
83	18.595	0.227	0.021	1.89	90	-3	99	0.6	-0.02	95	350	84	81
84	18.822	0.227	0.020	1.90	90	-3	101	0.6	-0.02	95	349	84	81
85	19.048	0.226	0.020	1.90	90	-3	101	0.6	-0.02	95	348	84	81
86	19.273	0.225	0.020	1.89	90	-3	100	0.6	-0.03	95	347	84	81
87	19.500	0.227	0.021	1.90	90	-3	99	0.5	-0.02	94	346	84	81
88	19.727	0.227	0.020	1.90	90	-3	101	0.5	-0.01	94	345	84	81
89	19.953	0.226	0.021	1.90	90	-3	98	0.5	-0.03	94	345	84	81
90	20.179	0.226	0.020	1.89	90	-3	101	0.5	-0.02	94	343	84	81
91	20.406	0.227	0.021	1.90	90	-3	98	0.4	-0.03	94	343	84	81
92	20.633	0.227	0.021	1.90	90	-3	98	0.4	-0.02	94	342	84	81
93	20.858	0.225	0.021	1.90	90	-3	98	0.4	-0.02	94	341	85	81
94	21.085	0.227	0.021	1.90	90	-3	98	0.4	-0.02	94	340	85	81
95	21.313	0.228	0.020	1.90	91	-3	101	0.4	-0.02	94	340	85	81

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: HHTJob #: 21-661Model: Expedition 1Tracking #: 100Run #: 2Technician: SJBDate: 5/13/2021

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
96	21.540	0.227	0.020	1.90	91	-3	101	0.3	-0.03	94	338	85	81
97	21.765	0.225	0.021	1.90	91	-3	97	0.3	-0.01	94	338	85	81
98	21.992	0.227	0.020	1.90	91	-3	101	0.3	-0.03	94	337	85	81
99	22.219	0.227	0.020	1.90	91	-3	101	0.3	-0.03	94	336	85	81
100	22.445	0.226	0.021	1.90	91	-3	98	0.2	-0.02	93	336	85	81
101	22.671	0.226	0.020	1.90	90	-3	100	0.2	-0.02	93	334	85	81
102	22.898	0.227	0.021	1.90	91	-3	98	0.2	-0.02	93	332	85	81
103	23.126	0.228	0.020	1.90	91	-3	101	0.2	-0.02	93	331	85	81
104	23.351	0.225	0.020	1.90	91	-3	100	0.2	-0.02	93	329	85	81
105	23.578	0.227	0.021	1.90	91	-3	98	0.1	-0.02	93	328	85	81
106	23.806	0.228	0.020	1.90	91	-3	101	0.1	-0.02	93	327	85	81
107	24.033	0.227	0.020	1.90	91	-3	101	0.1	-0.02	93	326	85	81
108	24.259	0.226	0.021	1.90	91	-3	98	0.1	-0.02	93	326	85	81
109	24.486	0.227	0.020	1.90	91	-3	101	0.1	-0.02	93	325	85	81
110	24.714	0.228	0.020	1.91	91	-3	101	0.0	-0.02	93	324	85	81
111	24.939	0.225	0.020	1.90	91	-3	100	0.0	-0.02	93	324	85	81
112	25.166	0.227	0.020	1.90	92	-3	101	0.0	-0.03	93	324	85	81
Avg/Tot	25.164	0.225	0.021	1.87	86	-3.00	100			102	480	85	79.6

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: HHTJob #: 21-661Model: Expedition 1Tracking #: 100Run #: 2Technician: SJBDate: 5/13/2021

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		0.99	79	-3		80	-0.060	2.33	0.40
1	0.223	0.223	1.98	79	-3	105	81	-0.080	1.23	0.30
2	0.446	0.223	1.97	79	-3	104	82	-0.070	6.13	0.40
3	0.668	0.222	1.96	79	-3	104	82	-0.070	6.54	0.77
4	0.890	0.222	1.95	79	-3	101	82	-0.080	8.60	0.58
5	1.111	0.221	1.95	79	-3	103	82	-0.080	8.66	0.59
6	1.332	0.221	1.94	79	-3	103	83	-0.090	10.67	0.48
7	1.552	0.220	1.94	79	-3	103	83	-0.090	11.57	0.62
8	1.772	0.220	1.93	79	-3	103	83	-0.100	12.22	0.61
9	1.991	0.219	1.93	80	-3	103	84	-0.100	12.51	1.26
10	2.210	0.219	1.92	80	-3	101	84	-0.100	12.61	1.26
11	2.430	0.220	1.92	80	-3	104	84	-0.100	12.63	1.28
12	2.650	0.220	1.92	80	-3	104	85	-0.100	12.60	1.43
13	2.869	0.219	1.92	80	-3	103	85	-0.100	12.47	1.55
14	3.087	0.218	1.91	80	-3	103	85	-0.100	12.74	1.38
15	3.305	0.218	1.91	80	-3	103	86	-0.100	12.85	1.11
16	3.523	0.218	1.91	80	-3	103	86	-0.100	13.12	0.80
17	3.740	0.217	1.91	80	-3	102	86	-0.100	13.07	0.65
18	3.958	0.218	1.91	81	-3	103	87	-0.100	13.14	0.60
19	4.176	0.218	1.90	81	-3	100	87	-0.100	12.79	0.69
20	4.395	0.219	1.90	81	-3	103	87	-0.100	12.87	0.76
21	4.613	0.218	1.90	81	-3	100	87	-0.100	12.74	0.58
22	4.831	0.218	1.90	81	-3	103	88	-0.100	12.63	0.51
23	5.048	0.217	1.90	81	-3	100	88	-0.100	12.58	0.52
24	5.265	0.217	1.90	82	-3	102	88	-0.100	12.61	0.48
25	5.482	0.217	1.90	82	-3	102	88	-0.100	12.71	0.43
26	5.700	0.218	1.90	82	-3	103	88	-0.100	12.82	0.46
27	5.918	0.218	1.89	82	-3	103	88	-0.100	12.90	0.55
28	6.135	0.217	1.90	82	-3	100	89	-0.100	12.84	0.54
29	6.352	0.217	1.89	82	-3	100	89	-0.100	12.72	0.49
30	6.568	0.216	1.89	82	-3	99	89	-0.100	12.58	0.41
31	6.785	0.217	1.90	83	-3	99	89	-0.100	12.54	0.39

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: HHT
 Model: Expedition 1
 Run #: 2

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

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 (%)
32	7.003	0.218	1.90	83	-3	100	89	-0.100	12.48	0.42
33	7.221	0.218	1.89	83	-3	100	89	-0.100	12.58	0.39
34	7.438	0.217	1.89	83	-3	99	89	-0.100	12.60	0.40
35	7.654	0.216	1.89	83	-3	99	89	-0.100	12.72	0.44
36	7.870	0.216	1.89	83	-3	101	89	-0.100	12.74	0.50
37	8.087	0.217	1.89	83	-3	99	88	-0.090	12.66	0.54
38	8.305	0.218	1.89	83	-3	100	88	-0.090	12.16	0.56
39	8.521	0.216	1.89	83	-3	99	88	-0.090	11.46	0.33
40	8.738	0.217	1.89	84	-3	102	88	-0.090	10.73	0.16
41	8.954	0.216	1.89	84	-3	99	88	-0.090	10.06	0.10
42	9.170	0.216	1.89	84	-3	98	88	-0.090	9.31	0.10
43	9.388	0.218	1.89	84	-3	99	88	-0.080	8.68	0.13
44	9.605	0.217	1.89	84	-3	99	87	-0.080	8.15	0.09
45	9.822	0.217	1.89	84	-3	99	87	-0.080	7.55	0.11
46	10.038	0.216	1.89	84	-3	98	87	-0.080	7.03	0.10
47	10.255	0.217	1.89	84	-3	98	87	-0.080	6.65	0.12
48	10.472	0.217	1.90	84	-3	98	87	-0.070	6.49	0.11
49	10.691	0.219	1.89	84	-3	99	87	-0.070	6.30	0.14
50	10.907	0.216	1.89	84	-3	98	86	-0.070	6.02	0.18
51	11.124	0.217	1.89	84	-3	98	86	-0.070	5.87	0.20
52	11.341	0.217	1.89	84	-3	98	86	-0.070	5.71	0.23
53	11.558	0.217	1.89	84	-3	98	86	-0.070	5.62	0.26
54	11.776	0.218	1.89	84	-3	98	86	-0.070	5.60	0.29
55	11.994	0.218	1.89	84	-3	98	85	-0.070	5.56	0.31
56	12.212	0.218	1.90	84	-3	98	85	-0.060	5.55	0.32
57	12.429	0.217	1.90	84	-3	98	85	-0.060	5.53	0.34
58	12.646	0.217	1.90	84	-3	98	85	-0.060	5.49	0.38
59	12.863	0.217	1.90	84	-3	98	85	-0.060	5.43	0.40
60	13.081	0.218	1.90	84	-3	98	85	-0.060	5.48	0.40
61	13.300	0.219	1.90	84	-3	99	86	-0.060	5.49	0.39
62	13.518	0.218	1.90	84	-3	98	86	-0.060	5.53	0.40
63	13.736	0.218	1.90	84	-3	98	86	-0.060	5.54	0.41

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: HHT
 Model: Expedition 1
 Run #: 2

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

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 (%)
64	13.953	0.217	1.90	84	-3	98	86	-0.060	5.47	0.43
65	14.171	0.218	1.90	84	-3	98	86	-0.060	5.44	0.45
66	14.389	0.218	1.90	84	-3	98	86	-0.060	5.48	0.43
67	14.607	0.218	1.90	84	-3	98	86	-0.060	5.45	0.44
68	14.826	0.219	1.90	84	-3	99	86	-0.060	5.52	0.44
69	15.045	0.219	1.90	84	-3	101	86	-0.060	5.51	0.45
70	15.263	0.218	1.90	84	-3	98	86	-0.060	5.43	0.46
71	15.481	0.218	1.90	84	-3	98	86	-0.060	5.40	0.48
72	15.699	0.218	1.90	84	-3	98	86	-0.060	5.42	0.48
73	15.917	0.218	1.90	84	-3	100	86	-0.060	5.38	0.47
74	16.135	0.218	1.90	84	-3	100	86	-0.060	5.30	0.49
75	16.354	0.219	1.90	84	-3	98	86	-0.060	5.14	0.54
76	16.573	0.219	1.91	84	-3	101	86	-0.060	5.07	0.57
77	16.792	0.219	1.90	84	-3	101	86	-0.060	5.03	0.60
78	17.010	0.218	1.90	84	-3	100	86	-0.060	5.02	0.64
79	17.229	0.219	1.90	84	-3	101	86	-0.060	4.96	0.66
80	17.447	0.218	1.90	84	-3	100	86	-0.050	4.93	0.67
81	17.665	0.218	1.90	84	-3	100	86	-0.060	4.92	0.68
82	17.883	0.218	1.90	84	-3	100	86	-0.050	4.91	0.68
83	18.101	0.218	1.90	85	-3	98	86	-0.050	4.90	0.69
84	18.320	0.219	1.90	85	-3	101	86	-0.050	4.91	0.70
85	18.539	0.219	1.90	85	-3	101	86	-0.060	4.89	0.69
86	18.758	0.219	1.90	85	-3	101	86	-0.050	4.89	0.70
87	18.976	0.218	1.90	85	-3	98	86	-0.050	4.88	0.72
88	19.194	0.218	1.90	85	-3	100	87	-0.050	4.84	0.72
89	19.412	0.218	1.90	85	-3	98	87	-0.050	4.80	0.72
90	19.630	0.218	1.90	85	-3	100	87	-0.050	4.78	0.73
91	19.849	0.219	1.90	85	-3	98	87	-0.050	4.78	0.74
92	20.067	0.218	1.90	85	-3	98	87	-0.050	4.72	0.75
93	20.286	0.219	1.90	85	-3	98	87	-0.050	4.70	0.78
94	20.506	0.220	1.90	85	-3	99	87	-0.050	4.69	0.78
95	20.724	0.218	1.90	85	-3	100	87	-0.050	4.68	0.79

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: HHTJob #: 21-661Model: Expedition 1Tracking #: 100Run #: 2Technician: SJBDate: 5/13/2021

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 (%)
96	20.943	0.219	1.90	85	-3	101	87	-0.050	4.67	0.78
97	21.162	0.219	1.90	85	-3	98	87	-0.050	4.59	0.82
98	21.380	0.218	1.91	85	-3	100	87	-0.050	4.55	0.84
99	21.599	0.219	1.91	85	-3	101	87	-0.050	4.51	0.86
100	21.817	0.218	1.90	85	-3	98	87	-0.050	4.47	0.88
101	22.036	0.219	1.91	85	-3	101	87	-0.050	4.44	0.91
102	22.256	0.220	1.91	85	-3	98	87	-0.050	4.34	0.96
103	22.475	0.219	1.91	85	-3	100	87	-0.050	4.30	0.96
104	22.695	0.220	1.91	85	-3	101	87	-0.050	4.32	0.96
105	22.915	0.220	1.91	85	-3	99	87	-0.050	4.19	0.98
106	23.134	0.219	1.91	85	-3	100	86	-0.050	4.17	1.00
107	23.353	0.219	1.91	85	-3	100	87	-0.050	4.13	1.00
108	23.572	0.219	1.91	85	-3	98	86	-0.050	4.14	1.01
109	23.791	0.219	1.91	85	-3	100	86	-0.050	4.12	0.99
110	24.010	0.219	1.91	85	-3	100	87	-0.050	4.04	1.01
111	24.229	0.219	1.91	85	-3	100	86	-0.050	4.39	0.88
112	24.448	0.219	1.91	85	-3	100	86	-0.050	4.33	0.89
Avg/Tot	24.448	0.218	1.90	83	-3.00	100	86	-0.072	7.57	0.60

WOODSTOVE SURFACE TEMPERATURE DATA

Client: HHT
 Model: Expedition 1
 Run #: 2

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Stove ΔT: 38

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	394	390	290	300	220	319.0	N/A
1	398	392	289	293	222	318.7	N/A
2	396	391	285	291	222	317.1	N/A
3	394	389	282	295	222	316.5	N/A
4	390	386	280	306	222	316.8	N/A
5	385	383	277	318	222	317.1	N/A
6	380	379	261	331	222	314.7	N/A
7	375	374	229	352	222	310.4	N/A
8	370	369	215	375	221	310.0	N/A
9	365	363	213	396	221	311.7	N/A
10	360	359	214	414	220	313.2	N/A
11	356	354	214	434	219	315.3	N/A
12	351	349	215	452	218	317.0	N/A
13	348	345	216	465	217	318.1	N/A
14	344	341	217	475	216	318.7	N/A
15	342	338	219	492	215	321.2	N/A
16	339	334	222	506	214	323.0	N/A
17	338	331	224	516	213	324.5	N/A
18	336	329	227	527	212	326.3	N/A
19	335	327	230	534	211	327.4	N/A
20	335	325	232	541	210	328.5	N/A
21	334	324	235	547	209	329.9	N/A
22	334	323	236	552	208	330.7	N/A
23	334	322	239	553	208	331.1	N/A
24	334	322	240	558	207	332.2	N/A
25	334	323	243	558	206	332.8	N/A
26	334	323	244	565	206	334.2	N/A
27	334	323	246	569	205	335.4	N/A
28	334	324	250	573	204	337.0	N/A
29	335	324	252	575	204	338.2	N/A
30	337	326	253	576	204	339.1	N/A
31	338	327	256	577	203	340.4	N/A
32	339	328	258	581	203	341.7	N/A
33	341	330	260	582	203	343.2	N/A
34	342	331	263	583	202	344.3	N/A
35	344	333	264	591	202	347.0	N/A
36	346	335	266	593	202	348.5	N/A
37	349	337	268	596	202	350.2	N/A
38	351	338	269	596	202	351.4	N/A
39	353	341	271	597	202	352.9	N/A
40	356	343	272	589	202	352.4	N/A
41	359	345	273	583	203	352.5	N/A
42	361	348	274	575	203	352.2	N/A
43	365	351	273	560	203	350.4	N/A
44	368	355	275	546	203	349.3	N/A
45	372	358	274	530	203	347.2	N/A
46	375	362	272	517	203	345.8	N/A
47	378	366	271	500	203	343.6	N/A

WOODSTOVE SURFACE TEMPERATURE DATA

Client: HHT
 Model: Expedition 1
 Run #: 2

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Stove ΔT: 38

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
48	381	369	269	488	204	342.4	N/A
49	385	373	270	468	204	339.9	N/A
50	388	376	269	461	204	339.6	N/A
51	391	380	266	443	204	337.0	N/A
52	394	383	254	432	205	333.4	N/A
53	396	385	250	417	205	330.6	N/A
54	398	389	262	412	205	333.1	N/A
55	400	391	321	400	205	343.6	N/A
56	401	393	322	391	205	342.5	N/A
57	402	395	319	380	205	340.3	N/A
58	403	397	317	376	205	339.6	N/A
59	404	398	314	369	206	337.9	N/A
60	403	398	312	360	206	335.9	N/A
61	403	400	309	356	207	334.9	N/A
62	403	400	307	350	208	333.4	N/A
63	402	400	304	347	209	332.4	N/A
64	402	401	302	343	209	331.2	N/A
65	401	401	300	337	210	329.7	N/A
66	400	401	297	334	210	328.3	N/A
67	399	400	295	330	211	327.0	N/A
68	398	400	294	327	211	325.9	N/A
69	396	400	292	323	211	324.6	N/A
70	395	400	290	323	212	323.9	N/A
71	394	400	289	317	211	322.3	N/A
72	393	399	288	317	211	321.6	N/A
73	393	399	287	312	211	320.4	N/A
74	392	398	285	312	211	319.7	N/A
75	392	398	284	308	210	318.7	N/A
76	391	398	283	310	210	318.4	N/A
77	390	398	282	306	209	316.9	N/A
78	390	397	281	306	208	316.2	N/A
79	389	397	279	302	207	314.7	N/A
80	388	396	278	299	206	313.4	N/A
81	388	394	277	296	205	312.1	N/A
82	388	394	276	296	204	311.7	N/A
83	387	393	275	293	204	310.2	N/A
84	387	392	274	294	203	309.7	N/A
85	386	390	273	290	202	308.0	N/A
86	385	389	272	289	201	307.2	N/A
87	385	388	271	287	200	306.0	N/A
88	384	387	270	284	200	304.8	N/A
89	384	386	268	284	199	304.1	N/A
90	383	384	267	282	198	302.9	N/A
91	382	383	266	281	197	301.9	N/A
92	382	382	265	279	197	300.8	N/A
93	381	380	264	277	196	299.8	N/A
94	381	379	263	277	196	299.1	N/A
95	380	378	262	276	195	298.1	N/A

WOODSTOVE SURFACE TEMPERATURE DATA

Client: HHT
 Model: Expedition 1
 Run #: 2

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

Stove ΔT : 38

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
96	379	376	261	277	194	297.5	N/A
97	379	375	260	274	194	296.3	N/A
98	378	374	259	274	193	295.7	N/A
99	378	373	258	272	192	294.6	N/A
100	377	372	257	271	192	293.6	N/A
101	376	370	256	270	191	292.6	N/A
102	375	370	255	269	190	291.8	N/A
103	375	368	254	268	190	290.9	N/A
104	374	367	253	265	189	289.6	N/A
105	373	366	252	264	188	288.6	N/A
106	372	365	250	264	188	287.7	N/A
107	371	364	249	262	187	286.7	N/A
108	370	363	248	261	187	285.6	N/A
109	369	362	247	259	186	284.5	N/A
110	368	361	246	259	185	283.7	N/A
111	367	359	245	259	185	282.8	N/A
112	365	358	244	257	184	281.5	N/A
Average	373	369	265	395	205	321	N/A

LAB SAMPLE DATA - ASTM E2515

Client: HHT
 Model: Expedition 1
 Run #: 2

Job #: 21-661
 Tracking #: 100
 Technician: SJB
 Date: 5/13/2021

	Sample ID	Tare, mg	Total, mg	Final, mg	Catch, mg
Train A Filters - 1st hr	G0041	119.1	239.7	241.5	1.8
	G0042	120.6			
Train A Probe - 1st hr	18A	117496.0	117496.0	117496.1	0.1
Train A O-Rings - 1st hr	18A	3396.6	3396.6	3396.6	0.0
Train A Filters - Remainder	G0043	120.0	240.8	240.8	0.0
	G0044	120.8			
Train A Probe-Remainder	19A	117024.3	117024.3	117024.4	0.1
Train A O-Rings - Remainder	19A	3366.1	3366.1	3366.2	0.1
Train B Filters	G0045	118.2	239.4	241.4	2.0
	G0046	121.2			
Train B Probe	19B	117009.7	117009.7	117009.8	0.1
Train B O-Rings	19B	3439.1	3439.1	3439.4	0.3
Background Filter	G0047	119.7	119.7	119.7	0.0

Placed in Dessicator on:	5/13/21 - 15:55
---------------------------------	-----------------

Train A Filters - 1st hr	241.5	5/17 9:12	241.5	5/18 8:23		
Train A Probe - 1st hr	117496.2	5/17 9:13	117496.1	5/18 8:23		
Train A O-Rings - 1st hr	3396.5	5/17 9:14	3396.6	5/18 8:24		
Train A Filters - Remainder	240.9	5/17 9:12	240.8	5/18 8:23		
Train A Probe - Remainder	117024.2	5/17 9:13	117024.4	5/18 8:24		
Train A O-Rings - Remainder	3366.2	5/17 9:14	3366.2	5/18 8:24		
Train B Filters	241.4	5/17 9:12	241.4	5/18 8:23		
Train B Probe	117009.9	5/17 9:14	117009.8	5/18 8:24		
Train B O-Rings	3439.3	5/17 9:14	3439.4	5/18 8:24		
Background Filter	119.7	5/17 9:12	119.7	5/18 8:23		

1st hour Sub-Total, mg:	1.9
Remainder Sub-Total, mg:	0.2
Train 1 Aggregate, mg:	2.1
Train 2 Aggregate, mg:	2.4
Ambient Aggregate, mg:	0.0

ASTM E2780 Wood Heater Run Sheets

Client: HHT Job Number: 21-661 Tracking #: 100
 Model: Expedition 1 Run Number: 2 Test Date: 5/13/2021

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): N/A – Single Burn Rate
 Targeted Burn Category: N/A – Single Burn Rate

Preburn Notes

Time	Notes
14:15 14:39 15:57	Ignited kindling fire (7.7 lbs), fan on high. @ 2.0 lbs of kindling remaining, loaded pre-burn test fuel, activated ACC. @ 2.4 lbs, leveled coal bed and zeroed scale in preparation of fuel loading.

Test Notes

Test Burn Start Time: 15:59 Test Fuel Loaded by: 40 seconds
 Door Closed: 80 seconds Air Control Set at: 0 seconds
 Other Loading Notes: N/A

Time	Notes
0 min 60 min 112 min	Loaded test fuel, activated ACC, fan on high. Changed 1 st hour filter train. End of test

Test Burn End Time: 17:51

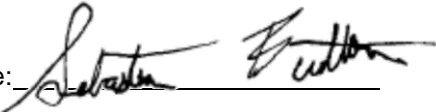
Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.14 CO (%): 4.3
 Mid Gas CO₂ (%): 9.90 CO (%): 2.47

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	11:07	11:12	11:09	18:01	18:03	18:04
CO ₂	0.00	10.04	17.14	-0.14	9.95	17.09
CO	0.00	2.452	4.299	-0.017	2.481	4.393

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

Technician Signature:  Date: 5/14/21

ASTM E2780 Wood Heater Run Sheets

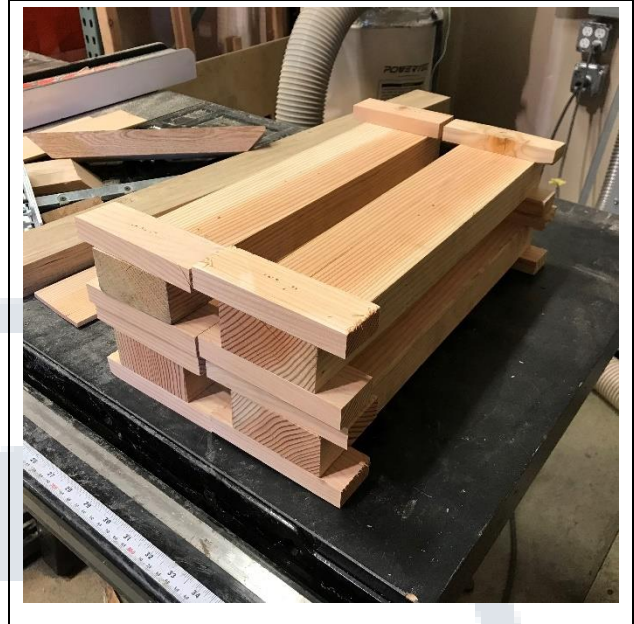
Client: HHT
Model: Expedition 1

Job Number: 21-661
Run Number: 2

Tracking #: 100
Test Date: 5/13/2021



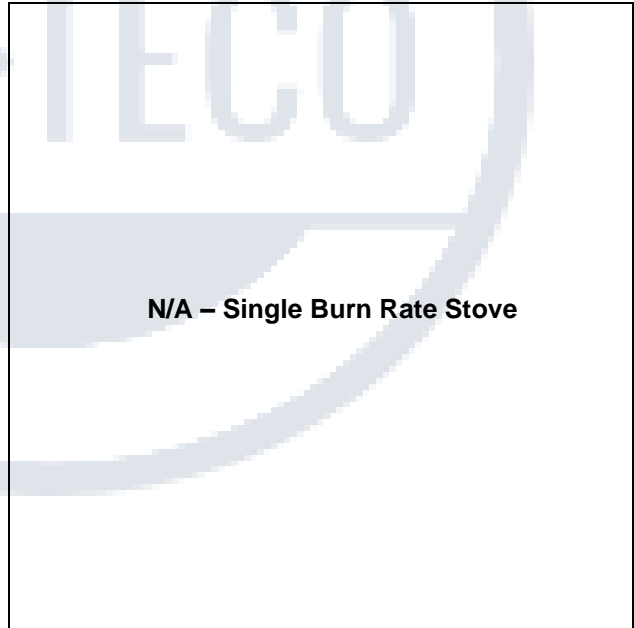
Test Fuel Side View



Test Fuel Iso View



Test Fuel Loaded in Stove



N/A – Single Burn Rate Stove

Air Setting

Technician Signature: _____

A handwritten signature in black ink that reads "Sebastian E. Sutton".

Date: 5/14/21

ASTM E2515 - Glass Filters

Sample	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
G00001	120.5	120.5	-	-	A	21-686	#1
G00002	120.8	120.8	-	-	A		
G00003	120.0	120.0	-	-	A		
G00004	121.2	121.2	-	-	A		
G00005	119.8	119.6	-	-	A		
G00006	121.1	121.3	-	-	A	21-686	#2
G00007	119.8	119.0	-	-	A		
G00008	239 120.3	120.2	-	-	A		
G00009	120.3	120.4	-	-	A		
G00010	119.8	119.8	-	-	A	↓	↓
G00011	120.4	120.5	-	-	A	21-686	#3
G00012	119.7	119.7	-	-	A		
G00013	120.3	120.3	-	-	A		
G00014	120.5	120.3	-	-	A		
G00015	121.5	121.4	-	-	A	↓	↓
G00016	120.0	120.0	-	-	A	21-686	#4
G00017	120.3	120.4	-	-	A	↓	↓
G00018	120.2	120.1	-	-	A	↓	↓

Weight 1 Date/Time:
3/18 9:45
Weight 2 Date/Time:
3/21 11:30
Weight 3 Date/Time:
Weight 4 Date/Time:

Sample	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
G0019	119.8	119.4	-	-	A	21-686	#4
G0020	119.4	119.5	-	-	A	↓	↓
G0021	121.0	121.0	-	-	A	21-695	#1
G0022	119.6	119.7	-	-	A		
G0023	121.7	121.8	-	-	A		
G0024	117.6	117.6	-	-	A		
G0025	121.0	120.9	-	-	A		
G0026	120.8	120.6	-	-	A		
G0027	120.8	121.0	-	-	A	21-694	#1
G0028	117.9	118.0	-	-	A		
G0029	120.0	120.0	-	-	A		
G0030	121.3	121.3	-	-	A		
G0031	119.5	119.6	-	-	A		
G0032	119.7	119.8	-	-	A		
G0033	120.5	120.4	-	-	A	21-691	#1
G0034	121.0	121.0	-	-	A		
G0035	119.6	119.0	-	-	A		
G0036	120.8	120.7	-	-	A	↓	↓

Weight 1 Date/Time:
3/18 9:45
Weight 2 Date/Time:
3/21 11:30
Weight 3 Date/Time:
Weight 4 Date/Time:

ASTM E2515 - Glass Filters

Sample	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
G00037	—	—	—	—	—		
G00038	120.3	120.3	—	—	SB	21-61	#1
G00039	121.0	121.1	—	—	SB	↓	↓
G00040	120.3	120.3	—	—	SB	↓	↓
G00041	119.1	119.1	—	—	SB	21-61	#2
G00042	120.7	120.6	—	—	SB	↑	↑
G00043	120.1	120.0	—	—	SB	↑	↑
G00044	120.8	120.8	—	—	SB	↑	↑
G00045	118.3	118.2	—	—	SB	↑	↑
G00046	121.3	121.2	—	—	SB	↑	↑
G00047	119.7	119.7	—	—	SB	↓	↓
G00048	121.1	121.0	—	—	SB		
G00049	118.7	118.6	—	—	SB		
G00050	120.9	121.0	—	—	SB		
G00051	119.9	119.9	—	—	SB		
G00052	119.6	119.7	—	—	SB		
G00053	120.5	120.3	—	—	SB		
G00054	121.1	121.1	—	—	SB		

Weight 1 Date/Time:	4/2 - 11:00
Weight 2 Date/Time:	4/5 - 9:45
Weight 3 Date/Time:	
Weight 4 Date/Time:	

Sample	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
G00055	119.1						
G00056	121.9						
G00057	121.0						
G00058	118.7						
G00059	119.9						
G00060	120.0						
G00061	118.3						
G00062	120.7						
G00063	120.5						
G00064	120.0						
G00065	119.2						
G00066	120.6						
G00067	120.4						
G00068	120.2						
G00069	120.1						
G00070	119.6						
G00071	121.3						
G00072	120.2						

Weight 1 Date/Time:	5/7 - 15:00
Weight 2 Date/Time:	
Weight 3 Date/Time:	
Weight 4 Date/Time:	

ASTM E2515 - Probes

Sample	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
1A	115627.6	115627.5	-	-	SB	20-635	#1
1B	115 115901.1	115900.9	-	-	SB		
2A	116075.6	116074.4	116074.4	-	SB	20-635	#2
2B	116202.2	116201.6	116201.5	-	SB		
3A	115901.4	115900.0	115899.9	-	SB	20-635	#3
3B	116151.4	116150.4	116150.3	-	SB		
4A	116037.3	116036.5	116036.5	-	SB	20-651	#1
4B	116192.0	116190.4	116190.3	-	SB		
5A	116767.7	116767.4	116767.7	116767.5	A	20-651	#2
5B	116875.3	116874.9	116875.5	116875.3	A		
6A	116400.5	116400.4	-	-	A	20-651	#3
6B	115961.2	115961.7	-	-	A		
7A	116573.2	116573.2	-	-	A	20-651	#4
7B	117148.4	117148.5	-	-	A		
8A	116679.5	116679.6	-	-	A	21-661	#1
8B	116676.4	116676.3	-	-	A		
9A	116538.8	116538.4	-	-	A	21-661	#2
9B	117244.0	117244.2	-	-	A		
10A	116651.2	116651.0	-	-	A	-	-
10B	117755.5	117755.4	-	-	A	-	-
11A	116888.7	116868.6	-	-	SB	21-686	#1
11B	117342.2	117341.0	117341.1	-	SB		
12A	116708.2	116708.1	-	-	SB	21-686	#2
12B	117775.0	117774.4	117774.6	-	SB		
13A	117316.7	117316.6	-	-	SB	21-686	#3
13B	116943.2	116942.8	116943.0	-	SB		
14A	116664.7	116661.3	116661.5	-	SB	21-686	#4
14B	116622.6	116620.4	116621.0	116620.9	SB		
15A	117244.6	117243.6	117243.6	-	SB	21-685	#1
15B	116757.7	116756.5	116756.6	-	SB		
16A	116381.4	116380.9	116380.9	-	A	21-694	#1
16B	115865.7	115865.3	115865.1	-	A		
17A	116808.9	116808.6	116808.6	-	A	21-661	#1
17B	117138.6	117138.5	-	-	A		
18A	117496.7	117496.2	117496.0	-	A	21-661	#1/#2
18B	117329.0	117328.7	117328.6	-	A		
19A	117024.5	117024.3	-	-	A	21-661	#2
19B	117009.9	117009.7	-	-	A		
20A	115624.7	115623.9	115624.1	-	A	-	-
20B	115964.1	115963.5	115963.7	-	A	-	-

Weight 1 Date/Time:	10/12 9:30
Weight 2 Date/Time:	10/12 - 16:30
Weight 3 Date/Time:	10/13 - 8:30
Weight 4 Date/Time:	12/15

Weight 1 Date/Time:	12/15 17:00
Weight 2 Date/Time:	12/16 10:00
Weight 3 Date/Time:	
Weight 4 Date/Time:	

Weight 1 Date/Time:	2/24 - 16:00
Weight 2 Date/Time:	3/21 - 10:00
Weight 3 Date/Time:	3/22 - 7:00
Weight 4 Date/Time:	

Weight 1 Date/Time:	4/2 - 11:00
Weight 2 Date/Time:	4/5 - 9:45
Weight 3 Date/Time:	4/11 - 12:00
Weight 4 Date/Time:	4/12 - 09:30

ASTM E2515 - O-Rings

Sample	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
1A	3562.1	3563.8	3563.9	-	SB	20-635	#1
1B	3552.3	3552.3	-	-	SB		
2A	3549.7	3549.4	-	-	SB	20-635	#2
2B	3568.4	3568.4	-	-	SB		
3A	3577.0	3577.3	3577.3	-	SB	20-635	#3
3B	3565.2	3565.6	3565.6	-	SB		
4A	3619.3	3619.9	3620.1	-	SB	20-651	#1
4B	3577.3	3577.5	-	-	SB		
5A	3531.8	3531.9	-	-	SB	20-651	#2
5B	3528.1	3528.4	3528.5	-	SB		
6A	3613.4	3613.6	-	-	L	20-651	#3
6B	3402.3	3394.6	3394.6	-	A		
7A	3571.0	3571.0	-	-	A	20-651	#4
7B	3520.9	3521.1	-	-	A		
8A	3550.2	3550.1	-	-	A	21-661	#1
8B	3584.0	3584.0	-	-	A		
9A	3579.9	3579.9	-	-	A	21-661	#2
9B	3523.0	3523.2	-	-	A		
10A	3428.3	3429.1	3429.2	-	A	-	-
10B	3568.9	3569.0	-	-	A	-	-
11A	3424.6	3424.1	3424.2	-	SB	21-686	#1
11B	4234.5	4234.1	4234.3	-	SB		
12A	3404.1	3403.8	3403.8	-	SB	21-686	#2
12B	3396.2	3396.0	3396.0	-	SB		
13A	3360.1	3359.6	3359.7	-	SB	21-686	#3
13B	3445.2	3444.7	3444.9	-	SB		
14A	3366.8	3366.6	3366.6	-	SB	21-686	#4
14B	3341.9	3341.5	3341.7	-	SB		
15A	3571.2	3570.1	3570.1	-	SB	21-695	#1
15B	3570.4	3570.9	3571.1	-	SB		
16A	3573.8	3573.6	-	-	SB	21-694	#1
16B	3638.8	3638.6	-	-	SB		
17A	3612.6	3612.5	-	-	SB	21-661	#1
17B	3569.1	3569.0	-	-	SB		
18A	3396.8	3396.6	-	-	SB	21-661	#1/#2
18B	3367.7	3367.5	-	-	SB		
19A	3366.3	3366.1	-	-	A	21-661	#2
19B	3439.3	3439.1	-	-	A		
20A	3593.0	3592.8	-	-	A	-	-
20B	3426.2	3426.0	-	-	A	-	-

Weight 1	Date/Time:
10/9/20	10:00
Weight 2	Date/Time:
10/12	9:30
Weight 3	Date/Time:
10/13	8:30
Weight 4	Date/Time:

Weight 1	Date/Time:
12/15/20	17:00
Weight 2	Date/Time:
12/16	10:00
Weight 3	Date/Time:
12/16	16:00
Weight 4	Date/Time:

Weight 1	Date/Time:
2/24	16:00
Weight 2	Date/Time:
3/21	10:00
Weight 3	Date/Time:
3/22	7:00
Weight 4	Date/Time:

Weight 1	Date/Time:
4/2	11:00
Weight 2	Date/Time:
4/5	9:45
Weight 3	Date/Time:
4/11	12:00
Weight 4	Date/Time:

Sample Calculations – ASTM E2780 & E2515

Client: HHT
 Model: Expedition 1
 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:

$$FM_S = 15.7 \%$$

$$M_{Swb} = 2.1 \text{ lbs}$$

0.4536 = Conversion factor from lbs to kg

$$M_{Sdb} = [(2.1 \times 0.4536) (100/(100 + 15.7))]$$

$$M_{Sdb} = \mathbf{0.82 \text{ kg}}$$

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

Sample Calculation (test fuel piece 1):

$$\begin{aligned} M_{CPnwb} &= 1.81 \\ FM_{CPn} &= 19.2 \\ &= 1.8 (100/(100+ 19.2) \\ &= 1.5 \text{ lbs} \end{aligned}$$

Total dry crib weight, excluding spacers = 6.11 lbs
 $M_{Cdb} = 2.77 \text{ kg}$

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:

$$V_C = 357 \text{ in}^3$$

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

$$D_{Cdb} = 6.11 / 357 * 1728$$

$$= \mathbf{29.56 \text{ lbs/ft}^3}$$

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

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

Sample calculation:

$$M_{FTAdb} = 0.82 + 2.77$$

$$= 3.59 \text{ kg}$$

BR – dry burn rate, kg/hr

ASTM E2780 equation (5)

$$BR = \frac{60 M_{FTAdb}}{\theta}$$

Where,

$$\theta = \text{Total length of test run, min}$$

Sample Calculation:

$$M_{Bdb} = 3.59 \quad \text{kg}$$

$$\theta = 94 \quad \text{min}$$

$$BR = \frac{60 \times 3.59}{94}$$

$$BR = \mathbf{2.29} \quad \text{kg/hr}$$

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:

$$F_p = \frac{8.61}{9.65} = 0.893$$

$$V_s = 0.893 \times 85.49 \times 0.99 \times 0.142 \times \left(\left(\frac{102.4}{30.00} + \frac{460}{13.6} \right) \times 28.78 \right)^{1/2}$$

$$V_s = \mathbf{8.66} \text{ ft/s}$$

*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:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 8.66 \times 0.7854 \times \frac{528}{102.4 + 460} \times \frac{30.00 + \frac{-0.06}{13.6}}{29.92}$$

Q_{sd} = **22571.5** 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. H₂O
 T_m = Absolute average dry gas meter temperature, °R

Sample Calculation:

Using equation for Train 1:

$$V_{m(std)} = 17.64 \times 21.640 \times 1.003 \times \frac{\left(30.00 + \frac{1.95}{13.6} \right)}{\left(81.8 + 460 \right)}$$

$$V_{m(std)} = \mathbf{21.300} \text{ dscf}$$

Using equation for Train 2:

$$V_{m(std)} = 17.64 \times 21.758 \times 0.999 \times \frac{\left(30.00 + \frac{2.08}{13.6} \right)}{\left(80.4 + 460 \right)}$$

$$V_{m(std)} = \mathbf{21.395} \text{ dscf}$$

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 16.69 \times 1.01 \times \frac{\left(\underline{30} + \frac{0.00}{13.6} \right)}{\left(78.6 + 460 \right)}$$

$$V_{m(std)} = \mathbf{16.562} \text{ dscf}$$

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):

$$m_n = 0.1 + 1.0 + 0.2$$

$$m_n = 1.3 \text{ mg}$$

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

$$m_n = 0.1 + 0.1 + 0.2$$

$$m_n = 0.4 \text{ mg}$$

Train A aggregate:

$$m_n = 1.3 + 0.4$$

$$m_n = 1.7 \text{ mg}$$

Using equation for Train B:

$$m_n = 0.1 + 1.1 + 0.2$$

$$m_n = 1.4 \text{ mg}$$

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:

- K₂ = Constant, 0.001 g/mg
- m_n = Total mass of particulate matter collected in the sampling train, mg
- V_{m(std)} = Volume of gas sampled corrected to dry standard conditions, dscf

Sample calculation:

For Train 1:

$$C_s = 0.001 \times \frac{1.7}{21.30}$$

$$C_s = \mathbf{0.00008} \text{ g/dscf}$$

For Train 2

$$C_s = 0.001 \times \frac{1.4}{21.40}$$

$$C_s = \mathbf{0.00007} \text{ g/dscf}$$

For Ambient Train

$$C_r = 0.001 \times \frac{0.0}{16.56}$$

$$C_r = \mathbf{0.000000} \text{ g/dscf}$$

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

$$E_T = (0.000080 - 0.000000) \times 22571.5 \times 94 /60$$
$$E_T = \mathbf{2.82} \text{ g}$$

For Train 2

$$E_T = (0.000065 - 0.000000) \times 22571.5 \times 94 /60$$
$$E_T = \mathbf{2.31} \text{ g}$$

Average

$$E = \mathbf{2.57} \text{ g}$$

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

- 7.5% of the average = **0.19**
- Train 1 difference = **0.25**
- Train 2 difference = **0.25**

PR - Proportional Rate Variation

ASTM E2515 equation (16)

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

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):

$$PR = \left(\frac{94 \times 0.223 \times 8.66 \times (109.9 + 460) \times (81.8 + 460)}{1 \times 21.64 \times 8.24 \times (102.4 + 460) \times (73.8 + 460)} \right) \times 100$$

PR = **105 %**

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:

$$E_T \text{ (Dual train average)} = 2.57 \text{ g}$$

$$\theta = 94 \text{ min}$$

$$PM_R = 60 \times (2.57 / 94)$$

$$PM_R = 1.64 \text{ g/hr}$$

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:

$$\begin{aligned} E_T (\text{Dual train average}) &= 2.57 \text{ g} \\ M_{Bdb} &= 3.59 \text{ kg} \\ \\ PM_F &= 2.57 / 3.59 \\ \\ PM_F &= \mathbf{0.72} \text{ g/kg} \end{aligned}$$

Installation Manual

Installation & Appliance Set-Up

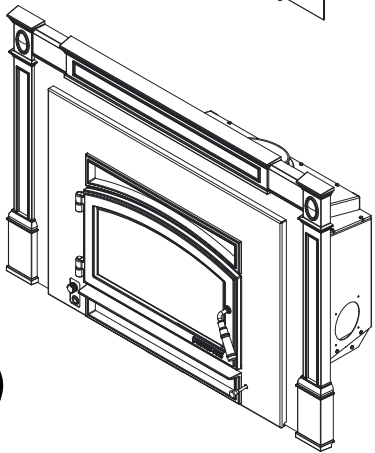
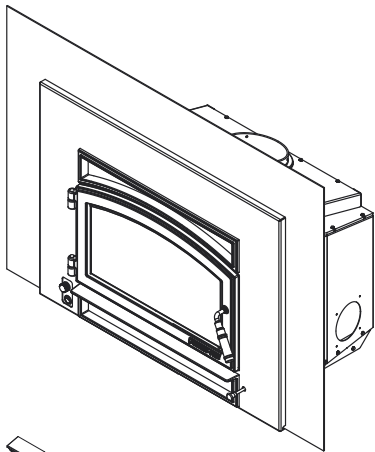
INSTALLER: Leave this manual with party responsible for use and operation.
OWNER: Retain this manual for future reference.

NOTICE: DO NOT DISCARD THIS MANUAL

QUADRA-FIRE®

**EXPEDITION I WOOD INSERT
AUTOMATIC COMBUSTION
CONTROL (ACC)**

**MODEL NUMBER:
EXPEDITION-I**



Installation and service of this appliance should be performed by qualified personnel. Hearth & Home Technologies recommends HHT Factory Trained or NFI certified professionals.

hearthED
FACTORY TRAINING
Fuel Your Fire

NFI NATIONAL
FIREPLACE
INSTITUTE®
A CERTIFICATION AGENCY



WARNING



If the information in these instructions is not followed exactly, a fire may result causing property damage, personal injury, or death.

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- Do not over fire - If heater or chimney connector glows, you are over firing. Over firing will void your warranty.
- Comply with all minimum clearances to combustibles as specified.

Failure to comply may cause house fire.



WARNING



HOT SURFACES!

Glass and other surfaces are hot during operation AND cool down.

Hot glass and appliance will cause burns.

- Do not touch glass until it is cooled
- Use leather gloves when reloading fuel
- NEVER allow children to touch glass
- Keep children away
- CAREFULLY SUPERVISE children in same room as appliance.
- Alert children and adults to hazards of high temperatures
- High temperatures may ignite clothing or other flammable materials.
- Keep clothing, furniture, draperies and other flammable materials away.



WARNING



Fire Risk.

For use with solid wood fuel only.
Other fuels may over fire and generate poisonous gases (i.e. carbon monoxide).

NOTE: To obtain a French translation of this manual, please contact your dealer or visit www.quadrafire.com

REMARQUE : Pour obtenir une traduction française de ce manuel, s'il vous plaît contacter votre revendeur ou visitez www.quadrafire.com



Safety Alert Key:

- **DANGER!** Indicates a hazardous situation which, if not avoided will result in death or serious injury.
- **WARNING!** Indicates a hazardous situation which, if not avoided may result in death or serious injury.
- **CAUTION!** Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
- **NOTICE:** Indicates practices which may cause damage to the appliance or to property.

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➔ = Contains updated information

1 Important Safety Information

A. Appliance Certification

Model Number:	EXPEDITION-I
Laboratory:	OMNI Test Laboratories, Inc.
Report Number:	XXXXXXXXXX
Type:	Solid Fuel Type, Listed Room Heater
Standard:	UL1482-2011 and ULC S628-93 and (UM) 84-HUD, Mobile Home Approved.

This EXPEDITION-I is Certified to comply with 2020 crib wood particulate emission standards.



This wood appliance needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood appliance in a manner inconsistent with the operating instructions in the owner's manual.

NOTE: This installation must conform with local codes. In the absence of local codes you must comply with the **UL1482, (UM) 84-HUD and NPFA211 in the U.S.A. and the ULC S628-93 and CAN/CSA-B365 Installation Codes in Canada. NOT APPROVED FOR MOBILE HOME INSTALLATIONS IN CANADA!**

Approved for ZC fireboxes.

B. BTU & Efficiency Specifications

EPA Certification #:	Number: N/A
EPA Certified Emissions:	1.9 grams per hour
*LHV Tested Efficiency:	70%
**HHV Tested Efficiency:	65%
***EPA BTU Output:	23,800 to 27,400 / hr
****Peak BTU/Hour Output:	XX,XXX
Vent Size:	6 inches
Firebox Size:	1.45 cubic feet
Recommended Wood Length:	17 inches
Fuel	Seasoned Cord Wood

* Weighted average LHV (Low Heating Value) efficiency using Douglas Fir dimensional lumber and data collected during EPA emission tests in accordance with the requirements of CSA B415.1. LHV assumes the moisture is already in a vapor state so there is no loss in energy to vaporize.

** Weighted average HHV (High Heating Value) efficiency using Douglas Fir dimensional lumber and data collected during EPA emission tests in accordance with the requirements of CSA B415.1. HHV includes the energy required to vaporize the water in the fuel.

*** A range of BTU outputs calculated using HHV Efficiency and the burn rates from the EPA tests, using Douglas Fir dimensional lumber.

**** A peak BTU out of the appliance calculated using the maximum first hour burn rate from the High EPA Test and BTU content of seasoned cordwood (8600) times the efficiency.

C. Mobile Home Approved (USA only)

- This appliance is approved for mobile home installations when not installed in a sleeping room and when an outside combustion air inlet is provided.
- The structural integrity of the mobile home floor, ceiling, and walls must be maintained.
- The appliance must be properly grounded to the frame of the mobile home with #8 copper ground wire, and chimney must be listed to **UL103 HT** or a listed **UL-1777** full length six inch (152mm) diameter liner must be used.
- Outside Air Kit, part OAK-ACC must be installed in a mobile home installation.

D. Electrical Rating

Maximum 1.5 Amps (blower).

E. Glass Specifications

This appliance is equipped with 5mm ceramic glass. Replace glass only with 5mm ceramic glass. Please contact your dealer for replacement glass.

F. Non-Combustible Materials

Material which will not ignite and burn, composed of any combination of the following:

- Steel
- Plaster
- Brick
- Iron
- Concrete
- Tile
- Glass
- Slate

Materials reported as passing **ASTM E 136, Standard Test Method for Behavior of Metals, in a Vertical Tube Furnace of 750° C.**

G. Combustible Materials

Material made of/or surfaced with any of the following materials:


- Wood
- Compressed Paper
- Plant Fibers
- Plastic
- Plywood/OSB
- Sheet Rock (drywall)

Any material that can ignite and burn: flame proofed or not, plastered or non-plastered.

H. Sleeping Room

When an appliance is installed in a sleeping room an outside air kit is required and it is recommended that a smoke and/or CO alarm be installed in the bedroom. The size of the room must be at least 50ft³ per 1,000 Btu/hr stove input

I. California - Prop65

	WARNING
<p>This product and the fuels used to operate this product (wood), and the products of combustion of such fuels, can expose you to chemicals including carbon black, which is known to the State of California to cause cancer, and 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</p>	

	WARNING
	<p>Fire Risk. Hearth & Home Technologies disclaims any responsibility for, and the warranty will be voided by, the following actions:</p> <ul style="list-style-type: none">• Installation and use of any damaged appliance.• Modification of the appliance.• Installation other than as instructed by Hearth & Home Technologies.• Installation and/or use of any component part not approved by Hearth & Home Technologies.• Operating appliance without fully assembling all components.• Operating appliance without legs attached (if supplied with unit).• <u>Do NOT Over fire</u> - If appliance or chimney connector glows, you are over firing. <p>Any such action that may cause a fire hazard.</p>

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage.

For assistance or additional information, consult a qualified installer, service agency or your dealer.

<p>Hearth & Home Technologies WILL NOT warranty stoves that exhibit evidence of over-firing. Evidence of over-firing includes, but is not limited to:</p> <ul style="list-style-type: none">• Warped air tube• Deteriorated refractory brick retainers• Deteriorated baffle and other interior components

<p>NOTE: Hearth & Home Technologies, manufacturer of this appliance, reserves the right to alter its products, their specifications and/or price without notice.</p>

2 Getting Started

A. Design and Installation Considerations



CAUTION

Check building codes prior to installation.

- Installation **MUST** comply with local, regional, state and national codes and regulations.
- Consult insurance carrier, local building, fire officials or authorities having jurisdiction about restrictions, installation inspection, and permits.

Before installing, determine the following:

- Type of chimney connector to be used
 - Single wall, 6 inch (152mm) diameter, stainless steel, or
 - Double wall, 6 inch (152mm) diameter, stainless steel
- Reference **Clearance to Combustibles** on page 10.
- Power outlet located close by for optional blower



WARNING

Asphyxiation Risk.



- Do NOT connect this unit to a chimney flue servicing another appliance.
- Do NOT connect to any air distribution duct or system.

May allow flue gases to enter the house.

B. Draft

Draft is the pressure difference needed to vent appliances successfully. When a appliance is drafting successfully, all combustion byproducts are exiting the home through the chimney.

Considerations for successful draft include:

- Preventing negative pressure
- Location of appliance and chimney



To be sure that your appliance burns properly:

- During the burn, the chimney draft (static pressure) should be approximately -0.07 inch water column (W.C.)
- Measure the W.C at 6 inches (152mm) above the top of the appliance after one hour of operation.

NOTICE: Hearth & Home Technologies assumes no responsibility for the improper performance of the appliance system caused by:

- Inadequate draft due to environmental conditions
- Down drafts
- Tight sealing construction of the structure
- Mechanical exhausting devices
- Over drafting caused by excessive chimney heights
- Ideal performance is with height of chimney between 14-16 feet (4.26-4.88m) measured from the base of the appliance.

C. Negative Pressure

 WARNING	
	<p>Asphyxiation Risk.</p> <ul style="list-style-type: none">• Negative pressure can cause spillage of combustion fumes, soot and carbon monoxide.• Appliance needs to draft properly for safety.



Negative pressure results from the imbalance of air available for the appliance to operate properly. It can be strongest in lower levels of the house.

Causes include:

- Exhaust fans (kitchen, bath, etc.)
- Range hoods
- Combustion air requirements for furnaces, water heaters and other combustion appliances
- Clothes dryers
- Location of return-air vents to furnace or air conditioning
- Imbalances of the HVAC air handling system
- Upper level air leaks such as:
 - Recessed lighting
 - Attic hatch
 - Duct leaks

To minimize the effects of negative air pressure:

- Install the outside air kit with the intake facing prevailing winds during the heating season
- Ensure adequate outdoor air for all combustion appliances and exhaust equipment
- Ensure furnace and air conditioning return vents are not located in the immediate vicinity of the appliance
- Avoid installing the appliance near doors, walkways or small isolated spaces
- Recessed lighting should be a “sealed can” design
- Attic hatches weather stripped or sealed
- Attic mounted duct work and air handler joints and seams taped or sealed
- Basement installations should be avoided

 WARNING	
	<p>Fire Risk.</p> <p>Hearth & Home Technologies disclaims any responsibility for, and the warranty will be voided by, the following actions:</p> <ul style="list-style-type: none">• Installation and use of any damaged appliance.• Modification of the appliance.• Installation other than as instructed by Hearth & Home Technologies.• Installation and/or use of any component part not approved by Hearth & Home Technologies.• Operating appliance without fully assembling all components.• Operating appliance without legs attached (if supplied with unit).• Do NOT Over fire - If appliance or chimney connector glows, you are over firing. <p>Any such action that may cause a fire hazard.</p>



D. Tools And Supplies Needed

Before beginning the installation be sure the following tools and building supplies are available:

- Reciprocating saw
- Framing material
- Pliers
- High temp caulking material
- Hammer
- Gloves
- Phillips screwdriver
- Framing square
- Flat blade screwdriver
- Electric drill and bits
- Plumb line
- Safety glasses
- Level
- Tape measure
- Misc. screws and nails
- 7/16 socket or wrench
- 1/2-3/4 in. length, #6 or #8 self-drilling screws

E. Inspect Appliance and Components

- Remove appliance and components from packaging and inspect for damage.
- Vent system components and doors are shipped in separate packages.
- Report to your dealer any parts damaged in shipment.
- Read all the instructions before starting the installation. Follow these instructions carefully during the installation to ensure maximum safety and benefit.

 WARNING	
	<p>Fire Risk.</p> <p>Inspect appliance and components for damage. Damaged parts may impair safe operation.</p> <ul style="list-style-type: none">• Do NOT install damaged components.• Do NOT install incomplete components.• Do NOT install substitute components. <p>Report damaged parts to dealer.</p>

F. Install Checklist

ATTENTION INSTALLER: Follow this Standard Work Checklist

This standard work checklist is to be used by the installer in conjunction with, not instead of, the instructions contained in this installation manual.

Customer: _____
 Date Installed: _____
 Lot / Address: _____
 Location of Appliance: _____
 Installer: _____
 Dealer / Distributor Phone #: _____
 Serial #: _____
 Model: _____

WARNING! Risk of Fire or Explosion! Failure to install appliance according to these instructions can lead to a fire or explosion.

Appliance Install

Verified clearances to combustibles.
 Appliance is leveled and connector is secured to appliance.
 Hearth extension size/height decided.
 Outside air kit installed.
 Floor protection requirements have been met.
 If appliance is connected to a masonry chimney, it should be cleaned and inspected by a professional. If installed to a factory built metal chimney, the chimney must be installed according to the manufacturer's instructions and clearances.

YES	IF NO, WHY?
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____

Chimney

Chimney configuration complies with diagrams.
 Chimney installed, locked and secured in place with proper clearance.
 Chimney meets recommended height requirements (14-16 feet).
 Roof flashing installed and sealed.
 Terminations installed and sealed.

<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____

Clearances

Combustible materials not installed in non-combustible areas.
 Verified all clearances meet installation manual requirements.
 Mantels and wall projections comply with installation manual requirements.
 Protective hearth strips and hearth extension installed per manual requirements.

<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____

Appliance Setup

All packaging and protective materials removed.
 Firebrick, baffle and ceramic blanket installed correctly.
 All labels have been removed from the door.
 All packaging materials are removed from inside/under the appliance.
 Manual bag and all of its contents are removed from inside/under the appliance and given to the party responsible for use and operation.

<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____

Hearth & Home Technologies recommends the following:

- Photographing the installation and copying this checklist for your file.
- That this checklist remain visible at all times on the appliance until the installation is complete.

Comments: Further description of the issues, who is responsible (Installer/Builder/Other Trades, etc.) and corrective action needed:
 Comments communicated to party responsible _____ by _____ on _____
(Builder / Gen. Contractor) (Installer) (Date)

3 Dimensions and Clearances

A. Dimensions

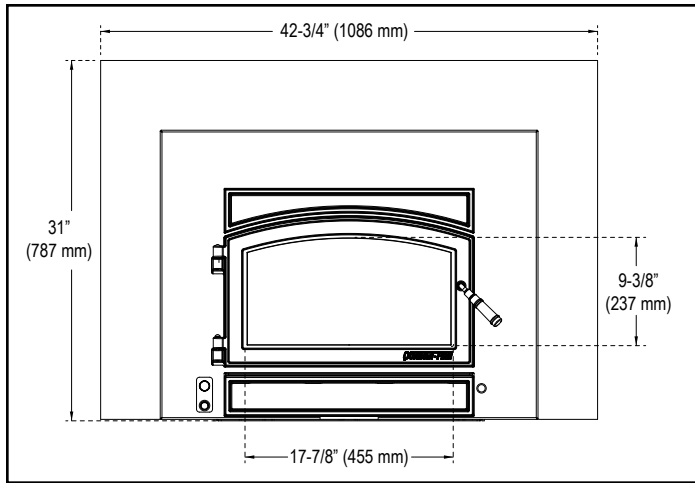


Figure 8.1 - Top View with Flat Surround

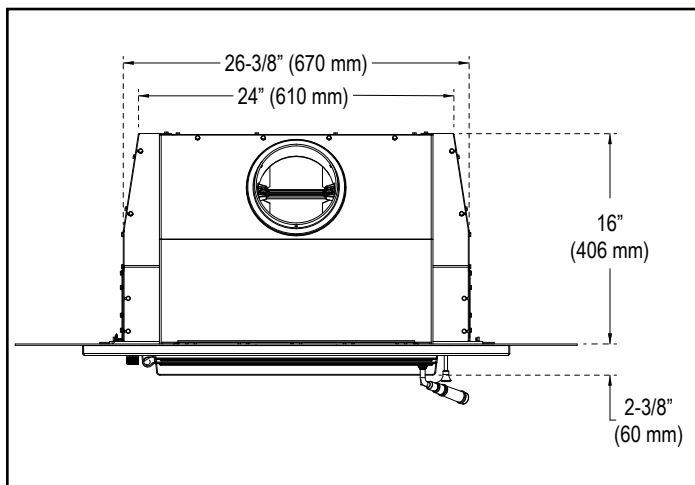


Figure 8.2 - Front View with Small Flat Surround (SP2-4331)

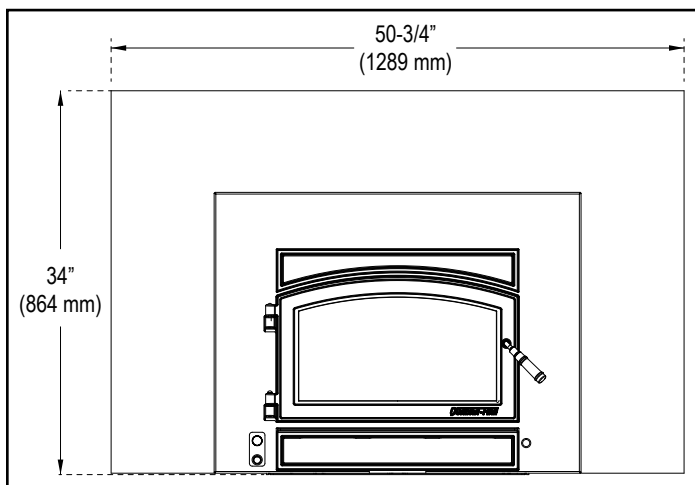


Figure 8.3 - Front View with Large Flat Surround (SP2-5134)

NOTE: Flue Collar size is 6 inch (152mm) diameter (ID)

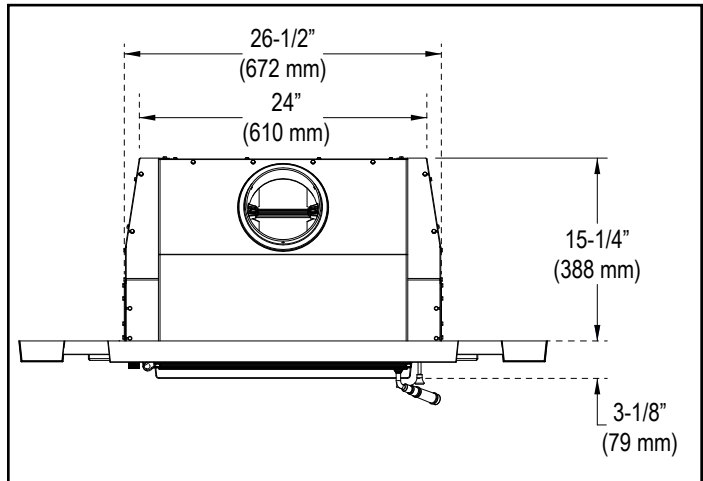


Figure 8.4 - Top View with Cast Surround

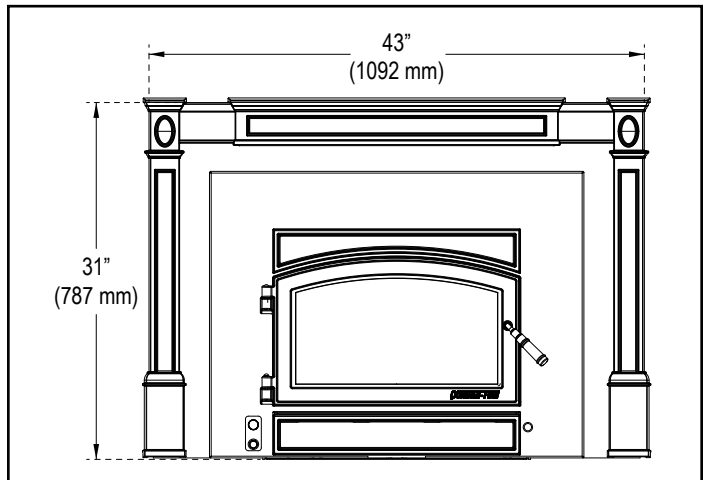


Figure 8.5 - Front View with Small Flat Surround with Cast Trim (CT2-4331)

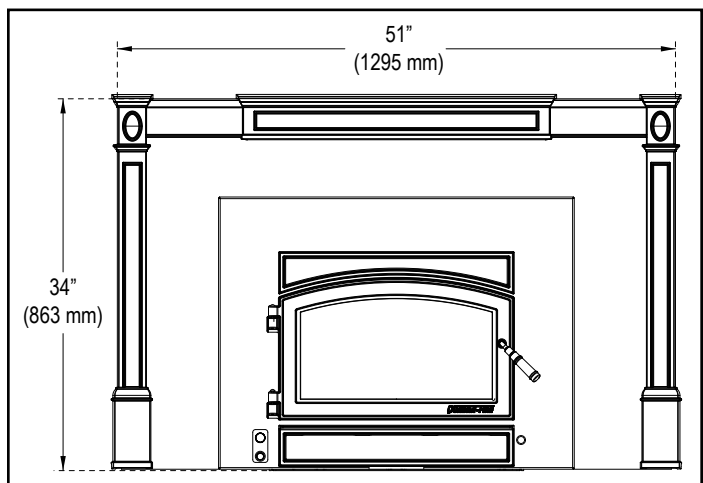


Figure 8.6 - Front View with Large Flat Surround with Cast Trim (CT2-5134)

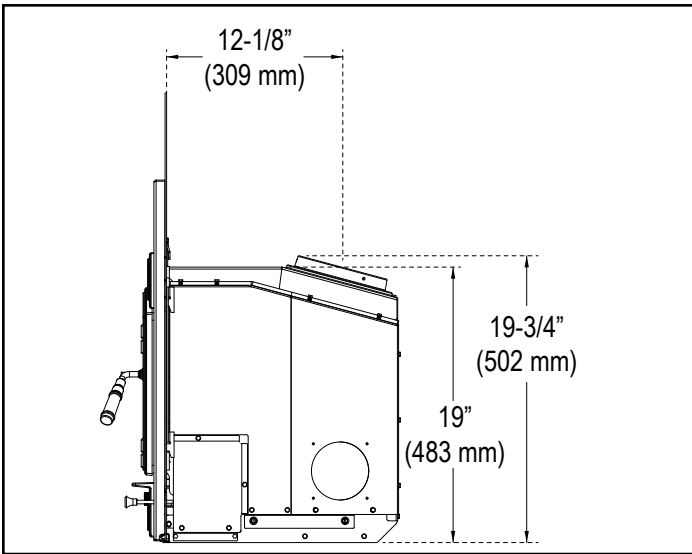


Figure 9.1 - Side View with Flat Surround

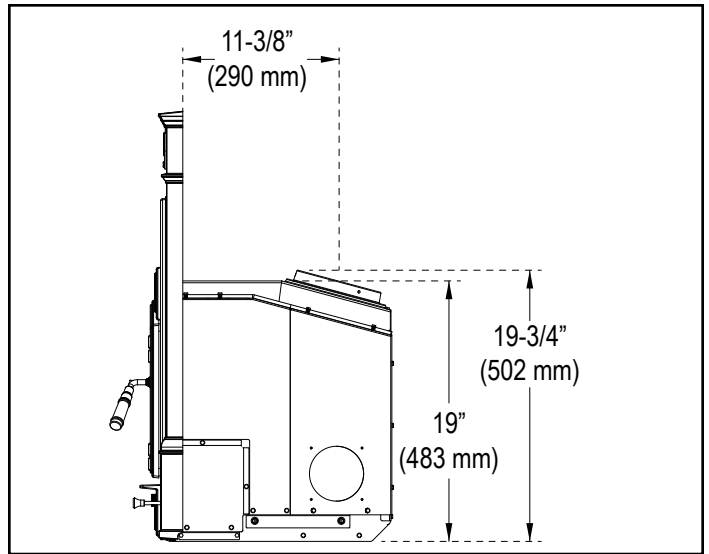


Figure 9.4 - Side View with Cast Surround

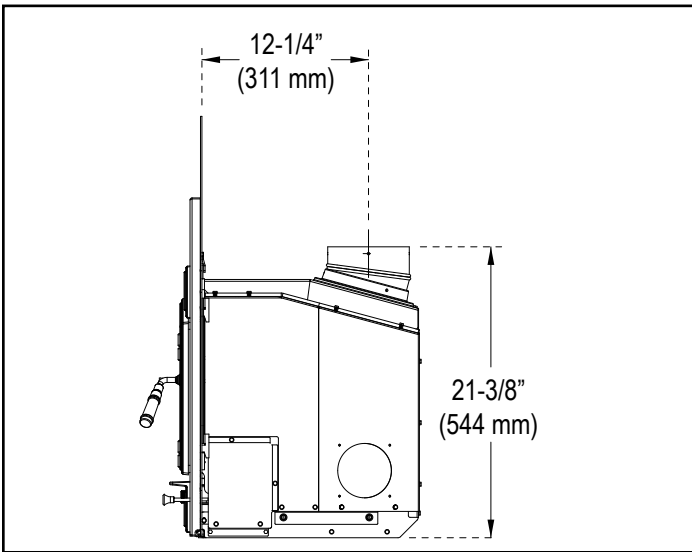


Figure 9.2 - Side View with Flat Surround and Optional 15 Degree Adapter (DV-6DLR-E15ADSS)

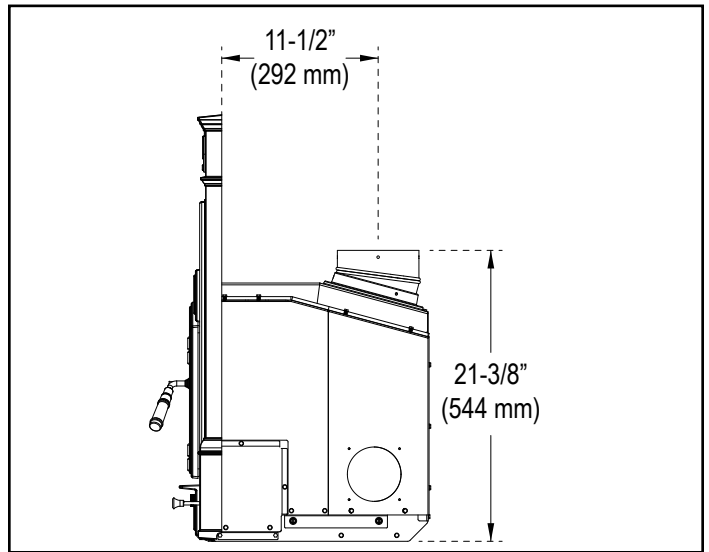


Figure 9.5 - Side View with Cast Surround and Optional 15 Degree Adapter (DV-6DLR-E15ADSS)

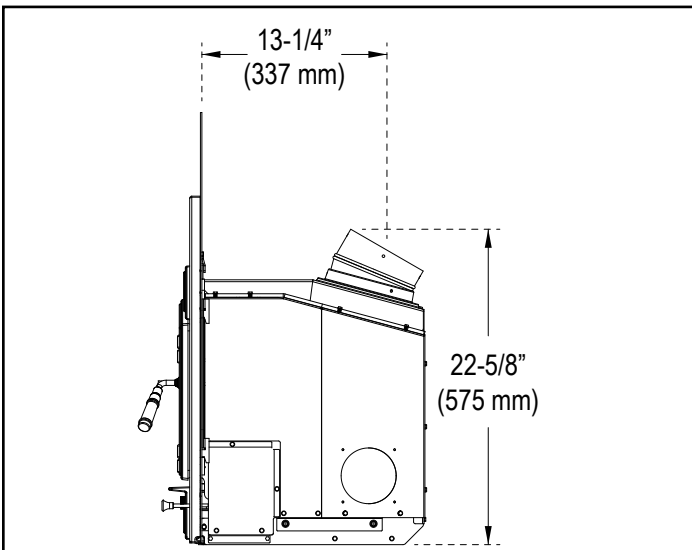


Figure 9.3 - Side View with Flat Surround and Optional 15 Degree Adapter (DV-6DLR-E15ADSS)

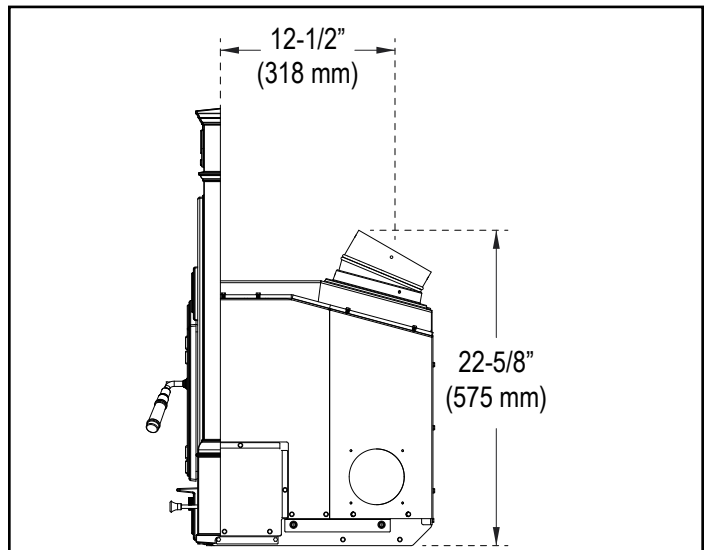


Figure 9.6 - Side View with Cast Surround and Optional 15 Degree Adapter (DV-6DLR-E15ADSS)

B. Clearances to Combustibles

In Canada a full length 6 inch (152mm) S635 flue liner required as per ULC S628.

In USA a minimum 5 ft length (1.82m), 6 inch (152mm) diameter flue liner is required as per UL 1482.

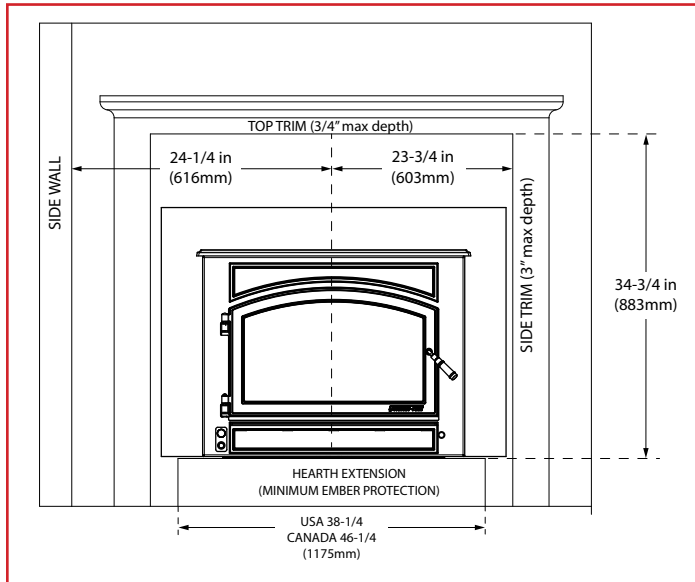


Figure 10.1

NOTE: If trim measurement is over 3/4 in (19mm) in depth use mantle or side clearances to combustibles.

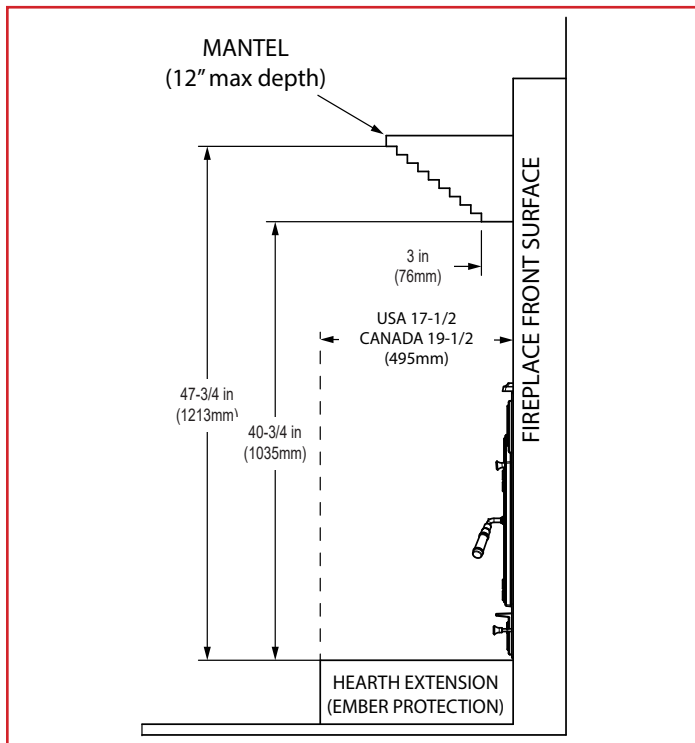


Figure 10.2

To calculate mantel height requirement, multiply the depth of the mantel by 0.78 inches then add 38.375 inches to the total.

United States and Canada (UL and ULC)

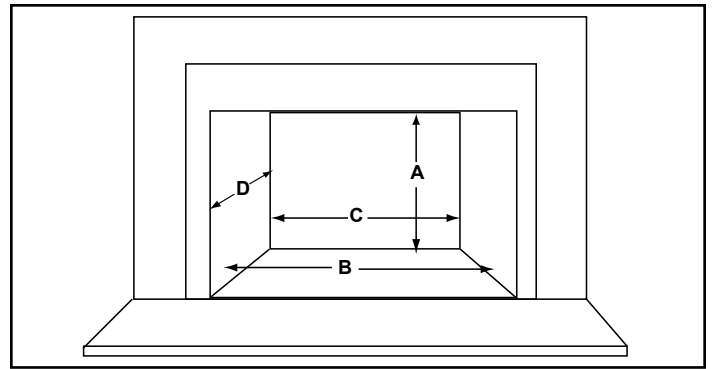


Figure 10.3

Minimum Opening Dimensions		Inches	Millimeters
A	Height	19-1/4	489
B	Front Width (Steel Surround)	27	686
	Front Width (Cast Surround)	27	686
C	Back Width	24-1/2	622
D	Depth (Steel Surround)	16	406
	Depth (Cast Surround)	15-1/4	387

Table 10.1

NOTE: Minimum opening dimensions include a 1/4 inch (6mm) clearance around unit.

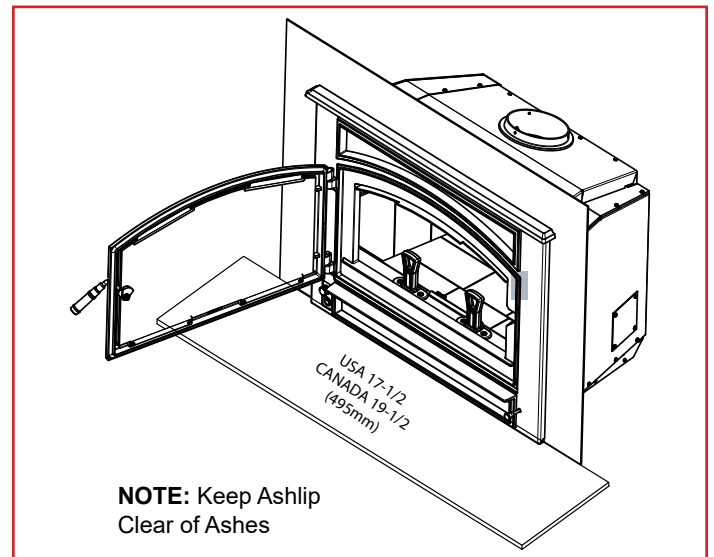


Figure 10.4

NOTE: Clearances may only be reduced by means approved by the regulatory authority having jurisdiction



WARNING



Fire Risk.

- Comply with all minimum clearances to combustibles as specified.
- Failure to comply may cause house fire.



WARNING



Fire Risk.

- Comply with all minimum clearances to combustibles as specified.
- Failure to comply may cause house fire.

NOTE: Clearances may only be reduced by means approved by the regulatory authority having jurisdiction

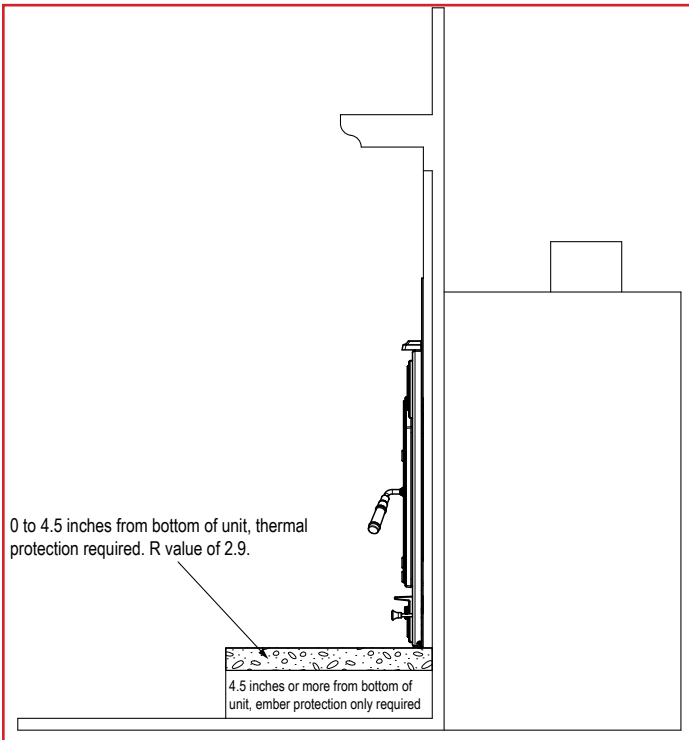


Figure 11.1

NOTE: Hearth Rug may be used in Suggested Area

Material

Thermal Resistance: R value

The R value is a measure of a material's resistance to heat transfer.

R value is convenient when more than one material is used since you can add the R values together, whereas you can not do this for k value.

The HIGHER the R factor means less heat is being conducted through the non-combustible material to the combustible material beneath it.

The R value of a material must be equal or larger then the required R value to be acceptable.

4 Chimney Systems

A. Locating Your Stove & Chimney

Location of the appliance and chimney will affect performance. As shown in **Figure 12.1** the chimney should:

- Install through the warm space enclosed by the building envelope. This helps to produce more draft, especially during lighting and die down of the fire.
- Penetrate the highest part of the roof. This minimizes the affects of wind turbulence and down drafts.
- Consider the appliance location in order to avoid floor and ceiling attic joists and rafters.
- Locate termination cap away from trees, adjacent structures, uneven roof lines and other obstructions.

Your local dealer is the expert in your geographic area and can usually make suggestions or discover solutions that will easily correct your flue problem.

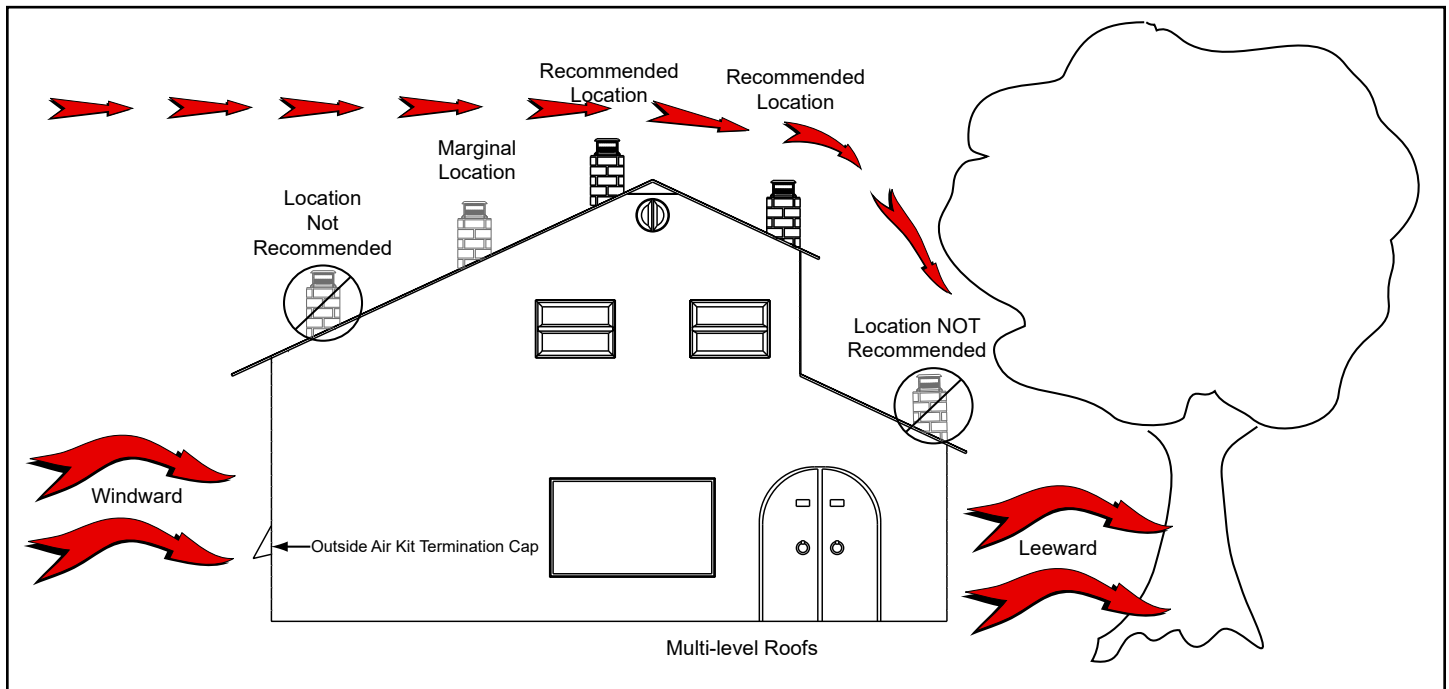


Figure 12.1

B. Chimney Termination Requirements

Follow manufacturer's instructions for clearance, securing flashing and terminating the chimney (**Figure 13.1** and **Figure 13.2**).

- Must have an approved and Listed cap
- Must not be located where it will become plugged by snow or other material
- Must terminate at least 3 feet (91cm) above the roof **and** at least 2 feet (61cm) above any portion of the roof within 10 feet (305cm).
- Must be located away from trees or other structures

NOTICE:

- Chimney performance may vary.
- Trees, buildings, roof lines and wind conditions affect performance.
- Chimney height may need adjustment if smoking or overdraft occurs.

NOTICE: Locating the appliance in a basement or in a location of considerable air movement can cause intermittent smoke spillage from appliance. Do not locate appliance near

- Frequently open doors
- Central heat outlets or returns

C. 2-10-3 Rule

These are safety requirements and are not meant to assure proper flue draft.

This appliance is made with a 6 inch (152mm) diameter chimney connector as the flue collar on the unit.

- Changing the diameter of the chimney can affect draft and cause poor performance.
- It is not recommended to use offsets and elbows at altitudes above 4000 feet above sea level and or when there are other factors that affect flue draft.

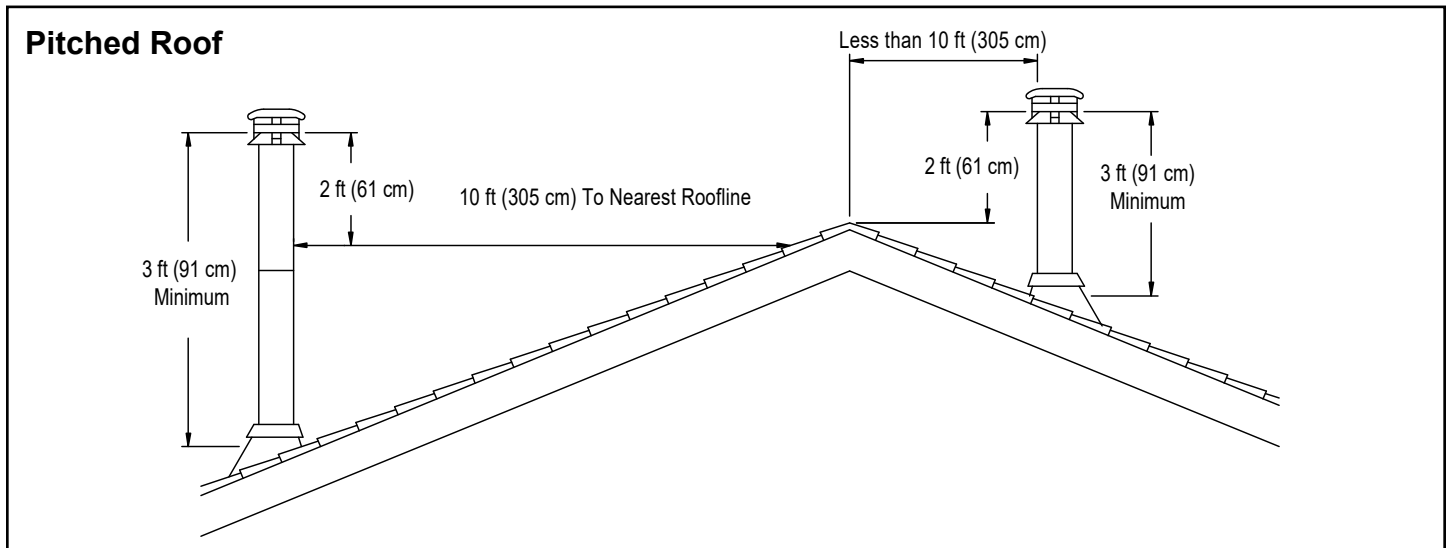


Figure 13.1

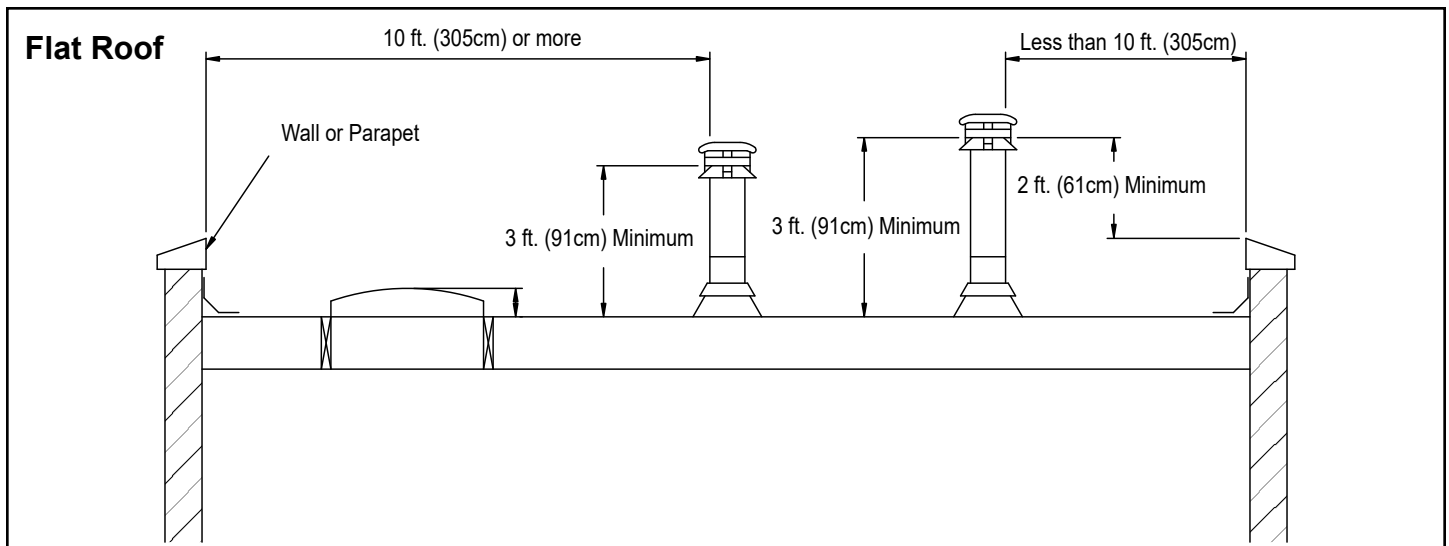


Figure 13.2



D. Venting Systems

Chimney Connector - It is also known as flue pipe or stove pipe. It must be 6 inches (152mm) minimum diameter stainless steel connector pipe.

Chimney - The chimney can be new or existing, masonry or prefabricated and must meet the following minimum requirements as specified below.



In Canada a full length 6 inch (152mm) S635 flue liner required as per ULC S628.

In USA a minimum 5 ft length (1.82m), 6 inch (152mm) diameter flue liner is required as per UL 1482.

 WARNING	
	Risk of Fire!
	Follow venting manufacturer's clearances and instructions when installing venting system.

E. Inspections



Existing chimneys should be inspected and cleaned by a qualified professional prior to installation. The chimney must not have cracks, loose mortar or other signs of deterioration and blockage. Hearth & Home recommends a **NFI or CSIA certified** professional or a technician, under the direction of a certified professional, conduct a Level II inspection per **NFPA 211**.


 WARNING	
	Fire Risk
	Inspection of Chimney: <ul style="list-style-type: none">• Chimney must be in good condition.• Meets minimum standard of NFPA 211• Factory-built chimney must be 6 inch (152mm) UL103 HT.

F. Chimney Height / Rise and Run

This product was designed for and tested on a 6 inch (152mm) chimney, 14 to 16 feet (420-480cm) high, (includes appliance height) measured from the base of the appliance. The further your stack height or diameter varies from this configuration, the greater the likelihood it may affect performance.

Chimney height may need to be increased by 2 - 3% per each 1000 feet above sea level. It is not recommended to use offsets or elbows at altitudes above 4000 feet above sea level or when there are other factors that affect flue draft.

 WARNING	
	Asphyxiation Risk.
	<ul style="list-style-type: none">• DO NOT CONNECT THIS Appliance TO A CHIMNEY FLUE SERVICING ANOTHER APPLIANCE.• DO NOT CONNECT TO ANY AIR DISTRIBUTION DUCT OR SYSTEM.
	May allow flue gases to enter the house.

 WARNING	
Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to the owner's information manual provided with this appliance. For assistance or additional information consult a qualified installer, service agency or your dealer.	

G. Securing Chimney Components

All joints should be secured with 3 sheet metal screws or rivets per pipe manufacturers instructions. The sections must be attached to the insert and to each other with the crimped (male) end pointing toward the insert (**Figure 14.1**).

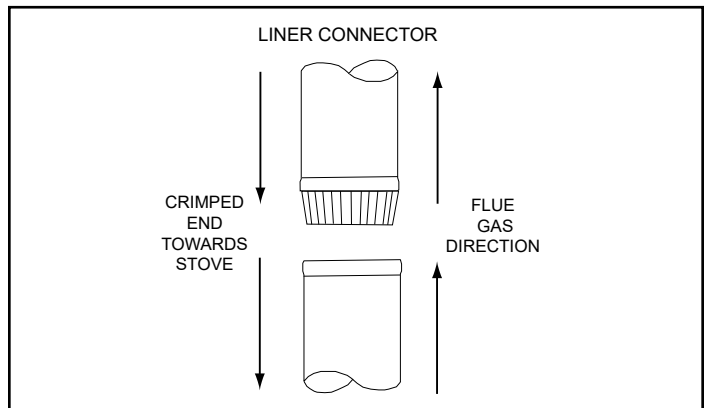




Figure 14.1

 WARNING	
	Fire Risk.
	Follow venting manufacturer's clearances and instructions when installing venting system.

H. Larger Chimneys

It is recommended that chimneys with larger diameters than 6 inches (152mm) be relined. An oversized flue can affect draft and impair performance and will allow increased build-up of creosote.

NOTICE: Check with your local building authorities and/or consult the **National Fire Protection Association (NFPA 211)**.

I. Masonry Chimney

This insert conforms with the **UL 1482 and ULC S628 (Canada)** in all respects, and is approved to **UL & ULC safety standards** for installation and use within a fireplace with a masonry chimney in accordance with **NFPA 211 and CAN/CSA-B365-01**.

- Must meet minimum standards of **NFPA 211**.
- Must have at least 5/8 inch (16mm) fire clay lining joined with refractory cement (Installations into a clay flue without a stainless steel liner may reduce draw which affects performance, will cause the glass to darken and produce excessive creosote).
- The masonry wall of the chimney, if brick or modular block, must be a minimum of 4 inches (102mm) nominal thickness.
- A chimney of rubble stone must be at least 12 inches (305mm) thick.

- Cross-sectional area shall conform to **NFPA 211-2006 Section 12.4.5.1**.
- Should be lined with a 6 inch (152mm) stainless steel flue liner to improve performance and reduce creosote build-up.
- An equivalent liner must be a listed chimney liner system or other approved material.
- No dilution air is allowed to enter the chimney.
 - a. Secure the fireplace damper in the open position. If this cannot be accomplished, it will be necessary to remove the damper
 - b. Seal damper area of chimney around chimney connector with a high temperature sealant or seal insert against the face of the fireplace.
 - c. Both methods must be removable and replaceable for cleaning and re-installation.
- When possible, install an airtight clean-out door to the rear of the smoke shelf.

NOTE: In Canada, this fireplace insert must be installed with a continuous chimney liner of a 6 inch (152mm) diameter extending from the fireplace insert to the top of the chimney. **The chimney liner must conform to the Class 3 requirements of CAN/ULC-S635, Standard for Lining Systems for Existing Masonry or Factory-Built Chimneys and Vents, or CAN/ULC-S640, Standard for Lining Systems for New Masonry Chimneys.**

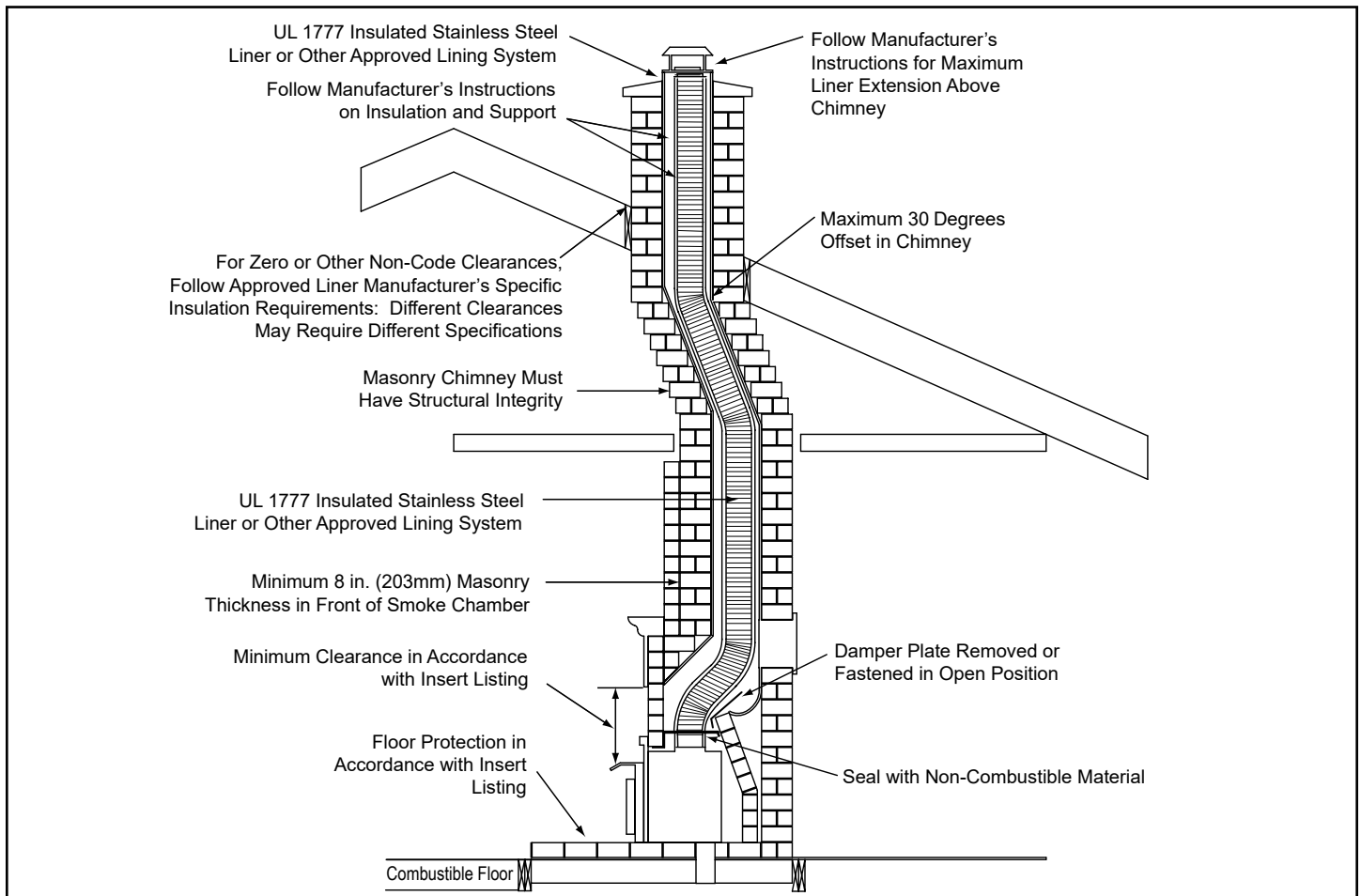


Figure 15.1 - Generic Insert Model Shown in Illustration

J. Metal Heat Circulating Masonry

This insert conforms with the safety standard **UL-1482 and ULC S628 (Canada)** in all respects and is approved to **UL & ULC safety standards** for installation and use within a fireplace with masonry chimney, in accordance with **NFPA 211**, with a direct flue collar connection.

K. Prefabricated Metal Chimney

The chimney can be new or existing, masonry or prefabricated and must meet the following minimum requirements:

- Must be minimum 6 inch (152mm) inside diameter of high temperature chimney listed to **UL 103 HT (2100°F) or ULC S628**.
- Must use components required by the manufacturer for installation.
- Must maintain clearances required by the manufacturer for installation.
- Refer to manufacturers instructions for installation
- This insert is listed to **UL 1482 Standard** and is approved for installation into listed factory-built zero clearance fireplaces listed to **UL 127** conforming to the following specifications and instructions:
- The original factory-built clearance fireplace chimney cap must be re-installed after installing the approved chimney liner meeting type **UL 103 HT** requirements (2100°F) per **UL 1777**.
- If the chimney is not listed as meeting HT requirements, or if the factory built fireplace was tested prior to 1998, a full height listed chimney liner must be installed from the appliance flue collar to the chimney top.
- The liner must be securely attached to the insert flue collar and the chimney top.
- The air flow of the factory-built zero-clearance fireplace system must not be altered. The flue liner top support attachment must not reduce the air flow for the existing air-cooled chimney system.


NOTE: Refer to chimney liner manufacturer for recommendations on supporting the liner. Installation into fireplaces without a permit will void the listing.

- No dilution air is allowed to enter the chimney.
 - a. Secure the fireplace damper in the open position. If this cannot be accomplished, it will be necessary to remove the damper.
 - b. Seal damper area of chimney around chimney connector with a high temperature sealant or seal insert against the face of the fireplace.
 - c. Both methods must be removable and replaceable for cleaning and re-installation.

Minimum Opening Dimensions		Inches	Millimeters
A	Height	23-3/8	594
B	Front Width (Steel Surround)	32	813
	Front Width (Cast Surround)	32	813
C	Back Width	23-7/8	606
D	Depth (Steel Surround)	18-1/4	464
	Depth (Cast Surround)	17-1/2	445

Table 16.1

NOTICE: In Canada when using a factory-built chimney it must be safety listed, **Type UL103 HT (2100°F) [1149°C] CLASS "A" or conforming to CAN/ULC-S629M, STANDARD FOR 650°C FACTORY-BUILT CHIMNEYS.**



WARNING

Fire Risk.
When lining air-cooled factory-built chimneys:

- Run chimney liner approved to **UL 1777 Type HT requirements (2100°F)**
- Re-install original factory built chimney cap **ONLY**.
- **DO NOT** block cooling air openings in chimney.
- Blocking cooling air will overheat the chimney.

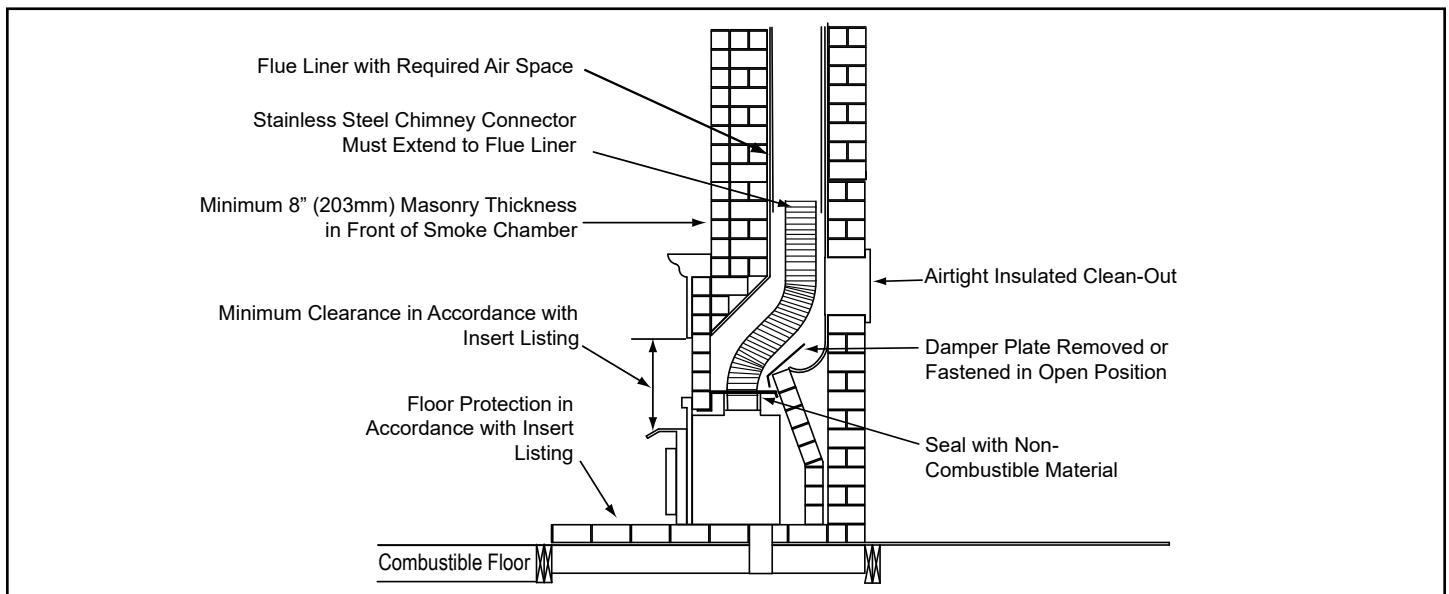


Figure 16.1 - Generic Insert Model Shown in Illustration

L. Ovalizing Round Stainless Steel Liners

Ovalizing round stainless steel liners to accommodate the liner passing through the damper region of a fireplace is an allowable and acceptable practice.

Ensure that the ovalization is minimized to the extent required to fit through the damper.

M. Altering the Fireplace

The following modifications of factory-built fireplaces are permissible:

The following parts may be removed:	
Damper	Smoke Shelf or Baffle
Ember Catches	Fire Grate
Viewing Screen/Curtain	Doors

Table 17.1

- The fireplace must not be altered. Cutting any sheet metal parts of the fireplace in which the fireplace insert is to be installed is prohibited per **ANSI Z21.88** except that the damper may be removed to accommodate a direct-connect starter pipe or chimney liner,
- External trim pieces which do not affect the operation of the fireplace may be removed providing they can be stored on or within the fireplace for reassembly if the insert is removed.
- The permanent metal warning label provided in the component pack must be attached to the back of the fireplace, with screws or nails, stating that the fireplace may have been altered to accommodate the insert, and must be returned to original condition for use as a conventional fireplace (**Figure 17.1**).
- If the hearth extension is lower than the fireplace opening, the portion of the insert extending onto the hearth must be supported.
- Manufacturer designed adjustable support kit can be ordered from your dealer.
- Final approval of this installation type is contingent upon the authority having jurisdiction.

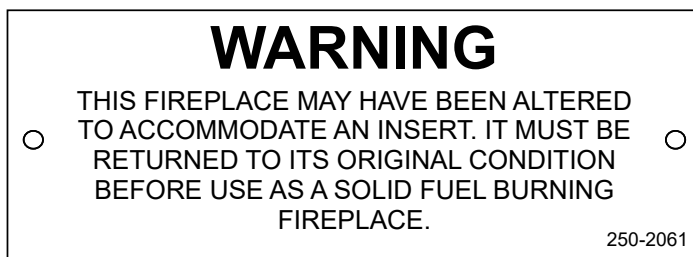


Figure 17.1

N. Zero-Clearance Fireplace

A permit may be required for installations, final approval is contingent of the authority having local jurisdiction. Consult insurance carrier, local building, fire officials or authorities having jurisdiction about restrictions, installation inspection, and permits.

Inspect the existing fireplace and chimney for any damage or flaws such as burnouts, metal or refractory warping.

Inspection to a minimum of **NFPA 211 Level II** is recommended. All repairs must be made prior to installing an insert. The fireplace must be structurally sound and be able to support the weight of the solid-fuel insert

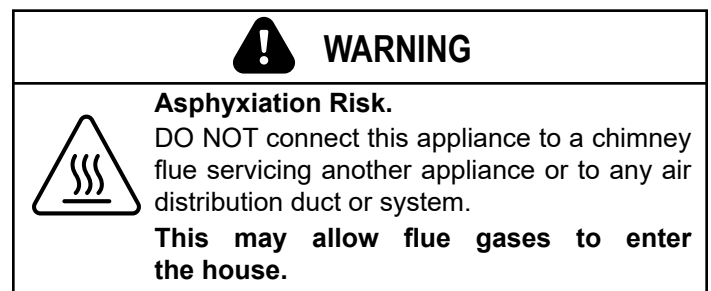
The factory-built chimney must be listed per **UL 127 or ULC 610-M87** for all installations. Install thermal protection per this appliance listing requirements.

A full height 6 inch diameter stainless steel full height listed chimney liner must be installed meeting type **HT (2100°F) requirements per UL 1777 (USA) or ULC S635** with "0" clearance to masonry (Canada). The full liner must be attached to the insert flue collar and to the top of the existing chimney.

The flue liner top support attachment must not reduce the air flow for the existing air-cooled chimney system. Re-install original factory-built chimney cap only; see section on **Prefabricated Metal Chimney** on [page 16](#).

To prevent room air passage to the chimney cavity of the fireplace, seal either the damper area around the chimney liner or the insert surround. Circulating air chamber (i.e. in a steel fireplace liner or metal hearth circulatory) may not be blocked. The air flow within and around the fireplace shall not be altered, blocked by the installation of the insert. (i.e. no louvers or cooling air inlet or outlet ports may be blocked by the insert or the insert surround.

See **Altering the Fireplace** on [page 17](#) for modifications allowed for factory-built fireplaces.






5 Appliance Set-Up

A. Outside Air Kit

A source of air (oxygen) is necessary in order for combustion to take place. Whatever combustion air is consumed by the fire must be replaced. Air is replaced via air leakage around windows and under doors. In homes that have tightly sealed doors and windows, an outside air source is needed.

Installation Instructions

1. Ensure existing access hole in fireplace will not be covered by the outer can. Existing outside air intake hole may be under, at the rear, or side of outer can. Outside air may also enter down existing chimney chase in some situations.
2. Remove screws holding outer covers in place on both sides. Place outside air plates in channel as shown (outside air plates are located in component pack). Re-install outer covers. (Figure 18.2)
3. Level outer can and install appliance. After installing the appliance in the outer can, seal the fireplace opening and trim package with insulation to prevent air leakage into the room.

 WARNING	
	Fire Risk. Asphyxiation Risk.
	Do not draw outside combustion air from: <ul style="list-style-type: none"> • Wall, floor or ceiling cavity • Enclosed space such as an attic or garage • Close proximity to exhaust vents or chimneys
	Fumes or odor may result

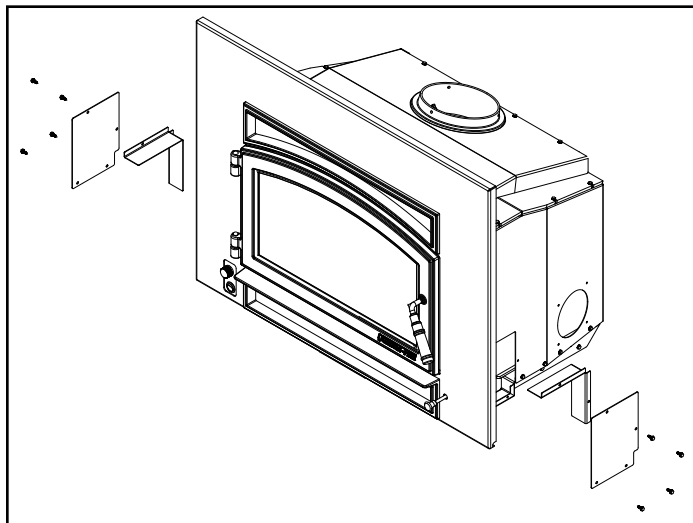


Figure 18.1

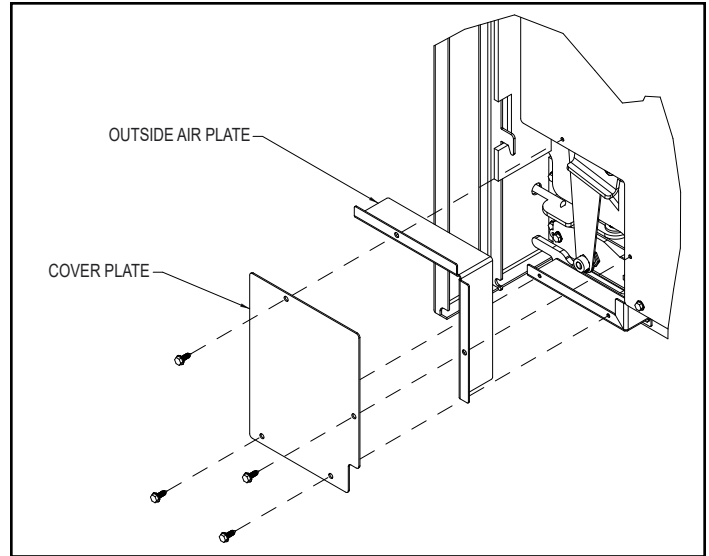






Figure 18.2

 WARNING	
	Asphyxiation Risk.
	Outside air inlet must be located to prevent blockage from: <ul style="list-style-type: none"> • Leaves • Snow or ice • Other debris
Blockage may cause combustion air starvation. Smoke spillage may set off alarms or irritate sensitive individuals.	

 WARNING	
	Asphyxiation Risk.
	Length of outside air supply duct shall NOT exceed the length of the vertical height of the exhaust flue. <ul style="list-style-type: none"> • Fire will not burn properly • Smoke spillage occurs when door is opened due to air starvation.

B. Stove Pipe or Liner to Flue Collar

1. There are 4 already drilled holes in the flue collar 90 degrees apart. Attach the flue collar to the stove pipe/liner. If the seal is questionable use high temperature sealant such as stove mastic (**Figure 19.1**).
2. Attach gasket to bottom side of flue collar with a thin coat of silicone.

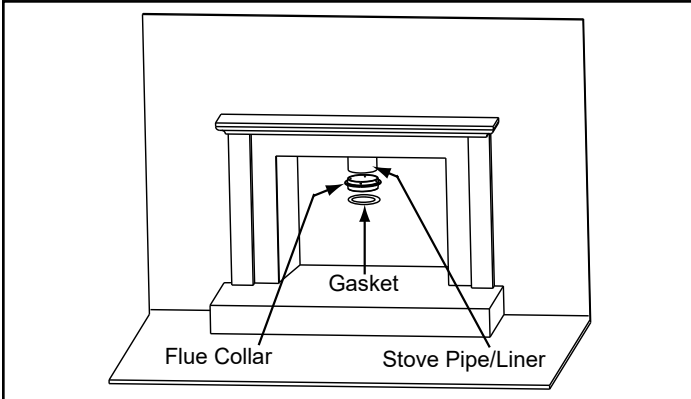


Figure 19.1

C. Optional Offset Adapter

Optional use of a Simpson DuraVent 15° Universal Elbow Part Number 4615 may be purchased directly through your local Simpson DuraVent Pipe Distributor or from your local Quadra-Fire dealer, Part Number DV-6DLR-E15ADSS.

Figure 19.2 shows a vertical installation and also how to create an optional 30° elbow installation.

The 15° elbow may be secured directly to the flue collar. Follow the pipe manufacturer's instructions for using screws or rivets for attachment. Most pipe manufacturer's 6 inch (152mm) diameter flue liners may be attached directly to the top of the 15° elbow.

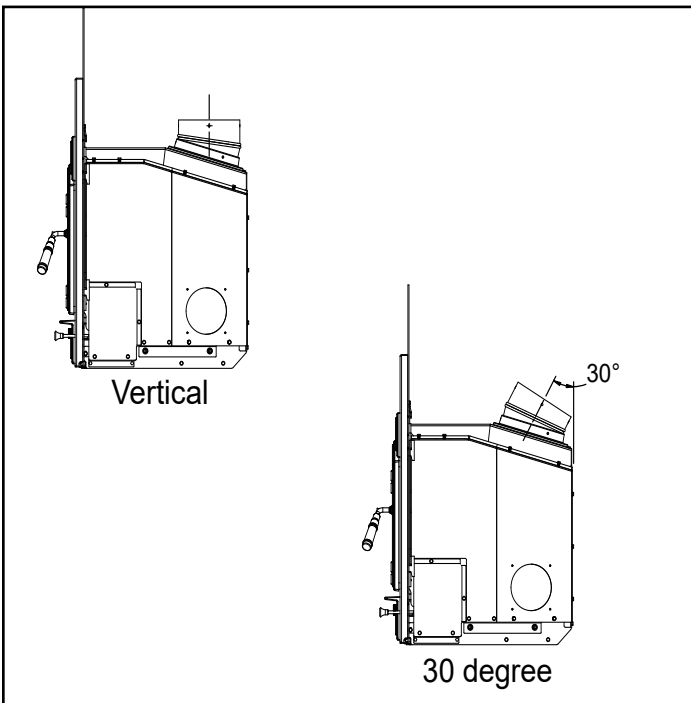


Figure 19.2

D. Appliance to Stove Pipe or Liner

1. Once you have the appliance in place and secured, reach up through the flue opening and grab the attachment bar and pull down inside flue opening (**Figure 19.3**).
2. Insert the 5/16 bolts inside the cast flue and through the chimney mounting bar. Securely tighten the nuts; fasteners are provided.
3. Re-install the tube channel assembly, baffle board, ceramic blanket and baffle protection channel.

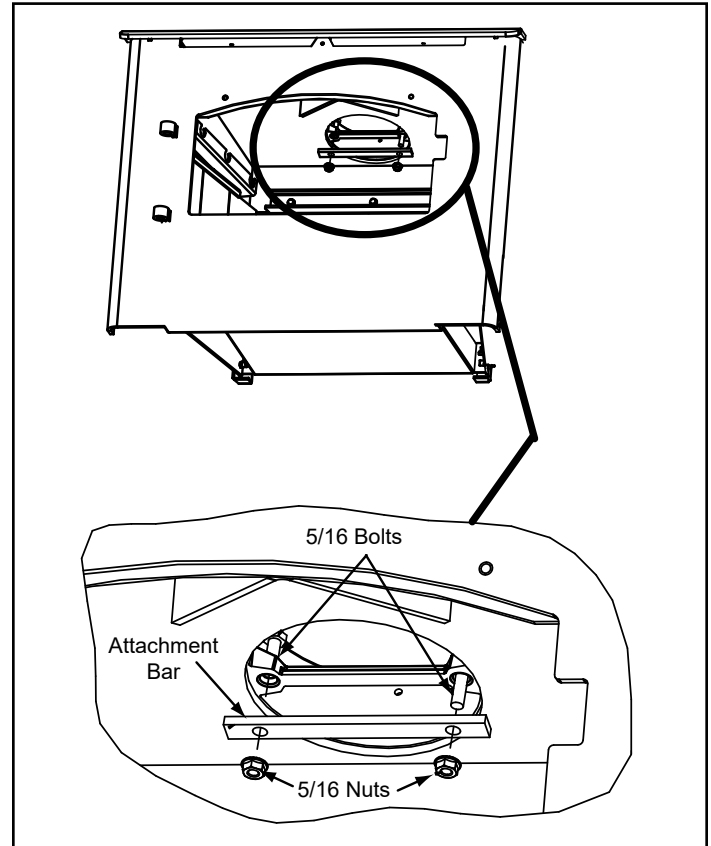


Figure 19.3

NOTE: These are generic drawings and may not represent your specific model.

E. Power Cord

The power cord is shipped assembled to the appliance. You may route the power cord either to the left or right side depending on your configuration for power source (**Figure 20.1**).

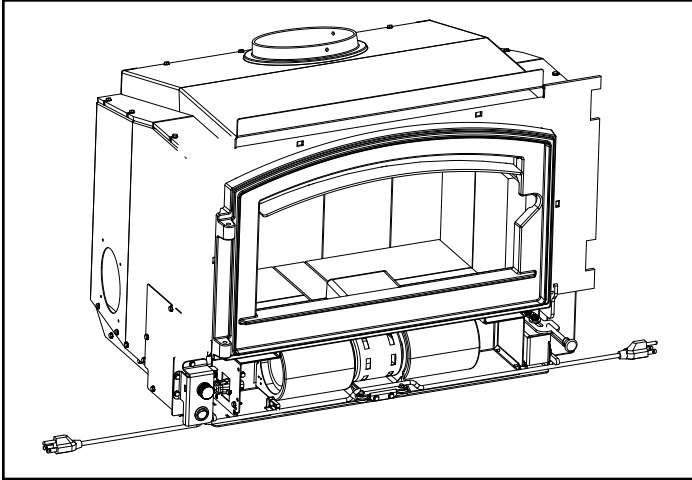


Figure 20.1

F. Flat Surround

	Overall Dimensions	Part Number
Standard Size	43" x 31"	SP1-4331
Large Size	51" x 34"	SP1-5134

1. Lay surround face down on a protected surface to prevent scratching.
2. Remove door from front of appliance and set aside laying it onto a protective surface (**Figure 20.2**).
3. Remove face from front of appliance and set aside laying it onto a protective surface (**Figure 20.2**).
4. Lift surround to front of appliance (**Figure 20.3**).
5. Reinstall face to front of appliance and then the door.

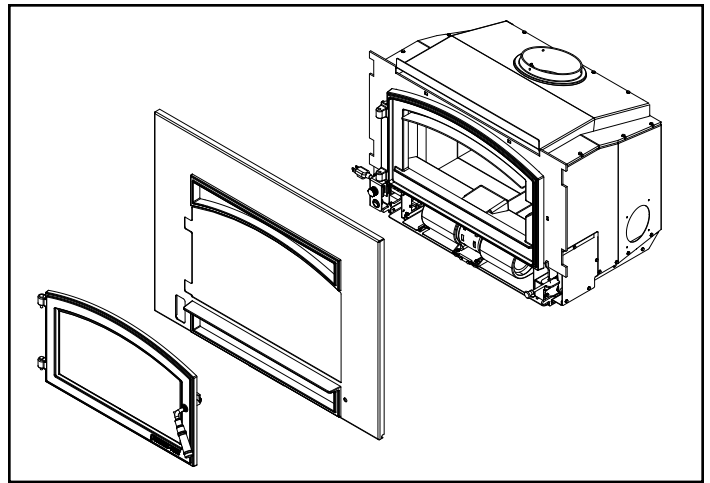


Figure 20.2

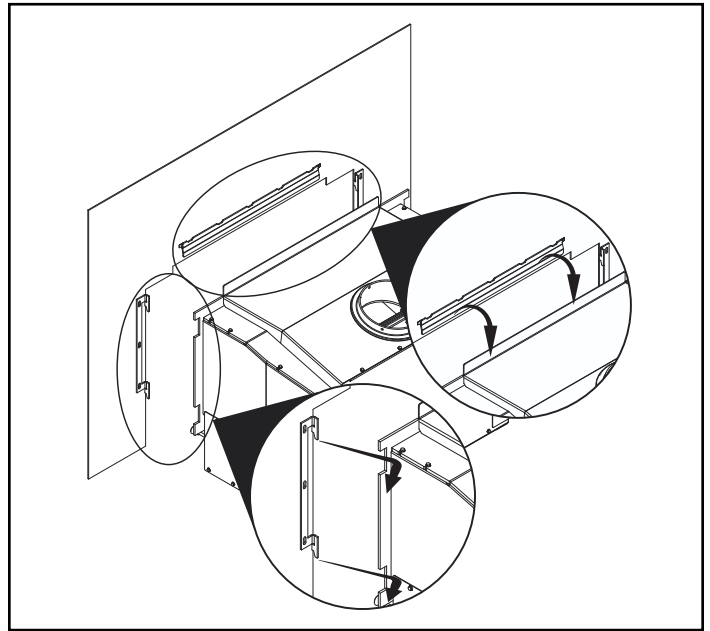


Figure 20.3

G. Flat Surround with Trim Kit

	Overall Dimensions	Part Number	Trim Kit
Standard Size	43" x 31"	SP1-4331	TRIMKIT-4331-NL
Large Size	51" x 34"	SP1-5134	TRIMKIT-5134-NL

1. Follow steps one through three of **Flat Surround** installation on [page 20](#).
2. Lift surround assembly to front of appliance (**Figure 20.3** on [page 20](#)).
3. Assemble trim as shown in **Figure 21.1**.

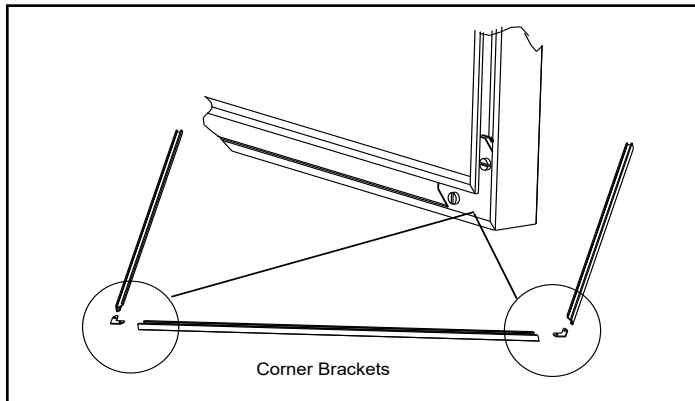


Figure 21.1

4. Slide trim over flat surround as shown in **Figure 21.2**.

NOTE: May need to pull appliance away from fireplace to clear mantle as you slide the trim over the flat surround.

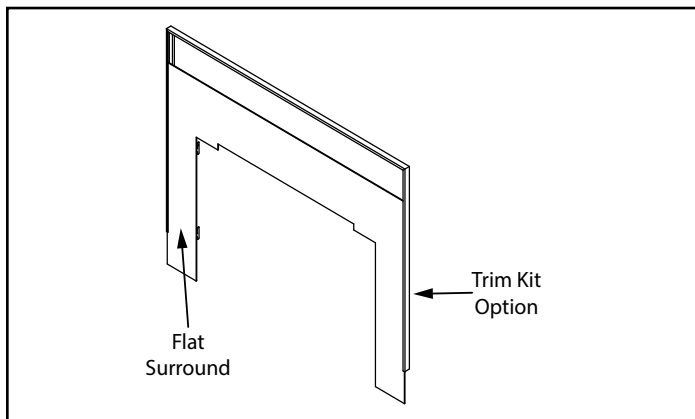


Figure 21.2

5. Install two steel springs at the top on each side and between the flat surround and the assembled trim kit as shown in **Figure 21.3**

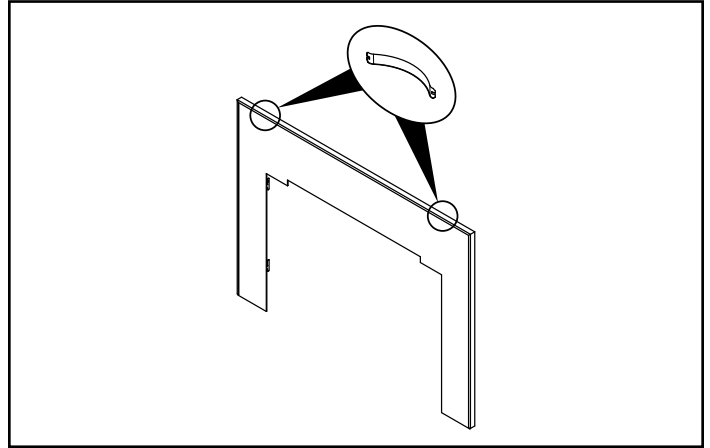


Figure 21.3

6. Install two steel springs on each side of the flat surround towards the bottom and the assembled trim kit (**Figure 21.4**).

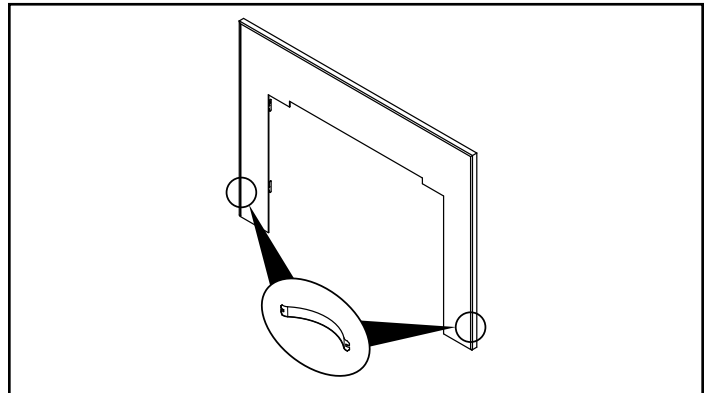


Figure 21.4

7. If needed push appliance back into fireplace.
8. Reinstall face to front of appliance (**Figure 20.2** on [page 20](#)).
9. Reinstall the door to the face of the appliance (**Figure 20.2** on [page 20](#)).

H. Standard Surround & Cast Trim Kit

	Overall Dimensions	Part Number
Standard Size	43" x 31"	CT1-4331
Large Size	51" x 34"	CT1-5134

1. Remove contents from box being careful not to scratch or damage the cast trim pieces.
2. Lay surround face down on a protected surface to prevent scratching.
3. Place the peel and stick round felt vibration insulation pads on the front side in each corner of the top metal piece and on the back side in each corner of the top cast piece (**Figure 22.1**).

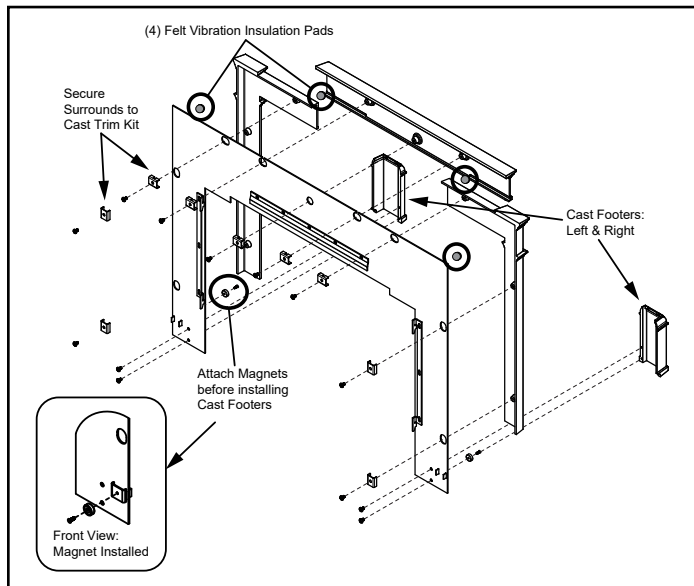


Figure 22.1

4. Place the corresponding cast trim pieces (2 cast trim sides and 1 cast trim header) underneath the panel set, also face down. Align the holes in the metal pieces with the 5 bosses on the top cast piece and 2 bosses on each side piece.
5. Secure the magnet to the bracket. The magnet is facing the front (**Figure 22.2**).

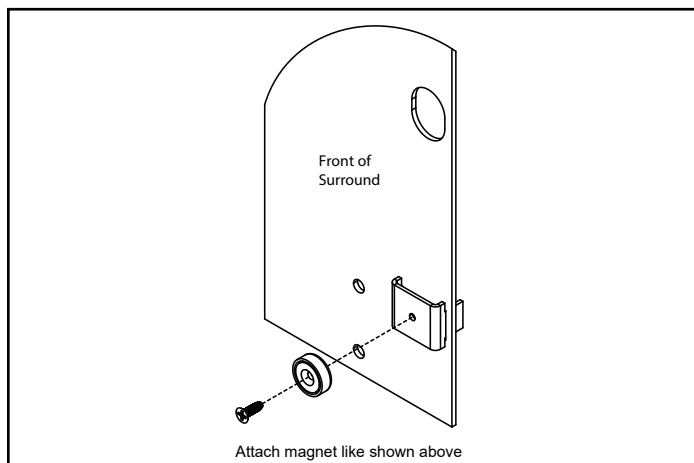


Figure 22.2

6. Place the cast footers under the metal sides aligning the top and bottom holes in the cast footers and metal sides.
7. The 9 mounting clips are shipped in one long strip. Hand break apart or use pliers.
8. Each clip has a clearance notch to allow room for the cast on the insert. Place the clip so the notch is facing the outer edges of the surrounds (**Figure 22.3**).

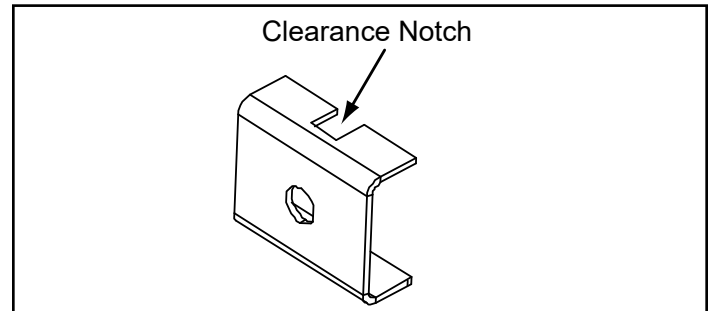


Figure 22.3

9. It is best to install all of the 1/4-20 screws only half way at first to allow for adjustments. After adjustment, tighten the 2 screws in each cast footer first and then work your way around to the rest.
10. Slide surround and trim over the top of the insert into place matching the mounting tabs on the metal sides with the slots on the insert (**Figure 22.4**).
11. Align the 2 screws in the top metal surround piece to the 2 alignment holes on the appliance top. Secure in place (**Figure 22.4**).

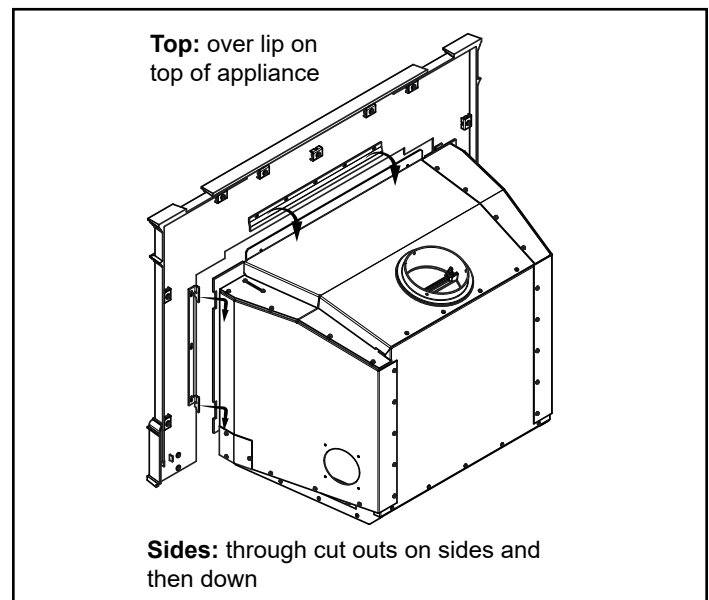


Figure 22.4

6 Mobile Home Installation, Approved for USA Installation ONLY!

You must use a Quadra-Fire Outside Air Kit Part #:

OAK-ACC

1. An outside air inlet must be provided for combustion and must remain clear of leaves, debris, ice and/or snow. It must be unrestricted while unit is in use to prevent room air starvation which can cause smoke spillage and an inability to maintain a fire. Smoke spillage can also set off smoke alarms.
2. Unit must be secured to the mobile home structure at two attachment points. Remove bolts from each side of insert and use plumbers tape to secure to structure (a washer may be required). Re-install bolts.
3. Unit must be grounded with #8 solid copper grounding wire or equivalent and terminated at each end with N.E.C. approved grounding device.
4. The factory-built fireplace must meet **(UM) 84-HUD** requirements for outside combustion air supply to the fireplace fire chamber and the chimney must be listed to **UL103 HT** or a listed **UL-1777** full length six inch (152mm) diameter liner must be used. It must be equipped with a spark arrestor cap and the outside air must be installed on the insert.
5. Refer to **page 10** of this manual for clearance to combustibles and floor protections requirements. All clearances must be followed precisely.
6. Use silicone to create an effective vapor barrier at the location where the chimney or other component penetrates to the exterior of the structure.
7. Follow the chimney and chimney connector manufacturer's instructions when installing the flue system for use in a mobile home.
8. Burn wood only. Other types of fuels may generate poisonous gases (e.g., carbon monoxide).
9. If unit burns poorly while an exhaust blower is on in home, (i.e., range hood), increase combustion air.
10. Installation shall be in accordance with the **Manufacturers Home & Safety Standard (HUD) CFR 3280, Part 24**.

NOTICE: Offsets from the vertical, not exceeding 45°, are allowed per **Section 905(a) of the Uniform Mechanical Code (UMC)**. Offsets greater than 45° are considered horizontal and are also allowed, providing the horizontal run does not exceed 75% of the vertical height of the vent. Construction, clearance and termination must be in compliance with the **UMC Table 9C**. This installation must also comply with **NFPA 211**.

NOTICE: Top sections of chimney must be removable to allow maximum clearance of 13.5 feet (411cm) from ground level for transportation purposes.

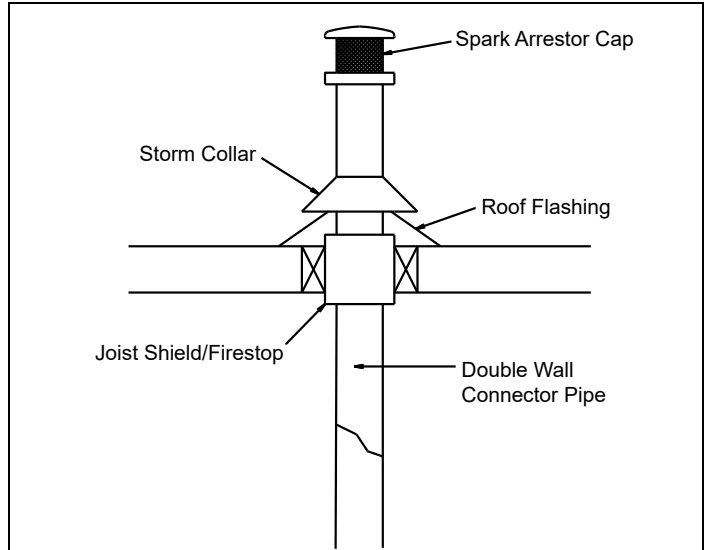


Figure 23.1



WARNING



Fire Risk. Asphyxiation Risk.

Do not draw outside combustion air from:

- Wall, floor or ceiling cavity
- Enclosed space such as an attic or garage
- Close proximity to exhaust vents or chimneys

Fumes or odor may result



CAUTION

THE STRUCTURAL INTEGRITY OF THE MOBILE HOME FLOOR, WALL AND CEILING/ROOF MUST BE MAINTAINED

Do NOT cut through:

- Floor joist, wall, studs or ceiling trusses.
- Any supporting material that would affect the structural integrity.



WARNING



Asphyxiation Risk.

NEVER INSTALL IN A SLEEPING ROOM.
Consumes oxygen in the room.

7 Reference Materials

A. Wiring Harness

Service Part: SRV7000-891

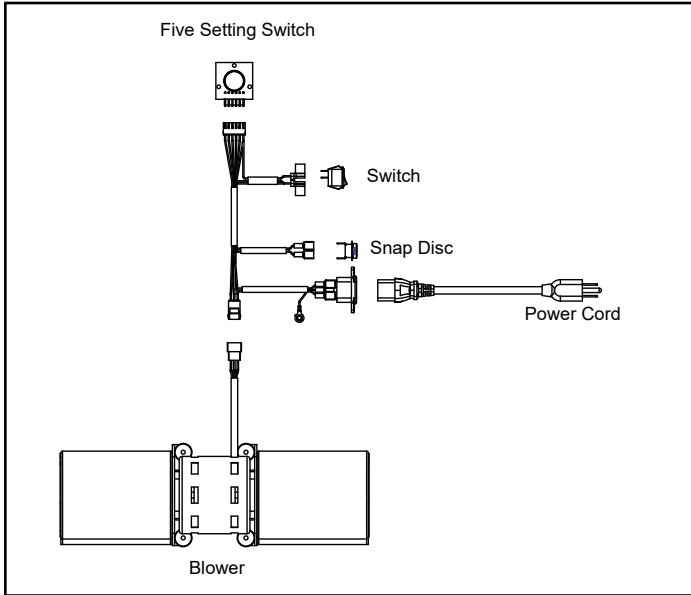


Figure 24.1

B. Brick Diagram

Service Part: SRV7094-022

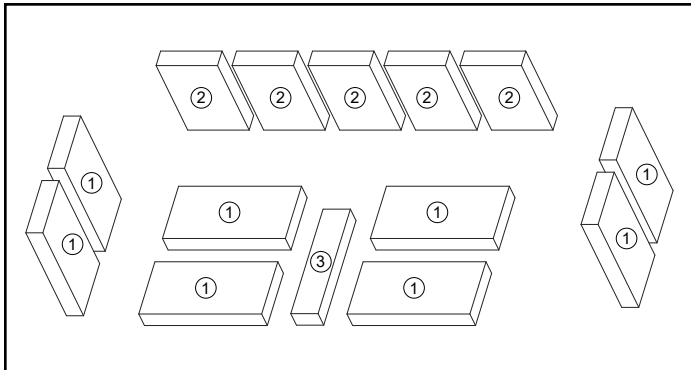
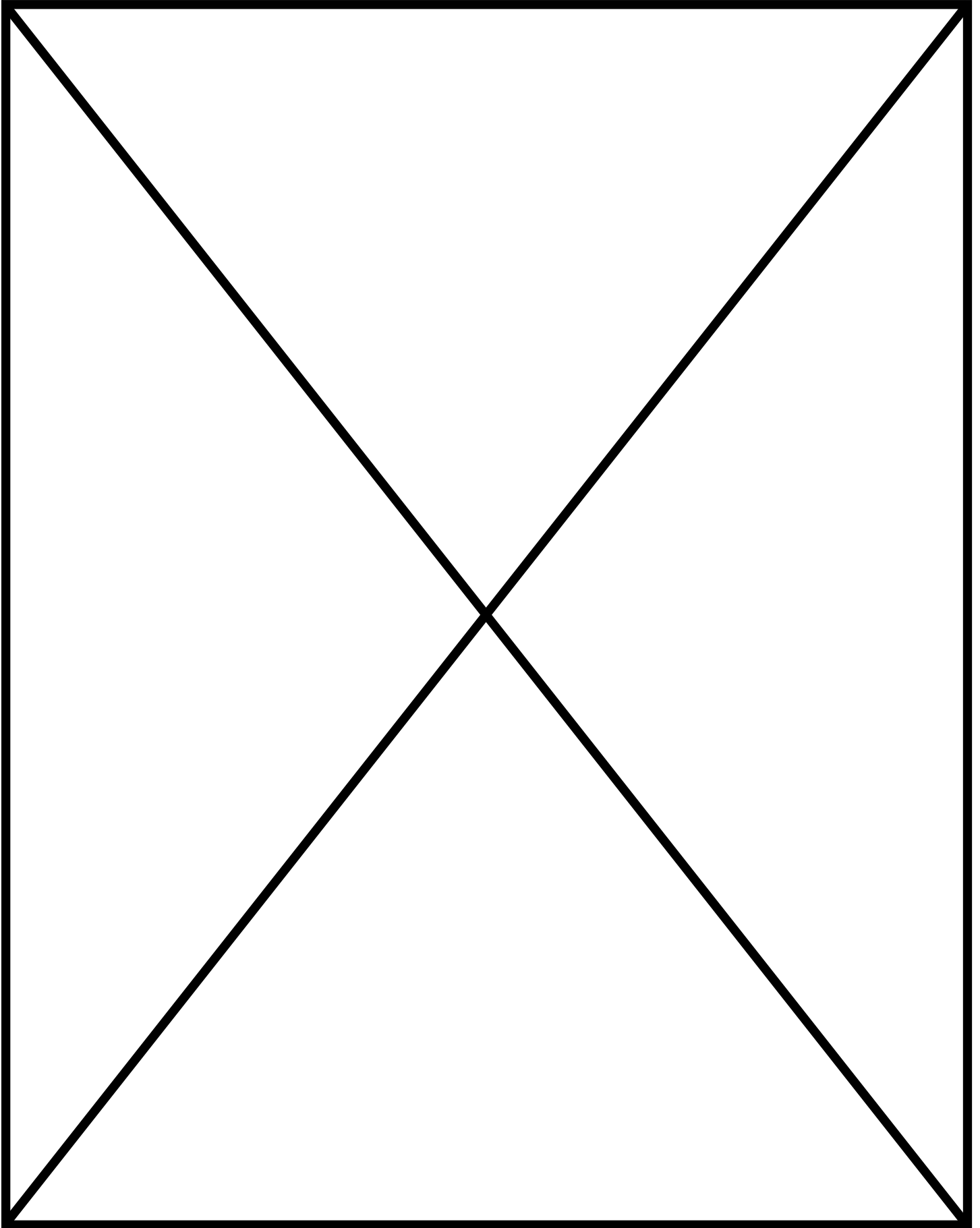
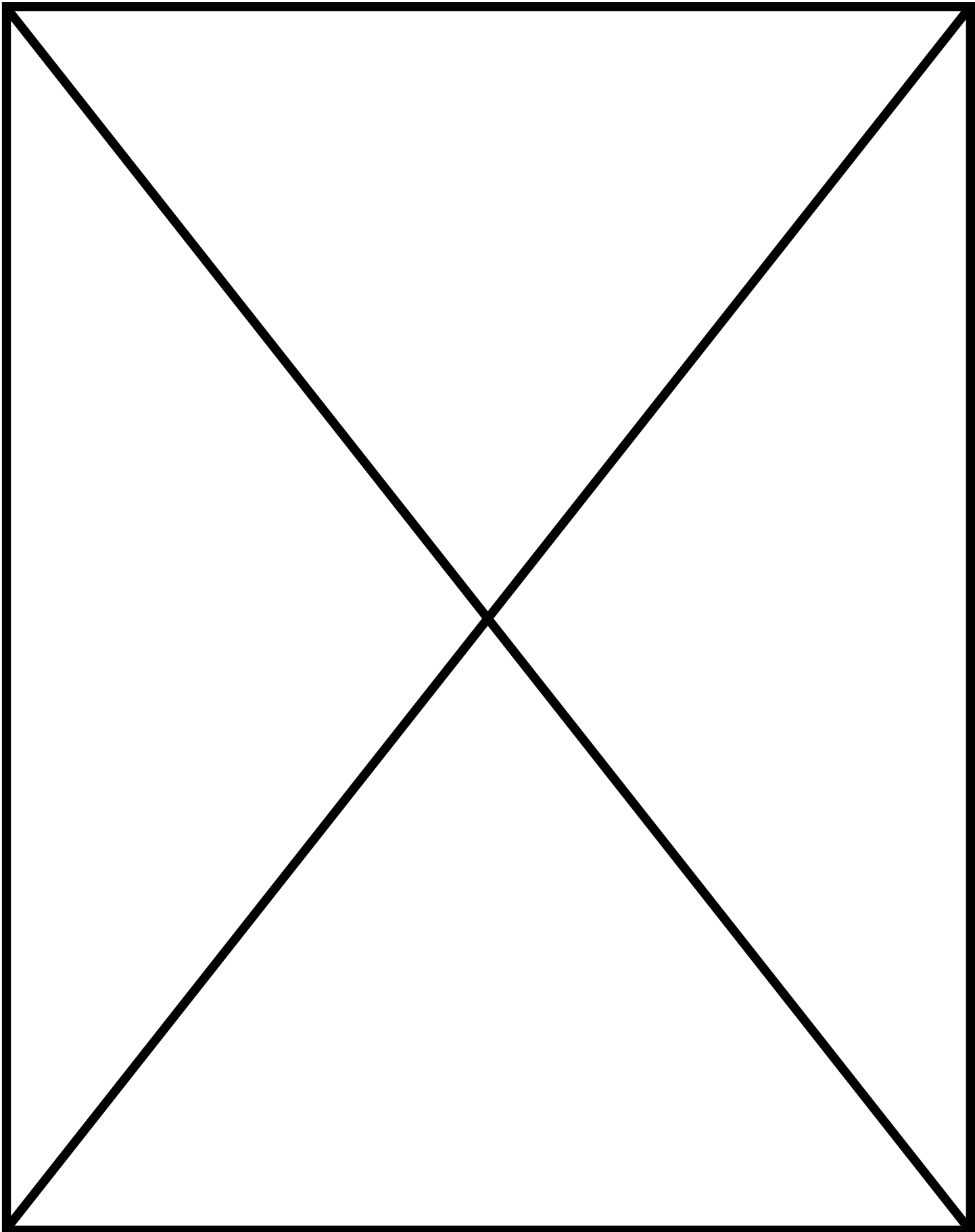


Figure 24.2

Placement	Dimensions	Qty Required
1	9" x 4.5" x 1.25"	8
2	7" x 4.5" x 1.25"	5
3	9" x 2" x 1.25"	1

D. Accessories





QUADRA-FIRE®

NOTHING BURNS LIKE A QUAD

CONTACT INFORMATION

Hearth & Home Technologies
 352 Mountain House Road
 Halifax, PA 17032
 Division of HNI INDUSTRIES

Please contact your Quadra-Fire dealer with any questions or concerns.
 For the number of your nearest Quadra-Fire dealer
 log onto www.quadrafire.com



CAUTION



DO NOT DISCARD THIS MANUAL

- Important operating and maintenance instructions included.
- Read, understand and follow these instructions for safe installation and operation.
- Leave this manual with party responsible for use and operation of this appliance.



We recommend that you record the following pertinent information for your heating appliance.

Date purchased/installed: _____

Serial Number: _____ Location on appliance: _____

Dealership purchased from: _____ Dealer Phone: 1() - _____

Notes: _____

This product may be covered by one or more of the following patents: (United States) 5341794, 5263471, 6688302, 7216645, 7047962 or other U.S. and foreign patents pending.



HEARTH & HOME
 technologies™

Owner's Manual

Operation & Care

INSTALLER: Leave this manual with party responsible for use and operation.

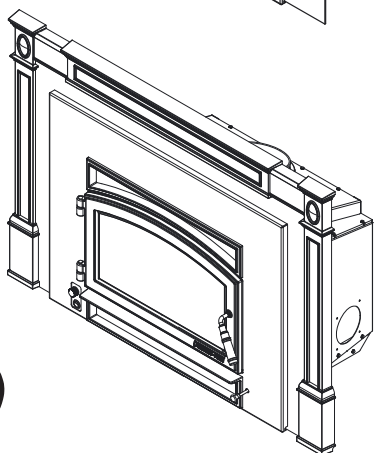
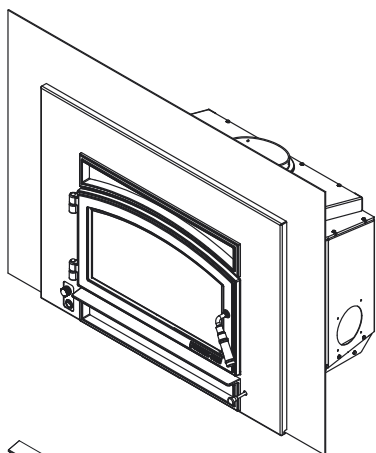
OWNER: Retain this manual for future reference.

Contact your dealer with questions on installation, operation, or service.

QUADRA-FIRE®

**EXPEDITION I WOOD INSERT
AUTOMATIC COMBUSTION
CONTROL (ACC)**

**MODEL NUMBER:
EXPEDITION-I**



Installation and service of this appliance should be performed by qualified personnel. Hearth & Home Technologies recommends HHT Factory Trained or NFI certified professionals.

hearthED
FACTORY TRAINING
Fuel Your Fire

NFI NATIONAL
FIREPLACE
INSTITUTE®
A CERTIFICATION AGENCY



WARNING



If the information in these instructions is not followed exactly, a fire may result causing property damage, personal injury, or death.

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- Do not over fire - If heater or chimney connector glows, you are over firing. Over firing will void your warranty.
- Comply with all minimum clearances to combustibles as specified.

Failure to comply may cause house fire.



WARNING



HOT SURFACES!

Glass and other surfaces are hot during operation AND cool down.

Hot glass and appliance will cause burns.

- Do not touch glass until it is cooled
- Use leather gloves when reloading fuel
- NEVER allow children to touch glass
- Keep children away
- CAREFULLY SUPERVISE children in same room as appliance.
- Alert children and adults to hazards of high temperatures
- High temperatures may ignite clothing or other flammable materials.
- Keep clothing, furniture, draperies and other flammable materials away.



WARNING



Fire Risk.

For use with solid wood fuel only. Other fuels may over fire and generate poisonous gases (i.e. carbon monoxide).

NOTE: To obtain a French translation of this manual, please contact your dealer or visit www.quadrafire.com
REMARQUE : Pour obtenir une traduction française de ce manuel, s'il vous plaît contacter votre revendeur ou visitez www.quadrafire.com

Congratulations

and Welcome to the Quadra-Fire Family!

NOTE: Clearances may only be reduced by means approved by the regulatory authority having jurisdiction

A. Sample of Serial Number / Safety Label

LOCATION: UNDER ASH LIP, PULL OUT TO VIEW

LISTED ROOM HEATER, SOLID FUEL TYPE
"For Use with Solid Wood Fuel Only."
 Also for use in Mobile Home.
PREVENT HOUSE FIRES

Install and use only in accordance with manufacturer's installation, venting and operating instructions. CONTACT YOUR LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION IN YOUR AREA. Refer to manufacturer's instructions and local codes for precautions required for passing chimney through a combustible wall or ceiling. **WARNING - For Mobile Homes:** Do not install in a sleeping room. An outside combustion air inlet must be provided and unrestricted while unit is in use. The structural integrity of the mobile home floor, ceiling and walls must be maintained. The insert must be properly grounded to the frame of the mobile home. A complete relining of the chimney system with a 6 inch (152mm) diameter listed stainless liner is required. Must be equipped with a spark arrestor cap. Outside Air comes standard on the insert and must be installed before operating insert.

When used as a masonry insert stove, install only in a masonry fireplace built to national and/or local codes. Do not remove brick or mortar to accommodate insert. Installation requires a 5 foot minimum length of a starter pipe into existing chimney with airtight face seal. A full reline with listed liner strongly recommended. Install only on a non-combustible hearth.

Approved for installation and use in factory built zero-clearance fireplaces conforming to minimum fire chamber specifications. A complete relining of the chimney system with a 6 inch (152mm) diameter listed stainless liner is required.

In Canada a full length 6 inch (152mm) S635 flue liner is required as per ULC S628-93.

WARNING - Inspect and clean chimney frequently. Under certain conditions of use, creosote buildup may occur rapidly. Do not connect this unit to a chimney serving another appliance. **DANGER: Risk of electrical shock.** Disconnect power supply before servicing. Route power cord away from unit. Do not route cord under or in front of appliance. Electrical Rating: 115 VAC 1.4 AMPS 60 Hz

Do not use grate or elevate fire. Build wood fire directly on hearth (brick). Do not overfire. If heater or chimney connector glows, you are overfiring. Operate with doors closed. Open only to add fuel to the fire. Replace glass only with safety ceramic available from your dealer.

Minimum Clearances To Combustible Material Masonry, Fireplaces, Circulating & Factory-Built Hearths as on other label for Canada	USA ONLY
A Side Wall to Fuel Loading Door	13.6 in.
B Mantel to Bottom of unit	47.75 in.
C Top Trim to Bottom of unit	34.75 in.
D Side Trim to Fuel Loading Door	13 in.
E Hearth Extension from Glass	16 in.
F Hearth Extension from Fuel Loading Door	8 in.

Factory-Built Floor Protection under Hearth Extension

Thermal & Ember Protection.
 Floor height 0 to 4.5 inches below Insert Base. Materials with R value of 2.9 required.
Ember Protection Only
 Greater than 4.5 inches below Insert Base.

CAUTION: HOT WHILE IN OPERATION DO NOT TOUCH, KEEP CHILDREN, CLOTHING AND FURNITURE AWAY. CONTACT MAY CAUSE SKIN BURNS. SEE NAMEPLATE AND INSTRUCTIONS.

XXXXXXXXXX

QUADRA-FIRE®

EXPEDITION I

Serial No. / N° de série

HF

U.S. ENVIRONMENTAL PROTECTION AGENCY
 Certified to comply with 2020 crib wood particulate emission standards for single burn rate heaters. This single burn rate wood heater is not approved for use with a flue damper.

This wood heater needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operating instructions in the owner's manual.

Mfg by:

HEARTH HOME
technologies
352 Mountain House Road
Hallifax, PA 17032
www.quadrafire.com

2021	2022	JAN	FEB	MAR	APR	MAY	JUN
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2023		JUL	AUG	SEP	OCT	NOV	DEC
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

DO NOT REMOVE THIS LABEL

Test Lab & Report Number

Serial Number

Model Name

Mfg Date



Safety Alert Key:

- **DANGER!** Indicates a hazardous situation which, if not avoided will result in death or serious injury.
- **WARNING!** Indicates a hazardous situation which, if not avoided could result in death or serious injury.
- **CAUTION!** Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE:** Indicates practices which may cause damage to the appliance or to property.

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➔ = Contains updated information

B. Warranty

Hearth & Home Technologies LLC LIMITED LIFETIME WARRANTY

Hearth & Home Technologies LLC (“HHT”) extends the following warranty for HHT gas, wood, pellet and electric hearth appliances each a “Product” and collectively, the “Product(s)” and certain component parts set forth in the table below (“Component Part(s)”) that are purchased from a HHT authorized dealer or distributor.

WARRANTY COVERAGE:

HHT warrants that the Products and their Component Parts will be free from defects in materials and workmanship for the applicable period of Warranty coverage set forth in the table below (“Warranty Period”). If a Product or Component Parts are found to be defective in materials or workmanship during the applicable Warranty Period, HHT will, at its option, repair the applicable Component Part(s), replace the applicable Component Part(s), or refund the purchase price of the applicable Product(s). The maximum amount coverable under this Warranty is limited to the purchase price of the Product. This Warranty is transferable from the original purchaser to subsequent owners, but the Warranty Period will not be extended in duration or expanded in coverage for any such transfer. This Warranty is subject to conditions, exclusions, and limitations as described below.

WARRANTY PERIOD:

Warranty coverage begins at the date of installation. In the case of new home constructions, Warranty coverage begins on the date of first occupancy of the dwelling or six months after the sale of the Product(s) by an independent, authorized HHT dealer or distributor, whichever occurs earlier. However, the Warranty coverage shall commence no later than 24 months following the date of Product shipment from HHT, regardless of the installation or occupancy date.

The term “Lifetime” in the table below is defined as: 20 years from the beginning date of warranty coverage for gas appliances, and 10 years from the beginning date of warranty coverage for wood and pellet appliances. These time periods reflect the minimum expected useful lives of the designated Component Parts under normal operating conditions.

Warranty Period		HHT Manufactured Appliances and Venting						
Component Parts	Labor	Gas	Pellet	Wood	Electric	Venting	Component Parts Covered by this Warranty	
1 Year		X	X	X		X	All parts including handles, external enameled components and other material except as covered by Warranty Conditions, Warranty Exclusions, and Warranty Limitations listed	
2 Years					X		All parts except as covered by Warranty Conditions, Warranty Exclusions, and Warranty Limitations listed	
2 years			X	X			Igniters, Auger Motors, Electronic Components, and Glass	
		X					Electrical components limited to modules, remotes/wall switches, valves, pilots, blowers, junction boxes, wire harnesses, transformers and lights (excluding light bulbs)	
		X		X			Molded Refractory Panels, Glass Liners	
3 years			X				Firepots, burnpots, mechanical feeders/auger assemblies	
5 years	1 year	X					Vent Free Burners, Vent Free Logs	
			X	X			Castings, Medallions and Baffles	
6 years	3 years			X			Catalysts	
7 years	3 years		X	X			Manifold tubes, HHT Chimney and Terminations	
10 years	1 year	X					Burners, logs and refractory	
Limited Lifetime	3 years	X	X	X			Firebox and heat exchanger, FlexBurn® System (engine, inner cover, access cover and fireback)	
1 Year	None	X	X	X	X	X	All purchased replacement parts	

WARRANTY CONDITIONS:

- Because HHT cannot control the quality of any Products sold by unauthorized sellers, this Warranty only covers Products that are purchased through an HHT authorized dealer or distributor unless otherwise prohibited by law; a list of HHT authorized dealers is available on the HHT branded websites.
- This Warranty is only valid while the applicable Product remains at the site of original installation.
- This Warranty is only valid in the country in which the HHT authorized dealer or distributor that sold the applicable Product is authorized to sell applicable Product.
- Contact your installing distributor or dealer for Warranty service. If the installing dealer or distributor is unable to provide necessary parts, contact the nearest HHT authorized dealer or supplier. Additional service fees may apply if you are seeking Warranty service from a dealer other than the dealer from whom you originally purchased the applicable Product.
- No HHT consumer should bear cost of warranty service or costs incurred while servicing warranty claims (i.e., travel, gas, or mileage) when the service is performed within the terms of this Warranty. Check with your dealer or distributor in advance for any costs to you when arranging a warranty call. Travel and shipping charges for parts are not covered by this Warranty.

WARRANTY EXCLUSIONS:

This Warranty does not cover the following:

- Changes in surface finishes as a result of normal use. As a heating appliance, some changes in color of interior and exterior surface finishes may occur. This is not a flaw and is not covered under the Warranty.
- Damage to printed, plated, or enameled surfaces caused by fingerprints, accidents, misuse, scratches, melted items or other external sources and residues left on the plated surfaces from the use of abrasive cleaners or polishes.
- Repair or replacement of parts that are subject to normal wear and tear during the Warranty Period are not covered. These parts include: paint, wood and pellet gaskets, firebricks, grates, flame guides, batteries and the discoloration of glass.
- Minor expansion, contraction, or movement of certain parts causing noise. These conditions are normal and complaints related to this noise are not covered by this Warranty.
- Damages resulting from: (1) failure to install, operate, or maintain the applicable Product in accordance with the installation instructions, operating instructions, and listing agent identification label furnished with the applicable Product; (2) failure to install the applicable Product in accordance with local building codes; (3) shipping or improper handling; (4) improper operation, abuse, misuse, continued operation with damaged, corroded or failed components, accident, or improperly/incorrectly performed repairs; (5) environmental conditions, inadequate ventilation, negative pressure, or drafting caused by tightly sealed constructions, insufficient make-up air supply, or handling devices such as exhaust fans or forced air furnaces or other such causes; (6) use of fuels other than those specified in the operation instructions; (7) installation or use of components not supplied with the applicable Product or any other components not expressly authorized and approved by HHT; (8) modification of the appliance not expressly authorized and approved by HHT in writing; and/or (9) interruptions or fluctuations of electrical power supply to the applicable Product.
- Non-HHT venting components, hearth connections or other accessories used in conjunction with the applicable Product.
- Any part of a pre-existing fireplace system in which an insert or a decorative gas applicable Product is installed.
- HHT's obligation under this Warranty does not extend to the Product's capability to heat the desired space. Information is provided to assist the consumer and the dealer in selecting the proper Product for the application. Consideration must be given to the Product location and configuration, environmental conditions, insulation and air tightness of the structure.

This warranty is void if:

- The applicable Product has been over-fired, operated in atmospheres contaminated by chlorine, fluorine, or other damaging chemicals. Over-firing can be identified by, but not limited to, warped plates or tubes, deformation/warping of interior cast iron structure or components, rust colored cast iron, bubbling, cracking and discoloration of steel or enamel finishes.
- The applicable Product is subjected to prolonged periods of dampness or condensation.
- There is any damage to the applicable Product due to water or weather damage which is the result of, but not limited to, improper chimney or venting installation.

LIMITATIONS OF REMEDIES AND LIABILITY:

- **EXCEPT TO THE EXTENT PROVIDED BY LAW, HHT MAKES NO EXPRESS WARRANTIES OTHER THAN THE WARRANTY SPECIFIED HEREIN. The owner's exclusive remedy and HHT's sole obligation under this Warranty or in contract, tort or otherwise, shall be limited to replacement of the Component Part(s), repair of the Component Part(s), or refund of the original purchase price of the applicable Product(s), as specified above; provided, however, that (i) if HHT is unable to provide replacement of the Component Part(s) and repair of the Component Part(s) is not commercially practicable or cannot be timely made, or (ii) the customer is willing to accept a refund of the purchase price of the applicable Product(s), HHT may discharge all such obligations by refunding the purchase price of the applicable Product. In no event will HHT be liable for any incidental or consequential damages caused by defects in the applicable Product. Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This Warranty gives you specific legal rights and you may also have other rights which vary from State to State. THE DURATION OF ANY IMPLIED WARRANTY IS LIMITED TO DURATION OF THE EXPRESSED WARRANTY SPECIFIED ABOVE FOR THE APPLICABLE PRODUCT. Some States do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.**

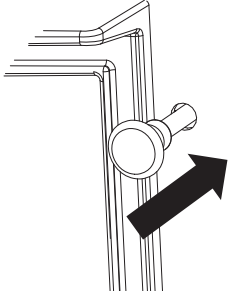
C. Quick Start Guide

NOTE: These are generic drawings and may not represent your specific model.

ITEMS NEEDED FOR FIRST FIRE:

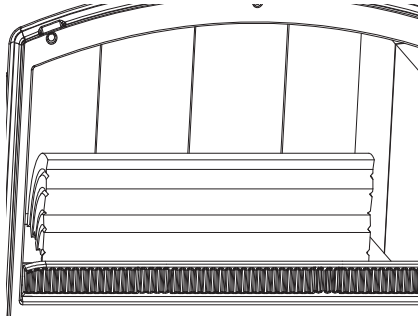
10 Pieces of Newspaper, 10-20 Pieces of Dry Kindling and Few Pieces of Dry Split Wood.

**ACTIVATE
Start-Up Air Control**



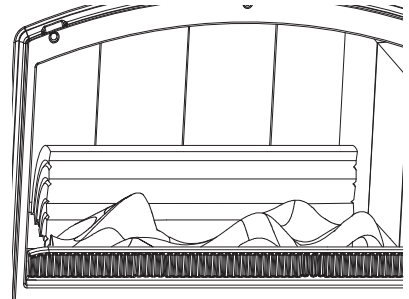
1

LOAD WOOD



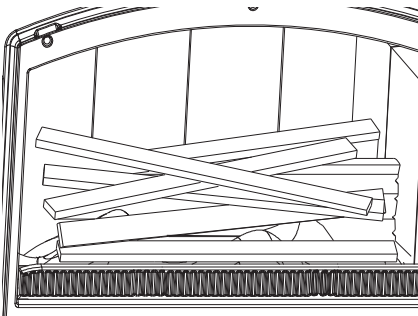
2

ADD NEWSPAPER



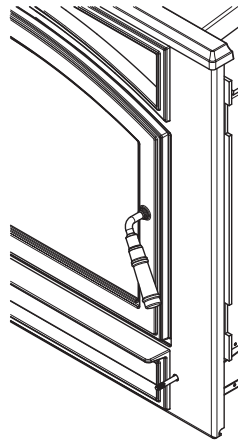
3

ADD KINDLING



LIGHT THE PAPER

4



Warning! Risk of Fire.

Close and securely latch the door after the fire has started, and after refueling, to prevent:

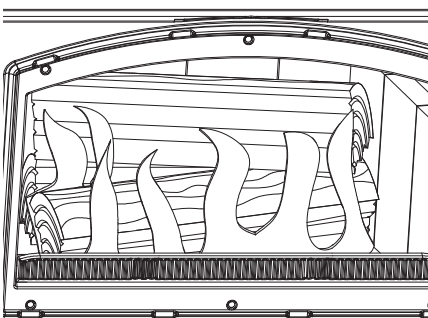
- Spillage of smoke, flame and carbon monoxide
- Spillage of sparks, coals, and logs
- Over firing

DO NOT leave the appliance unattended with the door open.

Starting a fire may not require an open door for draft.

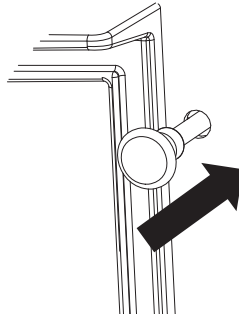
5

ADD MORE WOOD



6

**ACTIVATE
Start-Up Air Control**



7

**The appliance is ready for
normal operation.**

1 Listing and Code Approvals

A. Insert Safety Certification

Mode Number:	EXPEDITION-I
Laboratory:	OMNI Test Laboratories, Inc.
Report Number:	XXXXXXXXXX
Type:	Solid Fuel Type, Listed Room Heater
Standard:	UL1482, ULC S628-93 and (UM) 84-HUD, Mobile Home Approved.

B. Insert Emissions Certification

Model Number:	EXPEDITION-I
Laboratory:	OMNI Test Laboratories, Inc.
Report Number:	XXXXXXXXXX
Standard:	UL1482-2011
Can be found at:	www.quadrafire.com/about-us/epa-certification

This EXPEDITION-I is Certified to comply with 2020 crib wood particulate emission standards.



This wood heater needs periodic inspection and repair for proper operation. It is against federal regulations to operate this wood appliance in a manner inconsistent with operating instructions in this manual.

NOTE: This installation must conform with local codes. In the absence of local codes you must comply with the **UL1482, (UM) 84-HUD and NPFA211 in the U.S.A. and the ULC S628-93 and CAN/CSA-B365 Installation Codes in Canada. NOT APPROVED FOR MOBILE HOME INSTALLATIONS IN CANADA!**

C. BTU & Efficiency Specifications

EPA Certification #:	Number: N/A
EPA Certified Emissions:	XX.X grams per hours
*LHV Tested Efficiency:	XX.X%
**HHV Tested Efficiency:	XX.X%
***EPA BTU Output:	XX,XXX to XX,XXX / hr
****Peak BTU/Hour Output:	XX,XXX
Vent Size:	6 inches
Firebox Size:	XX.XX cubic feet
Recommended Wood Length:	XX inches
Fuel	Seasoned Cord Wood

* Weighted average LHV (Low Heating Value) efficiency using Douglas Fir dimensional lumber and data collected during EPA emission tests in accordance with the requirements of CSA B415.1. LHV assumes the moisture is already in a vapor state so there is no loss in energy to vaporize.

** Weighted average HHV (High Heating Value) efficiency using Douglas Fir dimensional lumber and data collected during EPA emission tests in accordance with the requirements of CSA B415.1. HHV includes the energy required to vaporize the water in the fuel.

*** A range of BTU outputs calculated using HHV Efficiency and the burn rates from the EPA tests, using Douglas Fir dimensional lumber.

**** A peak BTU out of the appliance calculated using the maximum first hour burn rate from the High EPA Test and BTU content of seasoned cordwood (8600) times the efficiency.

D. Mobile Home Approved (USA only)

- This appliance is approved for mobile home installations when not installed in a sleeping room and when an outside combustion air inlet is provided.
- The structural integrity of the mobile home floor, ceiling, and walls must be maintained.
- This appliance must be properly grounded to the frame of the mobile home with #8 copper ground wire, and chimney must be listed to UL103 HT or a listed UL-1777 full length six inch (152mm) diameter liner must be used.
- Outside Air Kit, part OAK-ACC must be installed in a mobile home installation.

E. Glass Specifications

This appliance is equipped with 5mm ceramic glass. Replace glass only with 5mm ceramic glass. Please contact your dealer for replacement glass.

F. Sleeping Room

When an appliance is installed in a sleeping room an outside air kit is required and it is recommended that a smoke and/or CO alarm be installed in the bedroom. The size of the room must be at least 50ft³ per 1,000 Btu/hr stove input

G. California - Prop65



WARNING

This product and the fuels used to operate this product (wood), and the products of combustion of such fuels, can expose you to chemicals including carbon black, which is known to the State of California to cause cancer, and 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



WARNING



Fire Risk.

Hearth & Home Technologies disclaims any responsibility for, and the warranty will be voided by, the following actions:

- Installation and use of any damaged appliance.
- Modification of the appliance.
- Installation other than as instructed by Hearth & Home Technologies.
- Installation and/or use of any component part not approved by Hearth & Home Technologies.
- Operating appliance without fully assembling all components.
- Operating appliance without legs attached (if supplied with unit).
- Do NOT Over fire - If appliance or chimney connector glows, you are over firing.

Any such action that may cause a fire hazard.

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage.

For assistance or additional information, consult a qualified installer, service agency or your dealer.

Hearth & Home Technologies WILL NOT warranty stoves that exhibit evidence of over-firing. Evidence of over-firing includes, but is not limited to:

- Warped air tube
- Deteriorated refractory brick retainers
- Deteriorated baffle and other interior components

NOTE: Hearth & Home Technologies, manufacturer of this appliance, reserves the right to alter its products, their specifications and/or price without notice.

2 Operating Instructions

WARNING



HOT SURFACES!

Glass and other surfaces are hot during operation AND cool down.

Hot glass will cause burns.

- Do not touch glass until it is cooled
- NEVER allow children to touch glass
- Keep children away
- CAREFULLY SUPERVISE children in same room as appliance.
- Alert children and adults to hazards of high temperatures.
- High temperatures may ignite clothing or other flammable materials.
- Keep clothing, furniture, draperies and other flammable materials away.

If you expect that children may come into contact with this appliance, we recommend a barrier such as a decorative screen. See your dealer for suggestions.

A. Your Wood Appliance

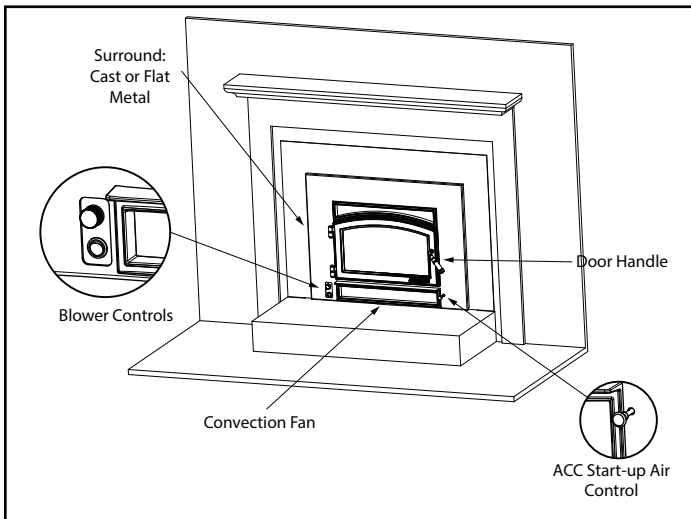


Figure 9.1 - General Operating Parts

WARNING



Do not operate appliance before reading and understanding operating instructions. Failure to operate appliance according to operating instructions could cause fire or injury.

B. Fire Safety

To provide reasonable fire safety, the following should be given serious consideration:

1. Install at least one smoke detector on each floor of your home to ensure your safety. They should be located away from the heating appliance and close to the sleeping areas. Follow the smoke detector manufacturer's placement and installation instructions, and be sure to maintain regularly.
2. A conveniently located Class A fire extinguisher to contend with small fires resulting from burning embers.
3. A CO detector should be installed in the room with the appliance.
4. A practiced evacuation plan, consisting of at least two escape routes.
5. A plan to deal with a chimney fire as follows:
 - In the event of a chimney fire:
 - Evacuate the house immediately
 - Notify fire department.

C. Over firing

WARNING



Fire Risk. Do not over-fire.

Over-firing may ignite creosote or will damage the appliance and chimney.

To prevent over-firing your appliance, DO NOT:

- Use flammable liquids.
- Overload with wood.
- Burn trash or large amounts of scrap lumber.
- Permit too much air to the fire.

1. Symptoms of Over-Firing

Symptoms of over-firing may include one or more of the following:

- Chimney connector or appliance glowing.
- Roaring, rumbling noises.
- Loud cracking or banging sounds.
- Metal warping.
- Chimney fire.

2. What To Do if Your Appliance is Over-Firing

- Immediately close the door and air controls to reduce air supply to the fire.
- If you suspect a chimney fire, call the fire department and evacuate your house.
- Contact your local chimney professional and have your appliance and vent pipe inspected for any damage.
- Do not use your appliance until the chimney professional informs you it is safe to do so.

Hearth & Home Technologies WILL NOT warranty stoves that exhibit evidence of over-firing. Evidence of over-firing includes, but is not limited to:

- Warped air tube
- Deteriorated refractory brick retainers
- Deteriorated baffle and other interior components

D. Combustible/Non-combustible Materials

- **Combustible Material** - Material made of or surfaced with wood, compressed paper, plant fibers, plastics, or any material capable of igniting and burning, whether flame-proofed or not, plastered or non-plastered.
- **Non-combustible Material** - Material which will not ignite and burn. Such materials are those consisting entirely of steel, iron, brick, tile, slate, glass or plasters, or any combination thereof.
- **Non-combustible Sealant Material** - Sealants which will not ignite and burn: Rutland, Inc. Fireplace Mortar #63, Rutland 76R, Nuflex 304, GE RTV106 or GE RTB116 (or equivalent).

E. Seasoned Wood

Burn only dry seasoned wood. Store wood under cover, out of the rain and snow. Dry and well-seasoned wood will not only minimize the chance of creosote formation, but will give you the most efficient fire. Even dry wood contains at least 15% moisture by weight, and should be burned hot enough to keep the chimney hot for as long as it takes to dry the wood out - about one hour. It is a waste of energy to burn unseasoned wood of any kind.

Dead wood lying on the forest floor should be considered wet, and requires full seasoning time. Standing dead wood can be considered to be about 2/3 seasoned. To tell if wood is dry enough to burn, check the ends of the logs. If there are cracks radiating in all directions from the center, it is dry. If your wood sizzles in the fire, even though the surface is dry, it may not be fully cured.

Splitting wood before it is stored reduces drying time. Wood should be stacked so that both ends of each piece are exposed to air, since more drying occurs through the cut ends than the sides. This is true even with wood that has been split. Store wood under cover, such as in a shed, or covered with a tarp, plastic, tar paper, sheets of scrap plywood, etc., as uncovered wood can absorb water from rain or snow, delaying the seasoning process.

F. Burning Process

In recent years there has been an increasing concern about air quality. Much of the blame for poor air quality has been placed on the burning of wood for home heating. In order to improve the situation, we at Quadra-Fire have developed cleaner-burning wood appliances that surpass the requirements for emissions established by our governing agencies. These wood appliances must be properly operated in order to ensure that they perform the way they are designed to perform.

NOTICE: Improper operation can turn any wood appliance into a smoldering environmental hazard.

1. **Kindling or First Stage** - It helps to know a little about the actual process of burning in order to understand what goes on inside a appliance. The first stage of burning is called the kindling stage. In this stage, the wood is heated to a temperature high enough to evaporate the moisture which is present in all wood. The wood will reach the boiling point of water (212°F) and will not get any hotter until the water is evaporated. This process takes heat from the coals and tends to cool the appliance.

Fire requires three things to burn - fuel, air and heat. So, if heat is robbed from the appliance during the drying stage, the new load of wood has reduced the chances for a good clean burn. For this reason, it is always best to burn dry, seasoned firewood. The heat generated from the fire should be warming your home and establishing the flue draft, not evaporating the moisture out of wet, unseasoned wood, resulting in wasted heat.
2. **Second Stage** - The next stage of burning, the secondary stage, is the period when the wood gives off flammable gases which burn above the fuel with bright flames. During this stage of burning it is very important that the flames be maintained and not allowed to go out. This will ensure the cleanest possible fire.

3. **Final Stage** - The final stage of burning is the charcoal stage. This occurs when the flammable gases have been mostly burned and only charcoal remains. This is a naturally clean portion of the burn. The coals burn with hot blue flames.

It is very important to reload your appliance while enough lively hot coals remain in order to provide the amount of heat needed to dry and rekindle the next load of wood. It is best to activate the ACC before reloading (**Figure 11.1**). This livens up the coal bed and reduces excessive emissions (opacity/smoke). Open door slowly so that ash or smoke does not exit appliance through opening. You should also break up any large chunks and distribute the coals so that the new wood is laid on hot coals.

Air quality is important to all of us, and if we choose to use wood to heat our homes we should do so responsibly. To do this we need to learn to burn our appliances in the cleanest way possible. Doing this will allow us to continue using our wood appliances for many years to come.

G. Automatic Combustion Control (ACC)

When using the Automatic Combustion Control (ACC) system, you do not have to continually monitor the fire. Once you set the ACC system it will control the fire for you. Follow the instructions below to learn how to operate your appliance with ease.

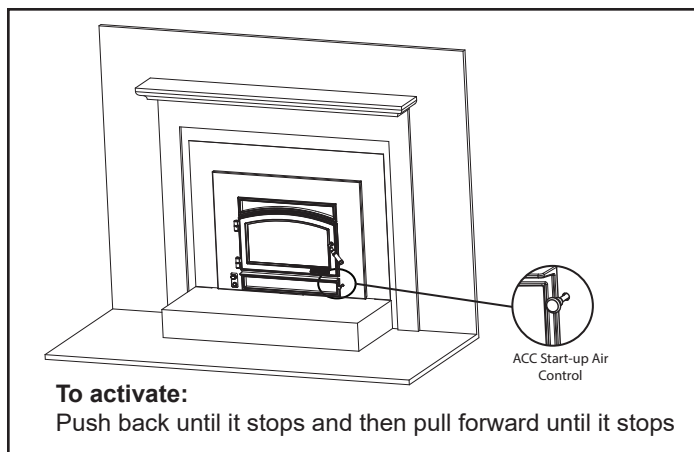




Figure 11.1

H. Burn Rate and Operating Efficiency

 WARNING	
	This wood appliance 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 pellet insert in a manner inconsistent with operating instructions in this manual.

For maximum operating efficiency

- Burn dry, well-seasoned wood.
- Follow these burn rate instructions below.

Burn Rate

1. Starting a Fire:

- Load appliance with wood and start fire (reference **Quick Start Guide** on [page 6](#)).
- Activate ACC.



2. Reloading:

- Add wood as needed.
- Activate ACC.

3. **Adjusting the Burn Rate** - This wood appliance is designed to optimize efficiency at all times. Since there are no user controls to adjust the burn rate, the easiest method is to learn how many logs you need at a time for the amount of heat desired. In addition to the amount of wood and the size of the logs, take the time to experiment with split and unsplit logs as split logs will burn faster than unsplit logs.

NOTE: If using the blower, it should be off for the first 30 minutes and then be operated in the desired setting at 30 minutes.
--

I. Wood Fuel

 WARNING	
	Fire Risk.
	<ul style="list-style-type: none"> • DO NOT BURN GARBAGE OR FLAMMABLE FLUIDS SUCH AS GASOLINE, NAPHTHA OR ENGINE OIL. • Do NOT burn treated wood or wood with salt (driftwood). <ul style="list-style-type: none"> • May generate carbon monoxide if burn material other than wood. <p>May result in illness or possible death.</p>

Hardwood vs Softwood

Your appliance performance depends on the quality of the firewood you use.



- Seasoned wood contains about 8,000 BTUs per pound.
- Hard woods are more dense than soft woods.
- Hard woods contain 60% more BTUs than soft woods.
- Hard woods require more time to season, burn slower and are harder to ignite.
- Soft woods require less time to dry, burn faster and are easier to ignite.
- Start the fire with softwood to bring the appliance up to operating temperature and to establish draft.
- Add hardwood for slow, even heat and longer burn time.

HARDWOODS	SOFTWOODS
Alder	Aspen
Apple	Cedar
Birch	Douglas Fir
Maple	Pine
Oak	Spruce
Poplar	

Processed Solid Fuel Fire Logs

- NOT permitted for use in this appliance

Moisture

 WARNING	
	Fire Risk.
	<ul style="list-style-type: none"> • Do NOT burn wet or green wood. • Store wood in dry location. • Stack wood so both ends are exposed to air. <p>Wet, unseasoned wood can cause accumulation of creosote.</p>

The majority of the problems appliance owners experience are caused by trying to burn wet, unseasoned wood.

- Wet, unseasoned wood requires energy to evaporate the water instead of heating your home, and
- Causes evaporating moisture which cools your chimney, accelerating formation of creosote.

Seasoned Wood

- Cut logs to size
- Split to 6 inches (152 mm) or less in diameter
- Air dry to a moisture content of not more than 20%
 - Softwood - about nine months to dry
 - Hardwood - about eighteen months to dry

NOTICE: Seasoning time may vary depending on drying conditions.

Storing Wood

Steps to ensure properly seasoned wood:

- Stack wood to allow air to circulate freely around and through woodpile.
- Elevate wood pile off ground to allow air circulation underneath.
- Smaller pieces of wood dry faster. Any piece over 6 in. (152 mm) in diameter should be split.
- Wood (whole or split) should be stacked so both ends of each piece are exposed to air. More drying occurs through the cut ends than the sides.
- Store wood under cover to prevent water absorption from rain or snow. Avoid covering the sides and ends completely.

 WARNING	
	Fire Risk
	<p>Do NOT store wood:</p> <ul style="list-style-type: none"> • In front of the appliance. • In space required for loading or ash removal.

J. Building A Fire

Before lighting your first fire in the appliance:

NOTE: The special high temperature paint that your appliance is finished with will cure as your appliance heats. You will notice an odor and perhaps see some vapor rise from the appliance surface; this is normal. We recommend that you open a window until the odor dissipates and paint is cured.

1. Confirm the baffle and ceramic blanket are correctly positioned. They should be touching back of firebox and secured into Baffle Protection Channel (**Figure 13.1 and Figure 13.2**).
2. Remove all labels from glass.

There are many ways to build a fire. The basic principle is to light easily-ignitable tinder or paper, which ignites the fast burning kindling, which in turn ignites the slow-burning firewood.

Here is one method that works well:


1. Activate ACC.
2. Place several wads of crushed paper on the firebox floor. Heating the flue with slightly crumpled newspaper before adding kindling keeps smoke to a minimum.
3. Lay small dry sticks of kindling on top of the paper.
4. Make sure that no matches or other combustibles are in the immediate area of the appliance. Be sure the room is ventilated and the flue unobstructed.
5. Light the paper in the appliance. NEVER light or rekindle fire with kerosene, gasoline, or charcoal lighter fluid; the results can be fatal.
6. Once the kindling is burning quickly, add several full-length logs 3 to 4 inches (76 - 102mm) in diameter. Be careful not to smother the fire. Stack the pieces of wood 1/2 to 1 inch apart (13-25mm); near enough to keep each other hot, but far enough away from each other to allow air flow between them.
7. Activate the timer system (ACC).
 - This livens up the coal bed and reduces excessive emissions (opacity/smoke).
 - Open door slowly so that ash or smoke does not exit appliance through opening.
 - Large logs burn slowly, holding a fire longer.
 - Small logs burn fast and hot, giving quick heat.
8. As long as there are hot coals, repeating steps 6 through 7 will maintain a continuous fire.


Fuel reloading:

1. **This appliance has a large door with an exceptional view of the fire.**
 - Door opens 26 inches (660mm) which goes beyond the standard size hearth pad covering the floor in front of the appliance.
 - May want to use a hearth rug in front of the hearth pad to protect the flooring from ash spillage and continuous cleaning of carpet, etc.
2. **Open door slowly so that ash or smoke does not exit appliance through opening.**
 - Check the level of the ash build-up. Remove ash if it reaches the top of the brick covers. Ash should not be spilling over the brick covers onto the ash lip.
 - Any ash or coals on the ash lip can be pressed into the door gasket and shorten the life of the gasket.
 - If the ash is left to accumulate on the ash lip it can interfere with the door closing and/or falling out onto the hearth pad or beyond.

Check the ash level each time you reload.

NOTE: Build fire on brick firebox floor. Do NOT use grates, andirons or other methods to support fuel. It will adversely affect emissions.


WARNING



Fire Risk.

Do NOT store wood:

- Closer than required clearances to combustibles to appliance
- Within space required for loading or ash removal.

Do NOT operate appliance:

- With appliance door open.
- With ash removal system door open.

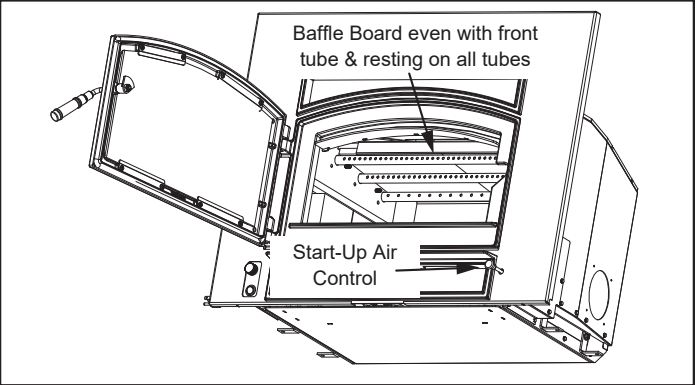


Figure 13.1

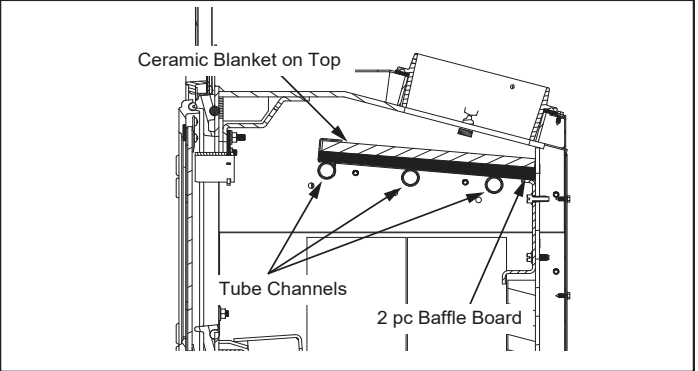




Figure 13.2


WARNING



Fire Risk.

- Do NOT burn wet or green wood.
- Store wood in dry location.
- Stack wood so both ends are exposed to air.

Wet, unseasoned wood can cause accumulation of creosote.

K. Blower Control Box with Snap Disc

1. The blower will turn on/off automatically when set to AUTO (**Figure 14.1**).
2. When set to MANUAL, the fan will turn on/off only. This setting over-rides the internal snap disc.
3. Adjust the speed of the fan by turning the HIGH/LOW knob to the desired setting.

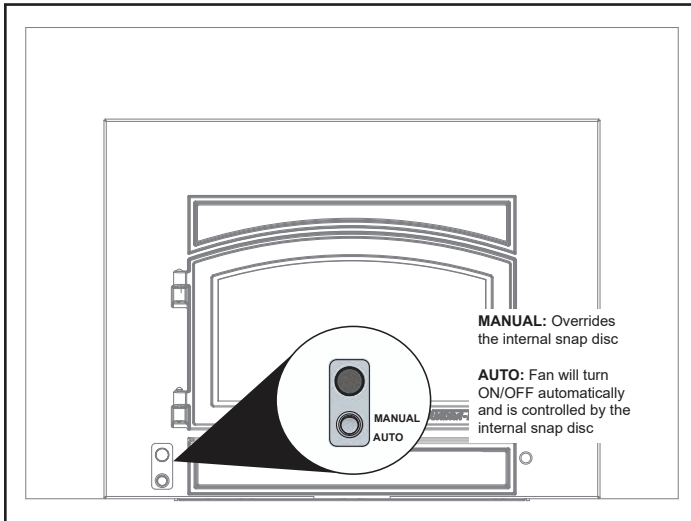


Figure 14.1

L. Blower Operation

1. **Initial (cold) startup** - Push the Start-up Air Control back until it stops. The blower tends to cool the appliance. Leave the blower off until the burn is well established, i.e., 30 minutes.

NOTE: For maximum efficiency and lowest emissions, when operating the blower in either the automatic or manual setting for the blower off until the burn is well established, i.e., 30 minutes.

2. The blower is equipped with five setting switch. Increase blower speed by turning the setting knob clockwise.

M. Opacity (Smoke)

Opacity is the measure of how cleanly your appliance is burning. Opacity is measured in percent; 100% opacity is when an object is totally obscured by the smoke column from a chimney, and 0% opacity means that no smoke column can be seen. As you become familiar with your appliance, you should periodically check the opacity. This will allow you to know how to burn as nearly smoke-free as possible (goal of 0% opacity).



CAUTION

When burning your first fire, you will experience smoke and odor from the appliance resulting from the curing of paint and burning off of any oils remaining from manufacturing.

Open windows during initial burn to dissipate smoke and odors!

- Odors may be irritating to sensitive individuals.
- Smoke detectors may activate.

NOTICE: Do NOT operate a circulating fan within close proximity, approximately 4 ft (1.2m), of appliance. Can reverse air flow, blowing hot air into appliance cavity. Can damage appliance blower due to overheating.

N. Clear Space

- Do NOT place combustible objects within 4 ft (1.2 m) of the front of appliance (**Figure 14.2**).
- **Mantel** - Avoid placing candles and other heat-sensitive objects on mantel or hearth. Heat may damage these objects.



WARNING

Do NOT place combustible objects in front of the appliance. High temperatures may ignite clothing, furniture or draperies.

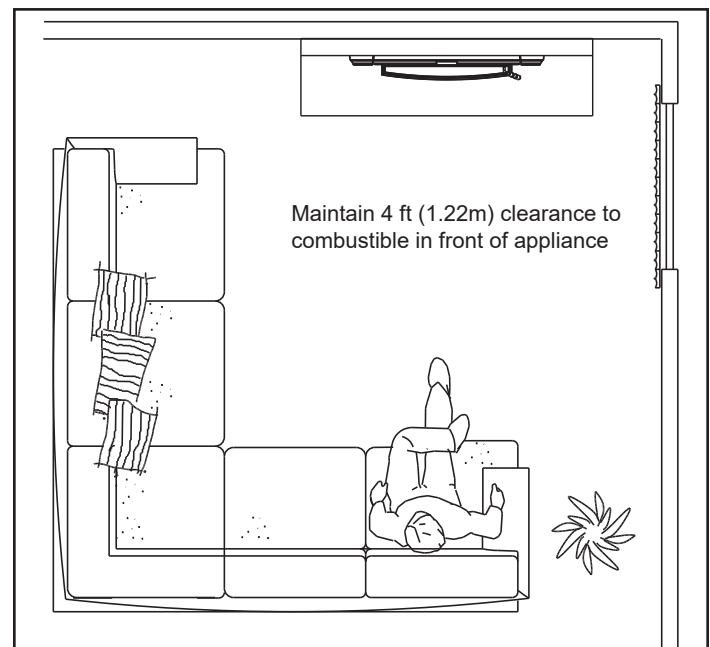




Figure 14.2

O. Negative Pressure

 WARNING	
	<p>Asphyxiation Risk.</p> <ul style="list-style-type: none"> Negative pressure can cause spillage of combustion fumes, soot and carbon monoxide. Appliance needs to draft properly for safety.


Negative pressure results from the imbalance of air available for the appliance to operate properly. It can be strongest in lower levels of the house.

Causes include:

- Exhaust fans (kitchen, bath, etc.).
- Range hoods.
- Combustion air requirements for furnaces, water appliances and other combustion appliances
- Clothes dryers.
- Location of return-air vents to furnace or air conditioning.
- Imbalances of the HVAC air handling system
- Upper level air leaks such as:
 - Recessed lighting
 - Attic hatch
 - Duct leaks

To minimize the effects of negative air pressure:

- Install the outside air kit with the intake facing prevailing winds during the heating season
- Ensure adequate outdoor air for all combustion appliances and exhaust equipment
- Ensure furnace and air conditioning return vents are not located in the immediate vicinity of the appliance
- Avoid installing the appliance near doors, walkways or small isolated spaces
- Recessed lighting should be a “sealed can” design
- Attic hatches weather stripped or sealed
- Attic mounted duct work and air handler joints and seams taped or sealed



 CAUTION	
<p>Do NOT operate a circulating fan within close proximity, approximately 4 ft (1.2m), of appliance:</p> <ul style="list-style-type: none"> Can reverse air flow, blowing hot air into appliance cavity. Can damage appliance blower due to overheating. 	



P. Frequently Asked Questions

ISSUES	SOLUTIONS
Odor from appliance	When first operated, this appliance may release an odor for the first several hours. This is caused by the curing of the paint and the burning off of any oils remaining from manufacturing.
Metallic noise	Noise is caused by metal expanding and contracting as it heats up and cools down, similar to the sound produced by a furnace or heating duct. This noise does not affect the operation or longevity of the appliance.
Whirring sound	If the blower has been installed, the blower produces a whirring sound which increases in volume as the speed is increased.

CONTACT YOUR DEALER for additional information regarding operation and troubleshooting.
 Visit www.quadrafire.com to find a dealer.

Table 15.1

 WARNING	
	<p>Fire Risk.</p> <ul style="list-style-type: none"> DO NOT BURN GARBAGE OR FLAMMABLE FLUIDS SUCH AS GASOLINE, NAPHTHA OR ENGINE OIL. Do NOT burn treated wood or wood with salt (driftwood). <p>• May generate carbon monoxide if burn material other than wood.</p> <p>May result in illness or possible death.</p>

 WARNING	
	<p>Fire Risk.</p> <p>Keep combustible materials, gasoline and other flammable vapors and liquids clear of appliance.</p> <ul style="list-style-type: none"> Do NOT store flammable materials in the appliance’s vicinity. <p>• DO NOT USE GASOLINE, LANTERN FUEL, KEROSENE, CHARCOAL LIGHTER FLUID OR SIMILAR LIQUIDS TO START OR “FRESHEN UP” A FIRE IN THIS APPLIANCE.</p> <ul style="list-style-type: none"> Keep all such liquids well away from the appliance while it is in use. Combustible materials may ignite.

3 Maintenance and Service

A. Quick Reference Maintenance Guide

When properly maintained, your appliance will give you many years of trouble-free service. Contact your dealer to answer questions regarding proper operation, troubleshooting and service for your appliance. Visit www.quadrafire.com/owner-resources to view basic troubleshooting, FAQs, use & care videos.



CAUTION

Allow the appliance to completely cool down before performing any cleaning or maintenance. Start the first inspection after the first 2 months of use, or if performance changes, and adjust your schedule accordingly. Maintenance is required for safe operation and must be performed to maintain your warranty.

	FREQUENCY	TASK
<p>Baffle & Blanket</p>	MONTHLY or after every one (1) cord of wood	Baffle and blanket placement is critical to heat output, efficiency and overall life of the appliance. Make sure the baffle is pushed all of the way to the back of the firebox and the blanket is laying flat. Inspect baffle for cracks.
<p>Blower</p>	YEARLY or after every four (4) cords of wood	Vacuum the blower impellers.
<p>Chimney System</p>	EVERY TWO MONTHS or after every four (4) cords of wood	<p>The chimney and chimney cap must be inspected for soot and creosote every two months during the burn season or more frequency if chimney exceeds or is under 14-16 ft (4.3m-4.8m) measured from bottom of appliance.</p> <p>This will prevent pipe blockage, poor draft, and chimney fires. Always burn dry wood to help prevent cap blockage and creosote build-up.</p>
<p>Firebrick & Ash Removal</p>	WEEKLY or after every 25 loads of wood	<p>Ashes must be cool before you can dispose of the ashes in a non-combustible container.</p> <p>Firebrick is designed to protect your firebox. After ashes are removed, inspect the firebrick and replace firebricks that are crumbling, cracked or broken.</p>
<p>Door & Glass Assemblies</p>	WEEKLY or after every 25 loads of wood	<p>Keep door and glass gasket in good shape to maintain good burn. <u>To test:</u> place a dollar bill between the appliance and door and then shut the door. If you can pull the dollar out, remove one washer from door handle behind latch cam and try again. If you can still pull it out, replace the door gasket.</p> <p>Check the glass frame for loose screws to prevent air leakage.</p> <p>Check glass for cracks.</p>
<p>Door Handles</p>	WEEKLY or after every 25 loads of wood	<p>Check the door latch for proper adjustment. This is very important especially after the door rope has formed to the appliance face.</p> <p>Check door handle for smooth cam operation.</p>

Table 16.1

These are generic drawings and may not represent your model.

B. Cleaning the Glass & Replacement

Most of the carbon deposits on the glass will burn off during hot fires.

However, the ash residue that accumulates on the glass surface should be removed regularly to prevent etching. To clean the glass, follow this procedure:

- Be sure the glass is completely cool.
- Clean the glass with water or a cleaner made especially for this purpose. Do not use abrasive cleaners. Use cleaning agents sparingly and be sure to keep them off the outer surfaces of the stove.
- Rinse the glass thoroughly.
- Dry the glass completely.

Replace Broken Glass Immediately

Do not operate your stove if the glass in the doors is damaged.

If you need to replace the glass, use only the high temperature 5 mm ceramic glass supplied by Quadra-Fire. Do not use substitutes.

Service Part: SRV7094-054

1. Ensure that the fire is out and the appliance is cool to the touch.
2. Protect a table or counter top with padding or towels. Protect your hands and wear gloves to prevent injury.
3. Remove the door with the broken glass by lifting the door up and off of the hinges.
4. Lay door face down on a table or counter making sure the handle hangs over the edge so the door lays flat, on a soft surface.
5. Remove the screws from each glass retainer and remove the glass. (If screws are difficult to remove, soak with penetrating oil first).
6. Center the glass with edges evenly overlapping the opening in the door, (i.e. same space top and bottom, left and right sides).
7. Replace the glass retainers. Be careful not to cross thread the screws.
8. Tighten each retainer just a few turns until each is secured. Check again for centering of glass in door frame. Continue to tighten each retainer alternately, a few turns at a time, until the glass is secure.

NOTE: DO NOT OVER TIGHTEN RETAINERS - can cause glass to break.

9. Replace the door on the appliance.


Quadra-Fire appliances are equipped with ceramic super heat-resistant glass, which can only be broken by impact or misuse.

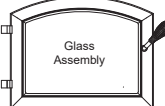
**WARNING**



Injury Risk.

- Use only glass specified in manual.
- DO NOT REPLACE with any other material.

**CAUTION**



Glass
Assembly

Handle glass assembly with care.
When cleaning glass:

- Avoid striking, scratching or slamming glass.
- Do NOT clean glass when hot.
- Do NOT use abrasive cleaners.
- Use a hard water deposit glass cleaner on white film.
- Use commercial oven cleaner on heavier deposits.
- Remove all residue of oven cleaner or will permanently stain glass on next firing.

Refer to maintenance instructions.

C. General Maintenance

1. Creosote (Chimney) Cleaning

- **Frequency:** Every 2 months during heating season or as recommended by a certified chimney sweep; more frequently if chimney exceeds or is under 14-16 ft. (measured from bottom of appliance)
- **By:** Certified Chimney Sweep

Remove all ash from the firebox and extinguish all hot embers before disposal. Allow the appliance to cool completely. Disconnect flue pipe or remove baffle and ceramic blanket from appliance before cleaning chimney. Otherwise residue can pile up on top of the baffle and ceramic blanket and the appliance will not work properly. (See **Baffle Board** on [page 19](#)). Close the door tightly. The creosote or soot should be removed with a brush specifically designed for the type of chimney in use. Clean out fallen ashes from the firebox.



It is also recommended that before each heating season the entire system be professionally inspected, cleaned and repaired, if necessary.



Inspection - Inspect the system at the appliance connection and at the chimney top. Cooler surfaces tend to build creosote deposits quicker, so it is important to check the chimney from the top as well as from the bottom.

Formation and Need For Removal - When wood is burned slowly, it produces tar and other organic vapors which combine with expelled moisture to form creosote.

The creosote vapors condense in the relatively cool chimney flue of a newly-started or a slow-burning fire. As a result, creosote residue accumulates on the flue lining. When ignited, this creosote creates an extremely hot fire which may damage the chimney or even destroy the house.

The chimney connector and chimney should be inspected once every 2 months during the heating season to determine if a creosote or soot buildup has occurred. If creosote or soot has accumulated, it should be removed to reduce the risk of a chimney fire.

 WARNING	
	Fire Risk. Prevent creosote buildup.
	<ul style="list-style-type: none"> • Inspect chimney connector and chimney once every two months during heating season. • Remove creosote to reduce risk of chimney fire. • Ignited creosote is extremely HOT.



 WARNING	
	Fire Risk.
	<ul style="list-style-type: none"> • Do not use chimney cleaners or flame colorants in your appliance. Will corrode chimney pipe.

2. Disposal of Ashes

- **Frequency:** When ash is within 1-3/4 in. (44mm) of firebox lip
- **By:** Homeowner

 WARNING	
	Fire Risk.
	Ashes could contain hot embers.

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 the closed container until all cinders have thoroughly cooled.

 WARNING	
	Fire Risk. Disposal of Ashes
	<ul style="list-style-type: none"> • Ashes should be placed in metal container with tight fitting lid. • Do not place metal container on combustible surface.
	<ul style="list-style-type: none"> • Ashes should be retained in closed container until all cinders have thoroughly cooled.

3. Appliance Inspection


- **Frequency:** Every 2 months at the same time the chimney and chimney connector are inspected.
- **By:** Homeowner

Check for:

- Cracks in glass
- Door handle - smooth cam operation
- Baffle and ceramic blanket correct placement
- Baffle for warp-age
- Firebrick for cracks, broken or crumbly
- Door gasket (Dollar bill test): Place a dollar bill between the stove and the door and then shut the door. If you can pull the dollar bill out, replace the door gasket.
- Glass frame for loose screws

4. Glass Cleaning

- **Frequency:** As desired
- **By:** Homeowner

 CAUTION	
Handle glass assembly with care. Glass is breakable.	
<ul style="list-style-type: none"> • Avoid striking, scratching or slamming glass • Avoid abrasive cleaners • Do not clean glass while it is hot 	

Clean glass with a non-abrasive glass cleaner. Abrasive cleaners may scratch and cause glass to crack. If the deposits on the glass are not very heavy, normal glass cleaners work well. Heavier deposits may be removed by using a damp cloth dipped in wood ashes or by using a commercially available oven cleaner.

After using an oven cleaner, it is advisable to remove any residue with a glass cleaner or soap and water. Oven cleaner left on during the next firing can permanently stain the glass and damage the finish on metal surfaces.

A portion of the combustion air entering the firebox is deflected down over the inside of the door glass. This air flow "washes" the glass, helping to keep smoke from adhering to its surface.

5. Cleaning Plated Surfaces

- **Frequency:** Prior to first burn and then as desired
- **By:** Homeowner

 CAUTION	
Do not use polishes with abrasives. It will scratch plated surfaces.	

Clean all the fingerprints and oils from plated surfaces **BEFORE** firing the appliance for the first time. If not cleaned properly before lighting your first fire, the oils can cause permanent markings on the plating.

After the plating is cured, the oils will not affect the finish and little maintenance is required. Wipe clean as needed.

6. Inspect Firebrick



- **Frequency:** After each ash removal
- **By:** Homeowner

Replace the firebrick if they become crumbly and/or if there is a 1/4 inch (6.35mm) gap between the bricks.

The firebox is lined with firebrick, which has exceptional insulating properties. Do not use a grate; simply build a fire on the firebox floor. Do not operate appliance without firebrick.

1. After the coals have completely cooled, remove all old brick and ash from unit and vacuum firebox.
2. Remove new brick set from box and lay out to the diagram shown in the instructions that come with the brick set or refer to the diagram on the service parts list at the end of this manual.
3. Lay bottom bricks in unit.
4. Install rear bricks on the top of the bottom bricks. Slide top of bricks under clip on back of firebox wall and push bottom of bricks back.
5. Install side bricks. Slide top of brick under clips on side of firebox and push the bottom of the brick until it is flush with the side of the unit.

D. Correct Baffle & Blanket Placement

	WARNING
	<p>Fire Risk. Firebox damage due to improper baffle placement is not covered by warranty. Operate the wood burning appliance with the baffle in the correct position only.</p> <p><u>Not doing so could result in:</u></p> <ul style="list-style-type: none"> • Reduced efficiency • Overheating the chimney • Overheating the rear of the firebox • Poor performance <p>Ensure correct baffle placement and replace baffle components if damaged or missing.</p>

	CAUTION
<p>The baffle boards are FRAGILE. Use extreme caution when loading firewood to prevent:</p> <ul style="list-style-type: none"> • Cracking, breaking or damaging the baffle boards <p>DO NOT operate the appliance without baffle boards</p>	

NOTE: A missing, damaged or improperly positioned baffle is dangerous and may cause damage and poor efficiency. It will also void your warranty.

NOTE: These are generic drawings and may not represent your specific model.

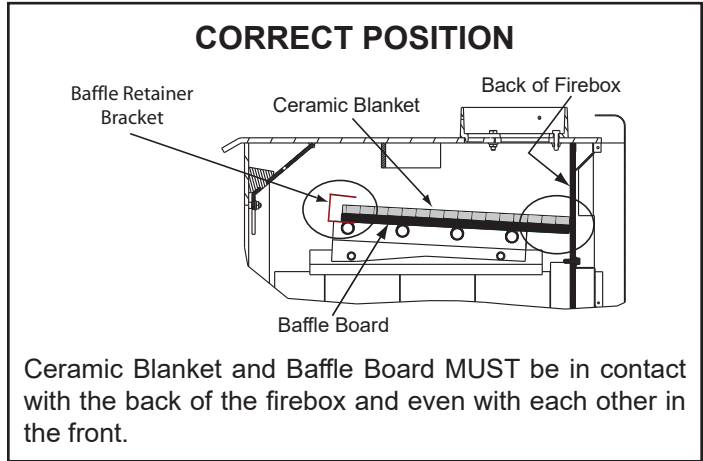


Figure 19.1 - Correct Baffle and Blanket Positions

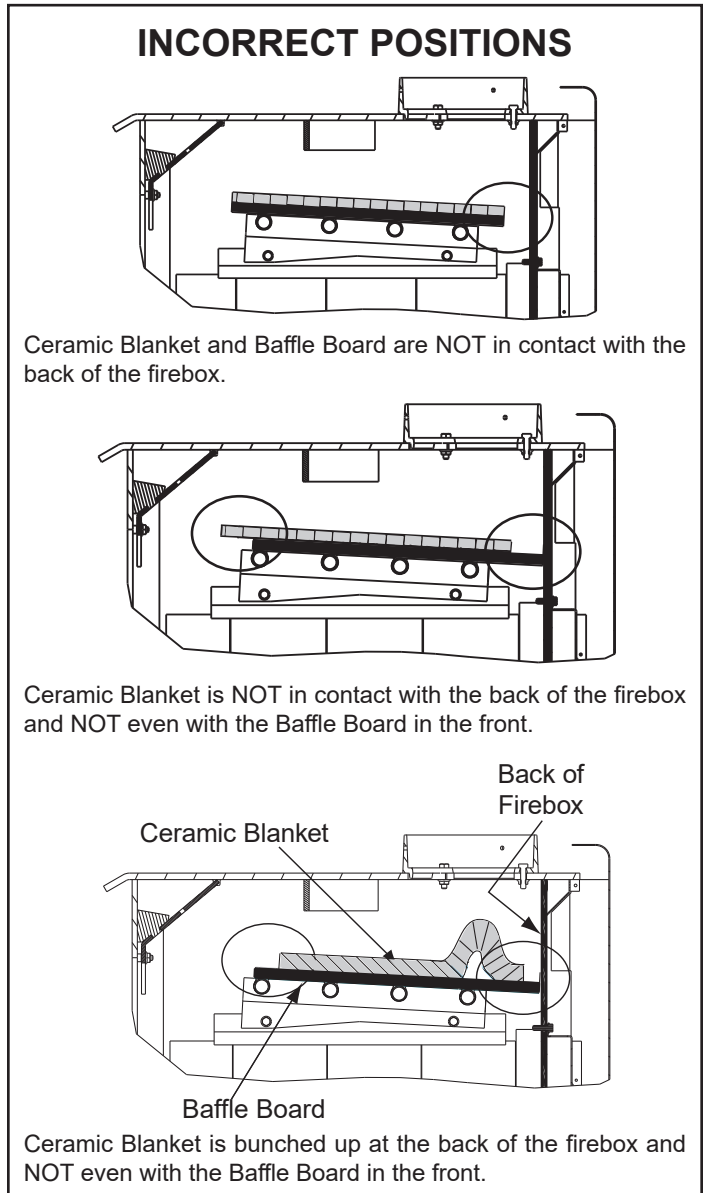


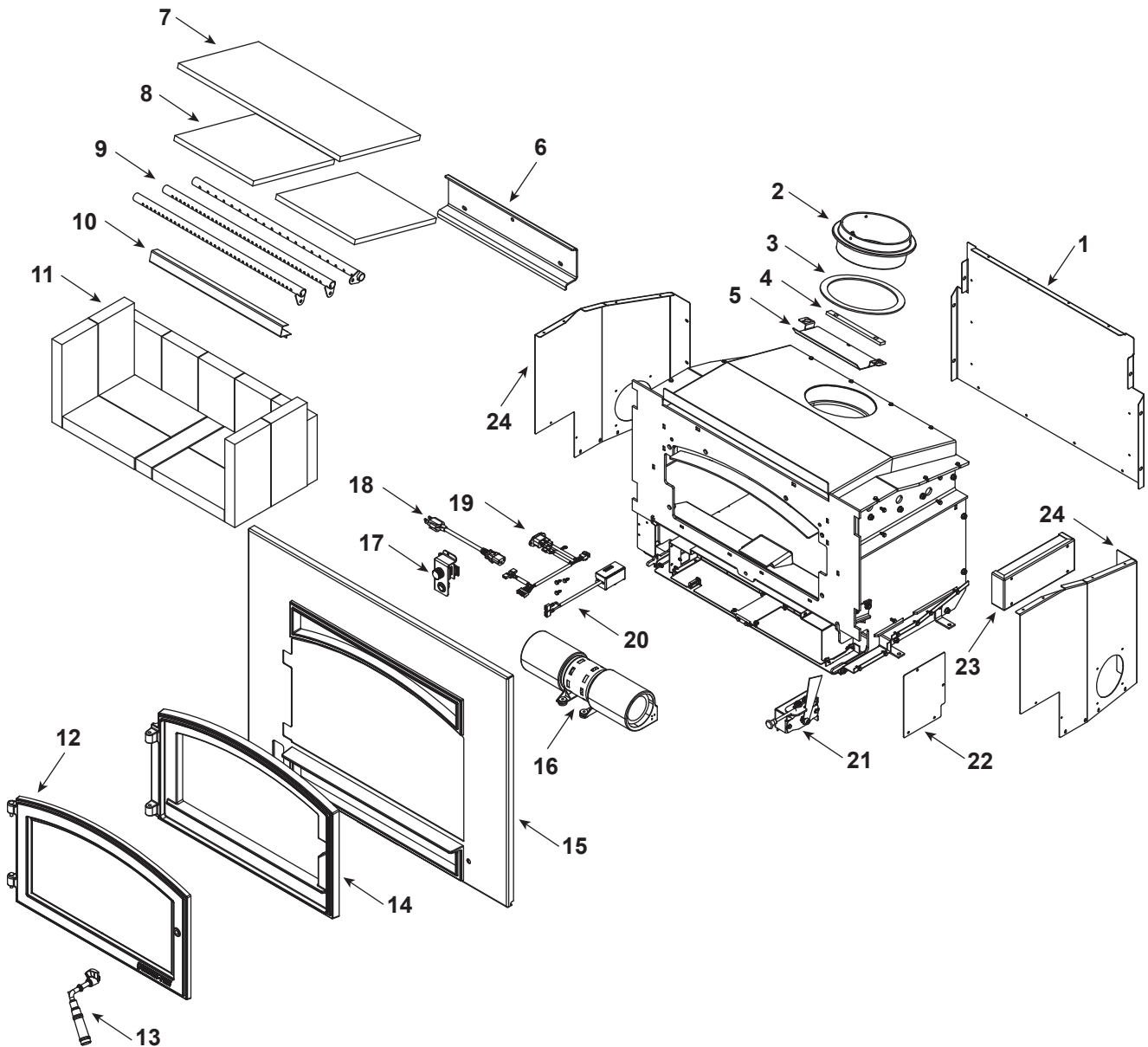
Figure 19.2 - Incorrect Baffle and Blanket Positions

4 Troubleshooting Guide

With proper installation, operation, and maintenance your wood appliance will provide years of trouble-free service. If you do experience a problem, this troubleshooting guide will assist you or a qualified service person in the diagnosis of a problem and the corrective action to be taken.

Start Fire Problems	Possible Cause	Solution
Can not get fire started Excessive smoke or spillage Burns too slowly Not enough heat output	Not enough kindling/paper or no kindling/paper	Use dry kindling, more paper. Arrange kindling & wood for air movement.
	Not enough air for fire to ignite	Check for restricted termination cap
		Check for blockage of outside air kit; if installed.
		Check for flue blockage.
		Pre-warm flue before starting fire (refer to Building a Fire on page 12).
		Check for adequate vent height (refer to Chimney Height / Rise and Run on page 14 in the Installation manual).
	Open window below the appliance towards the wind.	
	Wood condition is too wet, too large	Use dry, seasoned wood (refer to Seasoned Wood on page 10).
	Bed of coals not established before adding wood	Start with paper & kindling to establish bed of coals (refer to Building a Fire on page 12).
	Flue blockage such as birds' nests or leaves in termination cap	Have chimney inspected for creosote and cleaned by a certified chimney sweep.
Down draft or negative pressure Competition with exhaust devices	Do not use exhaust fans during start-up (refer to Negative Pressure on page 15).	
	Open window below the appliance towards the wind.	
Fire burns too fast	Extremely dry or soft wood	Mix in hardwood.
		Mix in less seasoned wood after fire is established (refer to Wood Fuel on page 12).
	Over drafting	Check for correct vent height; too much vertical height creates over drafting.
		Check location of vent termination (refer to Chimney Termination Requirement on page 13 in the Installation manual).

Table 20.1



Part number list on following page.

IMPORTANT: THIS IS DATED INFORMATION. Parts must be ordered from a dealer or distributor. **Hearth and Home Technologies does not sell directly to consumers.** Provide model number and serial number when requesting service parts from your dealer or distributor.

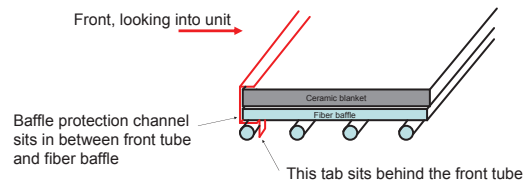


Stocked at Depot

ITEM	DESCRIPTION	COMMENTS	PART NUMBER	
1	Convection Back		SRV7094-161	
	Hurricane Screw	Pkg of 40	SRV2005-861/40	Y
	Screw, Hwh Ms 1/4-20 X 3/4 Ns	Pkg of 25	220-0080/25	Y
2	Flue Attach Ring		SRV7095-203	
	Bolt 5/16 X 18 X 1		7000-571	Y
	Nut, 5/16-18	Pkg of 10	A-3483-1/10	Y
3	Gasket, Flue Collar		SRV7044-194	
4	Chimney Ring Attach		SRV7044-181	
5	Flue Baffle Plate		SRV7094-185	
6	Rear Brick Retainer		SRV7094-127	
	Screw, Hwh Ms 1/4-20 X 3/4 Ns	Pkg of 25	220-0080/25	Y
7	Ceramic Fiber Blanket		SRV7094-118	Y
8	Baffle Board	Pkg of 2	SRV7094-117	Y
9	Secondary Tubes	Qty 2 req	SRV7094-121	
	Screw, Hwh Ms 1/4-20 X 3/4 Ns	Pkg of 25	220-0080/25	Y
	Nut, Flange 1/4-20	Pkg of 24	226-0130/24	Y

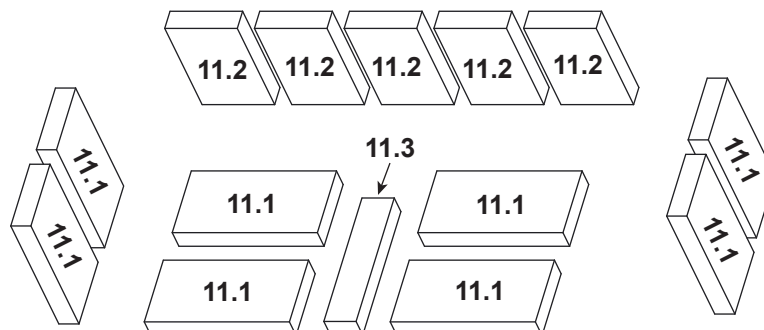
#10 Baffle Protection Channel

Side view



10	Baffle Protection Channel		SRV7094-119	Y
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#11 Brick Assembly



11	Brick Assembly		SRV7094-022	Y
11.1	Brick, Uncut (9" X 4.5" X 1.25")	Qty 8 req	832-0550	Y
11.2	Brick, 7" X 4.5" X 1.25"	Qty 5 req	SRV7128-011	
11.3	Brick, 9" X 2" X 1.25"	Qty 1 req	SRV7128-018	
	Brick, Uncut (9" X 4.5" X 1.25")	Pkg of 6	832-3040	

Additional service part numbers appear on following page.

IMPORTANT: THIS IS DATED INFORMATION. Parts must be ordered from a dealer or distributor. **Hearth and Home Technologies does not sell directly to consumers.** Provide model number and serial number when requesting service parts from your dealer or distributor.



**Stocked
at Depot**

ITEM	DESCRIPTION	COMMENTS	PART NUMBER	
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>#12 Door Assembly</p> </div> <div style="width: 45%;"> <p>#13 Door Handle Assembly</p> </div> </div>				
12	Door Assembly		SRV7094-053	
12.1	Door		SRV7094-205	
12.2	Glass Assembly		SRV7094-054	
12.3	Glass Retainers	Qty 4 req	SRV7094-174	
	Screw, Pan Head Phillips, 10-24 x 3/8	Pkg of 10	1200983-10	Y
12.4	Door Gasket	10 Feet	1-00-1203668	Y
13	Door Handle Assembly		SRV7063-014	Y
13.1	Fiber Handle		SRV7060-212	Y
13.2	Door Handle		SRV7063-137	
13.3	Key, cam Latch		SRV430-1151	
13.4	Washer, Sae 3/8 (3 ea)	Pkg of 3	832-0990	Y
13.5	Cam Latch		SRV430-1141	
13.6	Nut, Side Lock Jam	Pkg of 24	226-0100/24	Y
14	Front		SRV7094-201	
	Wire Jacket Rope, 1/2		7000-811/10	
<p>#15 Fascia Assembly</p>				
15	Fascia Assembly		SRV7094-057	
15.1	Front Trim, Upper (w/Screen)		SRV7094-209	
	Screw, Pan Head phillips 10-24 x 3/8	Pkg of 10	1200983-10	Y
15.2	Front Trim, Lower (w/Screen)		SRV7094-211	
	Screw, Pan Head phillips 10-24 x 3/8	Pkg of 10	1200983-10	Y
15.3	Fascia Weldment		SRV7095-061	
16	Blower Replacement		SRV7000-868	Y

Additional service part numbers appear on following page.

IMPORTANT: THIS IS DATED INFORMATION. Parts must be ordered from a dealer or distributor. **Hearth and Home Technologies does not sell directly to consumers.** Provide model number and serial number when requesting service parts from your dealer or distributor.



**Stocked
at Depot**

ITEM	DESCRIPTION	COMMENTS	PART NUMBER	
#17 Control Panel Assembly				
17	Control Panel Assembly		SRV7095-026	
17.1	Speed Control		SRV7000-888	Y
17.2	Knob, Speed Control		SRV7000-930	Y
17.3	Rocker Switch (Round)		SRV7000-940	Y
18	Power Cord		812-1180	Y
19	Wire Harness		SRV7000-891	Y
20	Snap Disc, #1, Convection Blower		SRV7094-068	Y
21	Timer Control Assembly		SRV7094-025	Y
	Knob	Pkg of 2	32284/2	Y
	Screw, Pan Head phillips 8-32 x 3/8	Pkg of 40	225-0500/40	Y
	Timer (Only) Replacement Assembly		SRV480-1940	Y
22	OA Cover		SRV7094-234	Y
23	Secondary Box/Covers		SRV7094-125	
	Screw, Machine Screw 1/4-20 x 3/4 Ns	Pkg of 25	220-0080/25	Y
	Hurricane Screw	Pkg of 40	SRV2005-861/40	Y

Additional service part numbers appear on following page.

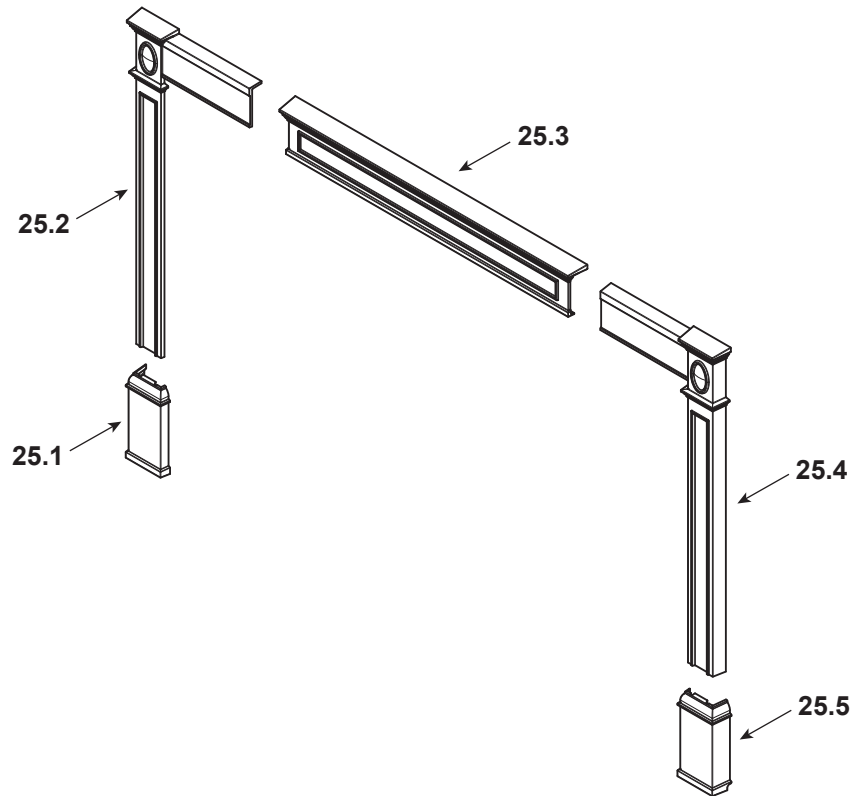
IMPORTANT: THIS IS DATED INFORMATION. Parts must be ordered from a dealer or distributor. **Hearth and Home Technologies does not sell directly to consumers.** Provide model number and serial number when requesting service parts from your dealer or distributor.



Stocked at Depot

ITEM	DESCRIPTION	COMMENTS	PART NUMBER	
24	Combustion Cover	Includes left & right	SRV7094-134	
	Hurricane Screw	Pkg of 40	SRV2005-861/40	Y
	Component Pack		SRV7094-062	
	Surround 43 x 31		SP1-4331	
	Surround Trim Assembly 43 x 31		TRIMKIT-4331-NL	
	Surround 51 x 34		SP1-5134	
	Surround Trim Assembly 51 x 34		TRIMKIT-5134-NL	
	Surround Cast Trim 43 x 31		CT1-4331	
	Surround Cast Trim 51 x 34		CT1-5134	
	Custom Surround		CUST-SP1-SPL	

#25 Cast Trim



25	Trim Cast, Full Set		811-0930	
25.1	Footer, Left		414-7090MBK	
25.2	Trim Leg, Left		414-7120MBK	
25.3	Header		414-7110MBK	
25.4	Trim Leg, Right		414-7130MBK	
25.5	Footer, Right		414-7100MBK	
	15 Degree Adapter		DV-6DLR-E15ADSS	

Additional service part numbers appear on following page.

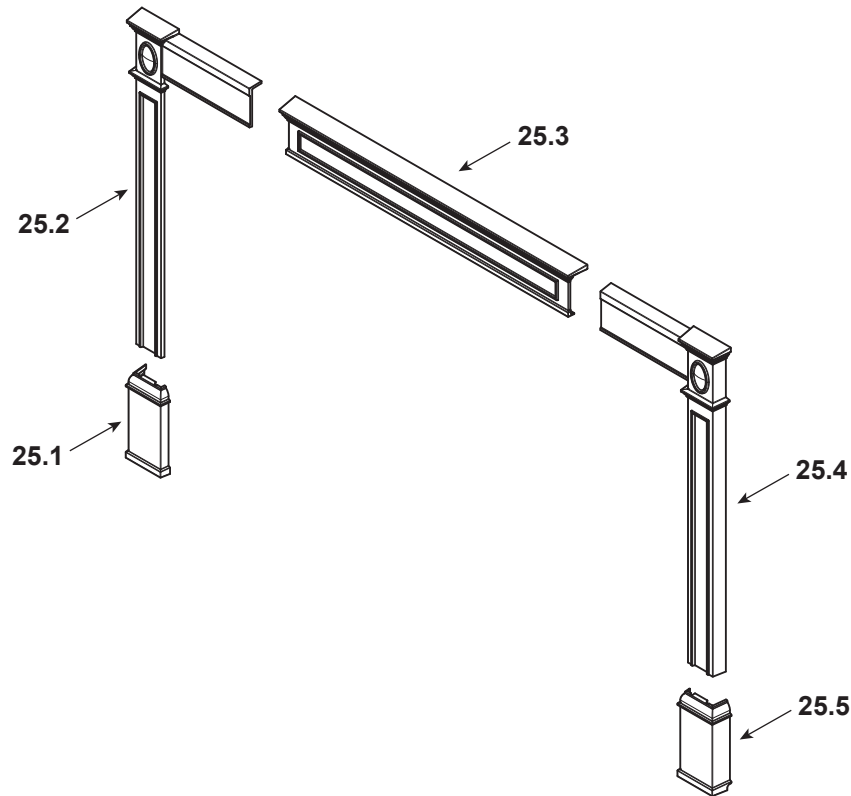
IMPORTANT: THIS IS DATED INFORMATION. Parts must be ordered from a dealer or distributor. **Hearth and Home Technologies does not sell directly to consumers.** Provide model number and serial number when requesting service parts from your dealer or distributor.



Stocked at Depot

ITEM	DESCRIPTION	COMMENTS	PART NUMBER	
24	Combustion Cover	Includes left & right	SRV7094-134	
	Hurricane Screw	Pkg of 40	SRV2005-861/40	Y
	Component Pack		SRV7094-062	
	Surround 43 x 31		SP1-4331	
	Surround Trim Assembly 43 x 31		TRIMKIT-4331-NL	
	Surround 51 x 34		SP1-5134	
	Surround Trim Assembly 51 x 34		TRIMKIT-5134-NL	
	Surround Cast Trim 43 x 31		CT1-4331	
	Surround Cast Trim 51 x 34		CT1-5134	
	Custom Surround		CUST-SP1-SPL	

#25 Cast Trim



25	Trim Cast, Full Set		811-0930	
25.1	Footer, Left		414-7090MBK	
25.2	Trim Leg, Left		414-7120MBK	
25.3	Header		414-7110MBK	
25.4	Trim Leg, Right		414-7130MBK	
25.5	Footer, Right		414-7100MBK	
	15 Degree Adapter		DV-6DLR-E15ADSS	

Additional service part numbers appear on following page.

QUADRA-FIRE®

NOTHING BURNS LIKE A QUAD

CONTACT INFORMATION

Hearth & Home Technologies
352 Mountain House Road
Halifax, PA 17032
Division of HNI INDUSTRIES

Please contact your Quadra-Fire dealer with any questions or concerns.
For the number of your nearest Quadra-Fire dealer
log onto www.quadrafire.com



CAUTION



DO NOT DISCARD THIS MANUAL

- Important operating and maintenance instructions included.
- Read, understand and follow these instructions for safe installation and operation.
- Leave this manual with party responsible for use and operation of this appliance.



We recommend that you record the following pertinent information for your heating appliance.

Date purchased/installed: _____

Serial Number: _____

Location on appliance: _____

Dealership purchased from: _____

Dealer Phone: 1() - _____

Notes:

This product may be covered by one or more of the following patents: (United States) 5341794, 5263471, 6688302, 7216645, 7047962 or other U.S. and foreign patents pending.



HEARTH & HOME
technologies™

Mettler Toledo
Service Business Unit Industrial
1900 Polaris Parkway
Columbus, OH 43240
1-800-523-5123



Accredited by the American Association
for Laboratory Accreditation (A2LA)
CALIBRATION CERT #1902.01

ISO 17025 Registered
ANSI/NCSL Z540-1 Accredited

Accuracy Calibration Certificate

Customer

Company: PFS-TECO
Address: 11785 SE Hwy 212; Ste 305
City: Clackamas **Contact:** John Steinert
Zip / Postal: 97015-9050
State / Province: Oregon

Weighing Device

Manufacturer: Mettler Toledo **Instrument Type:** Weighing Instrument
Model: PFD774-US11 **Asset Number:** 1
Serial No.: C112381341 **Terminal Model:** IND570
Building: N/A **Terminal Serial No.:** C101887027
Floor: N/A **Terminal Asset No.:** N/A
Room: N/A

Range	Max. Capacity	Readability (d)
1	1000 lb	0.02 lb

Procedure

Calibration Guideline: ASTM E898 - 20
METTLER TOLEDO Work Instruction: 30260953

This calibration certificate including procedures and uncertainty estimation also complies with EURAMET cg-18 v 4.0.

This calibration certificate contains measurements for As Found and As Left calibrations.

The sensitivity/span of the weighing instrument was adjusted before As Left calibration with an external weight.

	Temperature		Humidity	
As Found	Start: 20.0 °C	End: 20.0 °C	Start: 44.0 %	End: 44.0 %
As Left	Start: 20.0 °C	End: 20.0 °C	Start: 44.0 %	End: 28.0 %

Environmental conditions have been verified to ensure the accuracy of the calibration.

This certificate is issued in accordance with the conditions of accreditation granted by A2LA, which is based on ISO/IEC 17025. A2LA has assessed the measurement capability of the laboratory and its traceability to recognized national standards.

As Found Calibration Date: 16-Apr-2021
As Left Calibration Date: 16-Apr-2021
Issue Date: 16-Apr-2021
Requested Next Calibration Date: 30-Apr-2022

Authorized A2LA Signatory: 
Gary Sargent

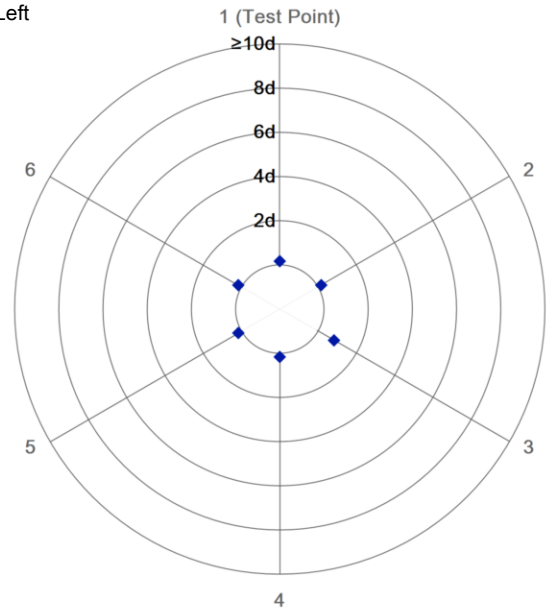
Measurement Results

Repeatability

Test Load: 500 lb

	As Found	As Left
1	N/A	500.00 lb
2	N/A	500.00 lb
3	N/A	500.02 lb
4	N/A	500.00 lb
5	N/A	500.00 lb
6	N/A	500.00 lb

○ As Found
◆ As Left



Standard Deviation	N/A	0.008 lb
--------------------	-----	----------

The "d" in the graph represents the readability of the range/interval in which the test was performed.

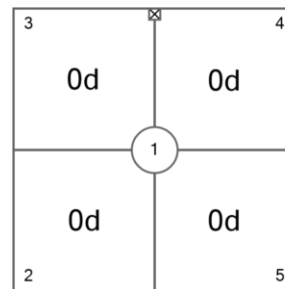
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

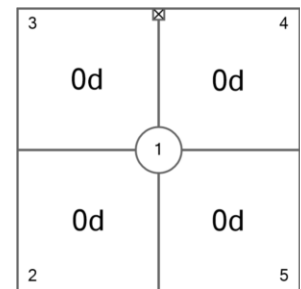
Test Load: 325 lb

Position	As Found	As Left
1	325.00 lb	325.00 lb
2	325.00 lb	325.00 lb
3	325.00 lb	325.00 lb
4	325.00 lb	325.00 lb
5	325.00 lb	325.00 lb

Maximum Deviation	0.00 lb	0.00 lb
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As Found



As Left

The "d" in the graph represents the readability of the range/interval in which the test was performed.

Error of Indication

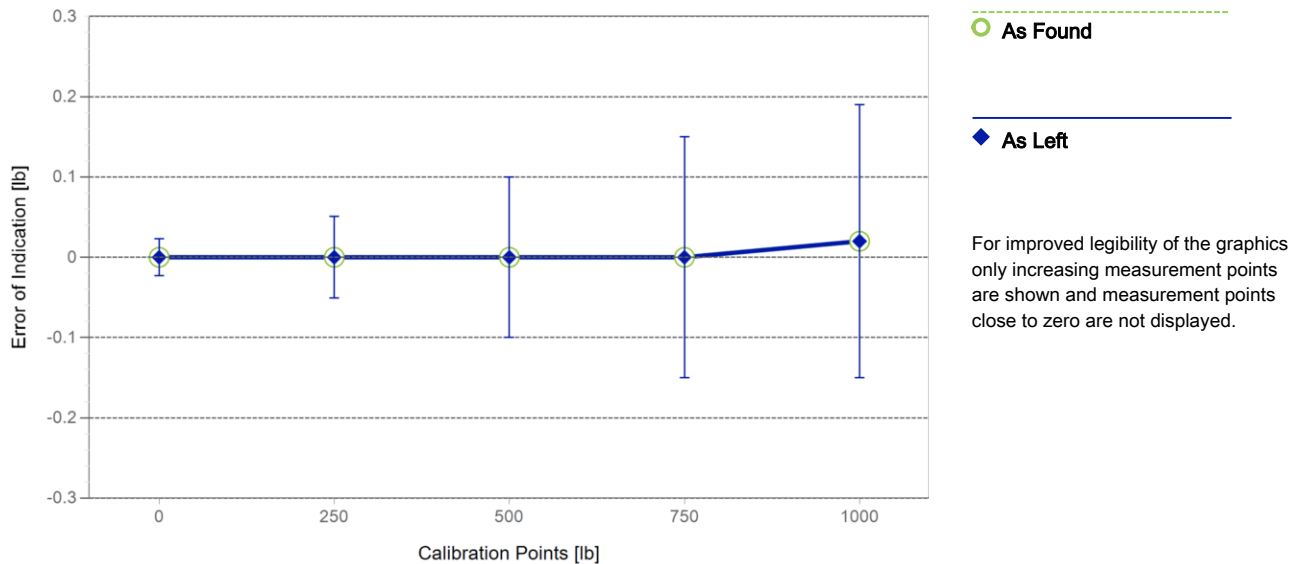
As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0 lb	0.00 lb	0.00 lb	N/A	N/A
2 ¹	250 lb	250.00 lb	0.00 lb	N/A	N/A
3 ¹	500 lb	500.00 lb	0.00 lb	N/A	N/A
4 ¹	750 lb	750.00 lb	0.00 lb	N/A	N/A
5	1000 lb	1000.02 lb	0.02 lb	N/A	N/A
6 ¹	750 lb	750.00 lb	0.00 lb	N/A	N/A
7 ¹	500 lb	500.00 lb	0.00 lb	N/A	N/A
8 ¹	250 lb	250.00 lb	0.00 lb	N/A	N/A
9	0 lb	0.00 lb	0.00 lb	N/A	N/A

As Left

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0 lb	0.00 lb	0.00 lb	0.023 lb	2.28
2 ¹	250 lb	250.00 lb	0.00 lb	0.051 lb	2
3 ¹	500 lb	500.00 lb	0.00 lb	0.10 lb	2
4 ¹	750 lb	750.00 lb	0.00 lb	0.15 lb	2
5	1000 lb	1000.02 lb	0.02 lb	0.17 lb	2.05
6 ¹	750 lb	750.00 lb	0.00 lb	0.15 lb	2
7 ¹	500 lb	500.00 lb	0.00 lb	0.10 lb	2
8 ¹	250 lb	250.00 lb	0.00 lb	0.051 lb	2
9	0 lb	0.00 lb	0.00 lb	0.023 lb	2.28

¹The calculated uncertainty was replaced by the CMC (Calibration and Measurement Capabilities) value because the calculated uncertainty was smaller than the CMC value.



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k - which can be larger than 2 according to ASTM E898 and EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: NIST NIST-F

Weight Set No.:	<u>182 50's & 25's</u>	Date of Issue:	<u>25-Jun-2019</u>
Certificate Number:	<u>OR-19-186-F</u>	Calibration Due Date:	<u>30-Jun-2021</u>

Remarks

Equipment condition: Good

Calibration after installation

The recording of false fictitious or fraudulent statements or entries on this document may be punishable as a felony under federal Statute

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with k=2 in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use: 10.0 · 10⁻⁶ / K

Temperature range on site for the evaluation of the measurement uncertainty in use: 10 K

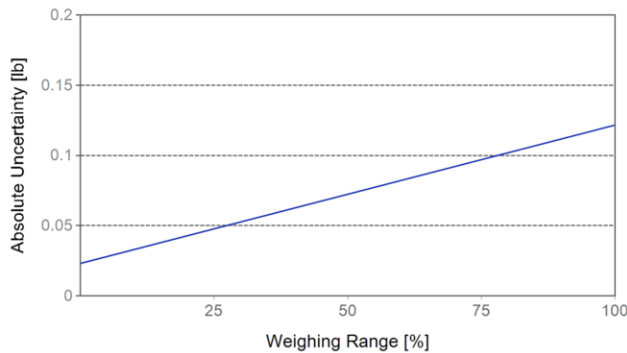
Linearization of Uncertainty Equation

Range			As Found	As Left
	d	Max		
1	0.02 lb	1000 lb	N/A	$U_1 = 0.023 \text{ lb} + 0.0000986 \text{ lb/lb} \cdot R$

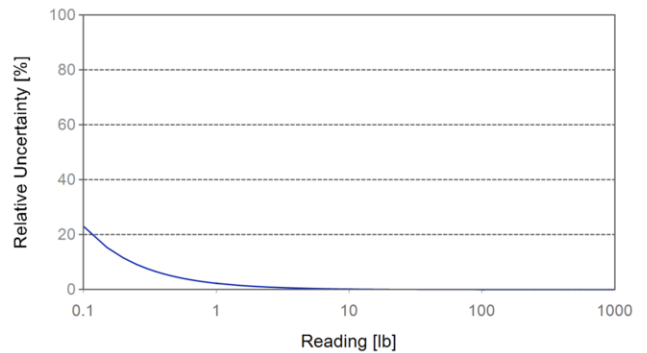
To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net Indication	As Found		As Left	
1.00 lb	N/A	N/A	0.023 lb	2.3%
10.00 lb	N/A	N/A	0.024 lb	0.24%
100.00 lb	N/A	N/A	0.033 lb	0.033%
500.00 lb	N/A	N/A	0.072 lb	0.014%
1000.00 lb	N/A	N/A	0.12 lb	0.012%



As Found



As Left

Handbook 44 Tolerance Assessment(Acceptance)

Assessment done without considering measurement uncertainty.

The measurements from the attached calibration certificate were assessed against the Tolerances defined by NIST Handbook 44.

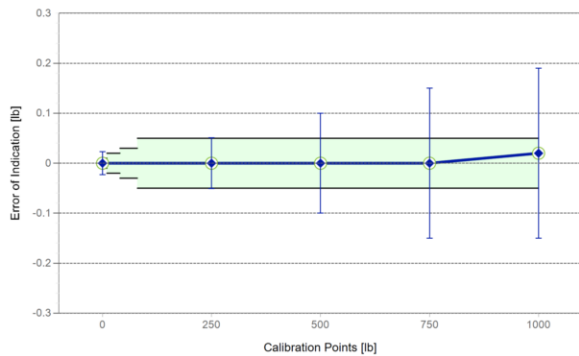
The range of measurements for both Eccentricity and Repeatability (if performed) tests is assessed against Maintenance Tolerances.

Overall **As Found** **As Left**

✔ ✔ ✔ = Passed
✘ = Failed

Weighing Device

Range	Max. Capacity	Readability (d)	Verification Scale Interval (e)	Class
1	1000 lb	0.02 lb	0.02 lb	III



Tolerances according to NIST Handbook 44

Test Load		Tolerance
From	To	
0.00 lb	0.00 lb	0.005 lb
0.02 lb	10.00 lb	0.01 lb
10.02 lb	40.00 lb	0.02 lb
40.02 lb	80.00 lb	0.03 lb
80.02 lb	1000.00 lb	0.05 lb

○ As Found
◆ As Left
— Tolerance

Eccentricity and Repeatability

Test	Test Load	Tolerance	As Found		As Left	
			Max. Error / Range	Result	Max. Error / Range	Result
Eccentricity (Max. Error)	325 lb	0.05 lb	0.00 lb	✔	0.00 lb	✔
Eccentricity (Range)	325 lb	0.1 lb	0.00 lb	✔	0.00 lb	✔
Repeatability (Max. Error)	500 lb	0.05 lb	N/A	N/A	0.02 lb	✔
Repeatability (Range)	500 lb	0.10 lb	N/A	N/A	0.02 lb	✔

Max. Error: Maximum of the absolute values of the individual errors.

Range: Difference between largest and smallest measurement value.

Error of Indication

	Reference Value	Tolerance	As Found		As Left	
			Error of Indication	Result	Error of Indication	Result
1	0 lb	0.01 lb	0.00 lb	✔	0.00 lb	✔
2	250 lb	0.05 lb	0.00 lb	✔	0.00 lb	✔
3	500 lb	0.05 lb	0.00 lb	✔	0.00 lb	✔
4	750 lb	0.05 lb	0.00 lb	✔	0.00 lb	✔
5	1000 lb	0.05 lb	0.02 lb	✔	0.02 lb	✔
6	750 lb	0.05 lb	0.00 lb	✔	0.00 lb	✔
7	500 lb	0.05 lb	0.00 lb	✔	0.00 lb	✔
8	250 lb	0.05 lb	0.00 lb	✔	0.00 lb	✔
9	0 lb	0.01 lb	0.00 lb	✔	0.00 lb	✔



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

Report Number: DIRI01D01487W16P200624

A2LA ACCREDITED CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Digi-Weigh	DWP-440 400 x 0.1	D01487W16P	N/A	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	0.1	QC033	6/24/20	6/10/19	6/2021

FUNCTIONAL CHECKS

SHIFT TEST		LINEARITY		REPEATABILITY		ENVIRONMENTAL CONDITIONS		
Test Wt:	Tol:	Test Wt:	Tol:	Test Wt:	Tol:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
100	0.5	HB44	HB44	50	0.1	Good	Fair	Poor
As-Found:		As-Found:		As-Found:		Temperature: 24.3°C		
Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>			
As-Left:		As-Left:		As-Left:				
Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>			

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
400	399.98	399.98	0.08
300	299.98	299.98	0.08
200	199.99	199.99	0.08
100	100.00	100.00	0.05
50	50.01	50.01	0.05
25	25.00	25.00	0.05

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Avoirdupois Cast W	Rice Lake	25 and 50lb	PWO990-CA	12/14/19	12/2021	20172265
Weight Set	Rice Lake	.001 to 10lb	PW0990	10/4/18	10/2020	20181977

Permanent Information Concerning this Equipment:
12 month calibration cycle

Comments/Information Concerning this Calibration
6/20 RH= 45%.

Report prepared/reviewed by: JC

Date: 6/24/20

Technician: J. Colacchio

Signature: [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.

Dry Gas Meter Calibration

Meter Manufacturer: Apex
 Model: XC-50-DIR
 Lab ID #: 129
 Serial #: 1906005
 Calibration Date: 3/15/2021
 Calibration Expiration: 9/15/2021
 Barometric Pressure: 30.07 in. Hg



Reference Standard DGM	
Manufacturer:	Apex
Model:	SK25DA
Lab ID#:	47
Serial #:	1101001
Calibration Expiration Date:	3/24/2021
Calibration γ Factor:	0.998

Unit Under Test Previous Calibration	
Date	8/17/2020
γ Factor:	0.999
Allowable Deviation ($\pm 5\%$):	0.04995
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)	141.383	272.209	183.411
Standard DGM Temperature ($^{\circ}$ F)	66.0	66.0	67.0
Standard DGM Pressure (in H ₂ O)	0.00	0.00	0.0
DGM Initial Volume (ft ³)	0.000	0.000	0.000
DGM Final Volume (ft ³)	5.147	9.868	6.720
DGM Temperature ($^{\circ}$ F)	86.0	87.0	88.0
DGM Pressure (in H ₂ O)	1.00	2.00	0.5
Time (min)	34.0	42.0	77.0
Net Volume for Standard DGM (ft ³)	4.993	9.613	6.477
Net Volume for DGM (ft ³)	5.147	9.868	6.720

Dry Gas Meter γ Factor	1.002	1.006	0.999
γ Factor Deviation From Average	1.002	1.006	0.999

Average Gas Meter γ Factor

1.003

Calculations:

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

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

Pressure Gauge Calibration Work Sheet

Gauge Manufacturer: Apex
 Maximum Range (inH₂O): 3
 Instrument ID #: 129 (dH)
 Calibration Date: 3/16/2021
 Calibration Expiration: 3/16/2022
 Barometric Pressure: 30.10 in. Hg



Reference Standard Gauge	
Manufacturer:	Dwyer
Model:	477AV-1
Instrument ID#:	174
Calibration Expiration Date:	10/8/2021

Calibration Point (inH ₂ O)	Reference Gauge Reading (inH ₂ O)	Pressure Gauge Reading (inH ₂ O)	Difference (Reference - UUT)	% Error of Full Range
0.0 - 0.6	0.45	0.51	0.06	2.0%
0.6 - 1.2	1.01	1.06	0.05	1.7%
1.2 - 1.8	1.59	1.63	0.04	1.3%
1.8 - 2.4	2.06	2.12	0.06	2.0%
2.4 - 3.0	2.78	2.84	0.06	2.0%

Acceptable tolerance is 4%

Technican Signature: _____

Date: 3/16/2021

Emissions Sampling System Thermocouple Calibration Check

*Calibration based on NIST Monograph 175 per ASTM E2515-11
All thermocouples are type "K"*

Date: 3/12/2021

Sampling System ID Numbers: 129/130

Performed By: S. Button

Calibration Instrument ID Number: 165

Reference Temperature (F)	Acceptable Error (F)	Thermocouple Location						
		FB Left	FB Right	FB Back	FB Top	FB Bottom	Catalyst Exit	Flue
0	± 4.0	-0.9	-0.9	-0.9	-1.2	-1.3	-0.8	-0.5
200	± 4.0	199.0	199.0	199.0	198.8	198.7	199.1	199.4
400	± 4.0	399.0	398.9	399.0	398.8	398.6	399.1	399.3
600	± 4.5	599.0	598.9	599.0	598.8	598.7	599.2	599.4
800	± 6.0	799.0	798.9	799.0	798.7	798.7	799.1	799.4

Reference Temperature (F)	Acceptable Error (F)	Thermocouple Location					
		Ambient	Filter A	Filter B	Meter A	Meter B	Dilution Tunnel
0	± 4.0	-1.3	-0.7	0.0	-1.0	-1.2	-0.3
200	± 4.0	198.6	199.3	200.4	199.0	198.8	199.6
400	± 4.0	398.6	399.2	400.2	399.0	398.7	399.6
600	± 4.5	598.7	599.3	600.1	599.0	598.8	599.6
800	± 6.0	798.6	799.2	799.9	798.9	798.7	799.5

Technician Signature: 

Date: 3/12/2021

Dry Gas Meter Calibration

Meter Manufacturer: Apex
 Model: XC-50-DIR
 Lab ID #: 130
 Serial #: 1906006
 Calibration Date: 3/15/2021
 Calibration Expiration: 9/15/2021
 Barometric Pressure: 30.06 in. Hg



Reference Standard DGM	
Manufacturer:	Apex
Model:	SK25DA
Lab ID#:	47
Serial #:	1101001
Calibration Expiration Date:	3/24/2021
Calibration γ Factor:	0.998

Unit Under Test Previous Calibration	
Date	8/17/2021
γ Factor:	1.004
Allowable Deviation ($\pm 5\%$):	0.0502
Actual Deviation:	0.005
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)	222.273	145.988	169.207
Standard DGM Temperature ($^{\circ}$ F)	67.0	66.0	67.0
Standard DGM Pressure (in H ₂ O)	0.00	0.00	0.0
DGM Initial Volume (ft ³)	0.000	0.000	0.000
DGM Final Volume (ft ³)	8.161	5.347	6.249
DGM Temperature ($^{\circ}$ F)	90.0	90.0	91.0
DGM Pressure (in H ₂ O)	1.10	2.20	0.6
Time (min)	51.0	22.0	60.0
Net Volume for Standard DGM (ft ³)	7.849	5.156	5.975
Net Volume for DGM (ft ³)	8.161	5.347	6.249

Dry Gas Meter γ Factor	0.999	1.001	0.996
γ Factor Deviation From Average	0.999	1.001	0.996

Average Gas Meter γ Factor

0.999

Calculations:

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

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

Pressure Gauge Calibration Work Sheet

Gauge Manufacturer: Apex
 Maximum Range (inH₂O): 3
 Instrument ID #: 130 (dH)
 Calibration Date: 3/16/2021
 Calibration Expiration: 3/16/2022
 Barometric Pressure: 30.10 in. Hg



Reference Standard Gauge	
Manufacturer:	Dwyer
Model:	477AV-1
Instrument ID#:	174
Calibration Expiration Date:	10/8/2021

Calibration Point (inH ₂ O)	Reference Gauge Reading (inH ₂ O)	Pressure Gauge Reading (inH ₂ O)	Difference (Reference - UUT)	% Error of Full Range
0.0 - 0.6	0.55	0.58	0.03	1.0%
0.6 - 1.2	1.12	1.15	0.03	1.0%
1.2 - 1.8	1.77	1.81	0.04	1.3%
1.8 - 2.4	2.13	2.16	0.03	1.0%
2.4 - 3.0	2.88	2.94	0.064	2.1%

Acceptable tolerance is 4%

Technican Signature: _____

Date: 3/16/2021

Certificate of Calibration

Certificate Number: **743897**



JJ Calibrations, Inc.

7724 SE Aspen Summit Drive
Portland, OR 97266-9217
Phone 503.786.3005
FAX 503.786.2994

PFS TECO

11785 SE Hwy 212
Suite 305
Clackamas, OR 97015

PO: **1033**

Order Date: **03/08/2021**

Authorized By: **N/A**



Calibrated on: **03/18/2021**

*Recommended Due: **03/18/2022**

Environment: **22 °C 37 % RH**

* As Received: **Within Tolerance**

* As Returned: **Within Tolerance**

Action Taken: **Calibrated w/Parts**

Technician: **146**

Property #: **064**

User: **N/A**

Department: **N/A**

Make: **Control Company**

Model: **4198**

Serial #: **80531676**

Description: **Digital Temp. / Barometer**

Procedure: **404323**

Accuracy: **±1°C ±0.2362Hg(±8mb)**

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

Replaced batteries.

Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
644A	Thunder Scientific	1200	Two Pressure Humidity Generator	11/17/2021	734190
847A	Fluke	RPM4	Reference Pressure Monitor	12/30/2021	738139

Parameter

Measurement Data

Measurement Description	Range	Unit	Reference	Min	Max	*Error	UUT	Uncertainty
Before/After Temperature								Accredited = \bar{U}
		°C	20.00	19.0	21.0	0.1	20.1 °C	8.1E-02 \bar{U}
		°C	30.00	29.0	31.0	0.2	30.2 °C	8.1E-02 \bar{U}
		°C	40.00	39.0	41.0	0.7	39.3 °C	8.1E-02 \bar{U}
Barometer								
		mbar	1013.0	1005	1021	8	1005 mbar	6.2E-01 \bar{U}

This instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual and is traceable to either the SI or to National Institute of Standards and Technology (NIST). The quality system and this certificate are in compliance with ANSI/NCCL Z540-1-1994, ISO/IEC 17025-2017, ISO 10012-1, the ISO 9000 family and QS 9000. The expanded uncertainties of measurements for this calibration are based upon 95% (2 sigma) confidence limits. Unless stated in the comments, certificates reflect the "Simple Acceptance Rule" as specified by JCGM 106:2012. Unless otherwise stated, a test accuracy ratio (TAR) of 4:1, if achievable, is maintained. The results reported herein apply only to the calibration of the item described above. This report may not be reproduced, except in full, without written approval of JJ Calibrations.

Reviewer

3 Issued 03/25/2021

Rev # 15

Inspector



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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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(503) 236-2712 • FAX (503) 235-2535 • www.qc-services.com



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

Report Number: DIRI0134307497200624

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	6/24/20	1/10/20	12/2020

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		<input type="checkbox"/> Good <input checked="" type="checkbox"/> Fair <input type="checkbox"/> Poor Temperature: 21.3°C
As-Found:		As-Found:		1. 100.0001	5. 100.0001	9. 100.0000	
Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	2. 100.0001	6. 100.0001	10. 100.0001	
As-Left:		As-Left:		3. 100.0001	7. 100.0001	<u>Result</u>	
Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	4. 100.0001	8. 100.0001	0.00003	

A2LA ACCREDITED SECTION OF REPORT

Standard	As-Found	As-Left	Expanded Uncertainty
200	199.9982	200.0000	0.00014
100	99.9992	100.0001	0.00014
50	49.9996	50.0001	0.00013
20	19.9998	20.0000	0.00013
1	1.0000	1.0000	0.00013
0.1	0.1000	0.1000	0.00013

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	Rice Lake	20 kg to 1mg	2831W	2/5/20	2/2021	20190236

Permanent Information Concerning this Equipment:

6 month calibration cycle
6/20 Extra checkpoint to encapsulate user range 0.05g.
AF/AL= 0.0500g

Comments/Info Concerning this Calibration:

6/20 RH= 42%. Leveled unit & adjusted span.

Report prepared/reviewed by: *XC*

Date: 6/24/20

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.



QUALITY CONTROL SERVICES

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



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

<u>Material</u>	<u>Assumed Density</u>	<u>Range</u>	<u>Tolerance Class</u>
Cast Iron	7.2 g/cm ³	20lb to 10lb	NIST HB 105-1 (F)

Method and Traceability

The procedure used for this calibration is NIST IR 6969 SOP 7 Single 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:

Avoirdupois Working Standards were calibrated: 06/18/2014 Due: 06/18/2016 Standards ID: 34AA
Mass Comparators Used: MET-09, 20 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: 01/15/16


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: 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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Report of Calibration

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

Test Completed: 08/27/18
Submitted By: John Steinert
Traceable Number: 20181772

Test Item: 5 lb Individual Grip Handle Weight
Serial No.: 10744

Manufacturer: Rice Lake

<u>Material</u>	<u>Assumed Density</u>	<u>Range</u>	<u>Tolerance Class</u>
Cast Iron	7.2 g/cm ³	5 lb	ASTM Class 7

Method and Traceability

The procedure used for this calibration is NIST IR 6969 SOP 7 Single 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:

20 kg to 200 g Working Standards Were Calibrated: 03/22/18 Due: 03/31/19 Standards ID: 75388
100 g to 1 mg Working Standards Were Calibrated: 04/04/18 Due: 04/30/19 Standards ID: 723318

Mass Comparators Used: MET-08

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. 8.0 g/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: 08/28/18

Signature David S. Thompson

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Report of Calibration

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

Test Completed: 08/27/18
Submitted By: John Steinert
Traceable Number: 20181772

Test Item: 5 lb Individual Grip Handle Weight
Serial No.: 10744

Manufacturer: Rice Lake

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
21.838	762.06	52.23

Conventional Mass Value

Nominal Value	As Found pounds	As Found Correction* (mg)	Uncertainty (mg)	Tolerance (mg)
5 lb	5.0006085	276.0	2.0	760

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

Comments: This weight was new from the manufacturer and was within ASTM Class 7 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: 08/28/18

Signature David S. Thompson

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Tape Measure Calibration

Rule Equipment ID: 148

Date: 1/23/2020

Std. Gage Block ID: 146

Ambient (F): 70

Cal. Expiration Date: 1/7/2023

Technician: AK

Std. Surface Plate ID: 147

Cal. Expiration Date: 1/3/2023

System: Imperial Metric



Visual Inspection

Pass Fail

Full Length Operation Check

Pass Fail

Tape in Tension

Tolerance: 0.1

Standard	Measured
1.0	1.0
6.0	6.0

Within Tolerance

Tape in Compression

Tolerance: 0.1

Standard	Measured
1.0	1.0
6.0	6.0

Within Tolerance

Body Length

Tolerance: 0.1

Standard	Measured
N/A	3.0

N/A

Calibration Due

1/23/2021

Notes

Body not intended as part of measuring apparatus

Technician Signature

A handwritten signature in black ink, appearing to read "AK", written over a grey rectangular background.



CERTIFICATE OF CALIBRATION

CUSTOMER:	PFS-TECO : CLACKAMAS, OR	CALIBRATION DATE:	04/30/2020
PO NUMBER:	1016	CALIBRATION DUE:	04/30/2021
INST. MANUFACTURER:	DWYER	PROCEDURE:	T.O.33K6-4-1769-1
INST. DESCRIPTION:	VELOMETER	CALIBRATION FLUID:	AIR @ 14.7 PSIA 70°F
MODEL NUMBER:	471	RECEIVED CONDITION:	WITHIN MFG. SPECS.
SERIAL NUMBER:	CP288559 (ID# 095)	LEFT CONDITION:	WITHIN MFG. SPECS.
RATED UNCERTAINTY:	SEE NOTES BELOW.	AMBIENT CONDITIONS:	763mm HGA 46% RH 69°F
UNCERTAINTY GIVEN:	± 0.43% RD ; k=2	CERTIFICATE FILE #:	490265.2020

NOTES: ± 3% FS (0-500 / 0-1500) *** ± 4% F.S. (0-5000) ***± 5% F.S. (0-15000) *** ± 2 °F
NOTES CONT. : Q.MANUAL IM 1.5 REV 2017.1 DATED 7-18-2017

UUT INDICATED FT/MIN	DM.STD. ACTUAL FT/MIN	UUT INDICATED DEG. F	DM.STD. ACTUAL DEG. F
55	56	0 TO 200°F	0 TO 200°F
128	130	43.9	43.2
219	223	71.4	70.7
499	509	99.0	98.4
542	546		
1019	1029		
1490	1510		
511	516		
3268	3308		
4995	5077		
6028	6137		
14519	14815		

STANDARDS USED:

A263A: KURZ / DMC WIND TUNNEL LFE 0 – 14000 FPM ± .122% RD. TRACE# 1453296155,1329407628	DUE	06/08/2020
A24: HART SCIENTIFIC TEMP. STANDARD ±.024 F TRACE# 1520423238	DUE	03/04/2021

All instruments used in the performance of the shown calibration have traceability to the National Institute of Standards and Technology (NIST). The uncertainty ratio between the calibration standards (DM.STD.) used and the unit under test (UUT) is a minimum of 4:1, unless otherwise noted. Calibration has been performed per the shown procedure number, in accordance with ISO 10012:2003, ISO 17025:2005, ANSI/NCSL-Z-540.3, and/or MIL-STD-45662A. Test methods: API2530-92 & ASME MFC-3M-1989.

Dick Munns Company • 11133 Winners Circle • Los Alamitos, CA 90720
Phone (714) 827-1215 • Fax (714) 827-0823

This Calibration Certificate shall not be reproduced except, in full, without approval by DICK MUNNS COMPANY. The data shown applies only to the instrument being calibrated and under the stated conditions of calibration.

Date:

Approved By:

Calibration Technician:

04/30/2020

[Signature]

[Signature]



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 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

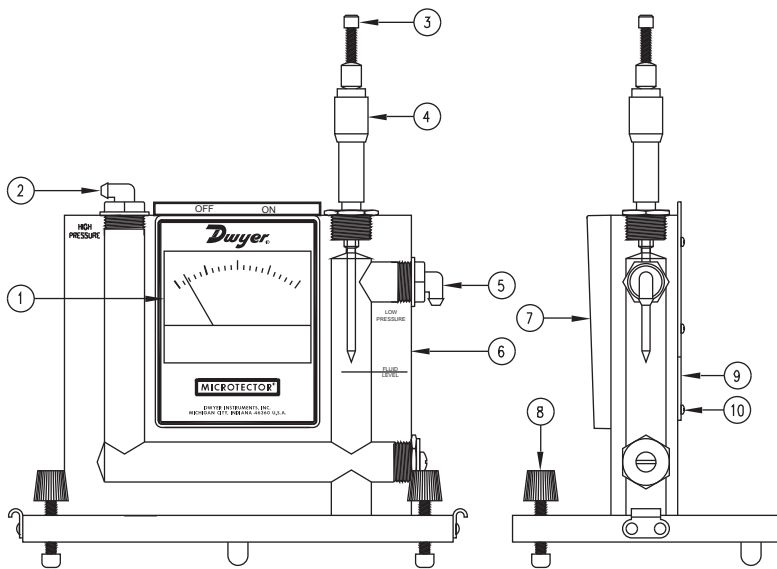
MICHIGAN CITY, INDIANA 46361, U.S.A.

Phone: 219/879-8000

Fax: 219/872-9057

www.dwyer-inst.com

e-mail: info@dwyer-inst.com



Microtector® Gage

Precision Pressure Measurement

The Microtector® Gage combines the time-proven principles of the Hook Gage type manometer and modern solid-state integrated circuit electronics. It provides an inexpensive means of achieving accuracy and repeatability within $\pm .00025$ inches water column throughout its 0 to 2 inches w.c. range. It is truly a new standard in precision measuring devices.

Principles of Operation

A pressure to be measured is applied to the manometer fluid which is displaced in each leg of the manometer by an amount equal to $1/2$ the applied pressure. A micrometer mounted point is then lowered until it contacts the manometer gage fluid. The instant of contact is detected by completion of a low-power A.C. circuit. Current for this circuit is supplied by a 1.5 volt penlight cell feeding two semiconductor amplifiers which act as a free-running multivibrator operating at a frequency of approximately two kilohertz. Completion of the A.C. circuit activates a bridge rectifier which provides the signal for indication on a sensitive (0 to 50 microamps) D.C. microammeter.

On indication of contact, the operator stops lowering the point and reads the micrometer which indicates one half the applied pressure. By interpolating eight divisions (each being $.000125$ w.c.) between $.001$ micrometer graduations, a total accuracy of $.00025$ can easily be achieved. The micrometer complies with Federal Specification GGG-C-105A and is traceable to a master at the NIST.

Locating and Opening

Stand the Microtector® Gage and case on a firm flat level surface. Remove cover by releasing the latches and lifting it straight up. If it is necessary to move the gage without case, handle only the base plate or clear acrylic block. **(CAUTION: Do not handle gage by grasping meter-electronic package housing Item 7 on drawing.)**

Fluid Level

Level the gage by adjusting the two front leveling screws (Item 8 on drawing) until the bubble in the spirit level is centered in the small circle. After leveling the gage, open both rapid shut-off valve tube connectors (Items 2 and 5). Back off the micrometer (Item 4), if necessary, to make sure that the point is not immersed in the gage fluid. The fluid level in the gage should now coincide with the mark on the right hand bore (Item 6) plus or minus approximately 1/32 inch. If the level of fluid is too high, fluid can be removed with an eye dropper pipette or carefully poured out of the right connection (Item 5).

If the level is too low, remove the top left rapid shut-off valve tube connector (Item 2) and add distilled water pre-mixed with the proper amount of green concentrate. (See maintenance instructions for proportions. After correcting the fluid level, re-install the rapid shut-off connectors and, with these in the open position, re-level the Microtector® Gage. The gage is now ready to be zeroed.

Zeroing

Turn the Micrometer barrel (Item 4) until its lower end just coincides with the zero mark on the scale and the zero on the barrel scale coincides with the vertical line on the internal scale. Note that the internal scale is graduated every .025" from 0 to 1.00 inch and the barrel scale is graduated in one thousandths from 0 to .025". Turn the meter circuit switch at the top of gage to the "on" position. While holding the barrel at the zero position (and with gage level), raise or lower the point by turning the knurled knob (Item 3) until the point is above, but near, the fluid.

Check to be sure that the meter registers zero. Watch the meter, hold the barrel, and lower the point slowly by turning the top knurled knob. As the knob is turned, the point will contact the fluid and the meter pointer will move from zero to some upscales position.

After making contact, turn the point out of the fluid by turning the micrometer barrel counter-clockwise to a reading of .010 or more. Again, watch the meter and, this time, lower the point by turning the micrometer barrel. The point position where the meter pointer begins to move up scale is the zero position. This position should correspond to the zero reading on the micrometer. Adjust the point in relation to the micrometer barrel by turning the top knob while holding the barrel steady. Repeat lowering the point, watching the meter for contact, and adjusting the point until the zero position and zero reading exactly coincide. The gage is now zeroed and should not be moved.

An alternative method of zeroing and reading can be used wherein, instead of zeroing the gage completely, a zero correction reading is taken and recorded, then subtracted from the final reading. Comparable results can be obtained with either method.

Positive Pressure Measurement

With the fluid at its proper level, a pressure of 2.0" water column maximum can be measured. Positive pressure should be applied to the top left connection (Item 2) with the micrometer zeroed as described above. This will permit a simple direct reading to be taken.

After an unknown pressure has been applied at the top left connection, the fluid level will drop in the left bore and rise over the point in the right bore. Note that the indicating meter point has moved upscales because the point is immersed in the fluid. Turn the micrometer counter-clockwise until the point leaves the fluid as indicated by the meter pointer dropping to zero on its scale. Then slowly turn the micrometer down until its point just touches the fluid surface, causing movement of the meter pointer. Withdraw the point and repeat several times, noting each time the micrometer reading where the meter pointer begins. The average of these readings multiplied by two is the pressure applied to the gage. (Avg. reading x 2 = pressure applied in inches w.c. The degree of uncertainty for the operator is indicated by the difference in these readings.

When the readings are complete, the pressure should be removed and the zero setting of Microtector® Gage rechecked. Any change in the zero position will indicate inaccurate readings. Should this happen, the zero-set and pressure measurement procedure should be repeated.

Negative Pressure or Vacuum Measurement

Zero the gage. Connect the source of vacuum or negative pressure to the right-side gage connection (Item 5) and proceed as described under Positive Pressure Measurement section. Remember that the pressure measured in this way is negative.

Differential Pressure Measurement

Differential pressures may be measured by connecting the higher (more positive) pressure to the left connection (Item 2) and the lower pressure to the right connection (Item 5).

Storage

Turn meter circuit switch to "off" position and withdraw the point well clear of fluid (by turning micrometer clockwise) when gage is not in use. This will conserve the batteries and minimize build-up of oxides, etc., on the point. Keep the unit covered and in an area free of strong solvent fumes.

Maintenance

When the meter reading becomes reduced or the pointer movement gets sluggish (with the circuit on and the point in fluid), the following should be done:

(1) Remove the point (by unscrewing) and clean the tip lightly using fine crocus cloth. Wipe off all grit and dirt with a clean rag; reassemble and recheck meter operation.

(2) If the meter operation continues to be sluggish, replace the size AA, 1.5 volt battery. (Replace the battery at least once a year to avoid deterioration of battery and damage to gage. Leakproof alkaline battery is recommended.)

To replace the battery, remove center screw (Item 10) located in the back of the electronic enclosure. Cover (Item 9) will come off, exposing the battery. Pull the old battery out and push a new battery into the battery holder with the positive (center) terminal to the right (to the end marked with + on the holder).

If the fluid becomes contaminated and requires replacement: empty old fluid from gage; flush out with clear water and replace with distilled water and A-126 fluorescein green color concentrate mixed with 3/4 oz. concentrate to each quart of water.

CAUTION:

1. Do not substitute other gage fluids, as proper gage operation depends on use of the specified gage fluid to provide proper surface tension, wetting ability and electrolyte capability with unity specific gravity.

If the gage bore is very dirty, a mild soap solution may be used to aid in cleaning prior to flushing with clear water.

2. Do not clean with liquid soaps, special solvent, de-greasers, aromatic hydrocarbons, etc. Such cleaners and solvents may contain chlorine, fluorine, acetone and related compounds that will permanently damage the gage and prevent proper operation.



IS 17025
ACCREDITED LABORATORY

55 N. 4th Street
Beaumont, TX 77701

Certificate of Analysis – EPA Protocol Gas

Customer:
Inter-Mountain Labs
555 Absaraka St.
Sheridan, WY 82801

PO Number: 196148
Reference#: CGS-10-20029 (2 of 2)
Date Filled:
Customer Part #:

Cylinder Number	Size	Concentration Basis	Standard type	Certificate ID
91005049	ALS	Mole	EPA Protocol	02-03112002

Certified Concentration

Carbon Monoxide=	2.47%	+/- 0.018%
Carbon Dioxide=	9.9%	+/- 0.1%
Oxygen=	10.37%	+/- 0.06%
Nitrogen =	Balance Gas	

Analytical Information

Component	Analyzer Make/Model/SN	Analytical Principle	Last Calibration Date
Carbon Monoxide	MKS/2031DJG2EKVS13T/017146467	FT-IR	3/13/2020
Carbon Dioxide	Thermo 410i/1162980025	NDIR	3/4/2020
Oxygen	Thermo 410i/1162980025	MPA	2/11/2020

First Assay Date 3/13/2020

Reference Standard(s)

Component	GMS #	Cylinder #	NIST Reference	Concentration	Uncertainty	Exp Date
Carbon Monoxide	CC219495.20151013g	CC219495	2642a	2.488%	+/- 0.015%	1/11/2024
Carbon Dioxide	EB007908.20190327	EB007908	C1579010.02	9.5%	+/- 0.02%	6/18/2027
Oxygen	EB0080793.20180118	EB0080793	071001	11.97%	+/- 0.06%	7/21/2026
Oxygen	EB0087693.20180504	EB0087693	071001	12%	+/- 0.12%	7/21/2026
Carbon Dioxide	EB0097897.20171018	EB0097897	C1309410.01	24.9%	+/- 0.10%	2/6/2026
Nitrogen	Balance Gas					

This calibration standard has been certified per the 2012 EPA Traceability Protocol, Document EPA 600/R-12/531, using the procedure G1.

Do Not Use This Standard Below 100 psig (0.7 Megapascals).

Valve Outlet Connection CGA: 660
Mix Pressure (psig) @ 70F: 2000
Certification Date: 3/13/2020
Shelf Life: 8 years
Expiration Date: 3/11/2028

Certified By: *Jennifer Healy* Reviewed By: *Kelly Ray*

Produced By:
Red Ball Technical Gas Service Phone 800-551-8150
555 Craig Kennedy Way Shreveport, LA 71107
Red Ball Technical Gas Service PGVP Vendor ID: G12020



CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

LXPKG TUALATIN OR H
10450 SW TUALATIN SHERWOOD ROAD
TUALATIN OR 97062

Certificate Issuance Date: 02/25/2019
Praxair Order Number: 70870813
Part Number: NI CD17C08E-AS

Fill Date: 02/20/2019
Lot Number: 70086905101
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure and Volume: 1200 psig 99 ft3

Certified Concentration

Expiration Date:	02/25/2027	NIST Traceable
Cylinder Number:	SA18857	Expanded Uncertainty
17.14 %	Carbon dioxide	± 0.3 %
4.30 %	Carbon monoxide	± 0.6 %
17.01 %	Oxygen	± 0.2 %
Balance	Nitrogen	

ProSpec EZ Cert



Certification Information:

Certification Date: 02/25/2019 Term: 96 Months Expiration Date: 02/25/2027

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 Oxygen IR Broadening 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: 17.14 %
Instrument Used: Horiba VIA-510 S/N 20C194WK
Analytical Method: NDIR
Last Multipoint Calibration: 01/28/2019

Reference Standard: Type / Cylinder #: GMIS / CC187238
Concentration / Uncertainty: 20.10 % ±0.24%
Expiration Date: 06/07/2026
Traceable to: SRM # / Sample # / Cylinder #: RGM#CC193512 / N/A / RGM#CC193512
SRM Concentration / Uncertainty: 26.99% / ±0.05%
SRM Expiration Date: 05/15/2023

First Analysis Data:		Date: 02/25/2019	
Z: 0	R: 20.1	C: 17.14	Conc: 17.14
R: 20.11	Z: 0	C: 17.16	Conc: 17.16
Z: 0	C: 17.14	R: 20.1	Conc: 17.14
UOM: %	Mean Test Assay:		17.14 %

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:		%

2. Component: Carbon monoxide
Requested Concentration: 4.25 %
Certified Concentration: 4.30 %
Instrument Used: Horiba VIA-510 S/N UB9UCSYX
Analytical Method: NDIR
Last Multipoint Calibration: 01/28/2019

Reference Standard: Type / Cylinder #: GMIS / CC242633
Concentration / Uncertainty: 5.00 % ±0.543%
Expiration Date: 04/03/2025
Traceable to: SRM # / Sample # / Cylinder #: SRM 2642a / 51-D-23 / FF23106
SRM Concentration / Uncertainty: 7.859% / ±0.039%
SRM Expiration Date: 07/15/2019

First Analysis Data:		Date: 02/25/2019	
Z: 0	R: 5	C: 4.3	Conc: 4.3
R: 5	Z: 0	C: 4.31	Conc: 4.31
Z: 0	C: 4.29	R: 4.99	Conc: 4.29
UOM: %	Mean Test Assay:		4.3 %

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:		%

3. Component: Oxygen
Requested Concentration: 17 %
Certified Concentration: 17.01 %
Instrument Used: OXYMAT 5E
Analytical Method: Paramagnetic
Last Multipoint Calibration: 02/04/2019

Reference Standard: Type / Cylinder #: GMIS / CC505868
Concentration / Uncertainty: 20.87 % ±0.108%
Expiration Date: 12/14/2026
Traceable to: SRM # / Sample # / Cylinder #: SRM 2659a / 71-E-19 / FF22331
SRM Concentration / Uncertainty: 20.863% / ±0.021%
SRM Expiration Date: 08/23/2021

First Analysis Data:		Date: 02/25/2019	
Z: 0	R: 20.88	C: 17.02	Conc: 17
R: 20.9	Z: 0	C: 17.02	Conc: 17
Z: 0	C: 17.04	R: 20.9	Conc: 17.02
UOM: %	Mean Test Assay:		17.01 %

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:		%

Analyzed By Jose Vasquez (AR)
Jose Vasquez

Certified By Nelson Ma
Nelson Ma