

**Non-Confidential Business Information  
(Non-CBI)**

**Certification Test Report**

**GHP Group, Inc.**

**Model Name:** Small Wood Stove, Legs  
Small Wood Stove, Pedestal

**Models:** SWS-1200, SWS-1200-B, HWS-1200, HWS-1200-B, PWS-1200-B, PH1200WS, PH1200WS-B, GWS-1200, GWS-1200-B, WSL-1200, WSL-1200-B, WS-1200, WS-1200-B

**Wood-Fired Freestanding Room Heater**

**Prepared for:** GHP Group, Inc.  
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Niles, IL 60714  
USA

**Prepared by:** OMNI-Test Laboratories, Inc.  
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**Test Period:** July 7, 2020 – July 8, 2020

**Report Issued:** October 13, 2020  
**Report Revision Date:** March 29, 2022

**Report Number:** 0418WS019E


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*GHP Group, Inc.  
Model: Small Wood Stove  
Report Number:0418WS019E*

## **AUTHORIZED SIGNATORIES**

This report has been reviewed and approved by the following authorized signatories:

### **Evaluator:**

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

Bruce Davis, Testing Manager  
OMNI-Test Laboratories

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# **Section 1**

## **Sampling Procedures and Test Results**



## INTRODUCTION

GHP Group, Inc. retained *OMNI* to perform U.S. Environmental Protection Agency (EPA) certification testing on the stove model Small Freestanding woodstove. The Small Wood Stove Freestanding wood stove is a Non-Catalytic-type room heater. The firebox is constructed of mild steel. Usable firebox volume was measured to be 1.53 cubic feet and the stove is vented through 6" flue collar located on the stove top.

Testing was performed at Nelke Consulting, altitude of the laboratory is 500 feet above sea level. The unit was received in good condition and logged in on 07/06/20, then assigned and labeled with *OMNI* ID #2416. *OMNI* representative Bruce Davis conducted the certification testing and completed all testing by July 8, 2020.

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

## SAMPLING PROCEDURE

The Small Wood Stove wood stove was tested in accordance with the U.S. EPA 40 CFR Part 60, Subpart AAA – Standards of Performance for New Residential Wood Heaters using ASTM E2515, EPA Alt-125, and ASTM E3053. Particulate emissions were measured using sampling trains consisting of two Teflon coated 47mm filters (front and back). See Appendix B for details on EPA Alt-125.

The model Small Wood Stove was tested for thermal efficiency and carbon monoxide (CO) emissions in accordance with CSA B415.1-10 using Cherry cordwood.

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

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

## SUMMARY OF RESULTS

The weighted average emissions of the three test runs included in the results indicate a particulate emission rate of 1.89 grams per hour. Particulate emissions used in the weighted average were sampled on only one of the high burn fuel loads, test 3 was conducted to generate a coal bed for test number 4. The Small Wood Stove results are within the EPA 2020 emissions limit of 2.5 g/h for affected products tested with cordwood.

The proportionality results for all 3 test runs were acceptable. Quality check results for each test run are presented in Section 2 of this report.

## INDIVIDUAL RUN SUMMARIES

Test procedures followed to produce a high burn rate with a primary air setting of fully open. Observed burn rate was calculated at 3.99 kg/hr. Emissions results were calculated using particulate sampling from kindling, start-up fuel, and test fuel load combined (cold to hot). Burn rate, and efficiency were calculated using data from the test fuel load only (hot to hot). No sampling anomalies occurred; this test run was determined to be valid and appropriate for inclusion in the weighted average.

**Run 2 -** Test procedures were followed to produce a low burn rate with a primary air setting of fully closed. Observed burn rate was calculated at 1.00 kg/hr. Emissions and efficiency results were calculated using a hot to hot burn cycle, a coal bed generated by the high burn conducted in test one was used. No sampling anomalies occurred; this test run was determined to be valid and appropriate for inclusion in the weighted average.

**Run 3 -** Test procedures followed to produce a high burn rate with a primary air setting of fully open. Observed burn rate was calculated at 3.33 kg/hr. Burn rate, was calculated using data from the kindling, start-up fuel, and test fuel (cold to hot). No sampling occurred during this test; it was conducted to generate a coal bed for test number 4.

**Run 4 -** Test procedures were followed to produce a medium burn rate with a primary air setting of 0.0625" (1/16") from full closed. Observed burn rate was calculated at 1.11 kg/hr. Emissions and efficiency results were calculated using a hot to hot burn cycle, a coal bed generated by the high burn procedure was used. No sampling anomalies occurred; this test run was determined to be valid and appropriate for inclusion in the weighted average

**Table 1 – Particulate Emissions**

<b>Run</b>	<b>Burn Rate</b> Calculated from a Hot to Hot burn cycle (kg/h dry)	<b>ASTM E2515</b> <b>Emissions</b> (g/h)	<b>ASTM E3053</b> <b>Weighting Factor</b> (%)	<b>ASTM E3053 Weighted</b> <b>Emissions</b> (g/h)
1	3.99	<sup>1</sup> 5.77	20	1.154
2	1.00	1.10	40	0.440
4	1.11	0.75	40	0.300
The sum of weighted particulate emission of 3 test runs, tests 1,2, and 4: $1.154 + 0.440 + 0.300 = \mathbf{1.89}$ grams per hour.				

**Note:** <sup>1</sup>Based on a cold start including kindling and start-up fuel.

**Table 2 – Particulate Emissions (First Hour)**

<b>Run</b>	<b>ASTM E2515</b> <b>Emissions – First Hour</b> (g/h)
1	2.80
2	4.93
4	2.56

**Table 3 – B415.1 Efficiency and CO Emissions**

<b>Run</b>	<b>Heat Output</b> (BTU/h)	<b>HHV Efficiency</b> (%)	<b>LHV Efficiency</b> (%)	<b>CO Emissions</b> (g/MJ Output)	<b>CO Emissions</b> (g/kg Dry Fuel)	<b>CO Emissions</b> (g/min)
1	56,107	75.1	80.5	2.52	36.64	2.488
2	14,295	78.2	83.8	3.81	57.63	0.958
4	15,963	78.5	84.1	3.75	56.98	1.053
Weighted average HHV efficiency of three test runs: $15.02 + 31.28 + 31.4 = \mathbf{77.7\%}$ .						
Average CO Emissions of three tests: $(2.488 + 0.958 + 1.053) / 3 = \mathbf{1.500 \text{ g/min}}$						

**Table 4 – Test Facility Conditions**

Run	Room Temperature (°F)		Barometric Pressure (Hg)		Air Velocity (ft/min)	
	Before	After	Before	After	Before	After
1	74	82	29.45	29.44	<50	<50
2	80	75	29.44	29.42	<50	<50
3	72	81	29.45	29.45	<50	<50
4	79	78	29.45	29.36	<50	<50

**Table 5 – Kindling and Start-up Fuel Description Summary  
 Cherry Cordwood**

Run	Kindling Weight Wet Basis (lbs)	Start-up Fuel Weight Wet Basis (lbs)	Residual Start-up fuel weight (lbs)
1	2.90	4.4	1.6
3	2.90	4.4	1.6

Note: Test 3 was a high burn used to create a coal bed for test number 4, no particulate sampling occurred during this test.

**Table 6 – Fuel Measurement and Cordwood Description Summary – TEST  
 Cherry Cordwood**

Run	Test Fuel Wet Basis (lbs)	Firebox Volume (ft <sup>3</sup> )	Fuel Loading Density Wet Basis (lbs/ft <sup>3</sup> )	Test Fuel Dry Basis (lbs)	Test Fuel Consumed During Test Dry Basis (lbs)	Piece Length (in)
1	14.9	1.53	9.7	12.25 + 6.31	15.6	<u>5@14.0</u>
2	18.1	1.53	11.8	15.0	15.0	<u>5@14.0</u>
3	15.0	1.53	9.8	12.19 + 6.32	15.4	<u>5@14.0</u>
4	17.8	1.53	11.6	14.7	14.7	<u>5@14.0</u>

**Table 7 – Dilution Tunnel Gas Measurements and Sampling Data Summary**

Run	Length of Test (min)	Average Dilution Tunnel Gas Measurements		
		Velocity (ft/sec)	Flow Rate (dscf/min)	Temperature (°F)
1	125	21.07	220.0	114
2	410	21.06	228.4	93
4	360	20.82	225.1	94

**Table 8 – Test Fuel Dimensions**

Run #	Fuel Piece		Fuel Piece		Fuel Piece		Fuel Piece		Fuel Piece	
	Major (Inches)	Minor (Inches)	Major (Inches)	Minor (Inches)	Major (Inches)	Minor (Inches)	Major (Inches)	Minor (Inches)	Major (Inches)	Minor (Inches)
1	4.6	2.5	4.6	2.8	5.4	2.9	6.2	4.6	5.1	4.3
2	4.1	2.8	4.0	2.2	4.7	2.8	6.4	5.1	5.8	5.3
3	5.5	3.9	4.2	2.2	4.6	2.9	6.7	5.4	5.8	4.9
4	4.7	3.3	4.6	2.6	6.3	3.0	6.4	5.3	6.7	5.8

**Note:** All minor dimensions were calculated to be greater than 40% of the major dimension.

**Table 9 – Test Configurations**

Run	Startup Procedures	Combustion Air
1	<p><u>Fuel Loading:</u> Kindling and start-up fuel loaded together; a torch was used for 40 seconds to establish a fire. At 51 minutes placed fuel load into the firebox and closed the loading door. Loading required less than 1 minute to complete.</p> <p><u>Door:</u> For kindling and start-up fuel, loading door was closed by 75 seconds. Test fuel load: fuel loading door was closed by 3:00 minute and 15 seconds.</p> <p><u>Primary Air:</u> Air control fully open for the entire test.</p> <p><u>Fan:</u> Turned to high 5 minutes after lighting fire, on high remainder of test.</p> <p><u>Bypass:</u> N/A</p>	Fully open for entire test.
2	<p><u>Fuel Loading:</u> Test fuel loaded onto coal bed generated by test number 1 by 60 seconds.</p> <p><u>Door:</u> Closed by 4 minutes.</p> <p><u>Primary Air:</u> Fully open until 8 minutes then set to half open. At 13 minutes air was set to fully closed.</p> <p><u>Fan:</u> Off for first 13 minutes, then turned to high for remainder of test.</p> <p><u>Bypass:</u> N/A</p>	Fully open for first 8 minutes, then set to half open. At 13 minutes set to full closed.
3	<p><u>Fuel Loading:</u> Kindling and start-up fuel loaded together; a torch was used for 40 seconds to establish a fire. At 51 minutes placed fuel load into the firebox and closed the loading door. Loading required less than 1 minute to complete.</p> <p><u>Door:</u> For kindling and start-up fuel, loading door was closed by 105 seconds. Test fuel load: fuel loading door was closed by 3:00 minutes.</p> <p><u>Primary Air:</u> Air control fully open for the entire test.</p> <p><u>Fan:</u> Turned to high 5 minutes after lighting fire, on high remainder of test.</p> <p><u>Bypass:</u> N/A</p>	Fully open for entire test.
4	<p><u>Fuel Loading:</u> Test fuel loaded onto coal bed generated by test number 3 by 45 seconds.</p> <p><u>Door:</u> Closed by 4 minutes.</p> <p><u>Primary Air:</u> Fully open until 7 minutes 30 seconds then set to half open. At 13 minutes air was set to 1/16" from fully closed.</p> <p><u>Fan:</u> Off for first 13 minutes, then turned to high for remainder of test.</p> <p><u>Bypass:</u> N/A</p>	Fully open for first 7 minutes 30 seconds, then set to half open. At 13 minutes set to 1/16" from full closed.

## **Section 2**

### **Photographs/Appliance Description/Drawings**

**GHP Group, Inc.**  
**Model Small Wood Stove**  
**Test Dates: July 7, 2020 – July 8, 2020**

Front Right View



Rear View



Front Left View





## GHP Group, Inc. Model Small Wood Stove

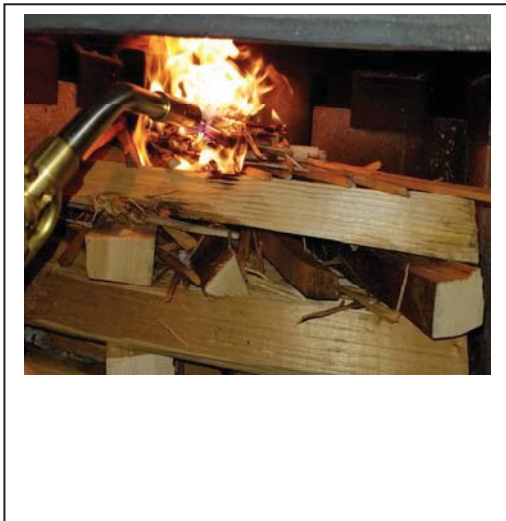
**Run 1 – Kindling and start-up fuel**



**Run 1 – Kindling and start-up fuel**



**Run 1 – Ignition of kindling**



**Run 1 – Fuel load**

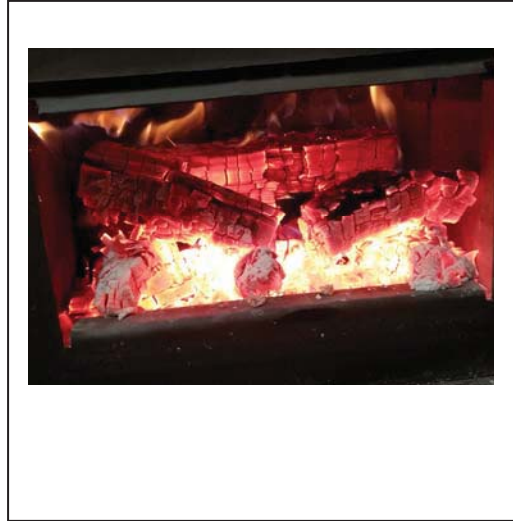


## GHP Group, Inc. Model Small Wood Stove

**Run 1 – Test Fuel Load In Stove**



**Run 1 – Remaining Coal After Test**



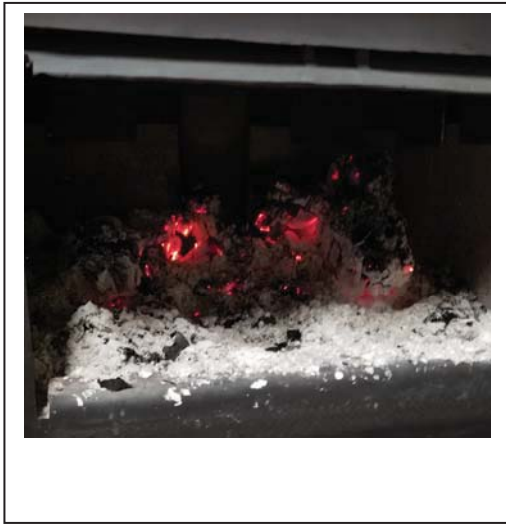
**Run 2 – Test Fuel Load**



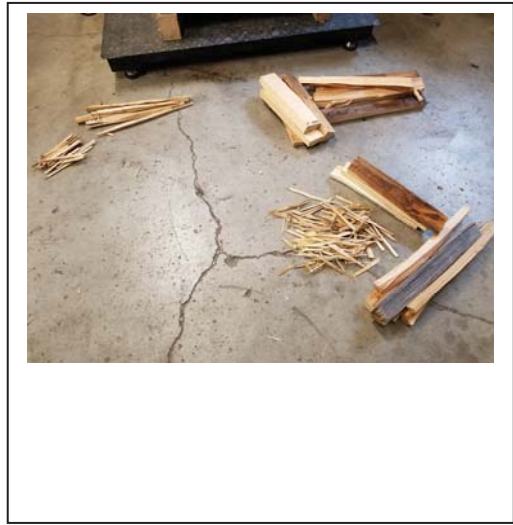
**Run 2 – Test Fuel Loaded into Stove**



**Run 2 – Remaining Coal After Test**



**Run 3 – Kindling and start-up fuel**



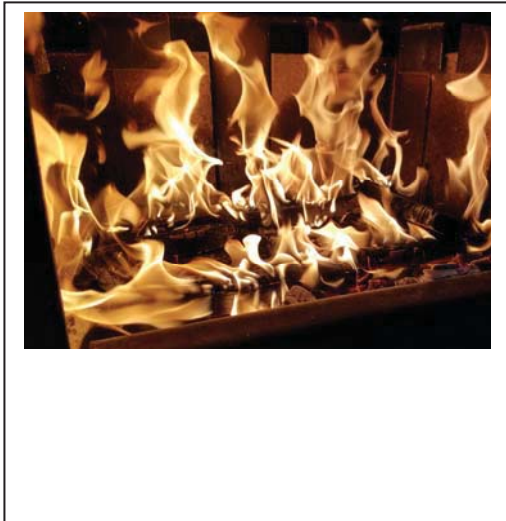
**Run 3 – Test Fuel Load**



**Run 3 – Test Fuel Loaded into Stove**



**Run 3 - Remaining Coal After Test**



**Run 4 – Test Fuel Load**



**Run 4 – Test Fuel Loaded into Stove**



**Run 4 – Remaining Coal After Test**





## WOOD HEATER DESCRIPTION

**Appliance Manufacturer:** GHP Group, Inc.

**Wood Stove Model:** Small Wood Stove

**Type:** Freestanding Wood Fired Room Heater

## WOOD HEATER INFORMATION

**Materials of Construction:** The unit is constructed primarily of mild steel. The firebox is lined with 1.25" thick refractory brick that measures 9.0 x 4.438" on the back, sides and hearth. The feed door has a 13.0 x 8.38 glass panel and 1" flat fiberglass gasket.

**Air Introduction System:** Primary air is controlled by a single slide plate located above the fuel loading door. Secondary air has no user control and enters the firebox through openings located on the bottom of the firebox.

**Combustion Control Mechanisms:** Combustion air control mechanism is a single slide plate that covers a 3.50" x 2.0" Triangular opening. A single 0.25" half round opening that feeds the lower primary air orifice is always open, regardless of air slide position.

**Combustor:** N/A

**Internal Baffles:** A vermiculite baffle is located above the secondary air tubes.

**Other Features:** An optional blower is offered; the motor is 110 volts with a 200 CFM rating. See drawings for additional information.

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

## WOOD HEATER OPERATING INSTRUCTIONS

**Specific Written Instructions:** See Section 4 of this report. All markings and instruction materials were reviewed for content prior to printing.

## **MODEL SIMILARITIES**

GHP Group Small Wood Stove models SWS-1200, SWS-1200-B, HWS-1200, HWS-1200-B, PWS-1200-B, PH1200WS, PH1200WS-B, GWS-1200, GWS-1200-B, WSL-1200, WSL-1200-B, WS-1200, WS-1200-B are identical in all parts and operation. They are named differently for marketing reasons. No differences between models are identified in this report.

# **Section 3**

## **Test Data by Run**

## GHP Small High Burn Procedure

### Kindling:

Kindling weight in total should be 2.5lbs ( $\pm 0.5$ bs) ten pieces in total of equal size, 11&15'' in length. Making sure the weight doesn't exceed what's allowed per the standard.

### Start-up Fuel:

The start-up fuel consists of ten pieces of equal size with a total weight of 4.0lbs ( $\pm 0.5$ lbs) and a length of 11&15''.

### Test Fuel:

The test fuel consists of five pieces with a nominal length of 14''. 13'' on the bottom and 15'' on top. Follow the fuel sheet guideline for specific weights of the core and remainder loads.

### Test fuel:



### Start-up Procedure:

The start-up fuel is comprised of six layers described below. All kindling pieces are placed in between the start-up pieces. A small handful of tiny kindling pieces are



to be scattered on each layer starting after the third stack. This should be close to 0.5lbs of the total kindling weight.

Bottom: Two kindling and two start-up pieces East/West- 15''

2<sup>nd</sup>: Two kindling and two start-up pieces North/South- 11''

3<sup>rd</sup>: Two kindling and two start-up pieces East/West- 15''

4<sup>th</sup>: Two kindling and two start-up pieces North/South- 11''

5<sup>th</sup>: Two kindling and two start-up pieces East/West- 15''

Top: A pile of small kindling pieces in the middle as shown in the picture below, (4-5 Layers).

### **Kindling and Start-up:**



Use a torch for 30 seconds to one minute to ignite the fuel, focusing the torch on the top middle portion of the load. Shut the door around one to one and a half minutes. Towards the end of the kindling and start-up phase you may need to reposition the fuel for maximum combustion. This usually will happen around 25-

35 minutes. If the flames on top start to go out, open the door and reposition the raw fuel on the bottom and move it on top in a pile to get any raw fuel burnt up.

Set the fan control to the high position at five minutes.

The test load should be loaded at the bottom end of the allowable coal bed within 0.2lbs.

When loading, use the smaller of the test pieces to gently level the remaining fuel. Use the by-pass if needed. Three of the smaller pieces cut at 13" are to be placed in a north/south direction on the bottom with gaps between the pieces. The remaining two pieces at 15" are on top in an east/west direction with gaps between fuel. See test fuel picture below for an example. The door should be open around one to four minutes. Once the fuel is loaded leave the door wide open and let the flames build before closing the door. Once the door is closed there should be flames on top of the fuel right away.

### High Burn Test Fuel:



End the test at the low end of the allowable remaining weight.

## **GHP Small Medium and Low Procedure**

### **Test Fuel:**

Follow the guidelines of the cordwood standard (E3053-17) for correct moisture and weight ratios for the core and sub loads. There are five pieces in total. The nominal length is 14”.



### **Coal Bed:**

The coal bed will always result in running a high burn. There may be large pieces of fuel left after the high burn, as soon as the high burn has been complete, move the larger raw pieces toward the middle of the firebox stacked up for best combustion. Load the test fuel at the very low end of the coal bed within 0.2lbs. This allows more room to place the fuel.

### **Fuel Loading & Settings:**

Level the coal bed before you start sampling. If there happens to be any raw pieces left over, place them in the very rear of the firebox. The Fan is turned on

high after the primary control has been set. Keep the door open no longer than five minutes. There should be minimal gaps between all fuel pieces. Three smaller pieces in a North/South direction and the remaining two pieces on top in an East/West direction (see test fuel picture above). Keep the primary control open until six to eight minutes then shut the control half way between the high and low setting until 15% of the fuel load has been consumed or if you see the combustion getting noticeably dirtier, set the control at the desired setting.

The setting for the low is closed to the stop.

The setting for the medium burn is 0.0625" open from the low setting.

**Moving Fuel Load:**

It may be necessary to move the fuel load at some point during the medium and low burns. Keep an eye on weight drop and stack draft to determine when to move the fuel if needed.



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# Analytical Test Report

**Report No:** USR:W219-0497-01  
**Issue No:** 1

**Client:** Nelke Consulting  
 30522 SE Leavenworth Ct  
 Eagle Creek, OR 97022  
**Attention:** Ben Nelke  
**PO No:** Prepaid

**Signed:** *Stephen Sundeen*  
 Stephen Sundeen  
 Chemistry Laboratory Manager  
**Date of Issue:** 7/2/2019  
THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

**Sample Details**  
**Sample Log No:** W219-0497-01  
**Sample Designation:** Sawdust  
**Sample Recognized As:** Biomass  
**Sample Date:**  
**Sample Time:**  
**Arrival Date:** 6/11/2019

	METHOD	UNITS	MOISTURE	
			FREE	AS RECEIVED
Moisture Total	ASTM E871	wt. %		10.63
Ash	ASTM D1102	wt. %	- 0.40 -	0.36
Volatile Matter	ASTM D3175	wt. %	82.82	74.02
Fixed Carbon by Difference	ASTM D3172	wt. %	16.78	15.00
Sulfur	ASTM D4239	wt. %	0.086	0.077
SO <sub>2</sub>	Calculated	lb/mmbtu		0.206
Net Cal. Value at Const. Pressure	ISO 1928	GJ/tonne	18.03	15.86
Gross Cal. Value at Const. Vol.	ASTM E711	Btu/lb	8316	7432
Carbon	ASTM D5373	wt. %	- 48.68 -	43.50
Hydrogen*	ASTM D5373	wt. %	- 6.01 -	5.37
Nitrogen	ASTM D5373	wt. %	< 0.20 <	0.18
Oxygen*	ASTM D3176	wt. %	> - 44.63 - >	39.89
*Note: As received values do not include hydrogen and oxygen in the total moisture.				
Chlorine	ASTM D6721	mg/kg		
Fluorine	ASTM D3761	mg/kg		
Mercury	ASTM D6722	mg/kg		
Density	ASTM E873	ka/m <sup>3</sup>		611

*kg/kg: 19,340*

**Comments:**



PJLA Testing  
 Accreditation #60243

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# Conditioning Data - ASTM E3053/ ASTM E2515

Manufacturer: GHP Group  
 Model: Small Series  
 Tracking No.: 2416  
 Project No.: 0418WS019E  
 Test Date: April - May 2020  
 Technician: Nelke Consulting  
 Operation Category: Medium

Operated for 50 hours at a medium rate, fuel moisture was between 18% and 28%.

Elapsed Time (hr)	Flue Gas Temp (° F)	Fuel Weight (lb)
0	205.0	9.1
1	337.0	
2	294.0	
3	243.0	
4	287.0	
5	207.0	
6	167.0	8.4
7	140.0	
8	123.0	
9	211.0	
10	388.0	
11	225.0	8.2
12	281.0	
13	369.0	
14	321.0	
15	349.0	2.8
16	296.0	
17	220.0	
18	363.0	8.7
19	371.0	
20	629.0	
21	413.0	
22	465.0	
23	466.0	10.1
24	212.0	
25	458.0	

Elapsed Time (hr)	Flue Gas Temp (° F)	Fuel Weight (lb)
26	352.0	
27	319.0	
28	297.0	
29	228.0	
30	179.0	7.4
31	366.0	
32	282.0	
33	271.0	
34	401.0	7.6
35	293.0	
36	212.0	
37	225.0	
38	375.0	6.8
39	203.0	
40	157.0	
41	264.6	
42	383.0	
43	261.0	7.2
44	210.0	
45	181.0	
46	161.0	
47	139.0	3.0
48	272.4	
49	390.0	
50	271.0	

Technician Signature: \_\_\_\_\_

# **Run 1**

## **High Burn 1-minute data**

### **Emissions Results (Cold to Hot Cycle)**

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1  
 Manufacturer: GNF Group  
 Model: Small  
 Tracking No.: 2416  
 Project No.: 2416W2019E  
 Test Date: 07-28-23  
 Beginning Clock Time: 10:40  
 Meter Box Y Factor: 0.994 (1) 0.998 (2) (Amb)  
 Barometric Pressure: Begin Middle End Average  
 29.45 29.44 29.45 in.Hg  
 OMNI Equipment Numbers:

PM Control Module: 371.372  
 Dilution Tunnel MW(wt/dry): 29.00 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.76 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: -0.255 in.Hg  
 Tunnel Area: 0.19635 ft<sup>2</sup>  
 Pilot Tube Cp: 0.99  
 Avg. Tunnel Velocity: 21.07 ft/sec  
 Initial Tunnel Flow: 227.8 scfm  
 Average Tunnel Flow: 220.0 scfm  
 Post-Test Leak Check (1): 0.000 cfm @ 12 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 10 in. Hg  
 Average Test Piece Fuel Moisture: 19.90 Dry Basis %

Technician Signature: *B. [Signature]*

Velocity Traverse Data									
	Pt. 1	Pt. 2	Pt. 3	Pt. 4	Pt. 5	Pt. 6	Pt. 7	Pt. 8	Center
Initial ΔP	0.094	0.100	0.094	0.094	0.082	0.100	0.100	0.090	0.098
Temp:	84	84	84	84	84	84	84	84	84
V <sub>initial</sub>	20.73		ft/sec		V <sub>vacant</sub>		21.23		ft/sec
F <sub>p</sub>	0.976								

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)				Temperature Data (°F)								Stack Gas Data								
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice ΔH 1 (in.H <sub>2</sub> O)	Meter 1 Temp (°F)	Meter 1 Vacuum (in.Hg)	Orifice ΔH 2 (in.H <sub>2</sub> O)	Meter 2 Temp (°F)	Meter 2 Vacuum (in.Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center Δp	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (in.H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)
0	0.000	0.000			2.66	73	-1.42	1.71	72	0.1	82	0.100			7.3		70	65	68	66	66	67	76	83	56	84	59	74	0.000	0.04	0
1	0.145	0.165	0.15	0.17	2.21	73	-1.81	1.78	72	0	88	0.100	86	93	7.2	-0.1	75	66	69	66	66	68	110	82	52	84	55	74	0.001	1.45	0.01
2	0.306	0.334	0.16	0.17	2.20	74	-1.56	1.76	72	-0.1	85	0.100	84	65	7.1	-0.1	106	66	70	67	66	75	120	83	51	84	54	74	0.002	2.2	0.2
3	0.471	0.508	0.17	0.17	2.33	74	-1.72	1.83	72	-0.1	84	0.100	98	97	7.1	0	130	66	72	69	68	81	123	83	51	84	54	74	0.004	7.87	0.26
4	0.635	0.678	0.16	0.17	2.28	74	-1.8	1.78	72	-0.2	85	0.100	97	97	7.0	-0.1	162	66	73	72	69	86	135	83	51	84	53	74	0.007	7.56	0.17
5	0.799	0.849	0.16	0.17	2.27	74	-1.74	1.77	72	-0.3	85	0.100	97	96	6.8	-0.1	178	66	75	75	72	93	148	83	50	85	53	75	0.017	8.01	0.25
6	0.963	1.019	0.16	0.17	2.26	74	-2.09	1.77	72	-0.4	87	0.100	97	96	6.8	-0.1	194	66	73	79	74	97	160	83	50	85	52	75	0.017	7.61	0.39
7	1.126	1.188	0.16	0.17	2.22	74	-2.14	1.74	72	-0.3	88	0.100	96	96	6.7	-0.1	225	66	74	83	77	105	162	83	50	85	52	75	0.023	9.08	0.29
8	1.287	1.357	0.16	0.17	2.22	74	-2.07	1.75	72	-0.3	81	0.100	96	96	6.5	-0.2	282	67	75	88	80	118	213	83	50	84	52	75	0.029	11.37	0.53
9	1.451	1.528	0.16	0.17	2.28	74	-2.13	1.82	73	-0.4	92	0.100	97	97	6.4	-0.1	326	67	76	84	84	129	230	83	50	84	52	75	0.035	10.46	0.45
10	1.613	1.700	0.16	0.17	2.24	74	-1.74	1.79	73	-0.4	86	0.100	97	98	6.2	-0.2	372	67	76	100	89	141	258	83	50	84	52	76	0.041	11.9	0.6
11	1.775	1.87	0.16	0.17	2.24	74	-2.12	1.78	73	-0.1	97	0.100	97	97	6.0	-0.2	426	67	77	107	94	164	273	83	50	84	52	76	0.046	12.12	0.64
12	1.938	2.041	0.16	0.17	2.26	74	-1.77	1.78	73	-0.2	86	0.100	97	97	5.8	-0.2	480	67	78	114	100	164	292	83	50	84	52	75	0.048	11.03	0.51
13	2.103	2.211	0.17	0.17	2.29	75	-2.27	1.76	73	-0.3	101	0.100	99	97	5.6	-0.2	495	68	80	122	105	174	299	83	50	84	52	76	0.051	11.86	0.63
14	2.267	2.381	0.16	0.17	2.29	75	-2.27	1.76	73	-0.1	101	0.100	98	97	5.5	-0.1	516	68	80	129	112	181	306	83	50	84	52	75	0.052	11.69	0.59
15	2.431	2.551	0.16	0.17	2.29	75	-2.27	1.76	73	-0.1	103	0.100	98	97	5.3	-0.2	534	68	81	136	118	187	315	83	50	84	52	75	0.053	11.73	0.61
16	2.595	2.720	0.16	0.17	2.29	75	-2.2	1.75	73	-0.2	104	0.100	98	97	5.1	-0.18	554	68	82	143	125	194	324	83	50	84	52	75	0.054	11.47	0.49
17	2.758	2.889	0.16	0.17	2.26	75	-1.85	1.75	73	-0.1	105	0.100	98	97	5.0	-0.14	580	69	83	151	133	203	333	83	51	83	52	76	0.055	11.83	0.57
18	2.922	3.058	0.16	0.17	2.27	76	-1.81	1.76	73	-0.1	105	0.100	98	97	4.8	-0.18	595	69	85	158	140	209	337	83	51	83	52	76	0.056	11.53	0.35
19	3.086	3.226	0.16	0.17	2.26	76	-1.97	1.75	73	-0.2	106	0.100	98	96	4.6	-0.2	605	69	85	166	148	215	343	83	51	83	52	76	0.057	11.05	0.34
20	3.249	3.396	0.16	0.17	2.25	76	-1.98	1.80	74	-0.2	107	0.100	98	97	4.5	-0.1	615	70	86	174	155	220	347	83	51	83	52	76	0.057	11.69	0.19
21	3.412	3.568	0.16	0.17	2.26	76	-1.91	1.80	74	-0.2	106	0.100	98	99	4.4	-0.1	617	70	87	182	163	224	342	83	51	83	52	76	0.057	10.53	0.2
22	3.575	3.739	0.16	0.17	2.26	77	-2.18	1.78	74	-0.4	106	0.100	97	98	4.2	-0.2	611	71	88	190	170	228	343	83	51	83	52	76	0.057	9.7	0.25
23	3.738	3.910	0.16	0.17	2.26	77	-1.83	1.78	74	-0.5	106	0.100	97	98	4.1	-0.1	602	72	88	197	178	227	338	83	51	83	52	76	0.056	9.56	0.3
24	3.901	4.081	0.16	0.17	2.25	77	-2.19	1.78	74	-0.2	105	0.100	97	98	4.0	-0.1	592	72	89	205	185	229	332	83	51	83	52	76	0.054	8.68	0.37
25	4.066	4.252	0.17	0.17	2.30	77	-2.35	1.78	74	-0.4	104	0.100	99	98	3.9	-0.1	580	73	90	212	193	230	328	83	51	83	52	76	0.053	7.99	0.45
26	4.231	4.422	0.17	0.17	2.27	77	-2.26	1.78	74	-0.2	103	0.100	98	97	3.8	-0.1	572	74	91	219	200	231	321	83	51	83	52	76	0.052	7.56	0.47
27	4.394	4.592	0.16	0.17	2.27	77	-2.23	1.77	74	-0.3	103	0.100	97	97	3.7	-0.06	558	75	92	226	208	232	314	83	51	83	52	76	0.050	7.23	0.54
28	4.552	4.760	0.16	0.17	1.89	78	-2.65	1.68	74	-0.6	111	0.100	95	97	3.6	-0.12	590	76	92	232	216	241	346	83	51	83	52	76	0.052	7.7	0.37
29	4.696	4.924	0.14	0.16	1.66	78	-2.62	1.65	74	-0.3	110	0.100	86	94	3.5	-0.12	625	77	93	238	223	251	346	83	52	83	52	76	0.055	11.4	0.39
30	4.846	5.092	0.15	0.17	2.24	78	-4.31	1.83	75	-0.8	108	0.100	90	96	3.3	-0.16	635	78	94	244	231	256	347	83	52	83	52	76	0.057	10.76	0.27
31	5.007	5.264	0.16	0.17	2.11	78	-4.98	1.78	75	-0.6	110	0.099	102	104	3.2	-0.14	638	79	95	249	239	260	351	83	52	83	52	77	0.058	10.65	0.25
32	5.169	5.434	0.16	0.17	2.31	78	-5.78	1.74	75	-0.6	110	0.100	97	98	3.0	-0.2	648	80	94	255	247	265	358	83	52	83	52	77	0.058	12.08	0.31
33	5.332	5.604	0.16	0.17	2.27	79	-5.91	1.81	75	-0.8	109	0.100	97	97	2.9	-0.1	655	81	95	261	255	269	367	83	52	83	52	76	0.058	11.47	0.23
34	5.496	5.778	0.16	0.17	2.25	79	-5.99	1.80	75	-0.8	109	0.100	98	99	2.8	-0.1	653	83	97	267	263	273	364	83	52	83	52	76	0.058	10.27	0.1
35	5.660	5.948	0.16	0.17	2.28	79	-6.46	1.79	75	-1	108	0.100	98	98	2.7	-0.1	638	84	98	272	271	273	347	83	52	83	53	77	0.057	9.26	0.1
36	5.823	6.119	0.16	0.17	2.22	79	-6.45	1.80	75	-1	107	0.100	97	98	2.6	-0.1	624	85	98	276	280	273	341	83	52	83	53	76	0.056	8.27	0.14



Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1  
 Manufacturer: GNF Group  
 Model: Small  
 Tracking No.: 2416  
 Project No.: 2416W2019E  
 Test Date: 07-26-23  
 Beginning Clock Time: 10:40  
 Meter Box Y Factor: 0.994 (1) 0.998 (2) (Amb)  
 Barometric Pressure: Begin Middle End Average  
 29.45 29.44 29.45 "Hg  
 OMNI Equipment Numbers:

PM Control Module: 371-372  
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.76 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: -0.295 "H<sub>2</sub>O  
 Tunnel Area: 0.19635 ft<sup>2</sup>  
 Pilot Tube Cp: 0.99  
 Avg. Tunnel Velocity: 21.07 ft/sec  
 Initial Tunnel Flow: 227.8 scfm  
 Average Tunnel Flow: 220.0 scfm  
 Post-Test Leak Check (1): 0.000 cfm @ 12 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 10 in. Hg  
 Average Test Piece Fuel Moisture: 19.90 Dry Basis %

Technician Signature: *[Handwritten Signature]*

Velocity Traverse Data									
	Pt. 1	Pt. 2	Pt. 3	Pt. 4	Pt. 5	Pt. 6	Pt. 7	Pt. 8	Center
Initial dP	0.084	0.100	0.094	0.094	0.082	0.100	0.100	0.090	0.098
Temp:	84	84	84	84	84	84	84	84	84
V <sub>initial</sub>	20.73		ft/sec		V <sub>actual</sub>		21.23		ft/sec
F <sub>p</sub>									0.976

Elapsed Time (min)	Particulate Sampling Data											Fuel Weight (lb)				Temperature Data (°F)								Stack Gas Data							
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (in.)	Meter 1 Temp (°F)	Meter 1 Vacuum (inHg)	Orifice dH 2 (in.)	Meter 2 Temp (°F)	Meter 2 Vacuum (inHg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (inHg)	CO <sub>2</sub> (%)	CO (%)
37	5.986	6.290	0.16	0.17	2.25	79	-6.36	1.79	75	-0.9	105	0.100	97	98	2.5	-0.1	614	86	98	284	288	274	336	83	82	83	83	76	0.054	8.07	0.13
38	6.149	6.461	0.16	0.17	2.23	80	-6.48	1.77	75	-0.9	105	0.100	97	98	2.5	0	597	88	99	289	295	274	329	83	82	83	83	76	0.053	8.11	0.14
39	6.312	6.632	0.16	0.17	2.25	80	-6.5	1.78	76	-0.8	104	0.100	97	97	2.4	-0.1	593	89	100	296	303	274	323	83	82	83	83	76	0.052	7.45	0.18
40	6.476	6.802	0.16	0.17	2.24	80	-6.73	1.78	76	-0.7	104	0.100	97	97	2.3	-0.1	570	90	100	301	309	274	318	82	82	83	83	76	0.051	7.24	0.21
41	6.638	6.973	0.16	0.17	2.20	80	-6.98	1.76	76	-0.7	103	0.100	97	97	2.2	-0.1	560	91	100	306	316	275	311	82	82	83	83	76	0.050	7.09	0.22
42	6.802	7.145	0.16	0.17	2.22	80	-7.12	1.78	76	-0.8	103	0.100	97	98	2.2	0	548	93	101	310	322	275	307	82	82	83	83	76	0.048	6.86	0.27
43	6.964	7.316	0.16	0.17	2.21	80	-7.18	1.79	76	-1	103	0.100	96	97	2.1	-0.1	537	94	101	315	328	275	300	82	82	83	83	76	0.048	6.63	0.31
44	7.128	7.488	0.16	0.17	2.30	80	-7.41	1.77	76	-1.1	102	0.100	97	97	2.1	0	527	95	101	319	334	275	296	82	82	83	83	76	0.047	6.87	0.4
45	7.290	7.658	0.16	0.17	2.14	80	-7.73	1.74	76	-1.1	101	0.100	96	97	2.1	0	514	96	102	322	339	275	292	82	82	82	83	76	0.045	6.66	0.43
46	7.452	7.825	0.16	0.17	2.20	80	-9.42	1.77	76	-0.9	100	0.100	96	96	2.0	-0.1	503	98	102	326	344	275	285	82	82	82	83	76	0.044	6.32	0.49
47	7.613	7.994	0.16	0.17	2.29	80	-10.17	1.69	76	-1.5	111	0.100	96	97	1.1	-0.92	486	99	102	329	348	273	288	82	82	82	83	76	0.043	4.97	0.51
48	7.775	8.163	0.16	0.17	2.20	80	-11.95	1.71	77	-2.4	102	0.100	96	96	1.8	0.72	465	100	102	331	351	274	286	82	82	82	83	76	0.044	6.86	0.33
49	7.943	8.329	0.17	0.16	2.29	80	-11.61	1.51	77	-2.7	101	0.100	99	92	1.7	-0.1	468	101	103	333	354	276	285	82	82	83	76	0.045	6.76	0.32	
50	8.108	8.402	0.17	0.17	2.29	80	-11.56	1.76	77	-3.8	101	0.100	98	95	1.6	-0.1	487	103	104	335	356	277	282	82	82	82	83	76	0.045	6.25	0.33
51	8.272	8.643	0.16	0.15	2.24	80	-11.85	1.85	77	-8.2	132	0.090	105	93	14.7	13.12	453	105	105	344	369	275	276	83	82	82	83	76	0.045	2.71	0.17
52	8.435	8.821	0.16	0.18	2.25	80	-11.9	1.98	77	-5.5	141	0.090	105	110	14.5	-0.2	417	107	104	346	372	269	278	84	82	83	83	76	0.043	2.03	0.2
53	8.598	8.994	0.16	0.17	2.23	80	-11.86	1.78	77	-7.1	162	0.090	107	109	14.3	-0.2	406	109	105	347	374	268	280	85	83	83	83	76	0.046	2.82	0.19
54	8.764	9.168	0.17	0.17	2.30	80	-11.86	1.89	77	-7.5	118	0.090	105	104	14.0	-0.32	442	111	104	341	365	273	293	85	83	83	83	76	0.049	4.17	0.26
55	8.929	9.339	0.17	0.17	2.30	80	-12.12	1.73	77	-7	110	0.100	98	99	13.9	-0.1	455	112	104	341	365	275	293	85	83	83	83	76	0.051	5.27	0.88
56	9.095	9.510	0.17	0.17	2.30	80	-12.02	1.76	77	-8	108	0.100	99	98	13.7	-0.2	476	112	103	341	365	279	298	84	83	83	83	76	0.052	6.36	0.65
57	9.261	9.680	0.17	0.17	2.31	80	-11.67	1.83	77	-8	107	0.100	99	97	13.6	-0.1	501	113	103	341	368	285	303	84	83	83	83	76	0.049	8.08	0.46
58	9.427	9.854	0.17	0.17	2.31	80	-11.84	1.84	77	-7.7	107	0.100	99	99	13.4	-0.2	534	114	102	340	365	291	313	84	83	83	83	76	0.051	8.59	0.44
59	9.593	10.032	0.17	0.16	2.29	80	-11.8	1.86	77	-6.7	108	0.100	98	102	13.3	-0.1	574	115	102	339	365	289	316	84	83	83	83	76	0.053	9.39	0.58
60	9.758	10.203	0.16	0.17	2.31	80	-11.71	1.82	78	-7.9	110	0.100	98	98	13.1	-0.2	598	116	101	338	364	303	331	84	83	83	83	76	0.055	9.48	0.47
61	9.923	10.374	0.17	0.17	2.30	80	-11.67	1.83	78	-9.2	112	0.100	98	98	12.9	-0.2	634	116	100	339	364	311	349	84	83	83	83	76	0.057	10.97	0.95
62	10.089	10.571	0.17	0.20	2.31	80	-12.12	3.22	78	-1.4	111	0.090	105	119	12.7	-0.2	653	116	100	338	362	314	355	84	84	83	83	76	0.059	11.28	0.92
63	10.255	10.738	0.17	0.17	2.30	80	-11.99	1.79	78	-0.4	113	0.100	99	96	12.5	-0.2	688	116	100	338	362	317	365	84	84	83	83	76	0.060	10.02	0.5
64	10.420	10.910	0.16	0.17	2.29	81	-11.9	1.79	78	-0.2	115	0.100	99	99	12.3	-0.2	683	117	100	338	363	320	376	84	84	84	83	76	0.062	11.14	0.39
65	10.585	11.082	0.17	0.17	2.29	81	-12.08	1.79	78	-0.4	115	0.090	104	104	12.1	-0.2	694	117	100	338	364	323	385	84	84	84	83	76	0.063	11.37	0.43
66	10.750	11.255	0.16	0.17	2.30	81	-12.04	1.78	78	-0.1	116	0.090	104	105	11.9	-0.18	703	117	100	338	366	325	390	84	84	84	83	76	0.064	11.29	0.41
67	10.915	11.428	0.16	0.17	2.29	81	-12.15	1.80	78	-0.4	116	0.100	99	98	11.7	-0.22	713	118	101	339	367	328	397	84	84	84	83	76	0.065	11.08	0.37
68	11.080	11.598	0.17	0.17	2.28	81	-11.67	1.80	78	-0.4	118	0.100	99	99	11.5	-0.2	720	118	100	340	369	329	398	84	84	84	83	76	0.065	11.23	0.35
69	11.245	11.769	0.16	0.17	2.29	81	-12.12	1.79	78	-0.4	118	0.090	104	104	11.3	-0.2	726	118	101	341	370	331	403	84	84	84	83	76	0.065	11.04	0.37
70	11.411	11.941	0.17	0.17	2.31	82	-11.81	1.79	78	-0.3	118	0.090	105	104	11.2	-0.1	739	119	101	342	372	333	402	84	84	84	83	76	0.065	10.98	0.33
71	11.576	12.113	0.17	0.17	2.29	82	-11.84	1.79	78	-0.2	118	0.100	99	99	11.0	-0.2	732	120	102	343	374	334	405	84	84	84	83	76	0.065	10.83	0.35
72	11.741	12.285	0.16	0.17	2.29	82	-11.81	1.80	78	-0.3	118	0.090	104	104	10.7	-0.28	735	120	102	344	377	336	407	84	84	84	83	76	0.065	11.06	0.39
73	11.906	12.457	0.17	0.17	2.29	83	-11.86	1.80	78	-0.2	119	0.090	104	104	10.6	-0.12	736	121	102	346	379	337	407	84	84	84	83	76	0.066	11.09	0.37

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1  
 Manufacturer: GNF Group  
 Model: Small  
 Tracking No.: 2418  
 Project No.: 2418W2019E  
 Test Date: 07-28-23  
 Beginning Clock Time: 10:40  
 Meter Box Y Factor: 0.994 (1) 0.998 (2)  
 Barometric Pressure: Begin Middle End Average  
 29.45 29.44 29.45 "Hg  
 OMNI Equipment Numbers:

PM Control Module: 371.372  
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Sulfate: 0.255 H<sub>2</sub>O  
 Tunnel Area: 0.19635 ft<sup>2</sup>  
 Pilot Tube Cp: 0.99  
 Avg. Tunnel Velocity: 21.07 ft/sec  
 Initial Tunnel Flow: 227.8 scfm  
 Average Tunnel Flow: 220.0 scfm  
 Post-Test Leak Check (1): 0.000 cfm @ 12 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 10 in. Hg  
 Average Test Piece Fuel Moisture: 19.90 Dry Basis %

Technician Signature: *B. [Signature]*

Velocity Traverse Data									
	Pt. 1	Pt. 2	Pt. 3	Pt. 4	Pt. 5	Pt. 6	Pt. 7	Pt. 8	Center
Initial dP	0.094	0.100	0.094	0.094	0.082	0.100	0.100	0.090	0.098
Temp:	84	84	84	84	84	84	84	84	84
V <sub>initial</sub>	20.73 ft/sec			V <sub>actual</sub> 21.23 ft/sec			F <sub>p</sub> 0.976		

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)				Temperature Data (°F)							Stack Gas Data									
	Gas Meter 2 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (in)	Meter 1 Temp (°F)	Meter 1 Vacuum (inHg)	Orifice dH 2 (in)	Meter 2 Temp (°F)	Meter 2 Vacuum (inHg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (inHg)	CO <sub>2</sub> (%)	CO (%)
74	12.071	12.628	0.16	0.17	2.30	83	-2.16	1.79	79	-0.4	120	0.090	104	104	10.4	-0.2	738	121	104	347	382	338	409	84	55	84	57	77	0.066	11.04	0.32
75	12.236	12.800	0.17	0.17	2.29	83	-1.89	1.80	79	-0.2	119	0.090	104	104	10.2	-0.2	741	122	104	350	385	340	410	84	55	84	57	77	0.066	11.14	0.23
76	12.401	12.972	0.16	0.17	2.29	83	-2.15	1.79	79	-0.3	120	0.090	104	104	10.0	-0.2	748	122	105	352	388	343	412	84	55	84	57	78	0.066	11.14	0.23
77	12.566	13.144	0.16	0.17	2.29	83	-1.89	1.78	79	-0.2	121	0.100	98	99	9.8	-0.2	754	122	105	353	391	345	413	84	55	84	57	78	0.066	11.22	0.21
78	12.731	13.315	0.17	0.17	2.30	84	-2.15	1.80	79	-0.2	122	0.100	98	98	9.6	-0.2	760	123	107	356	396	348	418	84	55	84	58	78	0.067	11.11	0.21
79	12.896	13.487	0.17	0.17	2.28	84	-1.89	1.78	79	-0.1	123	0.090	104	104	9.4	-0.2	767	124	107	358	398	351	420	85	56	85	58	78	0.068	10.86	0.23
80	13.061	13.659	0.16	0.17	2.28	84	-1.85	1.79	79	-0.3	123	0.090	104	104	9.2	-0.2	775	124	107	360	403	354	428	85	56	85	58	78	0.068	10.89	0.26
81	13.225	13.831	0.16	0.17	2.27	85	-2.17	1.79	79	-0.4	125	0.090	104	105	9.0	-0.22	794	124	108	363	407	359	433	85	56	85	58	78	0.069	10.59	0.29
82	13.391	14.003	0.17	0.17	2.28	85	-2.07	1.79	79	-0.1	125	0.090	105	105	8.7	-0.28	817	125	111	366	412	366	437	85	56	85	59	78	0.069	10.36	0.3
83	13.554	14.174	0.16	0.17	2.28	85	-1.74	1.79	79	-0.1	126	0.090	103	104	8.5	-0.2	834	125	108	370	416	371	443	85	56	85	59	79	0.070	10.09	0.33
84	13.718	14.345	0.16	0.17	2.26	85	-1.74	1.79	79	-0.4	127	0.090	104	104	8.3	-0.2	844	125	111	373	421	375	447	85	57	85	59	79	0.070	9.96	0.39
85	13.883	14.517	0.16	0.17	2.26	86	-2.19	1.78	80	-0.4	128	0.090	104	105	8.0	-0.3	852	126	111	377	426	378	449	85	57	85	59	78	0.071	10	0.44
86	14.047	14.688	0.16	0.17	2.24	86	-1.98	1.78	80	-0.1	129	0.090	104	104	7.8	-0.2	863	127	115	380	433	383	453	86	57	85	60	79	0.071	10.06	0.45
87	14.210	14.860	0.16	0.17	2.24	86	-2.2	1.78	80	-0.4	130	0.090	103	105	7.6	-0.2	867	127	115	385	440	387	456	86	57	85	60	78	0.071	10.16	0.44
88	14.374	15.031	0.16	0.17	2.25	87	-2.19	1.78	80	-0.4	129	0.090	104	104	7.4	-0.2	874	128	114	389	446	390	457	86	57	86	60	79	0.071	10.17	0.44
89	14.538	15.202	0.16	0.17	2.23	87	-1.74	1.78	80	-0.3	129	0.090	104	104	7.1	-0.3	872	128	115	395	452	392	456	86	57	86	60	80	0.071	10.14	0.45
90	14.701	15.374	0.16	0.17	2.23	87	-1.83	1.78	80	-0.3	130	0.090	103	105	6.9	-0.2	875	129	116	399	460	396	456	86	58	86	60	80	0.071	10.11	0.44
91	14.863	15.545	0.16	0.17	2.19	88	-1.9	1.78	80	-0.4	132	0.090	102	104	6.7	-0.2	876	129	118	404	467	399	459	86	58	86	61	80	0.071	10.11	0.43
92	15.025	15.716	0.16	0.17	2.17	88	-2.06	1.78	80	-0.2	131	0.090	102	104	6.5	-0.22	880	130	117	410	474	402	461	86	58	86	61	81	0.071	10.03	0.4
93	15.185	15.887	0.16	0.17	2.17	88	-2.28	1.77	80	-0.5	131	0.090	101	104	6.2	-0.24	884	130	119	415	480	406	460	87	58	86	61	80	0.071	10.21	0.41
94	15.347	16.059	0.16	0.17	2.17	89	-2.29	1.78	80	-0.2	132	0.090	102	105	6.0	-0.24	884	131	122	421	488	409	461	87	58	87	61	80	0.071	10.46	0.43
95	15.508	16.230	0.16	0.17	2.16	89	-2.07	1.78	81	-0.2	130	0.090	100	104	5.8	-0.2	884	132	121	427	495	412	459	87	59	87	61	81	0.071	10.71	0.43
96	15.671	16.401	0.16	0.17	2.31	89	-2.05	1.78	81	-0.1	129	0.090	104	104	5.6	-0.2	881	133	123	433	502	414	455	87	59	87	61	80	0.070	10.86	0.41
97	15.834	16.572	0.17	0.17	2.31	90	-2.39	1.78	81	-0.3	131	0.090	105	104	5.4	-0.2	876	133	122	439	509	416	453	87	59	87	62	81	0.069	10.97	0.38
98	16.004	16.743	0.17	0.17	2.32	90	-2.25	1.78	81	-0.4	130	0.090	104	104	5.2	-0.2	873	134	123	445	516	418	452	87	59	87	62	80	0.069	10.94	0.33
99	16.169	16.915	0.16	0.17	2.27	90	-2.51	1.77	81	-0.5	130	0.090	104	105	5.0	-0.2	872	135	125	448	523	421	449	87	59	87	62	81	0.068	10.91	0.31
100	16.335	17.087	0.17	0.17	2.30	90	-2.15	1.77	81	-0.5	128	0.090	104	104	4.8	-0.2	870	135	124	456	529	423	448	87	59	87	62	80	0.068	15.32	0.37
101	16.501	17.258	0.17	0.17	2.33	90	-2.49	1.78	81	-0.5	129	0.090	104	104	4.7	-0.1	865	136	127	461	535	425	445	87	59	87	61	81	0.067	15.2	0.27
102	16.669	17.430	0.17	0.17	2.31	90	-2.25	1.78	81	-0.2	128	0.100	100	99	4.5	-0.2	857	137	128	466	541	426	440	87	59	87	61	81	0.067	14.96	0.19
103	16.835	17.601	0.17	0.17	2.32	90	-2.35	1.78	81	-0.1	128	0.090	104	104	4.3	-0.2	849	138	128	471	548	427	437	87	59	87	61	81	0.067	14.72	0.19
104	17.001	17.772	0.17	0.17	2.33	90	-2.41	1.78	82	-0.1	128	0.090	104	104	4.1	-0.2	843	139	129	477	553	428	435	87	59	87	61	81	0.066	14.69	0.22
105	17.168	17.944	0.17	0.17	2.32	91	-2.04	1.77	82	-0.3	128	0.090	105	104	4.0	-0.1	840	140	129	481	559	430	434	87	59	87	61	82	0.066	14.61	0.24
106	17.334	18.115	0.17	0.17	2.34	91	-2.08	1.77	82	-0.5	128	0.090	104	104	3.8	-0.2	834	141	131	486	565	431	430	87	59	87	61	82	0.066	14.61	0.17
107	17.502	18.286	0.17	0.17	2.34	91	-2.33	1.78	82	-0.2	127	0.090	105	104	3.6	-0.2	827	142	130	491	570	432	429	87	60	87	62	81	0.066	14.8	0.1
108	17.670	18.457	0.17	0.17	2.34	91	-2.01	1.78	82	-0.3	126	0.090	106	103	3.5	-0.1	819	144	132	496	575	433	421	87	60	87	62	81	0.065	14.42	0.05
109	17.837	18.629	0.17	0.17	2.33	91	-2.22	1.77	82	-0.2	126	0.100	99	99	3.3	-0.2	810	145	134	500	580	434	421	87	60	87	62	81	0.065	14.1	0.02
110	18.005	18.800	0.17	0.17	2.34	92	-2.35	1.77	82	-0.4	125	0.090	106	103	3.2	-0.1	800	146	133	505	584	434	417	87	60	87	62	82	0.064	14	0.02

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515


Run: 1

Manufacturer: GHP Group  
 Model: Small  
 Tracking No.: 2418  
 Project No.: 2418W5019E  
 Test Date: 07-22-20  
 Beginning Clock Time: 10:40  
 Meter Box Y Factor: 0.994 (1) 0.998 (2)  
 Barometric Pressure: Begin Middle End Average  
29.45 29.44 29.45 "Hg  
 OMNI Equipment Numbers: \_\_\_\_\_

Total Sampling Time: 125 min  
 Recording Interval: 1 min  
 Background Sample Volume: \_\_\_\_\_ cubic feet  
 (Amb)

PM Control Modules: 371.372  
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Sulf: 0.255 H<sub>2</sub>O  
 Tunnel Area: 0.19635 ft<sup>2</sup>  
 Pilot Tube Cp: 0.99

Avg. Tunnel Velocity: 21.07 ft/sec  
 Initial Tunnel Flow: 227.8 scfm  
 Average Tunnel Flow: 220.0 scfm  
 Post-Test Leak Check (1): 0.000 cfm @ 12 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 10 in. Hg  
 Average Test Piece Fuel Moisture: 19.90 Dry Basis %

Technician Signature: 

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP	0.094	0.100	0.094	0.094	0.082	0.100	0.090	0.098	H <sub>2</sub> O
Temp:	84	84	84	84	84	84	84	84	Tf
V <sub>air</sub>	20.73			ft/sec			V <sub>air</sub>	21.23	
F <sub>p</sub>									0.976

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)				Temperature Data (°F)								Stack Gas Data									
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (in)	Meter 1 Temp (°F)	Meter 1 Vacuum (inHg)	Orifice dH 2 (in)	Meter 2 Temp (°F)	Meter 2 Vacuum (inHg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (inHg)	CO <sub>2</sub> (%)	CO (%)	
111	18.173	18.971	0.17	0.17	2.35	92	-2.14	1.77	82	-0.4	124	0.100	99	98	3.0	-0.2	793	147	134	509	588	434		413	87	60	87	62	81	0.063	13.76	0.02
112	18.341	19.143	0.17	0.17	2.35	92	-2.11	1.78	83	-0.3	124	0.090	105	104	2.9	-0.1	785	148	135	515	592	435		408	87	60	87	62	81	0.063	13.64	0.01
113	18.510	19.314	0.17	0.17	2.37	92	-2.02	1.77	83	-0.2	123	0.090	105	103	2.8	-0.1	773	149	134	519	595	434		406	87	61	87	62	81	0.063	13.37	0.01
114	18.678	19.485	0.17	0.17	2.38	92	-2.11	1.77	83	-0.2	122	0.100	99	98	2.7	-0.1	771	150	135	523	599	436		401	87	61	87	62	82	0.062	13.27	0
115	18.848	19.658	0.17	0.17	2.38	92	-2.06	1.77	83	-0.5	122	0.100	100	98	2.5	-0.2	782	152	136	528	601	436		398	87	61	87	62	82	0.062	12.96	0
116	19.017	19.827	0.17	0.17	2.39	92	-2.41	1.77	83	-0.3	123	0.090	105	103	2.4	-0.1	764	153	137	533	604	436		393	87	61	87	63	82	0.061	12.82	0
117	19.187	19.999	0.17	0.17	2.40	92	-2.04	1.76	83	-0.2	121	0.100	100	98	2.3	-0.1	748	154	137	537	607	437		392	87	61	87	63	81	0.061	12.77	0
118	19.357	20.170	0.17	0.17	2.39	92	-1.99	1.77	83	-0.2	121	0.100	100	98	2.2	-0.1	743	155	138	542	609	437		389	87	61	87	63	81	0.060	12.72	0
119	19.527	20.341	0.17	0.17	2.39	92	-1.95	1.77	83	-0.2	121	0.100	100	98	2.1	-0.1	736	156	138	546	611	437		387	87	61	87	63	81	0.060	12.65	0
120	19.697	20.512	0.17	0.17	2.40	92	-2.1	1.77	83	-0.4	120	0.090	106	103	1.9	-0.2	733	158	137	550	614	438		384	87	61	87	63	80	0.060	12.55	0
121	19.867	20.682	0.17	0.17	2.36	92	-2.22	1.76	83	-0.2	120	0.100	100	97	1.8	-0.1	728	159	139	554	616	439		379	87	62	87	63	81	0.059	12.55	0
122	20.033	20.854	0.17	0.17	2.28	93	-1.76	1.77	83	-0.2	119	0.100	98	98	1.7	-0.1	726	160	137	557	617	439		377	87	62	87	63	81	0.059	12.59	0
123	20.198	21.028	0.16	0.17	2.28	92	-2.19	1.76	84	-0.3	119	0.100	97	97	1.6	-0.1	720	162	137	560	619	440		376	87	62	87	63	81	0.059	12.68	0
124	20.365	21.198	0.17	0.17	2.30	92	-1.99	1.76	84	-0.6	119	0.090	104	102	1.5	-0.1	721	163	141	563	622	442		375	87	62	87	63	82	0.058	12.81	0
125	20.531	21.367	0.17	0.17	2.27	92	-1.8	1.76	84	-0.2	117	0.090	103	102	1.4	-0.1	722	164	139	568	623	443		378	87	62	87	63	82	0.057	12.66	0
Avg Tot	20.531	21.367	0.16	0.17	2.27	83		1.79	78		114	0.096	100	100								376.2		55	85	56	78	0.056				

## Wood Heater Lab Data - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group                      Equipment Numbers: \_\_\_\_\_  
 Model: Small  
 Tracking No.: 2416  
 Project No.: 0418WS019E  
 Run #: 1  
 Date: 7/7/20

**TRAIN 1 (First Hour emissions)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T263S	102.7	100.7	2.0
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

**Sub-Total**    Total Particulate, mg:    **2.0**

**TRAIN 1 (Post First Hour Change-out)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T257AP	185.3	181.4	3.9
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe	7	114982.4	114981.9	0.5
E. Filter seals catch*	Seals	R993	3347.4	3344.9	2.5

**Sub-Total**    Total Particulate, mg:    **6.9**

**Train 1 Aggregate**    Total Particulate, mg:    **8.9**

**TRAIN 2**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	T257BP	186.2	181.8	4.4
B. Rear filter catch	Filter	T264S	98.9	97.3	1.6
C. Probe catch*	Probe	8	115599.1	115598.4	0.7
D. Filter seals catch*	Seals	R994	3349.8	3347.8	2.0

Total Particulate, mg:    **8.7**

**AMBIENT**

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

Total Particulate, mg:    **0.0**

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

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

Technician Signature: 

## Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group  
 Model: Small  
 Project No.: 0418WS019E  
 Tracking No.: 2416  
 Run: 1  
 Test Date: 07/07/20

Burn Rate	<b>3.40 kg/hr dry</b>
Average Tunnel Temperature	114 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	21.07 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	13201.8 dscf/hour
Average Delta p	0.096 inches H2O
Total Time of Test	125 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	20.531 cubic feet	21.367 cubic feet	9.758 cubic feet
Average Gas Meter Temperature	78 degrees Fahrenheit	83 degrees Fahrenheit	78 degrees Fahrenheit	77 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	19.648 dscf	20.693 dscf	9.426 dscf
Total Particulates - m <sub>n</sub>	0 mg	8.9 mg	8.7 mg	2 mg
Particulate Concentration (dry-standard) - C <sub>r</sub> /C <sub>s</sub>	0.000000 grams/dscf	0.00045 grams/dscf	0.00042 grams/dscf	0.00021 grams/dscf
Total Particulate Emissions - E <sub>T</sub>	0.00 grams	12.46 grams	11.56 grams	2.80 grams
Particulate Emission Rate	0.00 grams/hour	5.98 grams/hour	5.55 grams/hour	2.80 grams/hour
Emissions Factor		1.76 g/kg	1.63 g/kg	1.81 g/kg
Difference from Average Total Particulate Emissions		0.45 grams	0.45 grams	

**Dual Train Comparison Results Are Acceptable**

FINAL AVERAGE RESULTS	
<b>Complete Test Run</b>	
Total Particulate Emissions - E <sub>T</sub>	12.01 grams
Particulate Emission Rate	<b>5.77 grams/hour</b>
Emissions Factor	1.70 grams/kg
<b>First Hour Emissions</b>	
Total Particulate Emissions - E <sub>T</sub>	2.80 grams
Particulate Emission Rate	2.80 grams/hour
Emissions Factor	1.81 grams/kg
7.5% of Average Total Particulate Emissions	0.90 grams

QUALITY CHECKS	
Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Train Precession 7.5%	3.73
Train Precision 0.5g/kg	0.13

Technician Signature: 

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version  
 Cordwood Fuel Load Calculators - 10 lb/ft<sup>3</sup> Nominal Load Density  
 Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight  
 Values to be input manually

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For All Usable Firebox Volumes - High Fire Test Only				
Nominal Required Load Density (wet basis)	10	lb/ft <sup>3</sup>		
Usable Firebox Volume	1.54	ft <sup>3</sup>		
Total Nom. Load Wt. Target	15.40	lb		
Total Load Wt. Allowable Range	14.60	to 16.20	lb	
Core Target Wt. Allowable Range	6.90	to 10.00	lb	
Remainder Load Wt. Allowable Range	5.40	to 8.50	lb	
				Mid-Point
Core Load Pc. Wt. Allowable Range	2.30	to 3.90	lb	3.10
Remainder Load Pc. Wt. Allowable Range	1.50	to 8.50	lb	5.00
	Pc. #			
Core Load Piece Wt. Actual	1	3.80	lb	In Range
	2	2.30	lb	In Range
	3	2.40	lb	In Range
Core Load Total. Wt. Actual		8.50	lb	In Range
	Pc. #			
Remainder Load Piece Wt.	1	4.20	lb	In Range
(1 to 3 Pcs.)	2	2.20	lb	In Range
	3		lb	NA
Remainder Load Tot. Wt. Act		6.40	lb	In Range
Total Load Wt. Actual		14.90	lb	In Range
Core % of Total Wt.		57%		In Range 45-65%
Remainder % of Total Wt.		43%		In Range 35-55%
Actual Load % of Nominal Target		97%		In Range 95-105%
Actual Fuel Load Density		9.7	lb/ft <sup>3</sup>	
<b>Kindling and Start-up Fuel</b>				
Maximum Kindling Wt. (20% of Tot. Load Wt.)		2.98	lb	
Actual Kindling Wt.		2.90	lb	In Range 19.5%
Maximum Start-up Fuel Wt. (30% of Tot. Load Wt.)		4.47	lb	
Actual Start-up Fuel Wt.		4.40	lb	In Range 29.5%
Allowable Residual Start-up Fuel Wt. Range	1.5	to 3.0	lb	Mid-Point
Actual Residual Start-up Fuel Wt.		1.6	lb	In Range 2.2
Total Wt. All Fuel Added (wet basis)		22.20	lb	
<b>High Fire Test Run End Point Range</b>				
	Low		High	Mid-Point
Based on Fuel Load Wt. (w/tares)	1.3	to	1.6	lb 1.5
Actual Fuel Load Ending Wt.		1.4	lb	In Range

Fuel Piece Moisture Reading (%-dry basis)					Pc. Wt. Dry Basis	
1	2	3	Ave.			
18	20.9	24.6	21.2	In Range	3.14	1.42
18	21.7	20.1	19.9	In Range	1.92	0.87
19.6	24.3	20.7	21.5	In Range	1.97	0.90
21.7	21.1	20	20.9	In Range	3.47	1.58
25.6	27.9	24.5	26.0	In Range	1.75	0.79
			NA	NA	NA	NA
Total Load Ave. MC (%-dry basis)			21.7	In Range		
Total Load Ave. MC % (wet basis)			17.8			
Total Test Load Weight (dry basis)					12.25	5.56
<b>Kindling Moisture (%-dry basis)</b>						
9.4	10.9	10.7	10.3	In Range	2.63	1.19
<b>Start-up Fuel Moisture Readings (%-dry basis)</b>						
18	19.3	21	19.4	In Range	3.68	1.67
Total Wt. All Fuel Added (dry basis)					18.56	8.42
Total Wt. All Fuel Burned (dry basis)					15.6	7.1

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 1  
 Model: GHP Small Tracking Number: 2416 Date: 7/7/2020  
 Test Crew: B. Davis  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Run Notes

##### Air Control Settings

Primary:

Fully open

Secondary: fixed

Tertiary/Pilot: w/A

Fan: On High

##### Preburn Notes

Time	Notes
Ø	Torch used for 40 seconds to light a top down burn. Door fully open until 1:15. Comb. Air fully open. Fan off until 5:00 min. then turned to high.
27	Adjusted Startup Fuel by bringing unburnt fuel forward.

##### Test Notes

Sketch test fuel configuration:

see photo

Start up procedures & Timeline:

Bypass: N/A

Fuel loaded by: 60 seconds

Door closed at: 3:15

Primary air: fully open entire test

Notes: FAN on High entire test

Time	Notes
47	changed front filter in train A
60	changed front filter in train B

Technician Signature: [Signature]

Date: 7/15/2020

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 1  
 Model: GHP Small Tracking Number: 2416 Date: 7/7/2020  
 Test Crew: B Daws  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Supplemental Data

Start Time: 10:40 Booth #: N/A

Stop Time: 12:45

**Stack Gas Leak Check:**

Initial: good Final: See end of Run 2

**Sample Train Leak Check:**

A: 0.0 @ 12 "Hg  
 B: 0.0 @ 10 "Hg

**Calibrations:** Span Gas CO<sub>2</sub>: 10.08 CO: 2.53

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>1012</u>	<u>1012</u>	<u>See end of Run 2</u>	
CO <sub>2</sub>	<u>0.00</u>	<u>10.10</u>		
CO	<u>0.00</u>	<u>2.53</u>		

Air Velocity (ft/min): Initial: 250 Final: 250

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

Pitot Tube Leak Test: Initial: good Final: good

Stack Diameter (in): 6"

Induced Draft: 0.0

% Smoke Capture: 100%

Flue Pipe Cleaned Prior to First Test in Series:

Date: 7/3/20 Initials: BD

	Initial	Middle	Ending
P <sub>b</sub> (in/Hg)	<u>29.45</u>		<u>29.44</u>
RH (%)	<u>52</u>		<u>48</u>
Ambient (°F)	<u>74</u>		<u>82</u>

Tunnel Traverse		
Microtector Reading	dP (in H <sub>2</sub> O)	T(°F)
	<u>.084</u>	<u>84</u>
	<u>.100</u>	<u>84</u>
	<u>.094</u>	<u>84</u>
	<u>.094</u>	<u>84</u>
	<u>.082</u>	<u>84</u>
	<u>.100</u>	<u>84</u>
	<u>.100</u>	<u>84</u>
	<u>.090</u>	<u>84</u>
Center:		
	<u>.098</u>	<u>84</u>

Background Filter Volume: N/A

Tunnel Static Pressure (in H <sub>2</sub> O):	
Beginning of Test	End of Test
<u>-265</u>	<u>-265</u>

Technician Signature: BD

Date: 7/15/2020



# **Run 1**

## **High Burn 1-minute data**

### **Efficiency and Heat Output Results** **Kindling and start-up fuel removed from calculations**

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group  
 Model: Small  
 Tracking No.: 2018  
 Project No.: 0218V5019E  
 Test Date: 07-Jul-20  
 Beginning Clock Time: 10:50  
 Meter Box Y Factor: 0.994 (1) 0.998 (2) \_\_\_\_\_ (Amb)  
 Background Sample Volume: \_\_\_\_\_ cubic feet  
 Barometric Pressure: Begin Middle End Average  
29.45 29.44 29.45 "Hg  
 OMNI Equipment Numbers: \_\_\_\_\_

PM Control Module: 371.372  
 Dilution Tunnel MW(dry): 29.90 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.92 percent  
 Dilution Tunnel Static: 0.250 "H<sub>2</sub>O  
 Tunnel Area: 5.1800 ft<sup>2</sup>  
 Pilot Tube Cp: 0.324  
 Avg. Tunnel Velocity: 80000 ft/sec  
 Initial Tunnel Flow: 80000 scfm  
 Average Tunnel Flow: 80000 scfm  
 Post-Test Leak Check (1): \_\_\_\_\_ in. Hg  
 Post-Test Leak Check (2): \_\_\_\_\_ in. Hg  
 Average Test Fuel Moisture: 21.51 Dry Basis %

Technician Signature: [Signature]

Velocity Traverse Data									
	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8	Center
Initial dP									
Temp.									
V <sub>avg</sub>									
V <sub>max</sub>									

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)					Temperature Data (°F)					Stack Gas Data													
	Gas Meter 1 (ft³)	Gas Meter 2 (ft³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (in.)	Meter 1 Temp (°F)	Meter 1 Vacuum (in.Hg)	Orifice dH 2 (in.)	Meter 2 Temp (°F)	Meter 2 Vacuum (in.Hg)	Dilution Tunnel (F)	Dilution Tunnel Center g/l	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (in.H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)			
0																																		
1																																		
2																																		
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Wood Heater Test Data - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group  
 Model: Small  
 Tracking No.: 2018  
 Project No.: 1218VSW019E  
 Test Date: 07-Jul-20  
 Beginning Clock Time: 10:50  
 Meter Box Y Factor: 0.994 (1) 0.998 (2) \_\_\_\_\_ (Amb)  
 Background Sample Volume: \_\_\_\_\_ cubic feet  
 Barometric Pressure: Begin Middle End Average  
29.45 29.44 29.45 "Hg  
 OMNI Equipment Numbers: \_\_\_\_\_

PM Control Module: 371, 372  
 Dilution Tunnel MW(wet): 29.90 lb/lb-mole  
 Dilution Tunnel MW(dry): 28.78 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.92 percent  
 Dilution Tunnel Static: 0.250 "H<sub>2</sub>O  
 Tunnel Area: 5.1800 ft<sup>2</sup>  
 Pilot Tube Cp: 0.325  
 Avg. Tunnel Velocity: #DIV/0! ft/sec  
 Initial Tunnel Flow: #DIV/0! scfm  
 Average Tunnel Flow: #DIV/0! scfm  
 Post-Test Leak Check (1): \_\_\_\_\_ in. Hg  
 Post-Test Leak Check (2): \_\_\_\_\_ in. Hg  
 Average Test Piece Fuel Moisture: 21.91 Dry Basis %

Technician Signature: [Signature]

Velocity Traverse Data									
	PT.1	PT.2	PT.3	PT.4	PT.5	PT.6	PT.7	PT.8	Center
Initial dP									
Temp.									
V <sub>avg</sub>									

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)		Temperature Data (°F)										Stack Gas Data								
	Gas Meter 1 (ft³)	Gas Meter 2 (ft³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice #H 1 (H <sub>2</sub> O)	Meter 1 Temp (°F)	Meter 1 Vacuum (°Hg)	Orifice #H 2 (H <sub>2</sub> O)	Meter 2 Temp (°F)	Meter 2 Vacuum (°Hg)	Dilution Tunnel (F)	Dilution Tunnel-Center (F)	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)
36															8.2		397	127	115	385	440	397	456	86	57	85	80	78	0.071	10.16	0.44
37															6.0		374	128	114	389	448	390	457	86	57	86	80	79	0.071	10.17	0.44
38															5.7		372	128	115	395	452	392	456	86	57	86	80	80	0.071	10.14	0.45
39															5.5		375	129	116	399	460	396	456	86	58	86	80	80	0.071	10.11	0.44
40															5.3		376	129	119	404	467	399	459	86	58	86	81	81	0.071	10.07	0.44
41															5.1		380	130	117	410	474	402	461	86	58	86	81	81	0.071	10.03	0.4
42															4.8		384	130	119	415	480	406	460	87	58	86	81	80	0.071	10.21	0.41
43															4.6		384	131	122	421	488	409	461	87	58	87	81	80	0.071	10.46	0.43
44															4.4		384	132	121	427	495	412	459	87	59	87	81	81	0.071	10.71	0.43
45															4.2		381	133	123	433	502	414	455	87	59	87	81	80	0.070	10.88	0.41
46															4.0		376	133	122	439	509	416	453	87	59	87	82	81	0.069	10.97	0.38
47															3.8		373	134	123	445	516	418	452	87	59	87	82	80	0.069	10.94	0.33
48															3.6		372	135	125	448	523	421	449	87	59	87	82	81	0.068	10.91	0.31
49															3.4		370	135	124	450	529	423	448	87	59	87	82	80	0.068	13.32	0.37
50															3.3		365	136	127	461	535	425	445	87	59	87	81	81	0.067	15.2	0.27
51															3.1		357	137	128	466	541	426	440	87	59	87	81	81	0.067	14.96	0.19
52															2.9		349	138	128	471	548	427	437	87	59	87	81	81	0.067	14.72	0.19
53															2.7		343	139	129	477	553	428	435	87	59	87	81	81	0.066	14.69	0.22
54															2.6		340	140	129	481	559	430	434	87	59	87	81	82	0.066	14.61	0.24
55															2.4		334	141	131	486	565	431	430	87	60	87	81	82	0.066	14.81	0.17
56															2.2		327	142	130	491	570	432	429	87	60	87	82	81	0.066	14.8	0.1
57															2.1		319	144	132	496	575	433	421	87	60	87	82	81	0.065	14.42	0.05
58															1.9		310	145	134	500	580	434	421	87	60	87	82	81	0.065	14.1	0.02
59															1.8		300	146	133	505	584	434	417	87	60	87	82	82	0.064	14	0.02
60															1.6		293	147	134	509	588	434	413	87	60	87	82	81	0.063	13.78	0.02
61															1.5		285	148	135	515	592	436	408	87	60	87	82	81	0.063	13.64	0.01
62															1.4		273	149	134	519	595	434	406	87	61	87	82	81	0.063	13.27	0.01
63															1.3		271	150	135	523	599	436	401	87	61	87	82	82	0.062	13.27	0
64															1.1		262	152	136	528	601	436	396	87	61	87	82	82	0.062	12.98	0
65															1.0		254	153	137	533	604	436	393	87	61	87	83	82	0.061	12.82	0
66															0.9		248	154	137	537	607	437	392	87	61	87	83	81	0.061	12.77	0
67															0.8		243	155	138	542	609	437	389	87	61	87	83	81	0.060	12.72	0
68															0.7		236	156	139	546	611	437	387	87	61	87	83	81	0.060	12.66	0
69															0.5		233	158	137	550	614	438	384	87	61	87	83	80	0.060	12.55	0
70															0.4		228	159	139	554	616	439	379	87	62	87	83	81	0.059	12.55	0
71															0.3		226	160	137	557	617	439	377	87	62	87	83	81	0.059	12.59	0
72															0.2		220	162	137	560	619	440	376	87	62	87	83	81	0.059	12.68	0
73															0.1		221	163	141	563	622	442	375	87	62	87	83	82	0.058	12.81	0
74															0.0		222	164	139	568	623	443	378	87	62	87	83	82	0.057	12.69	0
Avg/Std	0.000	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	168.0																

## Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group  
 Model: Small  
 Project No.: 0418WS019E  
 Tracking No.: 2416  
 Run: 1  
 Test Date: 07/07/20

Burn Rate	<b>3.99 kg/hr dry</b>
Total Time of Test	74 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)

#DIV/0!

FINAL AVERAGE RESULTS	

QUALITY CHECKS	
Ambient Temp (55-90°F)	OK

Control No. P-SSAR-0003

Technician Signature: 

High Burn Run 1-Efficiency

# Wood Heater Efficiency Results - CSA B415.1

**Manufacturer:** GHP Group  
**Model:** Small  
**Date:** 07/07/20  
**Run:** 1  
**Control #:** 0418WS019E  
**Test Duration:** 74  
**Output Category:** IV

**Technician Signature:** 

**Test Results in Accordance with CSA B415.1-09**

	HHV Basis	LHV Basis
Overall Efficiency	75.1%	80.5%
Combustion Efficiency	97.6%	97.6%
Heat Transfer Efficiency	77%	82.4%

Output Rate (kJ/h)	59,146	56,107	(Btu/h)
Burn Rate (kg/h)	4.07	8.98	(lb/h)
Input (kJ/h)	78,786	74,737	(Btu/h)

Test Load Weight (dry kg)	5.02	11.07	dry lb
MC wet (%)	17.97451742		
MC dry (%)	21.91		
Particulate (g)			
CO (g)	184		
Test Duration (h)	1.23		

Emissions	Particulate	CO
g/MJ Output		2.52
g/kg Dry Fuel		36.64
g/h		149.27
lb/MM Btu Output		5.87

Air/Fuel Ratio (A/F)	9.58
----------------------	------

VERSION:                      2.2                      12/14/2009

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version  
 Cordwood Fuel Load Calculators - 10 lb/ft<sup>3</sup> Nominal Load Density  
 Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight  
 Values to be input manually

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For All Usable Firebox Volumes - High Fire Test Only				
Nominal Required Load Density (wet basis)	10	lb/ft <sup>3</sup>		
Usable Firebox Volume	1.54	ft <sup>3</sup>		
Total Nom. Load Wt. Target	15.40	lb		
Total Load Wt. Allowable Range	14.60	to 16.20	lb	
Core Target Wt. Allowable Range	6.90	to 10.00	lb	
Remainder Load Wt. Allowable Range	5.40	to 8.50	lb	
				Mid-Point
Core Load Pc. Wt. Allowable Range	2.30	to 3.90	lb	3.10
Remainder Load Pc. Wt. Allowable Range	1.50	to 8.50	lb	5.00
	Pc. #			
Core Load Piece Wt. Actual	1	3.80	lb	In Range
	2	2.30	lb	In Range
	3	2.40	lb	In Range
Core Load Total. Wt. Actual		8.50	lb	In Range
	Pc. #			
Remainder Load Piece Wt.	1	4.20	lb	In Range
(1 to 3 Pcs.)	2	2.20	lb	In Range
	3		lb	NA
Remainder Load Tot. Wt. Act		6.40	lb	In Range
Total Load Wt. Actual		14.90	lb	In Range
Core % of Total Wt.		57%		In Range 45-65%
Remainder % of Total Wt.		43%		In Range 35-55%
Actual Load % of Nominal Target		97%		In Range 95-105%
Actual Fuel Load Density		9.7	lb/ft <sup>3</sup>	
<u>Kindling and Start-up Fuel</u>				
Maximum Kindling Wt. (20% of Tot. Load Wt.)		2.98	lb	
Actual Kindling Wt.		2.90	lb	In Range 19.5%
Maximum Start-up Fuel Wt. (30% of Tot. Load Wt.)		4.47	lb	
Actual Start-up Fuel Wt.		4.40	lb	In Range 29.5%
Allowable Residual Start-up Fuel Wt. Range	1.5	to 3.0	lb	Mid-Point
Actual Residual Start-up Fuel Wt.		1.6	lb	In Range 2.2
Total Wt. All Fuel Added (wet basis)		22.20	lb	
<u>High Fire Test Run End Point Range</u>				
	Low		High	Mid-Point
Based on Fuel Load Wt. (w/tares)	1.3	to	1.6	lb 1.5
Actual Fuel Load Ending Wt.		1.4	lb	In Range

Fuel Piece Moisture Reading (%-dry basis)					Pc. Wt. Dry Basis	
1	2	3	Ave.			
18	20.9	24.6	21.2	In Range	3.14	1.42
18	21.7	20.1	19.9	In Range	1.92	0.87
19.6	24.3	20.7	21.5	In Range	1.97	0.90
21.7	21.1	20	20.9	In Range	3.47	1.58
25.6	27.9	24.5	26.0	In Range	1.75	0.79
			NA	NA	NA	NA
Total Load Ave. MC (%-dry basis)			21.7	In Range		
Total Load Ave. MC % (wet basis)			17.8			
Total Test Load Weight (dry basis)					12.25	5.56
<u>Kindling Moisture (%-dry basis)</u>						
9.4	10.9	10.7	10.3	In Range	2.63	1.19
<u>Start-up Fuel Moisture Readings (%-dry basis)</u>						
18	19.3	21	19.4	In Range	3.68	1.67
Total Wt. All Fuel Added (dry basis)					18.56	8.42
Total Wt. All Fuel Burned (dry basis)					15.6	7.1

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 1  
 Model: GHP Small Tracking Number: 2416 Date: 7/7/2020  
 Test Crew: B. Davis  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Run Notes

##### Air Control Settings

Primary:

Fully open

Secondary: fixed

Tertiary/Pilot: w/A

Fan: on High

##### Preburn Notes

Time	Notes
Ø	Torch used for 40 seconds to light a top down burn. Door fully open until 1:15. Comb. Air fully open. Fan off until 5:00 min. then turned to high.
27	Adjusted Startup Fuel by bringing unburnt fuel forward.

##### Test Notes

Sketch test fuel configuration:

see photo

Start up procedures & Timeline:

Bypass: N/A

Fuel loaded by: 60 seconds

Door closed at: 3:15

Primary air: fully open entire test

Notes: FAN on High entire test

Time	Notes
47	changed front filter in train A
60	changed front filter in train B

Technician Signature: [Signature]

Date: 7/15/2020

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 1  
 Model: GHP Small Tracking Number: 2416 Date: 7/7/2020  
 Test Crew: B Daws  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Supplemental Data

Start Time: 10:40 Booth #: N/A

Stop Time: 12:45

**Stack Gas Leak Check:**

Initial: good Final: See end of Run 2

**Sample Train Leak Check:**

A: 0.0 @ 12 "Hg  
 B: 0.0 @ 10 "Hg

**Calibrations:** Span Gas CO<sub>2</sub>: 10.08 CO: 2.53

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>1012</u>	<u>1012</u>	<u>See end of Run 2</u>	
CO <sub>2</sub>	<u>0.00</u>	<u>10.10</u>		
CO	<u>0.00</u>	<u>2.53</u>		

Air Velocity (ft/min): Initial: 250 Final: 250

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

Pitot Tube Leak Test: Initial: good Final: good

Stack Diameter (in): 6"

Induced Draft: 0.0

% Smoke Capture: 100%

Flue Pipe Cleaned Prior to First Test in Series:

Date: 7/3/20 Initials: BD

	Initial	Middle	Ending
P <sub>b</sub> (in/Hg)	<u>29.45</u>		<u>29.44</u>
RH (%)	<u>52</u>		<u>48</u>
Ambient (°F)	<u>74</u>		<u>82</u>

Tunnel Traverse		
Microtector Reading	dP (in H <sub>2</sub> O)	T(°F)
	<u>.084</u>	<u>84</u>
	<u>.100</u>	<u>84</u>
	<u>.094</u>	<u>84</u>
	<u>.094</u>	<u>84</u>
	<u>.082</u>	<u>84</u>
	<u>.100</u>	<u>84</u>
	<u>.100</u>	<u>84</u>
	<u>.090</u>	<u>84</u>
Center:		
	<u>.098</u>	<u>84</u>

Background Filter Volume: N/A

Tunnel Static Pressure (in H <sub>2</sub> O):	
Beginning of Test	End of Test
<u>-265</u>	<u>-265</u>

Technician Signature: BD

Date: 7/15/2020




# **Run 2**

## **Medium Burn**

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 2  
 Manufacturer: GNF Group  
 Model: Small Series  
 Tracking No.: 2416  
 Project No.: 2416W5019E  
 Test Date: 07-28-23  
 Total Sampling Time: 410 min  
 Recording Interval: 5 min  
 Background Sample Volume: cubic feet  
 Meter Box Y Factor: 0.994 (1) 0.998 (2) (Amb)  
 Barometric Pressure: Begin Middle End Average  
 29.44 29.42 29.43 "Hg  
 OMNI Equipment Numbers:

PM Control Module: 371-372  
 Dilution Tunnel MW(dry): 23.00 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: -0.258 "H<sub>2</sub>O  
 Tunnel Area: 0.19635 ft<sup>2</sup>  
 Pilot Tube Cp: 0.99  
 Avg. Tunnel Velocity: 21.08 ft/sec  
 Initial Tunnel Flow: 236.2 scfm  
 Average Tunnel Flow: 228.4 scfm  
 Post-Test Leak Check (1): 0.000 cfm @ 6 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 6 in. Hg  
 Average Test Piece Fuel Moisture: 20.57 Dry Basis %

Technician Signature: 

Velocity Traverse Data									
	Pt. 1	Pt. 2	Pt. 3	Pt. 4	Pt. 5	Pt. 6	Pt. 7	Pt. 8	Center
Initial dP	0.084	0.100	0.098	0.098	0.082	0.100	0.100	0.094	0.100
Temp:	81	81	81	81	81	81	81	81	81
V <sub>initial</sub>	20.85		ft/sec		V <sub>actual</sub>		21.39		ft/sec
F <sub>p</sub>									0.975

Elapsed Time (min)	Particulate Sampling Data											Fuel Weight (lb)				Temperature Data (°F)										Stack Gas Data					
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice #H1 (in.)	Meter 1 Temp (°F)	Meter 1 Vacu (in.Hg)	Orifice #H2 (in.)	Meter 2 Temp (°F)	Meter 2 Vacu (in.Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (in.H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)
0	0.000	0.000			2.55	92	-1.49	1.68	84	-0.3	109	0.100			18.1		565	185	141	589	609	418	310	82	65	83	66	80	0.047	4.82	0.34
5	0.815	0.858	0.16	0.17	2.28	90	-2.07	1.79	85	-0.1	135	0.090	105	109	17.1	-1	519	196	190	574	589	414	389	88	83	88	84	79	0.057	5.88	0.23
10	1.640	1.720	0.17	0.17	2.23	89	-1.76	1.78	85	-0.3	119	0.100	100	102	16.0	-1.08	672	191	195	549	554	432	365	86	83	87	84	80	0.063	14.96	0.53
15	2.460	2.580	0.16	0.17	2.22	90	-1.87	1.77	85	-0.4	116	0.100	99	102	15.0	-1.04	751	189	142	531	533	429	381	85	83	86	84	80	0.064	14.57	0.74
20	3.287	3.441	0.17	0.17	2.29	90	-1.8	1.78	85	-0.4	113	0.100	99	102	14.2	-0.8	740	189	130	516	517	418	357	85	84	87	85	80	0.058	13.28	0.45
25	4.117	4.300	0.17	0.17	2.29	90	-2.19	1.78	85	-0.1	111	0.100	99	101	13.4	-0.8	737	187	125	502	503	411	348	85	85	87	86	80	0.057	13.07	0.47
30	4.948	5.160	0.17	0.17	2.30	90	-2.16	1.78	85	-0.2	109	0.100	99	101	12.8	-0.8	740	184	123	490	492	406	346	84	86	86	86	80	0.057	13.37	0.43
35	5.779	6.019	0.17	0.17	2.28	90	-2.25	1.77	85	-0.1	109	0.100	99	101	11.9	-0.7	739	180	118	481	483	400	340	85	86	87	89	80	0.056	13.15	0.4
40	6.612	6.879	0.17	0.17	2.31	90	-1.75	1.78	85	-0.4	108	0.100	99	101	11.3	-0.82	714	177	116	474	477	392	331	85	87	87	70	80	0.054	12.05	0.4
45	7.445	7.739	0.17	0.17	2.32	91	-1.77	1.78	86	-0.3	107	0.100	99	101	10.6	-0.68	691	174	119	466	473	385	321	84	88	86	71	80	0.052	11.57	0.35
50	8.281	8.599	0.17	0.17	2.32	90	-2.08	1.77	86	-0.1	106	0.100	100	101	10.1	-0.5	680	171	118	460	469	380	313	85	89	86	71	79	0.050	11.68	0.43
55	9.119	9.459	0.17	0.17	2.32	90	-2.04	1.78	86	-0.4	106	0.100	100	101	9.5	-0.6	680	169	115	454	467	377	314	84	89	86	72	80	0.050	12.15	0.39
60	9.957	10.319	0.17	0.17	2.31	90	-1.84	1.78	86	-0.2	105	0.100	100	101	8.9	-0.8	695	166	118	449	466	379	317	84	70	86	73	80	0.051	13.35	0.32
65	10.794	11.179	0.17	0.17	2.32	90	-2.12	1.77	86	-0.2	106	0.100	100	101	8.3	-0.62	701	164	117	448	468	380	321	86	70	86	73	80	0.051	13.38	0.25
70	11.634	12.039	0.17	0.17	2.34	90	-1.86	1.77	86	-0.4	105	0.100	100	101	7.7	-0.58	704	162	118	448	472	381	318	86	71	86	74	80	0.050	13.18	0.14
75	12.475	12.899	0.17	0.17	2.32	90	-2.11	1.77	86	-0.4	106	0.100	100	101	7.1	-0.6	705	161	119	450	477	382	317	85	71	86	75	80	0.050	12.22	0.21
80	13.316	13.759	0.17	0.17	2.32	90	-1.79	1.76	86	-0.1	105	0.100	100	101	6.6	-0.5	708	160	119	452	483	384	317	86	72	86	75	80	0.050	12.93	0.11
85	14.157	14.619	0.17	0.17	2.34	90	-2.06	1.77	86	-0.4	103	0.100	100	101	6.1	-0.5	697	159	119	454	487	383	308	86	72	86	76	80	0.049	11.7	0.08
90	14.999	15.479	0.17	0.17	2.32	90	-1.99	1.77	86	-0.1	103	0.100	100	100	5.7	-0.4	670	158	119	456	491	379	298	85	73	86	78	80	0.048	11.05	0.19
95	15.841	16.339	0.17	0.17	2.35	90	-1.71	1.77	86	-0.2	101	0.100	100	100	5.4	-0.32	639	158	119	455	492	373	287	86	73	85	77	79	0.044	10.21	0.35
100	16.684	17.199	0.17	0.17	2.33	89	-2.12	1.77	86	-0.3	100	0.100	100	100	5.0	-0.38	616	158	119	455	489	367	279	85	74	86	77	79	0.042	10.2	0.34
105	17.527	18.060	0.17	0.17	2.36	89	-1.95	1.77	86	-0.2	101	0.100	100	100	4.7	-0.3	616	157	117	454	488	367	276	85	74	86	77	79	0.042	10.75	0.3
110	18.370	18.922	0.17	0.17	2.34	89	-2	1.77	86	-0.1	100	0.100	100	100	4.4	-0.3	609	157	118	453	486	365	274	85	75	85	79	79	0.041	10.11	0.22
115	19.213	19.783	0.17	0.17	2.34	88	-1.66	1.77	86	-0.2	99	0.100	100	100	4.0	-0.4	609	156	118	454	484	364	274	85	75	85	78	79	0.041	10.47	0.11
120	20.056	20.645	0.17	0.17	2.34	88	-1.7	1.77	86	-0.1	98	0.100	100	100	3.7	-0.28	605	155	118	454	485	363	267	85	75	86	78	79	0.040	9.62	0.16
125	20.898	21.508	0.17	0.17	2.34	88	-1.66	1.78	86	-0.1	96	0.100	100	100	3.5	-0.24	584	155	117	454	484	359	259	85	75	85	79	78	0.038	8.73	0.23
130	21.741	22.368	0.17	0.17	2.35	87	-2.13	1.79	86	-0.1	96	0.100	100	100	3.3	-0.2	561	155	117	455	481	354	250	84	72	86	76	79	0.036	8.2	0.32
135	22.584	23.229	0.17	0.17	2.35	87	-1.87	1.79	86	-0.4	94	0.100	100	100	3.2	-0.1	531	155	115	455	479	347	240	85	68	85	72	78	0.034	7.15	0.59
140	23.427	24.091	0.17	0.17	2.35	87	-1.97	1.78	85	-0.4	95	0.100	100	100	3.0	-0.2	506	155	116	454	476	341	230	84	84	85	69	79	0.032	6.76	0.73
145	24.271	24.954	0.17	0.17	2.33	86	-1.72	1.78	85	-0.1	94	0.100	100	100	2.9	-0.1	484	154	115	451	471	335	222	84	82	85	67	79	0.030	6.55	0.75
150	25.114	25.818	0.17	0.17	2.35	86	-2.08	1.78	85	-0.3	93	0.100	100	100	2.8	-0.1	458	155	114	448	465	328	211	84	81	85	66	79	0.027	6.01	0.74
155	25.957	26.677	0.17	0.17	2.34	86	-1.8	1.78	85	-0.2	93	0.100	100	100	2.7	-0.1	440	155	115	442	460	323	207	84	80	85	65	80	0.025	5.02	0.74
160	26.800	27.538	0.17	0.17	2.36	86	-2.1	1.78	85	-0.1	92	0.100	100	100	2.5	-0.2	420	155	115	437	451	316	199	84	80	85	64	80	0.024	5.57	1.02
165	27.642	28.400	0.17	0.17	2.36	86	-2.07	1.78	85	-0.4	91	0.100	100	100	2.5	0	403	156	113	431	443	309	193	84	80	85	64	79	0.022	5.37	0.9
170	28.486	29.262	0.17	0.17	2.35	86	-2.06	1.78	85	-0.1	91	0.100	100	100	2.4	-0.1	389	156	113	425	435	304	189	84	80	85	63	80	0.021	5.27	0.85
175	29.328	30.124	0.17	0.17	2.36	86	-2.09	1.77	85	-0.1	91	0.100	100	100	2.3	-0.1	379	156	113	420	427	299	185	84	80	85	63	79	0.019	5.22	0.84
180	30.171	30.965	0.17	0.17	2.35	85	-1.84	1.78	85	-0.1	90	0.100	100	100	2.3	0	371	156	113	415	420	295	180	84	80	85	63	79	0.019	5.2	0.84

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 2  
 Manufacturer: GNF Group  
 Model: Small Series  
 Tracking No.: 2416  
 Project No.: 5419W2019E  
 Test Date: 07-28-23  
 Beginning Clock Time: 13:02  
 Meter Box Y Factor: 0.994 (1) 0.998 (2) (Amb)  
 Barometric Pressure: Begin Middle End Average  
 29.44 29.42 29.43 "Hg  
 OMNI Equipment Numbers:

PM Control Module: 371-372  
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: -0.258 "H<sub>2</sub>O  
 Tunnel Area: 0.19635 ft<sup>2</sup>  
 Pilot Tube Cp: 0.99  
 Avg. Tunnel Velocity: 21.08 ft/sec  
 Initial Tunnel Flow: 236.2 scfm  
 Average Tunnel Flow: 228.4 scfm  
 Post-Test Leak Check (1): 0.000 cfm @ 6 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 6 in. Hg  
 Average Test Piece Fuel Moisture: 20.57 Dry Basis %

Technician Signature:

Velocity Traverse Data									
	Pt. 1	Pt. 2	Pt. 3	Pt. 4	Pt. 5	Pt. 6	Pt. 7	Pt. 8	Center
Initial dP	0.084	0.100	0.098	0.098	0.082	0.100	0.100	0.094	0.100
Temp:	81	81	81	81	81	81	81	81	81
V <sub>traverse</sub>	20.85		ft/sec		V <sub>vacant</sub>		21.39		ft/sec
F <sub>p</sub>									0.975

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)					Temperature Data (°F)										Stack Gas Data						
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH1 (in)	Meter 1 Temp (°F)	Meter 1 Vacuum (inHg)	Orifice dH2 (in)	Meter 2 Temp (°F)	Meter 2 Vacuum (inHg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (inHg)	CO <sub>2</sub> (%)	CO (%)	
185	31.013	31.848	0.17	0.17	2.35	85	-1.78	1.77	85	-0.1	91	0.100	100	100	2.2	-0.1	364	156	112	411	414	291	178	84	80	85	63	80	0.018	5.18	0.82	
190	31.856	32.710	0.17	0.17	2.32	85	-1.78	1.77	85	-0.1	91	0.100	100	100	2.1	-0.1	358	156	112	406	407	288	176	84	81	85	64	80	0.017	5.15	0.83	
195	32.698	33.572	0.17	0.17	2.35	85	-1.79	1.77	85	-0.4	90	0.100	100	100	2.1	-0.02	353	156	111	403	402	285	175	84	82	85	64	79	0.016	5.13	0.88	
200	33.540	34.434	0.17	0.17	2.35	85	-1.86	1.77	85	-0.4	80	0.100	100	100	2.0	-0.08	348	156	112	399	397	282	174	84	82	85	65	79	0.015	5.09	0.89	
205	34.383	35.297	0.17	0.17	2.33	84	-2.1	1.78	85	-0.1	90	0.100	100	100	1.9	-0.1	342	156	111	396	392	279	170	84	83	85	65	79	0.015	4.94	0.85	
210	35.225	36.160	0.17	0.17	2.33	84	-1.71	1.77	85	-0.1	90	0.100	100	100	1.8	-0.1	338	155	110	393	387	277	168	84	84	85	66	80	0.015	4.85	0.82	
215	36.068	37.022	0.17	0.17	2.35	84	-2.01	1.78	85	-0.1	89	0.100	100	100	1.8	0	333	155	110	390	384	274	166	84	84	85	66	79	0.014	4.67	0.78	
220	36.910	37.885	0.17	0.17	2.35	84	-2.12	1.79	85	-0.1	88	0.100	100	100	1.7	-0.1	329	154	110	386	378	271	165	83	85	67	79	0.014	4.62	0.79		
225	37.753	38.748	0.17	0.17	2.33	84	-2.09	1.78	85	-0.4	88	0.100	100	100	1.7	0	323	153	111	383	372	268	163	83	85	84	87	79	0.013	4.57	0.78	
230	38.595	39.610	0.17	0.17	2.35	83	-2.1	1.78	85	-0.3	88	0.100	100	100	1.6	-0.1	320	152	109	380	367	266	162	83	86	85	68	79	0.013	4.54	0.79	
235	39.437	40.472	0.17	0.17	2.35	83	-1.81	1.78	85	-0.2	87	0.100	100	100	99	1.6	0	316	151	108	378	362	263	161	83	86	85	68	79	0.012	4.48	0.82
240	40.281	41.334	0.17	0.17	2.35	83	-1.72	1.78	85	-0.4	87	0.100	100	100	99	1.5	-0.1	310	151	107	374	359	260	159	83	87	84	68	78	0.012	4.25	0.78
245	41.124	42.197	0.17	0.17	2.35	83	-1.78	1.77	85	-0.4	87	0.100	100	100	1.5	0	307	150	106	372	354	258	158	83	87	85	69	78	0.012	4.14	0.75	
250	41.967	43.059	0.17	0.17	2.35	82	-1.74	1.78	85	-0.3	86	0.100	100	100	99	1.4	-0.1	303	149	107	368	351	256	157	83	88	84	69	78	0.011	4.09	0.74
255	42.809	43.922	0.17	0.17	2.34	82	-1.91	1.77	85	-0.3	85	0.100	100	100	99	1.3	-0.1	299	148	106	364	347	253	155	83	88	84	70	78	0.011	3.93	0.73
260	43.653	44.785	0.17	0.17	2.34	82	-2.09	1.77	84	-0.1	85	0.100	100	100	1.3	0	295	147	105	361	342	250	153	83	88	85	70	78	0.010	3.88	0.72	
265	44.495	45.647	0.17	0.17	2.36	82	-1.84	1.78	84	-0.4	85	0.100	100	100	99	1.3	0	290	147	106	357	339	248	151	83	89	84	70	78	0.010	3.8	0.7
270	45.338	46.510	0.17	0.17	2.34	82	-2.09	1.78	84	-0.1	85	0.100	100	100	1.3	0	285	146	105	353	335	245	150	82	89	84	70	77	0.009	3.75	0.69	
275	46.180	47.372	0.17	0.17	2.35	81	-1.88	1.78	84	-0.2	85	0.100	100	100	99	1.3	0	280	145	105	349	332	242	148	83	89	84	71	77	0.009	3.77	0.7
280	47.023	48.234	0.17	0.17	2.33	81	-1.75	1.79	84	-0.4	85	0.100	100	100	99	1.2	-0.1	277	145	104	346	328	240	148	82	89	84	71	77	0.008	3.74	0.69
285	47.866	49.098	0.17	0.17	2.33	81	-2.04	1.79	84	-0.2	84	0.100	100	100	99	1.1	-0.1	275	144	105	342	326	238	145	83	70	84	71	77	0.008	3.75	0.71
290	48.707	49.957	0.17	0.17	2.33	81	-1.94	1.78	84	0	84	0.100	100	100	99	1.1	0	271	144	104	338	322	236	145	83	70	84	71	77	0.008	3.69	0.7
295	49.549	50.819	0.17	0.17	2.34	81	-2.08	1.78	84	-0.1	83	0.100	100	100	99	1.0	-0.08	269	143	102	335	319	234	143	82	70	84	72	77	0.007	3.8	0.78
300	50.391	51.681	0.17	0.17	2.34	81	-1.97	1.78	84	-0.4	84	0.100	100	100	99	0.9	-0.1	267	142	103	331	316	232	143	83	71	84	72	77	0.007	3.89	0.81
305	51.233	52.543	0.17	0.17	2.38	81	-1.66	1.78	84	-0.4	83	0.100	100	100	99	0.9	-0.04	266	141	103	328	314	230	141	82	71	84	72	77	0.007	4.02	0.84
310	52.075	53.405	0.17	0.17	2.35	81	-2.09	1.78	83	-0.1	84	0.100	100	100	100	0.9	0	265	141	104	326	312	230	141	83	71	84	72	77	0.007	4.05	0.85
315	52.916	54.268	0.17	0.17	2.34	81	-2.03	1.78	83	-0.2	83	0.100	100	100	99	0.8	-0.1	264	140	103	324	310	228	141	82	71	84	73	77	0.007	4.11	0.86
320	53.758	55.127	0.17	0.17	2.34	81	-1.82	1.78	83	0	83	0.100	100	100	99	0.8	0	263	139	104	322	309	227	142	82	72	84	73	77	0.007	4.08	0.86
325	54.600	55.988	0.17	0.17	2.34	81	-2.09	1.78	83	-0.2	82	0.100	100	100	99	0.7	-0.1	263	139	105	320	308	227	141	82	72	84	73	77	0.007	4.06	0.86
330	55.441	56.848	0.17	0.17	2.34	81	-1.82	1.77	83	-0.2	83	0.100	100	100	99	0.7	0	262	138	104	319	307	226	141	82	72	84	73	77	0.007	4.0	0.84
335	56.283	57.709	0.17	0.17	2.35	81	-2.09	1.78	83	-0.4	83	0.100	100	100	99	0.6	-0.1	262	138	105	317	307	226	141	82	72	83	73	76	0.007	3.95	0.84
340	57.124	58.559	0.17	0.17	2.35	80	-1.8	1.78	83	-0.1	83	0.100	100	100	99	0.6	-0.02	261	137	103	316	306	225	141	82	72	84	74	76	0.007	3.88	0.83
345	57.966	59.425	0.17	0.17	2.34	80	-1.78	1.78	83	-0.4	83	0.100	100	100	99	0.5	-0.08	260	137	105	314	305	224	140	82	73	84	74	76	0.007	3.98	0.84
350	58.807	60.290	0.17	0.17	2.34	80	-1.82	1.78	83	-0.1	82	0.100	100	100	99	0.5	0	258	137	104	313	304	223	140	82	73	84	74	76	0.007	3.8	0.86
355	59.648	61.148	0.17	0.17	2.38	80	-1.81	1.77	83	-0.2	82	0.100	100	100	99	0.5	0	258	137	105	311	303	223	140	82	73	84	74	76	0.007	3.8	0.85
360	60.490	62.009	0.17	0.17	2.33	80	-1.64	1.78	83	-0.3	82	0.100	100	100	99	0.4	-0.1	257	136	106	309	302	222	139	82	73	84	74	77	0.007	3.75	0.84
365	61.330	62.869	0.17	0.17	2.35	80	-2.09	1.78	83	-0.2	82	0.100	100	100	99	0.4	0	256	136	105	308	301	221	139	82	73	84	74	76	0.007	3.7	0.82

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 2

Manufacturer: GHP Group  
 Model: Small Series  
 Tracking No.: 2418  
 Project No.: 2418W/5015E  
 Test Date: 07-22-20  
 Beginning Clock Time: 13:02  
 Meter Box Y Factor: 0.994 (1) 0.998 (2)  
 Barometric Pressure: Begin Middle End Average  
29.44 29.42 29.43 "Hg  
 OMNI Equipment Numbers: \_\_\_\_\_

Total Sampling Time: 410 min  
 Recording Interval: 5 min  
 Background Sample Volume: \_\_\_\_\_ cubic feet  
 (Amb)

PM Control Modules: 371, 372  
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Sulf: 0.258 H<sub>2</sub>O  
 Tunnel Area: 0.19635 ft<sup>2</sup>  
 Pilot Tube Cp: 0.99

Avg. Tunnel Velocity: 21.08 ft/sec  
 Initial Tunnel Flow: 236.2 scfm  
 Average Tunnel Flow: 228.4 scfm  
 Post-Test Leak Check (1): 0.000 cfm @ 6 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 6 in. Hg  
 Average Test Piece Fuel Moisture: 20.57 Dry Basis %

Technician Signature: B. K. [Signature]

Velocity Traverse Data									
	Pt. 1	Pt. 2	Pt. 3	Pt. 4	Pt. 5	Pt. 6	Pt. 8	Center	
Initial dP	0.084	0.100	0.098	0.098	0.082	0.100	0.100	0.094	0.100
Temp:	81	81	81	81	81	81	81	81	81
V <sub>trav</sub>	20.85		ft/sec		V <sub>avert</sub>		21.39		ft/sec
F <sub>p</sub>	0.975								

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)		Temperature Data (°F)										Stack Gas Data								
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (in)	Meter 1 Temp (°F)	Meter 1 Vacuum (inHg)	Orifice dH 2 (in)	Meter 2 Temp (°F)	Meter 2 Vacuum (inHg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (inHg)	CO <sub>2</sub> (%)	CO (%)
370	62.172	63.729	0.17	0.17	2.33	80	-1.79	1.78	83	-0.1	82	0.100	100	99	0.3	-0.1	255	135	105	305	301	220	139	82	73	84	74	76	0.006	3.76	0.88
375	63.013	64.589	0.17	0.17	2.34	79	-1.98	1.78	83	-0.1	82	0.100	100	99	0.3	0	255	135	106	303	300	220	139	82	74	83	75	76	0.006	3.63	0.81
380	63.853	65.448	0.17	0.17	2.34	79	-1.78	1.78	83	-0.1	82	0.100	100	99	0.2	-0.1	254	134	106	301	300	219	139	82	74	84	75	76	0.007	3.54	0.79
385	64.696	66.309	0.17	0.17	2.35	79	-1.91	1.78	83	-0.3	82	0.100	100	99	0.2	0	253	134	104	298	300	218	139	82	74	84	75	75	0.007	3.39	0.76
390	65.536	67.168	0.17	0.17	2.35	80	-2.05	1.78	82	-0.1	82	0.100	100	99	0.1	-0.1	251	134	104	298	298	217	138	82	74	84	75	75	0.006	3.31	0.74
395	66.377	68.028	0.17	0.17	2.35	79	-2.05	1.77	82	-0.1	81	0.100	100	99	0.1	0	248	133	104	293	297	215	137	82	74	84	75	76	0.006	3.28	0.75
400	67.218	68.888	0.17	0.17	2.36	79	-1.65	1.78	82	-0.3	81	0.100	100	99	0.1	0	246	133	103	290	296	214	136	82	74	83	75	75	0.006	3.22	0.74
405	68.059	69.747	0.17	0.17	2.35	79	-1.84	1.78	82	-0.4	81	0.100	100	99	0.1	0	243	133	104	287	295	212	135	82	74	84	75	75	0.005	3.11	0.71
410	68.897	70.607	0.17	0.17	2.32	79	-2	1.77	82	-0.1	80	0.100	100	99	0.0	-0.1	240	132	103	284	293	210	133	81	74	84	75	75	0.005	2.93	0.65
AvgTot	68.897	70.607	0.17	0.17	2.34	85		1.78	85		83	0.100	100	100								207.4		69	85	71	78	0.024			

## Wood Heater Lab Data - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group                      Equipment Numbers: \_\_\_\_\_  
 Model: Small Series \_\_\_\_\_  
 Tracking No.: 2416 \_\_\_\_\_  
 Project No.: 0418WS019E \_\_\_\_\_  
 Run #: 2 \_\_\_\_\_  
 Date: 7/7/20 \_\_\_\_\_

**TRAIN 1 (First Hour emissions)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T265S	100.9	97.5	3.4
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

**Sub-Total**    Total Particulate, mg:    3.4

**TRAIN 1 (Post First Hour Change-out)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T258AP	179.6	181.1	-1.5
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe	9	115697.1	115696.0	1.1
E. Filter seals catch*	Seals	R001	3366.0	3363.4	2.6

**Sub-Total**    Total Particulate, mg:    2.2

**Train 1 Aggregate**    Total Particulate, mg:    5.6

**TRAIN 2**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	T258BP	181.6	180.8	0.8
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe	11	114189.2	114188.6	0.6
D. Filter seals catch*	Seals	R002	3395.9	3392.2	3.7

Total Particulate, mg:    5.1

**AMBIENT**

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

Total Particulate, mg:    0.0

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

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

Technician Signature: 

## Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group  
 Model: Small Series  
 Project No.: 0418WS019E  
 Tracking No.: 2416  
 Run: 2  
 Test Date: 07/07/20

Burn Rate	<b>1.00 kg/hr dry</b>
Average Tunnel Temperature	93 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	21.06 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	13703.2 dscf/hour
Average Delta p	0.100 inches H2O
Total Time of Test	410 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	68.897 cubic feet	70.607 cubic feet	9.957 cubic feet
Average Gas Meter Temperature	78 degrees Fahrenheit	85 degrees Fahrenheit	85 degrees Fahrenheit	86 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	65.653 dscf	67.479 dscf	9.459 dscf
Total Particulates - m <sub>n</sub>	0 mg	5.6 mg	5.1 mg	3.4 mg
Particulate Concentration (dry-standard) - C <sub>r</sub> /C <sub>s</sub>	0.000000 grams/dscf	0.00009 grams/dscf	0.00008 grams/dscf	0.00036 grams/dscf
Total Particulate Emissions - E <sub>T</sub>	0.00 grams	7.99 grams	7.08 grams	4.93 grams
Particulate Emission Rate	0.00 grams/hour	1.17 grams/hour	1.04 grams/hour	4.93 grams/hour
Emissions Factor		1.17 g/kg	1.04 g/kg	1.42 g/kg
Difference from Average Total Particulate Emissions		0.45 grams	0.45 grams	

**Dual Train Comparison Results Are Acceptable**


FINAL AVERAGE RESULTS	
<b>Complete Test Run</b>	
Total Particulate Emissions - E <sub>T</sub>	7.53 grams
Particulate Emission Rate	<b>1.10 grams/hour</b>
Emissions Factor	1.11 grams/kg
<b>First Hour Emissions</b>	
Total Particulate Emissions - E <sub>T</sub>	4.93 grams
Particulate Emission Rate	4.93 grams/hour
Emissions Factor	1.42 grams/kg
7.5% of Average Total Particulate Emissions	0.56 grams

QUALITY CHECKS	
Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Train Precision 7.5%	6.04
Train Precision 0.5g/kg	0.13

Technician Signature: 

# Wood Heater Efficiency Results - CSA B415.1

**Manufacturer:** GHP Group  
**Model:** Small Series  
**Date:** 07/07/20  
**Run:** 2  
**Control #:** 0418WS019E  
**Test Duration:** 410  
**Output Category:** II

Technician Signature: 

## Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	78.2%	83.8%
Combustion Efficiency	96.1%	96.1%
Heat Transfer Efficiency	81%	87.2%

Output Rate (kJ/h)	15,070	14,295	(Btu/h)
Burn Rate (kg/h)	1.00	2.20	(lb/h)
Input (kJ/h)	19,277	18,286	(Btu/h)

Test Load Weight (dry kg)	6.81	15.01	dry lb
MC wet (%)	17.0629216		
MC dry (%)	20.57		
Particulate (g)	1.10		
CO (g)	393		
Test Duration (h)	6.83		

Emissions	Particulate	CO
g/MJ Output	0.01	3.81
g/kg Dry Fuel	0.16	57.63
g/h	0.16	57.45
lb/MM Btu Output	0.02	8.86

Air/Fuel Ratio (A/F)	14.12
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VERSION:

2.2

12/14/2009

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version

Cordwood Fuel Load Calculators - 12 lb/ft<sup>3</sup> Nominal Load Density

Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight

Values to be input manually

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**For Usable Firebox Volumes up to 3.0 ft<sup>3</sup> - Low and Medium Fire**

Nominal Required Load Density (wet basis)	12	lb/ft <sup>3</sup>	
Usable Firebox Volume	1.54	ft <sup>3</sup>	
Total Nom. Load Wt. Target	18.48	lb	
Total Load Wt. Allowable Range	17.56	to 19.40	lb
Core Target Wt. Allowable Range	8.316	to 12.01	lb
Remainder Load Wt. Allowable Range	6.47	to 10.16	lb
			Mid-Point
Core Load Fuel Pc. Wt. Allowable Range	2.77	to 4.62	lb 3.70
Remainder Load Pc. Wt. Allowable Range	1.85	to 5.54	lb 3.70
	Pc. #		
Core Load Piece Wt. Actual	1	4.40	lb In Range
	2	3.00	lb In Range
	3	3.70	lb In Range
Core Load Total. Wt. Actual		11.10	lb In Range
	Pc. #		
Remainder Load Piece Wt.	1	5.00	lb In Range
(2 or 3 Pcs.)	2	2.00	lb In Range
	3		lb NA
Remainder Load Piece Weight Ratio - Small/Large		40%	In Range ≤ 67%
Remainder Load Tot. Wt. Act		7.00	lb In Range
Total Load Wt. Actual		18.10	lb In Range
Core % of Total Wt.		61%	In Range 45-65%
Remainder % of Total Wt.		39%	In Range 35-55%
Actual Load % of Nominal Target		98%	In Range 95-105%
Actual Fuel Load Density		11.8	lb/ft <sup>3</sup>
Allowable Charcoal Bed Wt. Range (lb)	1.9	to 3.6	lb Mid-Point
Actual Charcoal Bed Wt.		1.9	lb In Range 2.7
Actual Fuel Load Ending Wt.		0.0	lb Valid Test ≥ 90%
Total Wt. of Fuel Burned During Test Run lb.		18.1	lb

**Fuel Piece Moisture Reading (%-dry basis)**

	1	2	3	Ave.		Pc. Wt. Dry Basis	
	25.9	22.4	20.1	22.8	In Range	3.58	lb 1.63 kg
	21.1	21	18.5	20.2	In Range	2.50	lb 1.13 kg
	22	21.8	22.8	22.2	In Range	3.03	lb 1.37 kg
	18.9	18.6	18.9	18.8	In Range	4.21	lb 1.91 kg
	20.4	18	18.2	18.9	In Range	1.68	lb 0.76 kg
				NA	NA	NA	lb NA kg
Total Load Ave. MC % (dry basis)				20.7	In Range		
Total Load Ave. MC % (wet basis)				17.1			
Total Test Load Weight (dry basis)						15.00	lb 6.80 kg
Total Fuel Weight Burned During Test Run (dry basis)						15.0	lb 6.80 kg



### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 2  
 Model: GHP Small Tracking Number: 2416 Date: 7/7/2020  
 Test Crew: B. Davis  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Run Notes

##### Air Control Settings

Primary:

Fully closed

Secondary: fixed

Tertiary/Pilot: n/a

Fan: on High

##### Preburn Notes

Time	Notes

##### Test Notes

Sketch test fuel configuration:

See photo

Start up procedures & Timeline:

Bypass: n/a  
 Fuel loaded by: 60 seconds  
 Door closed at: 4:00 minutes  
 Primary air: fully open until 8:00 min then set to 1/2 open. At 13 min 15% of fuel had been consumed  
 Notes: A. - set to full closed  
Fan turned to high @ 13 minutes

Time	Notes
60	changed from S. Heat to from A

Technician Signature: [Signature]

Date: 7/15/2020

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 2  
 Model: GHP Small Tracking Number: 2416 Date: 7/7/2020  
 Test Crew: ADAs  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Supplemental Data

Start Time: 1302 Booth #: N/A  
 Stop Time: 1952

**Stack Gas Leak Check:**

Initial: \_\_\_\_\_ Final: good

**Sample Train Leak Check:**

A: 0.0 @ 6 "Hg  
 B: 0.0 @ 6 "Hg

**Calibrations:** Span Gas CO<sub>2</sub>: 10.08 CO: 2.53

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>See start of Run 1</u>		<u>1956</u>	<u>1956</u>
CO <sub>2</sub>			<u>0.14</u>	<u>9.95</u>
CO			<u>0.00</u>	<u>2.48</u>

Air Velocity (ft/min): Initial: 250 Final: 250

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

Pitot Tube Leak Test: Initial: good Final: good

Stack Diameter (in): 6"

Induced Draft: 0.0

% Smoke Capture: 100%

Flue Pipe Cleaned Prior to First Test in Series:

Date: 7/3/20 Initials: DL

	Initial	Middle	Ending
P <sub>b</sub> (in/Hg)	<u>29.44</u>		<u>29.42</u>
RH (%)	<u>48</u>		<u>45</u>
Ambient (°F)	<u>80</u>		<u>75</u>

Tunnel Traverse		
Microtector Reading	dP (in H <sub>2</sub> O)	T(°F)
	<u>.084</u>	<u>81</u>
	<u>.100</u>	<u>81</u>
	<u>.098</u>	<u>81</u>
	<u>.098</u>	<u>81</u>
	<u>.082</u>	<u>81</u>
	<u>.100</u>	<u>81</u>
	<u>.100</u>	<u>81</u>
	<u>.094</u>	<u>81</u>
Center:		
	<u>0.100</u>	<u>81</u>

Background Filter Volume: N/A

Tunnel Static Pressure (in H <sub>2</sub> O):	
Beginning of Test	End of Test
<u>- .258</u>	<u>- .258</u>

Technician Signature: [Signature]

Date: 7/15/2020

**Run 3**  
**High Burn 1-minute data**  
**Non-Sampling High Burn**

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 3

Manufacturer: GHP Group  
 Model: Small  
 Tracking No.: 2416  
 Project No.: 2418W/S019E  
 Test Date: 20-12-20  
 Beginning Clock Time: 29:13  
 Meter Box Y Factor: 0.994 (1) 0.998 (2)  
 Total Sampling Time: 126 min  
 Recording Interval: 1 min  
 Background Sample Volume: cubic feet  
 Barometric Pressure: Begin Middle End Average  
 29.45 29.44 29.45 "Hg  
 OMNI Equipment Numbers:

PM Control Modules: 271, 372  
 Dilution Tunnel MW(dry): 22.90 lb/bt-mole  
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: H<sub>2</sub>O  
 Tunnel Area: 0.19635 R2  
 Pilot Tube Cp: 0.99

Avg. Tunnel Velocity: ID(V)/ID<sup>2</sup> ft/sec  
 Initial Tunnel Flow: ID(V)/ID<sup>2</sup> scfm  
 Average Tunnel Flow: ID(V)/ID<sup>2</sup> scfm  
 Post-Test Leak Check (1): cfm @ in. Hg  
 Post-Test Leak Check (2): cfm @ in. Hg  
 Average Test Piece Fuel Moisture: 20.93 Dry Basis %

Technician Signature: *[Signature]*

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP									"H <sub>2</sub> O
Temp.									"F
V <sub>traverse</sub>	ft/sec			ft/sec			F <sub>p</sub>		

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)										Temperature Data (°F)										Stack Gas Data		
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H <sub>2</sub> O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH 2 (H <sub>2</sub> O)	Meter 2 Temp (°F)	Meter 2 Vacuum (Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Slove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)		
0															7.3		74	74	74	75	76	76	73								72	0.000	
1															7.2		79	74	74	75	76	76	112								71	0.001	
2															7.0		97	74	75	76	76	80	125								72	0.004	
3															7.0		126	74	76	77	77	86	124								72	0.006	
4															6.9		144	73	77	79	79	90	131								71	0.009	
5															6.8		165	73	78	81	80	95	139								71	0.011	
6															6.8		186	73	75	84	83	100	151								72	0.015	
7															6.6		211	73	75	87	85	106	166								72	0.020	
8															6.5		242	73	75	90	87	113	167								72	0.025	
9															6.4		268	73	76	95	90	120	197								72	0.029	
10															6.2		287	72	76	100	94	126	207								72	0.033	
11															6.2		305	72	77	105	98	131	217								72	0.036	
12															6.0		348	72	79	111	101	142	240								73	0.037	
13															5.8		400	72	79	117	106	155	263								73	0.041	
14															5.6		450	72	80	124	111	167	287								73	0.047	
15															5.4		491	72	81	130	117	178	304								74	0.051	
16															5.2		516	72	82	136	123	188	318								74	0.054	
17															5.0		540	73	83	142	130	194	329								74	0.056	
18															4.9		566	73	84	148	137	202	335								74	0.057	
19															4.7		582	73	85	155	145	208	337								75	0.057	
20															4.5		591	73	86	163	153	213	343								74	0.057	
21															4.4		599	74	86	171	160	218	346								74	0.057	
22															4.2		600	74	87	179	168	222	349								75	0.057	
23															4.1		598	75	89	187	176	225	350								75	0.057	
24															3.9		598	75	89	195	184	228	350								75	0.057	
25															3.8		592	76	90	203	193	231	349								75	0.057	
26															3.7		592	77	91	211	201	234	350								75	0.056	
27															3.6		596	77	91	218	210	238	344								76	0.056	
28															3.5		592	78	93	226	219	242	340								76	0.054	
29															3.4		588	79	94	234	228	245	337								76	0.053	
30															3.3		594	80	95	241	237	247	335								76	0.053	
31															3.1		575	82	95	248	246	249	332								76	0.052	
32															3.1		571	83	96	256	254	252	327								75	0.052	
33															3.0		565	84	97	263	263	254	323								75	0.051	
34															2.9		558	85	98	270	271	256	321								75	0.051	
35															2.8		552	87	99	277	280	259	317								75	0.050	

Control No. P-SSAR-0003

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High Burn Run 3 Non-Sampling

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 3

Manufacturer: GHP Group  
 Model: Small  
 Tracking No.: 2416  
 Project No.: 2418W/S019E  
 Test Date: 20-12-20  
 Beginning Clock Time: 29:13

Total Sampling Time: 126 min  
 Recording Interval: 1 min  
 Background Sample Volume: cubic feet

Meter Box Y Factor: 0.994 (1) 0.998 (2) (Amb)

Barometric Pressure: Begin Middle End Average  
 29.45 29.44 29.45 "Hg

OMNI Equipment Numbers:

PM Control Modules: 271.372  
 Dilution Tunnel MW(dry): 229.00 lb/bt-mole  
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: H<sub>2</sub>O  
 Tunnel Area: 0.19635 R2  
 Pilot Tube Cp: 0.99

Avg. Tunnel Velocity: IDV1/01 f/sec  
 Initial Tunnel Flow: IDV1/01 scfm  
 Average Tunnel Flow: IDV1/01 scfm  
 Post-Test Leak Check (1): cfm @ in. Hg  
 Post-Test Leak Check (2): cfm @ in. Hg  
 Average Test Piece Fuel Moisture: 20.93 Dry Basis %

Technician Signature: *[Signature]*

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP									
Temp.									

V<sub>trav</sub> f/sec V<sub>vac</sub> f/sec F<sub>p</sub> °F

Elapsed Time (min)	Particulate Sampling Data										Temperature Data (°F)										Stack Gas Data												
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H <sub>2</sub> O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH 2 (H <sub>2</sub> O)	Meter 2 Temp (°F)	Meter 2 Vacuum (Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Slove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)		
36															2.7		548	88	99	284	287	261		316							76	0.050	
37															2.6		540	90	100	280	284	263		312							75	0.050	
38															2.6		535	91	100	287	302	265		309							75	0.049	
39															2.5		530	93	101	302	309	267		305							75	0.048	
40															2.3		547	95	102	308	315	273		334							76	0.051	
41															2.2		574	96	102	313	321	281		332							76	0.053	
42															2.1		563	98	102	318	327	288		329							75	0.055	
43															2.0		585	99	103	323	332	288		330							76	0.055	
44															1.9		596	101	103	328	336	291		330							76	0.054	
45															1.8		584	102	103	334	341	293		328							75	0.054	
46															1.7		581	104	103	339	346	295		325							75	0.053	
47															1.6		581	105	104	345	349	297		325							75	0.053	
48															11.9		548	108	106	357	366	297		341							76	0.056	
49															14.7		497	110	107	362	371	289		305							76	0.053	
50															14.5		463	113	107	366	375	285		317							76	0.052	
51															14.2		472	114	106	362	367	284		306							76	0.049	
52															14.1		463	115	106	365	369	288		303							76	0.050	
53															13.9		465	116	106	367	370	291		311							76	0.052	
54															13.8		517	117	105	368	371	296		321							76	0.053	
55															13.6		542	118	104	369	371	301		331							76	0.055	
56															13.5		565	119	105	370	371	306		338							76	0.057	
57															13.3		574	121	104	369	371	308		342							75	0.058	
58															13.1		585	121	104	368	370	310		344							76	0.058	
59															12.9		601	122	103	367	370	313		351							76	0.059	
60															12.7		618	122	103	366	369	316		361							76	0.060	
61															12.5		641	123	104	364	369	320		375							75	0.061	
62															12.3		662	123	103	364	369	324		389							76	0.063	
63															12.1		679	124	103	363	371	328		394							76	0.065	
64															11.9		695	124	102	363	372	331		402							76	0.066	
65															11.6		709	125	103	362	373	334		410							76	0.066	
66															11.4		719	125	103	362	374	337		416							76	0.067	
67															11.2		728	126	103	362	376	339		419							76	0.067	
68															11.0		733	126	103	363	379	341		423							76	0.068	
69															10.8		741	127	104	363	380	343		423							76	0.068	
70															10.6		742	127	104	364	382	344		421							76	0.068	
71															10.4		744	127	104	365	384	345		425							75	0.068	

Control No. P-SSAR-0003

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High Burn Run 3 Non-Sampling

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 3  
 Manufacturer: GHP Group  
 Model: Small  
 Tracking No.: 2416  
 Project No.: 2418W/S019E  
 Test Date: 20-12-20  
 Beginning Clock Time: 29:13  
 Meter Box Y Factor: 0.994 (1) 0.998 (2) (Amb)  
 Barometric Pressure: Begin Middle End Average  
 29.45 29.44 29.45 "Hg  
 OMNI Equipment Numbers:

PM Control Modules: 271.372  
 Dilution Tunnel MW(dry): 22.92 lb/bt-mole  
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: H<sub>2</sub>O  
 Tunnel Area: 0.19635 R2  
 Pilot Tube Cp: 0.99  
 Avg. Tunnel Velocity: ID/IV/1 f/sec  
 Initial Tunnel Flow: ID/IV/1 scfm  
 Average Tunnel Flow: ID/IV/1 scfm  
 Post-Test Leak Check (1): cfm @ in. Hg  
 Post-Test Leak Check (2): cfm @ in. Hg  
 Average Test Piece Fuel Moisture: 20.93 Dry Basis %

Technician Signature: *[Signature]*

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP									
Temp.									

V<sub>trav</sub> \_\_\_\_\_ f/sec      V<sub>vac</sub> \_\_\_\_\_ f/sec      F<sub>p</sub> \_\_\_\_\_

Elapsed Time (min)	Particulate Sampling Data										Temperature Data (°F)										Stack Gas Data														
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H <sub>2</sub> O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH 2 (H <sub>2</sub> O)	Meter 2 Temp (°F)	Meter 2 Vacuum (Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Slove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)				
72															10.2		747	128	104	366	387	346		424							76	0.068			
73															10.0		752	127	104	368	388	348		426								76	0.068		
74															9.8		753	128	104	370	390	349		429								76	0.068		
75															9.6		767	129	104	372	392	351		426								76	0.068		
76															9.4		759	129	105	374	395	352		430								76	0.067		
77															9.2		762	129	104	377	397	354		429								76	0.067		
78															9.0		764	130	107	379	399	358		430								77	0.068		
79															8.8		770	130	107	383	400	358		432								77	0.068		
80															8.6		769	130	107	385	402	359		432								77	0.068		
81															8.4		773	131	107	389	404	361		433								77	0.068		
82															8.2		782	131	108	393	407	364		435								77	0.068		
83															8.0		781	131	108	396	409	365		437								77	0.068		
84															7.7		783	132	108	400	410	367		437								77	0.068		
85															7.6		787	132	110	402	413	369		439								77	0.068		
86															7.4		790	132	108	407	415	370		439								78	0.068		
87															7.2		793	133	109	411	417	373		441								78	0.068		
88															7.0		790	134	111	415	420	374		439								78	0.068		
89															6.8		791	134	111	419	423	375		440								78	0.067		
90															6.6		792	134	113	423	425	377		437								78	0.068		
91															6.4		796	135	114	427	428	378		436								78	0.068		
92															6.2		785	138	116	432	431	380		435								79	0.068		
93															6.1		782	136	114	437	433	380		434								78	0.068		
94															5.9		778	137	114	441	438	381		432								78	0.067		
95															5.7		778	137	117	446	440	384		431								78	0.067		
96															5.5		776	138	116	449	443	384		427								79	0.066		
97															5.4		775	138	115	455	446	386		427								79	0.066		
98															5.2		773	139	118	458	448	387		425								78	0.066		
99															5.0		772	139	119	462	451	389		421								78	0.065		
100															4.9		767	140	121	466	454	390		420									79	0.065	
101															4.7		763	140	119	470	457	390		421								79	0.064		
102															4.6		760	141	122	473	460	391		419								79	0.064		
103															4.4		763	142	122	477	463	393		416								79	0.064		
104															4.2		760	142	120	481	468	394		416								79	0.064		
105															4.1		763	143	123	484	469	396		417								80	0.063		
106															3.9		763	144	121	489	473	398		416									80	0.063	
107															3.8		765	144	123	491	476	400		415									80	0.064	

Control No. P-SSAR-0003

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High Burn Run 3 Non-Sampling

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 3  
 Manufacturer: GHP Group  
 Model: Small  
 Tracking No.: 2416  
 Project No.: 2418W/2019E  
 Test Date: 20-12-20  
 Beginning Clock Time: 09:13  
 Meter Box Y Factor: 0.994 (1) 0.998 (2) (Amb)  
 Barometric Pressure: Begin Middle End Average  
 29.45 29.44 29.45 "Hg  
 OMNI Equipment Numbers:

PM Control Modules: 271, 372  
 Dilution Tunnel MW(dry): 22.90 lb/bt-mole  
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: H<sub>2</sub>O  
 Tunnel Area: 0.19635 R2  
 Pilot Tube Cp: 0.99  
 Avg. Tunnel Velocity: #DIV/0! ft/sec  
 Initial Tunnel Flow: #DIV/0! scfm  
 Average Tunnel Flow: #DIV/0! scfm  
 Post-Test Leak Check (1): #DIV/0! cfm @ in. Hg  
 Post-Test Leak Check (2): #DIV/0! cfm @ in. Hg  
 Average Test Piece Fuel Moisture: 20.93 Dry Basis %

Technician Signature: *[Signature]*

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP									"H <sub>2</sub> O
Temp:									"F
	V <sub>trav</sub> _____ ft/sec		V <sub>vac</sub> _____ ft/sec		F <sub>p</sub> _____				

Elapsed Time (min)	Particulate Sampling Data											Temperature Data (°F)										Stack Gas Data										
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H <sub>2</sub> O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH 2 (H <sub>2</sub> O)	Meter 2 Temp (°F)	Meter 2 Vacuum (Hg)	Dilution Tunnel (°F)	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)	
108															3.6		767	145	125	494	479	402		418						80	0.064	
109															3.4		770	146	125	497	483	404		416						80	0.064	
110															3.3		774	147	126	500	487	407		418						80	0.064	
111															3.1		777	147	126	504	490	409		419						81	0.063	
112															3.0		777	148	128	508	494	411		420						80	0.064	
113															2.8		780	149	128	512	487	413		421						81	0.063	
114															2.7		786	150	130	516	501	417		421						80	0.063	
115															2.5		784	151	132	518	505	418		419						81	0.063	
116															2.4		780	152	135	523	508	420		414						81	0.062	
117															2.3		771	152	130	527	513	419		407						81	0.062	
118															2.2		771	153	131	531	517	421		403						81	0.061	
119															2.0		764	154	134	534	521	421		400						81	0.060	
120															1.9		760	154	135	538	526	423		393						81	0.059	
121															1.9		763	155	136	543	529	423		384						81	0.058	
122															1.8		744	156	135	547	533	423		377						81	0.058	
123															1.7		730	157	138	550	536	422		372						82	0.057	
124															1.6		714	157	134	553	539	419		368						81	0.056	
125															1.6		700	158	137	556	542	419		362						81	0.055	
126															1.5		687	159	134	558	545	417		358						81	0.054	
Avg Tot	0.000	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!						342.0			#DIV/0!	#DIV/0!	#DIV/0!	77	0.056			

## Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group  
 Model: Small  
 Project No.: 0418WS019E  
 Tracking No.: 2416  
 Run: 3  
 Test Date: 07/08/20

Burn Rate	<b>3.33 kg/hr dry</b>
Total Time of Test	126 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
<b>#DIV/0!</b>				

FINAL AVERAGE RESULTS	

QUALITY CHECKS	
Ambient Temp (55-90°F)	OK

Technician Signature: 



Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version  
 Cordwood Fuel Load Calculators - 10 lb/ft<sup>3</sup> Nominal Load Density  
 Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight  
 Values to be input manually

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For All Usable Firebox Volumes - High Fire Test Only				
Nominal Required Load Density (wet basis)	10	lb/ft <sup>3</sup>		
Usable Firebox Volume	1.54	ft <sup>3</sup>		
Total Nom. Load Wt. Target	15.40	lb		
Total Load Wt. Allowable Range	14.60	to 16.20	lb	
Core Target Wt. Allowable Range	6.90	to 10.00	lb	
Remainder Load Wt. Allowable Range	5.40	to 8.50	lb	
				Mid-Point
Core Load Pc. Wt. Allowable Range	2.30	to 3.90	lb	3.10
Remainder Load Pc. Wt. Allowable Range	1.50	to 8.50	lb	5.00
	Pc. #			
Core Load Piece Wt. Actual	1	3.20	lb	In Range
	2	3.00	lb	In Range
	3	2.60	lb	In Range
Core Load Total. Wt. Actual		8.80	lb	In Range
	Pc. #			
Remainder Load Piece Wt.	1	4.50	lb	In Range
(1 to 3 Pcs.)	2	1.70	lb	In Range
	3		lb	NA
Remainder Load Tot. Wt. Act		6.20	lb	In Range
Total Load Wt. Actual		15.00	lb	In Range
Core % of Total Wt.		59%		In Range 45-65%
Remainder % of Total Wt.		41%		In Range 35-55%
Actual Load % of Nominal Target		97%		In Range 95-105%
Actual Fuel Load Density		9.7	lb/ft <sup>3</sup>	
<b>Kindling and Start-up Fuel</b>				
Maximum Kindling Wt. (20% of Tot. Load Wt.)		3.00	lb	
Actual Kindling Wt.		2.90	lb	In Range 19.3%
Maximum Start-up Fuel Wt. (30% of Tot. Load Wt.)		4.50	lb	
Actual Start-up Fuel Wt.		4.40	lb	In Range 29.3%
Allowable Residual Start-up Fuel Wt. Range	1.5	to 3.0	lb	Mid-Point
Actual Residual Start-up Fuel Wt.		1.6	lb	In Range 2.3
Total Wt. All Fuel Added (wet basis)		22.30	lb	
<b>High Fire Test Run End Point Range</b>				
	Low		High	Mid-Point
Based on Fuel Load Wt. (w/tares)	1.4	to	1.7	lb 1.5
Actual Fuel Load Ending Wt.		1.5	lb	In Range

Fuel Piece Moisture Reading (%-dry basis)					Pc. Wt. Dry Basis	
1	2	3	Ave.			
24.4	24.2	23.9	24.2	In Range	2.58 lb	1.17 kg
20.4	18.8	21.9	20.4	In Range	2.49 lb	1.13 kg
25.4	26.6	19.8	23.9	In Range	2.10 lb	0.95 kg
23.7	23.9	20.5	22.7	In Range	3.67 lb	1.66 kg
26.6	22.8	27.9	25.8	In Range	1.35 lb	0.61 kg
			NA	NA	NA lb	NA kg
Total Load Ave. MC (%-dry basis)			23.1	In Range		
Total Load Ave. MC % (wet basis)			18.8			
Total Test Load Weight (dry basis)					12.19 lb	5.53 kg
<b>Kindling Moisture (%-dry basis)</b>						
10.2	9.7	9.8	9.9	In Range	2.64 lb	1.20 kg
<b>Start-up Fuel Moisture Readings (%-dry basis)</b>						
18.5	20.1	20.4	19.7	In Range	3.68 lb	1.67 kg
Total Wt. All Fuel Added (dry basis)					18.50 lb	8.39 kg
Total Wt. All Fuel Burned (dry basis)					15.4 lb	7.0 kg

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 3  
 Model: GHP Small Tracking Number: 2416 Date: 7/8/20  
 Test Crew: \_\_\_\_\_  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Run Notes

##### Air Control Settings

Primary:

*fully open*

Secondary: fixed

Tertiary/Pilot: N/A

Fan: on High

##### Preburn Notes

Time	Notes
∅	Torch used for 40 seconds on top. down burn, door closed by 105 seconds
39	FAN off until 5.0 then turned to High. Comb Air fully open entire test. Pulled start up fuel forward from the Rear of Fire box - less than 30 seconds.

##### Test Notes

Sketch test fuel configuration:

*See photo*

Start up procedures & Timeline:

Bypass: N/A

Fuel loaded by: 45 seconds

Door closed at: 3:00 min

Primary air: fully open entire test

Notes: FAN on High entire test

Time	Notes
	<i>Non-sampling high burn</i>

Technician Signature: *[Signature]*

Date: 7/15/2020

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 3  
 Model: GHP Small Tracking Number: 2416 Date: 7/8/2020  
 Test Crew: \_\_\_\_\_  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Supplemental Data

Start Time: 0913 Booth #: \_\_\_\_\_

Stop Time: 1119

**Stack Gas Leak Check:**

Initial: N/A Final: \_\_\_\_\_

**Sample Train Leak Check:**

A: N/A @ \_\_\_\_\_ "Hg  
 B: \_\_\_\_\_ @ \_\_\_\_\_ "Hg

**Calibrations:** Span Gas CO<sub>2</sub>: N/A CO: \_\_\_\_\_

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>N/A</u>			
CO <sub>2</sub>				
CO				

Air Velocity (ft/min): Initial: 250 Final: 250  
 Scale Audit (lbs): Initial: 10.0 Final: 10.0  
 Pitot Tube Leak Test: Initial: N/A Final: N/A  
 Stack Diameter (in): 6"  
 Induced Draft: 0.0  
 % Smoke Capture: 100%  
 Flue Pipe Cleaned Prior to First Test in Series:  
 Date: 7/3/20 Initials: DL

Tunnel Traverse		
Microtector Reading	dP (in H <sub>2</sub> O)	T(°F)
<u>N/A</u>		
Center:		

	Initial	Middle	Ending
P <sub>b</sub> (in/Hg)	<u>29.45</u>		<u>29.45</u>
RH (%)	<u>44</u>		<u>43</u>
Ambient (°F)	<u>72</u>		<u>81</u>

Background Filter Volume: N/A

Tunnel Static Pressure (in H <sub>2</sub> O):	
Beginning of Test	End of Test

Technician Signature: [Signature]

Date: 7/15/2020

# **Run 4**

## **Low Burn**

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 4  
 Manufacturer: GHF Group  
 Model: Small Series  
 Tracking No: 2418  
 Project No: 0418050156  
 Test Date: 08-30-20  
 Beginning Clock Time: 11:43  
 Meter Box Y Factor: 0.994 (1) 0.998 (2)  
 Barometric Pressure: Begin Middle End Average  
 29.45 29.36 29.41 Hg  
 OMNI Equipment Numbers:

PM Control Module: 371, 372  
 Dilution Tunnel MM(dry): 29.00 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.00 percent  
 Dilution Tunnel Static: -0.260 H<sub>2</sub>O  
 Tunnel Area: 0.18635 ft<sup>2</sup>  
 Pitot Tube Co: 0.99  
 Avg. Tunnel Velocity: 20.82 ft/sec  
 Initial Tunnel Flow: 225.3 scfm  
 Average Tunnel Flow: 225.1 scfm  
 Post-Test Leak Check (1): 0.000 cfm @ 8 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 6 in. Hg  
 Average Test Piece Fuel Moisture: 21.43 Dry Basis %

Technician Signature: *[Signature]*

Velocity Traverse Data									
	PS1	PS2	PS3	PS4	PS5	PS6	PS7	PS8	Center
Initial dP	0.084	0.068	0.096	0.092	0.082	0.100	0.102	0.090	0.100
Temp	88	88	88	88	88	88	88	88	88
V <sub>avg</sub>	20.71 ft/sec			V <sub>cent</sub> 21.53 ft/sec			F <sub>p</sub> 0.962		

Elapsed Time (min)	Particulate Sampling Data											Fuel Weight (lb)											Temperature Data (F)											Stack Gas Data		
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH1 (in)	Meter 1 Temp (F)	Meter 1 Vacuum (Hg)	Orifice dH2 (in)	Meter 2 Temp (F)	Meter 2 Vacuum (Hg)	Dilution Tunnel dP	Dilution Tunnel Center dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Slove Surface	Stack	Filter 1	Dryer Ext 1	Filter 2	Dryer Ext 2	Ambient	Draft (H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)					
0	0.000	0.000			2.27	89	-1.09	1.06	83	0.3	104	0.100			17.8		499	175	133	538	551	379	279	83	69	87	73	79	0.041	4.85	0.48					
5	0.812	0.835	0.16	0.17	2.23	88	-1.82	1.83	84	-0.2	130	0.090	105	104	16.8	-1	522	183	177	524	536	388	373	88	58	89	62	79	0.063	10.98	0.71					
10	1.637	1.702	0.17	0.17	2.27	87	-1.97	1.79	84	-0.4	117	0.100	101	102	15.8	-1	607	179	178	503	520	409	380	86	57	89	61	79	0.062	13.83	0.4					
15	2.461	2.561	0.16	0.17	2.23	88	-1.71	1.77	84	-0.2	114	0.100	100	100	14.8	-1	730	177	136	488	509	408	372	85	57	89	60	80	0.062	13.34	0.3					
20	3.281	3.417	0.16	0.17	2.22	88	-1.72	1.75	84	-0.2	112	0.100	99	100	14.0	-0.8	748	177	125	478	496	405	360	85	57	89	60	80	0.059	13.61	0.3					
25	4.114	4.291	0.17	0.17	2.31	89	-1.82	1.83	84	-0.3	113	0.100	101	102	13.2	-0.8	762	176	119	471	484	402	381	86	58	89	60	80	0.059	14.09	0.47					
30	4.949	5.165	0.17	0.17	2.29	89	-2.16	1.83	84	-0.1	114	0.100	101	102	12.3	-0.8	774	174	118	487	475	402	382	86	58	88	61	80	0.058	14.18	0.38					
35	5.782	6.036	0.17	0.17	2.30	90	-1.86	1.84	84	-0.2	112	0.100	101	102	11.6	-0.72	776	172	117	486	468	400	359	85	59	88	62	80	0.058	13.92	0.25					
40	6.615	6.913	0.17	0.17	2.29	90	-1.91	1.83	85	-0.1	112	0.100	101	102	10.8	-0.78	778	164	112	465	464	396	354	85	60	88	63	79	0.057	13.7	0.25					
45	7.449	7.787	0.17	0.17	2.31	90	-1.8	1.83	85	-0.4	110	0.100	101	102	10.2	-0.6	740	169	111	466	462	388	342	86	61	87	63	79	0.055	12.24	0.28					
50	8.283	8.661	0.17	0.17	2.31	90	-2.08	1.83	85	-0.4	107	0.100	100	101	9.6	-0.6	732	165	109	465	462	385	333	85	62	88	64	78	0.054	12.5	0.15					
55	9.119	9.535	0.17	0.17	2.32	89	-1.64	1.83	85	-0.4	106	0.100	101	101	9.1	-0.5	738	158	108	464	459	385	329	84	62	87	65	75	0.054	12.55	0.15					
60	9.955	10.410	0.17	0.18	2.31	87	-2.04	1.82	85	-0.1	104	0.100	101	101	8.5	-0.6	735	158	110	464	460	385	323	85	63	87	65	75	0.053	12.59	0.16					
65	10.804	11.282	0.17	0.17	2.37	87	-1.93	1.82	84	-0.4	104	0.100	102	101	8.0	-0.5	723	157	112	465	461	384	320	85	63	87	65	75	0.053	12.46	0.18					
70	11.641	12.154	0.17	0.17	2.29	88	-1.83	1.82	84	-0.1	104	0.100	101	101	7.4	-0.6	724	157	111	468	468	385	318	85	64	87	66	78	0.052	12.84	0.17					
75	12.474	13.024	0.17	0.17	2.31	88	-2.05	1.82	84	-0.3	102	0.100	100	101	6.9	-0.5	733	156	111	467	472	388	323	85	64	87	66	74	0.053	12.99	0.11					
80	13.306	13.884	0.17	0.17	2.30	85	-1.84	1.81	83	-0.2	102	0.100	101	101	6.4	-0.46	714	155	112	470	477	386	313	85	64	87	66	76	0.051	11.44	0.06					
85	14.139	14.764	0.17	0.17	2.29	85	-1.65	1.81	83	-0.1	99	0.100	100	100	6.1	-0.34	682	150	107	472	478	378	301	85	65	86	67	74	0.050	10.86	0.1					
90	14.972	15.634	0.17	0.17	2.30	85	-2.03	1.81	83	-0.4	99	0.100	100	100	5.7	-0.4	688	149	106	476	477	373	294	84	65	87	67	75	0.047	10.52	0.09					
95	15.805	16.503	0.17	0.17	2.29	85	-1.87	1.81	83	-0.3	98	0.100	100	100	5.4	-0.3	642	153	108	478	476	371	289	85	65	88	67	75	0.047	10.11	0.15					
100	16.638	17.374	0.17	0.17	2.29	84	-1.88	1.82	83	-0.2	97	0.100	100	100	5.1	-0.3	621	152	107	481	474	367	279	84	66	88	67	74	0.045	9.87	0.18					
105	17.470	18.243	0.17	0.17	2.30	84	-2.02	1.81	82	-0.3	97	0.100	100	100	4.8	-0.3	638	154	111	480	473	371	275	84	66	88	68	76	0.043	10.01	0.22					
110	18.301	19.113	0.17	0.17	2.28	85	-2.01	1.81	82	-0.4	99	0.100	100	101	4.5	-0.3	635	155	111	478	474	371	272	85	66	88	68	75	0.043	10.18	0.24					
115	19.131	19.981	0.17	0.17	2.28	85	-2.03	1.81	82	-0.3	100	0.100	100	101	4.2	-0.3	641	156	114	478	473	372	274	84	66	88	68	77	0.042	9.96	0.38					
120	19.962	20.849	0.17	0.17	2.29	85	-1.82	1.81	82	-0.4	98	0.100	100	100	3.8	-0.4	630	157	113	477	472	370	274	84	67	88	68	76	0.045	9.46	0.31					
125	20.793	21.718	0.17	0.17	2.28	86	-1.64	1.81	82	-0.2	99	0.100	100	101	3.6	-0.24	591	158	115	478	472	363	263	85	67	88	69	75	0.039	8.29	0.41					
130	21.623	22.588	0.17	0.17	2.30	86	-1.61	1.81	82	-0.3	97	0.100	100	100	3.3	-0.26	592	158	115	472	474	354	251	85	67	88	69	78	0.036	7.64	0.62					
135	22.455	23.454	0.17	0.17	2.30	85	-1.66	1.80	82	-0.4	95	0.100	100	100	3.2	-0.1	510	159	114	468	477	345	237	84	68	88	69	75	0.035	6.7	0.61					
140	23.287	24.324	0.17	0.17	2.30	85	-2.03	1.79	82	-0.3	93	0.100	100	100	3.0	-0.2	475	159	113	459	478	337	225	84	68	88	69	76	0.031	5.54	1.03					
145	24.119	25.192	0.17	0.17	2.29	85	-1.85	1.81	82	-0.3	92	0.100	100	100	2.9	-0.1	449	160	111	450	470	328	216	84	68	88	70	76	0.029	5.49	1.02					
150	24.951	26.060	0.17	0.17	2.29	84	-1.78	1.80	82	-0.4	91	0.100	100	100	2.8	-0.1	424	160	112	442	460	320	208	83	68	88	70	76	0.027	5.23	0.97					
155	25.782	26.926	0.17	0.17	2.29	84	-1.72	1.80	82	-0.1	90	0.100	100	100	2.7	-0.1	408	160	109	434	450	312	200	84	68	88	70	75	0.024	5.11	0.88					
160	26.614	27.798	0.17	0.17	2.29	83	-1.57	1.80	82	-0.1	89	0.100	100	100	2.7	0	390	160	111	428	442	306	194	83	68	88	70	75	0.023	5.17	0.87					
165	27.445	28.664	0.17	0.17	2.30	82	-1.98	1.80	82	-0.1	88	0.100	100	99	2.6	-0.1	379	160	110	420	434	301	190	83	68	88	70	74	0.024	5.03	0.89					
170	28.277	29.532	0.17	0.17	2.29	81	-1.98	1.80	82	-0.2	87	0.100	100	99	2.5	-0.1	368	159	108	414	427	295	185	83	69	88	70	75	0.021	4.77	0.9					
175	29.109	30.399	0.17	0.17	2.28	81	-1.96	1.81	82	-0.1	87	0.100	100	99	2.5	0	358	158	108	408	421	290	180	83	69	88	70	75	0.020	4.78	0.92					
180	29.940	31.266	0.17	0.17	2.29	81	-1.93	1.81	82	-0.2	88	0.100	100	99	2.4	-0.1	351	156	107	402	414	286	178	82	69	84	70	75	0.019	4.83	0.94					


### Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 4

Manufacturer: GHP Group  
 Model: Small Series  
 Tracking No: 2418  
 Project No: 048885515E  
 Test Date: 08-30-20  
 Beginning Clock Time: 11:43  
 Meter Box Y Factor: 0.994 (1) 0.998 (2)  
 Barometric Pressure: Begin Middle End Average  
 29.45 29.36 29.41 Hg  
 OMNI Equipment Numbers:

PM Control Module: 371, 372  
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole  
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole  
 Dilution Tunnel H<sub>2</sub>O: 2.92 percent  
 Dilution Tunnel Sulfate: 0.260 %H<sub>2</sub>O  
 Tunnel Area: 0.16635 ft<sup>2</sup>  
 Plect Tube Cp: 0.90

Avg. Tunnel Velocity: 20.82 ft/sec  
 Initial Tunnel Flow: 225.3 scfm  
 Average Tunnel Flow: 225.1 scfm  
 Post-Test Leak Check (1): 0.000 cfm @ 8 in. Hg  
 Post-Test Leak Check (2): 0.000 cfm @ 6 in. Hg  
 Average Post-Test Fuel Moisture: 21.43 Dry Basis %

Technician Signature: 

Velocity Traverse Data									
	PS1	PS2	PS3	PS4	PS5	PS6	PS7	PS8	Center
Initial dP	0.084	0.088	0.096	0.092	0.082	0.100	0.102	0.090	0.100
Temp	88	88	88	88	88	88	88	88	88
V <sub>avg</sub>	20.71		ft/sec		V <sub>center</sub>	21.53		ft/sec	
F <sub>p</sub>	0.962								

Elapsed Time (min)	Particulate Sampling Data												Fuel Weight (lb)											Temperature Data (F)								Stack Gas Data		
	Gas Meter 1 (ft <sup>3</sup> )	Gas Meter 2 (ft <sup>3</sup> )	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH1 (in)	Meter 1 Temp (F)	Meter 1 Vacuum (Hg)	Orifice dH2 (in)	Meter 2 Temp (F)	Meter 2 Vacuum (Hg)	Dilution Tunnel Temp (F)	Dilution Tunnel dP	Pro. Rate 1	Pro. Rate 2	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Avg. Stove Surface	Stack	Filter 1	Dryer Ext 1	Filter 2	Dryer Ext 2	Ambient	Draft (H <sub>2</sub> O)	CO <sub>2</sub> (%)	CO (%)			
185	30.772	32.135	0.17	0.17	2.30	80	-1.82	1.80	81	-0.1	87	0.100	100	100	2.3	-0.1	343	156	106	400	407	282		175	83	69	85	71	74	0.018	4.73	0.84		
190	31.604	33.003	0.17	0.17	2.29	80	-1.56	1.81	81	-0.3	86	0.100	100	99	2.3	0	337	156	107	396	401	279		175	83	69	85	71	73	0.018	4.52	0.9		
195	32.435	33.871	0.17	0.17	2.29	80	-1.9	1.81	81	-0.4	86	0.100	100	99	2.2	-0.1	330	155	106	392	396	276		180	82	69	84	71	73	0.017	4.47	0.86		
200	33.264	34.739	0.17	0.17	2.28	80	-1.58	1.81	81	-0.1	86	0.100	100	99	2.1	-0.1	325	153	105	387	389	272		169	83	69	85	71	75	0.016	4.21	0.81		
205	34.094	35.606	0.17	0.17	2.27	80	-1.55	1.80	81	-0.1	87	0.100	100	99	2.1	0	320	154	108	383	384	270		167	83	69	84	71	75	0.015	4.09	0.79		
210	34.922	36.473	0.17	0.17	2.27	80	-1.89	1.80	81	-0.2	87	0.100	100	99	2.0	-0.1	311	149	101	377	379	263		165	82	70	84	71	75	0.015	4.02	0.76		
215	35.751	37.340	0.17	0.17	2.28	79	-1.88	1.80	81	-0.4	86	0.100	100	99	1.9	-0.1	308	149	106	371	372	261		161	83	70	85	71	76	0.014	3.99	0.77		
220	36.580	38.206	0.17	0.17	2.27	79	-1.8	1.80	81	-0.1	87	0.100	100	99	1.9	0	302	148	101	366	369	257		161	83	70	84	71	75	0.014	3.97	0.76		
225	37.408	39.073	0.17	0.17	2.28	79	-1.55	1.80	81	-0.1	86	0.100	100	99	1.9	0	300	148	104	362	364	256		161	82	70	84	72	74	0.013	3.96	0.75		
230	38.236	39.939	0.17	0.17	2.28	80	-1.98	1.80	81	-0.3	85	0.100	99	99	1.8	-0.1	298	148	102	358	360	253		161	83	70	85	72	75	0.013	3.83	0.76		
235	39.064	40.804	0.17	0.17	2.28	80	-1.63	1.80	80	-0.1	86	0.100	100	99	1.8	0	292	143	102	354	356	249		159	82	70	84	72	73	0.013	3.84	0.78		
240	39.892	41.670	0.17	0.17	2.27	80	-1.93	1.80	80	-0.3	85	0.100	99	99	1.7	-0.1	290	145	104	350	352	248		156	82	71	85	72	73	0.013	3.74	0.78		
245	40.720	42.537	0.17	0.17	2.28	80	-1.7	1.80	80	-0.3	84	0.100	99	99	1.7	0	285	144	103	346	347	245		154	83	71	84	72	75	0.012	3.69	0.78		
250	41.547	43.403	0.17	0.17	2.27	79	-2.01	1.81	80	-0.1	84	0.100	99	99	1.6	-0.1	282	144	99	343	342	242		153	82	71	84	72	74	0.012	3.66	0.76		
255	42.375	44.269	0.17	0.17	2.28	79	-1.64	1.80	80	-0.1	84	0.100	100	99	1.6	-0.02	280	143	103	340	338	241		152	82	71	85	72	75	0.012	3.54	0.74		
260	43.203	45.135	0.17	0.17	2.28	79	-1.59	1.80	80	-0.1	85	0.100	100	99	1.6	-0.08	277	142	103	337	334	239		151	83	71	84	72	76	0.010	3.52	0.74		
265	44.032	46.002	0.17	0.17	2.27	78	-1.62	1.80	80	-0.2	85	0.100	100	99	1.5	0	273	140	102	333	330	238		150	82	71	84	73	75	0.011	3.47	0.74		
270	44.861	46.869	0.17	0.17	2.28	78	-1.76	1.80	80	-0.2	84	0.100	100	99	1.5	0	270	139	101	329	327	233		148	83	71	85	73	75	0.010	3.41	0.74		
275	45.689	47.735	0.17	0.17	2.28	79	-1.81	1.81	80	-0.1	86	0.100	100	100	1.2	-0.3	279	139	101	324	323	233		154	83	71	84	73	76	0.012	5.18	1.04		
280	46.517	48.602	0.17	0.17	2.27	79	-1.73	1.81	80	-0.1	86	0.100	100	99	1.1	-0.1	297	137	100	322	322	236		160	82	72	85	73	76	0.014	6.38	0.87		
285	47.344	49.469	0.17	0.17	2.27	80	-1.7	1.80	80	-0.4	87	0.100	99	100	1.1	0	307	139	100	323	326	239		164	83	72	85	73	75	0.014	5.02	1.06		
290	48.171	50.335	0.17	0.17	2.28	80	-1.6	1.80	81	-0.4	86	0.100	99	99	1.0	-0.1	312	140	104	326	330	242		164	83	72	84	73	75	0.014	4.93	0.99		
295	48.999	51.200	0.17	0.17	2.27	80	-1.64	1.80	81	-0.2	87	0.100	100	99	0.9	-0.1	313	139	103	327	335	243		164	82	72	85	73	76	0.015	4.91	0.95		
300	49.826	52.067	0.17	0.17	2.27	80	-1.55	1.79	81	-0.4	87	0.100	99	99	0.8	-0.1	315	141	105	329	339	246		165	83	72	85	73	77	0.016	4.76	0.89		
305	50.653	52.933	0.17	0.17	2.27	81	-1.53	1.80	81	-0.2	87	0.100	99	99	0.7	-0.1	315	142	104	330	343	247		165	83	72	84	74	76	0.014	4.71	0.88		
310	51.480	53.799	0.17	0.17	2.28	81	-1.66	1.80	81	-0.1	87	0.100	99	99	0.7	0	314	143	105	331	346	248		165	82	72	85	74	77	0.014	4.68	0.85		
315	52.308	54.664	0.17	0.17	2.28	81	-1.54	1.80	81	-0.1	88	0.100	100	99	0.6	-0.1	314	144	106	331	348	249		165	83	73	85	74	76	0.014	4.58	0.9		
320	53.136	55.529	0.17	0.17	2.28	81	-1.54	1.80	81	-0.4	88	0.100	100	99	0.5	-0.1	313	145	106	331	348	248		165	83	73	85	74	77	0.015	4.59	0.92		
325	53.962	56.395	0.17	0.17	2.25	82	-1.55	1.79	81	-0.1	88	0.100	99	99	0.4	-0.1	310	145	106	332	349	248		165	83	73	85	74	77	0.013	4.18	0.89		
330	54.789	57.260	0.17	0.17	2.26	81	-1.61	1.79	81	-0.1	87	0.100	99	99	0.4	-0.04	307	144	104	331	350	247		164	83	73	85	74	77	0.014	4.07	0.88		
335	55.617	58.127	0.17	0.17	2.27	81	-1.74	1.80	82	-0.2	87	0.100	99	99	0.3	-0.06	304	143	105	328	348	246		162	83	73	85	75	76	0.014	3.92	0.85		
340	56.444	58.993	0.17	0.17	2.28	81	-1.64	1.81	82	-0.1	87	0.100	100	99	0.3	0	303	144	104	329	346	245		162	83	73	85	75	76	0.013	3.84	0.87		
345	57.272	59.860	0.17	0.17	2.28	81	-1.57	1.80	82	-0.2	87	0.100	100	99	0.2	-0.1	297	144	105	326	344	243		160	83	73	84	75	77	0.013	3.74	0.86		
350	58.104	60.728	0.17	0.17	2.28	81	-1.54	1.80	82	-0.1	87	0.100	100	99	0.1	-0.1	294	144	106	325	341	242		160	83	74	85	75	77	0.012	3.61	0.78		
355	58.933	61.595	0.17	0.17	2.28	81	-1.75	1.80	82	-0.3	87	0.100	100	99	0.1	0	291	144	105	322	338	240		158	82	74	85	75	77	0.012	3.51	0.78		
360	59.761	62.461	0.17	0.17	2.25	81	-1.58	1.80	82	-0.2	87	0.100	99	99	0.0	-0.1	287	144	106	320	334	238		157	83	74	84	75	78	0.011	3.51	0.78		
Avg/Std	59.761	62.461	0.17	0.17	2.28	83		1.80	82		94	0.100	100	100								141.0			88	88	70	78	0.029					

## Wood Heater Lab Data - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group                      Equipment Numbers: \_\_\_\_\_  
 Model: Small Series \_\_\_\_\_  
 Tracking No.: 2416 \_\_\_\_\_  
 Project No.: 0418WS019E \_\_\_\_\_  
 Run #: 4 \_\_\_\_\_  
 Date: 7/8/20 \_\_\_\_\_

**TRAIN 1 (First Hour emissions)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T266S	98.1	96.3	1.8
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

**Sub-Total**    Total Particulate, mg:    1.8

**TRAIN 1 (Post First Hour Change-out)**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T259AP	179.7	180.5	-0.8
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe	16	114267.4	114266.9	0.5
E. Filter seals catch*	Seals	R003	4118.5	4116.6	1.9

**Sub-Total**    Total Particulate, mg:    1.6

**Train 1 Aggregate**    Total Particulate, mg:    3.4

**TRAIN 2**

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	T259BP	183.5	181.6	1.9
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe	17	114562.7	114562.2	0.5
D. Filter seals catch*	Seals	R004	3504.0	3503.3	0.7

Total Particulate, mg:    3.1

**AMBIENT**

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

Total Particulate, mg:    0.0

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

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

Technician Signature: 

## Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group  
 Model: Small Series  
 Project No.: 0418WS019E  
 Tracking No.: 2416  
 Run: 4  
 Test Date: 07/08/20

Burn Rate	<b>1.11 kg/hr dry</b>
Average Tunnel Temperature	94 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	20.82 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	13503.3 dscf/hour
Average Delta p	0.100 inches H2O
Total Time of Test	360 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	59.761 cubic feet	62.461 cubic feet	9.955 cubic feet
Average Gas Meter Temperature	76 degrees Fahrenheit	83 degrees Fahrenheit	82 degrees Fahrenheit	83 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	57.067 dscf	59.925 dscf	9.500 dscf
Total Particulates - m <sub>n</sub>	0 mg	3.4 mg	3.1 mg	1.8 mg
Particulate Concentration (dry-standard) - C <sub>r</sub> /C <sub>s</sub>	0.000000 grams/dscf	0.00006 grams/dscf	0.00005 grams/dscf	0.00019 grams/dscf
Total Particulate Emissions - E <sub>T</sub>	0.00 grams	4.83 grams	4.19 grams	2.56 grams
Particulate Emission Rate	0.00 grams/hour	0.80 grams/hour	0.70 grams/hour	2.56 grams/hour
Emissions Factor		0.72 g/kg	0.63 g/kg	0.74 g/kg
Difference from Average Total Particulate Emissions		0.32 grams	0.32 grams	

**Dual Train Comparison Results Are Acceptable**

FINAL AVERAGE RESULTS	
<b>Complete Test Run</b>	
Total Particulate Emissions - E <sub>T</sub>	4.51 grams
Particulate Emission Rate	<b>0.75 grams/hour</b>
Emissions Factor	0.68 grams/kg
<b>First Hour Emissions</b>	
Total Particulate Emissions - E <sub>T</sub>	2.56 grams
Particulate Emission Rate	2.56 grams/hour
Emissions Factor	0.74 grams/kg
7.5% of Average Total Particulate Emissions	0.34 grams

QUALITY CHECKS	
Filter Temps < 90 °F	OK
Filter Face Velocity (47 mm)	OK
Dryer Exit Temp < 80F	OK
Leakage Rate	OK
Ambient Temp (55-90°F)	OK
Negative Probe Weight Eval.	OK
Pro-Rate Variation	OK
Train Precision 7.5%	7.05
Train Precision 0.5g/kg	0.10

Technician Signature: 



# Wood Heater Efficiency Results - CSA B415.1

**Manufacturer:** GHP Group  
**Model:** Small Series  
**Date:** 07/08/20  
**Run:** 4  
**Control #:** 0418WS019E  
**Test Duration:** 360  
**Output Category:** II

Technician Signature: 

## Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	78.5%	84.1%
Combustion Efficiency	96.1%	96.1%
Heat Transfer Efficiency	82%	87.5%

Output Rate (kJ/h)	16,828	15,963	(Btu/h)
Burn Rate (kg/h)	1.11	2.44	(lb/h)
Input (kJ/h)	21,439	20,337	(Btu/h)

Test Load Weight (dry kg)	6.65	14.66	dry lb
MC wet (%)	17.64576699		
MC dry (%)	21.43		
Particulate (g)	0.75		
CO (g)	379		
Test Duration (h)	6.00		

Emissions	Particulate	CO
g/MJ Output	0.01	3.75
g/kg Dry Fuel	0.11	56.98
g/h	0.13	63.17
lb/MM Btu Output	0.02	8.72

Air/Fuel Ratio (A/F)	13.55
----------------------	-------

VERSION:

2.2

12/14/2009

Values to be input manually

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For Usable Firebox Volumes up to 3.0 ft <sup>3</sup> - Low and Medium Fire				
Nominal Required Load Density (wet basis)	12	lb/ft <sup>3</sup>		
Usable Firebox Volume	1.54	ft <sup>3</sup>		
Total Nom. Load Wt. Target	18.48	lb		
Total Load Wt. Allowable Range	17.56	to 19.40	lb	
Core Target Wt. Allowable Range	8.316	to 12.01	lb	
Remainder Load Wt. Allowable Range	6.47	to 10.16	lb	
				Mid-Point
Core Load Fuel Pc. Wt. Allowable Range	2.77	to 4.62	lb	3.70
Remainder Load Pc. Wt. Allowable Range	1.85	to 5.54	lb	3.70
	Pc. #			
Core Load Piece Wt. Actual	1	4.30	lb	In Range
	2	3.50	lb	In Range
	3	2.90	lb	In Range
Core Load Total. Wt. Actual		10.70	lb	In Range
	Pc. #			
Remainder Load Piece Wt.	1	5.10	lb	In Range
(2 or 3 Pcs.)	2	2.00	lb	In Range
	3		lb	NA
Remainder Load Piece Weight Ratio - Small/Large		39%		In Range ≤ 67%
Remainder Load Tot. Wt. Act		7.10	lb	In Range
Total Load Wt. Actual		17.80	lb	In Range
Core % of Total Wt.		60%		In Range 45-65%
Remainder % of Total Wt.		40%		In Range 35-55%
Actual Load % of Nominal Target		96%		In Range 95-105%
Actual Fuel Load Density		11.6	lb/ft <sup>3</sup>	
Allowable Charcoal Bed Wt. Range (lb)	1.8	to 3.5		Mid-Point
Actual Charcoal Bed Wt.		1.9	lb	In Range 2.7
Actual Fuel Load Ending Wt.		0.0	lb	Valid Test ≥ 90%
Total Wt. of Fuel Burned During Test Run lb.		17.8	lb	

Fuel Piece Moisture Reading (%-dry basis)									
1	2	3	Ave.		Pc. Wt. Dry Basis				
21.3	20.4	19.4	20.4	In Range	3.57	lb	1.62	kg	
20.7	23	21.9	21.9	In Range	2.87	lb	1.30	kg	
26.7	23.3	22.7	24.2	In Range	2.33	lb	1.06	kg	
18.1	18.2	18.7	18.3	In Range	4.31	lb	1.95	kg	
18.1	25.9	23	22.3	In Range	1.63	lb	0.74	kg	
			NA	NA	NA	lb	NA	kg	
Total Load Ave. MC % (dry basis)				20.9	In Range				
Total Load Ave. MC % (wet basis)				17.3					
Total Test Load Weight (dry basis)					→	14.72	lb	6.68	kg
Total Fuel Weight Burned During Test Run (dry basis)						14.7	lb	6.68	kg

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 4  
 Model: GHP Small Tracking Number: 2416 Date: 7/8/2020  
 Test Crew: \_\_\_\_\_  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Run Notes

##### Air Control Settings

Primary:

*1/16" from full closed*

Secondary: fixed

Tertiary/Pilot: N/A

Fan: On High

##### Preburn Notes

Time	Notes

##### Test Notes

Sketch test fuel configuration:

*See photo*

Start up procedures & Timeline:

Bypass: N/A  
 Fuel loaded by: 45 seconds  
 Door closed at: 4:00 min  
 Primary air: Fully open until 7:30  
then set to 50% At 13  
min set to 1/16" From Full  
 Notes: closed  
At 13 min fan set to High

Time	Notes
<u>60</u>	<u>Changed front filter in frame A.</u>
<u>270</u>	<u>Fuel WAS moved forward in the fire box due to weight loss in 10 min.</u>

Technician Signature: *[Signature]*

Date: 7/15/2020

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 4  
 Model: GHP Small Tracking Number: 2416 Date: 7/8/2020  
 Test Crew: B. Dawson  
 OMNI Equipment ID numbers: \_\_\_\_\_

#### Wood Heater Supplemental Data

Start Time: 1143 Booth #: N/A

Stop Time: 1743

**Stack Gas Leak Check:**

Initial: good Final: good

**Sample Train Leak Check:**

A: 0.0 @ 8 "Hg  
 B: 0.0 @ 6 "Hg

**Calibrations:** Span Gas CO<sub>2</sub>: 10.08 CO: 2.53

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>1102</u>	<u>1102</u>	<u>1745</u>	<u>1745</u>
CO <sub>2</sub>	<u>0.00</u>	<u>10.08</u>	<u>0.10</u>	<u>9.92</u>
CO	<u>0.00</u>	<u>2.54</u>	<u>0.00</u>	<u>2.54</u>

Air Velocity (ft/min): Initial: 250 Final: 250

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

Pitot Tube Leak Test: Initial: good Final: good

Stack Diameter (in): 6"

Induced Draft: 0.0

% Smoke Capture: 100%

Flue Pipe Cleaned Prior to First Test in Series:

Date: 7/3/20 Initials: AD

	Initial	Middle	Ending
P <sub>b</sub> (in/Hg)	<u>29.45</u>		<u>29.36</u>
RH (%)	<u>43</u>		<u>40</u>
Ambient (°F)	<u>79</u>		<u>78</u>

Tunnel Traverse		
Microtector Reading	dP (in H <sub>2</sub> O)	T(°F)
	<u>.084</u>	<u>88</u>
	<u>.088</u>	<u>88</u>
	<u>.096</u>	<u>88</u>
	<u>.092</u>	<u>88</u>
	<u>.082</u>	<u>88</u>
	<u>.100</u>	<u>88</u>
	<u>.102</u>	<u>88</u>
	<u>.090</u>	<u>88</u>
Center:		
	<u>.100</u>	<u>88</u>

Background Filter Volume: N/A

Tunnel Static Pressure (in H <sub>2</sub> O):	
Beginning of Test	End of Test
<u>-.260</u>	<u>-.260</u>

Technician Signature: B. Dawson

Date: 7/15/2020

## **Section 4**

### **Quality Assurance/Quality Control**

## QUALITY ASSURANCE/QUALITY CONTROL

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

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

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

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

The manufacturing facilities and quality control system to produce the Small Wood Stove at GHP Group, Inc. were evaluated to determine if sufficient to maintain conformance with OMNI’s requirements for product certification. OMNI has concluded that the manufacturing facilities, processes, and quality control system are adequate to produce the appliance congruous with the standards and model codes to which it was evaluated.

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



### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 1  
 Model: GHP Small Tracking Number: 2416 Date: 7/7/2020  
 Test Crew: B. Davis  
 OMNI Equipment ID numbers: 632, 223A, 592

#### ASTM E2515 Lab Sheet

Assembled By:

B. Davis

Date/Time in Dessicator:

7/9/20 10:20

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>07/13/2020 7:50</u>	Date/Time: <u>07/14/2020 7:45</u>	Date/Time:	Date/Time:	Date/Time:
R/H %: <u>11.5</u>	R/H %: <u>17.8</u>	R/H %:	R/H %:	R/H %:
Temp: <u>75.2</u>	Temp: <u>76.8</u>	Temp:	Temp:	Temp:
200 mg Audit: <u>200.0</u>	200 mg Audit: <u>200.1</u>	200 mg Audit:	200 mg Audit:	200 mg Audit:
2 g Audit: <u>2000.3</u>	2 g Audit: <u>2000.3</u>	2 g Audit:	2 g Audit:	2 g Audit:
100 g Audit: <u>99997.9</u>	100 g Audit: <u>99997.9</u>	100 g Audit:	100 g Audit:	100 g Audit:
Initials: <u>TT</u>	Initials: <u>TT</u>	Initials:	Initials:	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	<u>F203S</u>	<u>100.7</u>	<u>102.6</u>	<u>102.7</u>			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	<u>F257AP</u>	<u>181.4</u>	<u>185.3</u>	<u>185.3</u>			
	Rear Filter							
	Probe	<u>7</u>	<u>114981.9</u>	<u>114982.5</u>	<u>114982.4</u>			
	O-Ring Set	<u>R993</u>	<u>3364.9</u>	<u>3347.3</u>	<u>3347.4</u>			
B	Front Filter	<u>F2570P</u>	<u>181.8</u>	<u>186.4</u>	<u>186.2</u>			
	Rear Filter	<u>F264S</u>	<u>97.3</u>	<u>98.9</u>	<u>98.9</u>			
	Probe	<u>8</u>	<u>115598.4</u>	<u>115599.2</u>	<u>115599.1</u>			
	O-Ring Set	<u>R994</u>	<u>3367.8</u>	<u>3349.7</u>	<u>3349.8</u>			
BG	Filter							

Technician Signature: B. Davis

Date: 7/15/20



### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 2  
 Model: GHP Small Tracking Number: 2416 Date: 7/7/2020  
 Test Crew: B Daws  
 OMNI Equipment ID numbers: 687, 2234, 552

#### ASTM E2515 Lab Sheet

Assembled By:

B Daws

Date/Time in Dessicator:

7/9/20 1020

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>07/13/2020</u> <u>7:50</u>	Date/Time: <u>07/14/2020</u> <u>7:45</u>	Date/Time: <u>07/15/2020</u> <u>7:50</u>	Date/Time:	Date/Time:
R/H %: <u>11.5</u>	R/H %: <u>17.8</u>	R/H %: <u>10.0</u>	R/H %:	R/H %:
Temp: <u>75.2</u>	Temp: <u>76.8</u>	Temp: <u>78.0</u>	Temp:	Temp:
200 mg Audit: <u>200.0</u>	200 mg Audit: <u>200.1</u>	200 mg Audit: <u>200.0</u>	200 mg Audit:	200 mg Audit:
2 g Audit: <u>2000.3</u>	2 g Audit: <u>2000.3</u>	2 g Audit:	2 g Audit:	2 g Audit:
100 g Audit: <u>99997.9</u>	100 g Audit: <u>99997.9</u>	100 g Audit:	100 g Audit:	100 g Audit:
Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: <u>TT</u>	Initials:	Initials:

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
<b>A</b> (First Hour)	Front Filter	<u>T265S</u>	<u>97.5</u>	<u>100.8</u>	<u>100.9</u>			
	Rear Filter							
	Probe							
	O-Ring Set							
<b>A</b> (Remainder)	Front Filter	<u>T258AP</u>	<u>181.1</u>	<u>179.2</u>	<u>179.5</u>	<u>179.6</u>		
	Rear Filter							
	Probe	<u>9</u>	<u>115696.0</u>	<u>115697.0</u>	<u>115697.1</u>			
	O-Ring Set	<u>R01</u>	<u>3363.4</u>	<u>3366.1</u>	<u>3366.0</u>			
<b>B</b>	Front Filter	<u>T2580P</u>	<u>180.8</u>	<u>181.6</u>	<u>181.6</u>			
	Rear Filter							
	Probe	<u>11</u>	<u>114188.6</u>	<u>114189.4</u>	<u>114189.2</u>			
	O-Ring Set	<u>R02</u>	<u>3392.2</u>	<u>3395.9</u>	<u>3395.9</u>			
<b>BG</b>	Filter							

Technician Signature: B Daws

Date: 7/15/20

### Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS019E Run Number: 4  
 Model: GHP Small Tracking Number: 2416 Date: 7/8/2020  
 Test Crew: B Davis  
 OMNI Equipment ID numbers: 637, 243A, 592

#### ASTM E2515 Lab Sheet

Assembled By:

B Davis

Date/Time in Dessicator:

7/9/20 1020

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>07/13/2020</u>	Date/Time: <u>07/14/2020</u>			
R/H %: <u>7.5</u>	R/H %: <u>7.45</u>			
Temp: <u>11.5</u>	Temp: <u>17.8</u>			
200 mg Audit: <u>75.2</u>	200 mg Audit: <u>76.8</u>			
2 g Audit: <u>200.0</u>	2 g Audit: <u>200.1</u>			
100 g Audit: <u>2000.3</u>	100 g Audit: <u>2000.3</u>			
Initials: <u>TT</u>	Initials: <u>TT</u>			

Train	Element	ID #	Tare (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)	Weight (mg)
A (First Hour)	Front Filter	<u>T246S</u>	<u>96.3</u>	<u>98.2</u>	<u>98.1</u>			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	<u>T259AP</u>	<u>180.5</u>	<u>179.9</u>	<u>179.7</u>			
	Rear Filter							
	Probe	<u>16</u>	<u>114266.9</u>	<u>114267.5</u>	<u>114267.4</u>			
	O-Ring Set	<u>R003</u>	<u>4116.6</u>	<u>4118.5</u>	<u>4118.5</u>			
B	Front Filter	<u>T259AP</u>	<u>181.6</u>	<u>183.7</u>	<u>183.5</u>			
	Rear Filter							
	Probe	<u>17</u>	<u>114562.2</u>	<u>114562.9</u>	<u>114562.7</u>			
	O-Ring Set	<u>R004</u>	<u>3503.3</u>	<u>3504.1</u>	<u>3504.0</u>			
BG	Filter							

Technician Signature: [Signature]

Date: 2/15/20



Tare Sheet: (check one) Probes \_\_\_\_\_ 47mm Filters  100mm Filters \_\_\_\_\_ O-Ring Pair \_\_\_\_\_  
 Prepared By: Tomy Tong Balance ID #: 00637 Thermohyrometer ID #: 00592 Audit Weight ID #/Mass: 00283A 1200mg

Placed in Dessicator: Date: <u>04/28/2020</u> Time: <u>8:15</u>	Date: <u>04/29/2020</u> Time: <u>8:15</u> RH %: <u>19.6</u> T (°F): <u>72.5</u> Audit: <u>199.8</u>	Date: <u>04/30/2020</u> Time: <u>9:00</u> RH %: <u>18.6</u> T (°F): <u>71.9</u> Audit: <u>200.1</u>	Date: _____ Time: _____ RH %: _____ T (°F): _____ Audit: _____	Date: _____ Time: _____ RH %: _____ T (°F): _____ Audit: _____	Date Used	Project Number	Run No.
	ID #	Audit: <u>199.8</u>	Audit: <u>200.1</u>	Audit: _____			
T253AP	198.3	198.3 ✓					
T253BP	198.0	197.9 ✓					
T254AP	199.4	199.6 ✓					
T254BP	198.3	198.3 ✓					
T255AP	189.4	189.3 ✓					
T255BP	179.7	179.7 ✓					
T256AP	182.7	182.6 ✓					
T256BP	181.7	181.6 ✓					
T257AP	181.5	181.4 ✓			7/7/2020	0418WS019E	1
T257BP	181.9	181.8 ✓			↓	↓	↓
T258AP	181.0	181.1 ✓			↓	↓	2
T258BP	180.9	180.8 ✓			↓	↓	↓
T259AP	180.5	180.5 ✓			7/8/2020	↓	4
T259BP	181.7	181.6 ✓			↓	↓	↓
T260AP	192.3	192.2 ✓					
T260BP	192.0	191.8 ✓					
T261AP	195.0	195.1 ✓					
T261BP	196.0	196.1 ✓					
T262AP	196.0	196.1 ✓			✓	✓	✓
T262BP	193.9	194.0 ✓					
Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: _____	Initials: _____	Initials: _____			

Final Technician Signature: Tomy Tong  
 Control No. P-SFDP-0002.xls, Effective date: 2/1/2017

Date: 05/04/2020

Evaluator signature: BCD = 7/15/2020

Tare Sheet: (check one) Probes \_\_\_\_\_ 47mm Filters  100mm Filters \_\_\_\_\_ O-Ring Pair \_\_\_\_\_  
 Prepared By: Tony Tong Balance ID #: 00637 Thermohygrometer ID #: 00592 Audit Weight ID #/Mass: 00283A 1200 mg

Placed in Dessicator:	Date: <u>04/29/2020</u>	Date: <u>04/30/2020</u>	Date: <u>05/04/2020</u>	Date: _____	Date Used	Project Number	Run No.
	Time: <u>8:15</u>	Time: <u>9:00</u>	Time: <u>8:00</u>	Time: _____			
Date: <u>04/28/2020</u>	RH %: <u>19.6</u>	RH %: <u>18.6</u>	RH %: <u>24.7</u>	RH %: _____			
Time: <u>8:15</u>	T (°F): <u>72.5</u>	T (°F): <u>71.9</u>	T (°F): <u>67.4</u>	T (°F): _____			
ID #	Audit: <u>199.8</u>	Audit: <u>199.8</u>	Audit: <u>199.8</u>	Audit: _____			
T263S	100.8	100.7 ✓			7/7/20	041845019 E	1
T264S	97.2	97.3 ✓			↓	↓	↓
T265S	97.9	97.6 ✓	97.5 ✓		↓		2
T266S	96.3	96.3 ✓			7/8/2020	↓	4
T267S	98.0	97.9 ✓					
T268S	98.5	98.4 ✓					
T269S	96.9	97.0 ✓					
T270S	96.5	96.5 ✓					
T271S	96.6	96.6 ✓					
T272S	97.1	96.9 ✓					
T273S	97.1	97.1 ✓					
T274S	98.4	98.3 ✓					
T275S	90.8	90.9 ✓					
T276S	90.9	91.0 ✓					
T277S	90.6	90.4 ✓					
T278S	91.1	90.9 ✓					
T279S	90.8	91.0 ✓					
T280S	97.3	97.2 ✓					
T281S	96.9	96.8 ✓					
T282S	98.5	98.4 ✓					
Initials: <u>TT</u>		Initials: <u>TT</u>		Initials: <u>TT</u>		Initials: _____	

Final Technician Signature: Tony Tong  
 Control No. P-SFDP-0002.xls, Effective date: 2/10/2017

Date: 05/04/2020

Evaluator signature: [Signature] = 7/15/2020





Tare Sheet: (check one) Probes \_\_\_\_\_ 47mm Filters \_\_\_\_\_ 100mm Filters \_\_\_\_\_ O-Ring Pair

Prepared By: Terry Long Balance ID #: OMNI-00637 Thermohyrometer ID #: OMN-00592 Audit Weight ID #/Mass: OMNI-00283A/5g

Placed in Dessicator: Date: <u>05/26/2020</u> Time: <u>9:00</u>	Date: <u>06/03/2020</u>	Date: <u>06/04/2020</u>	Date: _____	Date: _____	Date Used	Project Number	Run No.
	Time: <u>13:45</u>	Time: <u>8:30</u>	Time: _____	Time: _____			
RH %: <u>16.8</u>	RH %: <u>6.8</u>	RH %: _____	RH %: _____	RH %: _____			
T (°F): <u>74.3</u>	T (°F): <u>73.4</u>	T (°F): _____	T (°F): _____	T (°F): _____			
Audit: <u>5000.1</u>	Audit: <u>5000.0</u>	Audit: _____	Audit: _____	Audit: _____			
R993	3345.0	3344.9 ✓			7/7/20	0418WS019E	1
R994	3347.9	3347.8 ✓			↓	↓	↓
R995	4153.2	4153.2 ✓			Not Used		
R996	3315.7	3315.6 ✓			Not Used		
Initials: <u>TL</u>	Initials: <u>TL</u>	Initials: _____	Initials: _____	Initials: _____			

Final Technician Signature: Terry Long Date: 06/04/2020 Evaluator signature: DD 7/15/20

Control No. P-SFDP-0002.xls, Effective date: 2/1/2017

Tare Sheet: (check one) Probes \_\_\_\_\_ 47mm Filters \_\_\_\_\_ 100mm Filters \_\_\_\_\_ O-Ring Pair

Prepared By: Tomy Tong Balance ID #: OMNI-00637 Thermohyrometer ID #: OMNI-00592 Audit Weight ID #/Mass: OMNI-00283A/5g

Placed in Dessicator: Date: <u>05/26/2020</u> Time: <u>9:00</u>	Date: <u>06/08/2020</u> Time: <u>8:30</u> RH %: <u>8.1</u> T (°F): <u>69.2</u> Audit: <u>5000.0</u>	Date: <u>06/09/2020</u> Time: <u>8:00</u> RH %: <u>6.9</u> T (°F): <u>70.3</u> Audit: <u>4999.8</u>	Date: <u>06/10/2020</u> Time: <u>11:40</u> RH %: <u>9.4</u> T (°F): <u>72.1</u> Audit: <u>5000.0</u>	Date: _____ Time: _____ RH %: _____ T (°F): _____ Audit: _____	Date Used	Project Number	Run No.
	ID #						
R 997	3301.1	3301.0 ✓					
R 998	3499.3	3499.1 ✓					
R 999	3546.6	3546.5 ✓					
R 1000	3593.8	3593.5 ✓	3593.6 ✓				
R 0001	3363.2	3363.4 ✓			7/7/2020	0418WS019E	2
R 0002	3392.0	3392.2 ✓			↓		↓
R 0003	4116.5	4116.6 ✓			7/8/20		4
R 0004	3503.5	3503.3 ✓			↓		↓
R 0005	3513.9	3513.9 ✓					
R 0006	3333.3	3333.2 ✓					
R 0007	3587.0	3587.1 ✓					
R 0008	3304.1	3304.0 ✓					
R 0009	3347.1	3347.2 ✓					
R 0010	3329.6	3329.7 ✓					
R 0011	3346.6	3346.7 ✓			Not Used		
R 0012	3484.7	3484.6 ✓					
R 0013	3499.7	3499.8 ✓					
R 0014	4131.8	4131.8 ✓					
R 0015	4085.9	4086.0 ✓					
R 0016	3286.2	3286.2 ✓					
Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: _____				

Final Technician Signature: Tomy Tong  
Control No. P-SFDP-0002.xls, Effective date: 2/1/2017

Date: 06/10/2020

Evaluator signature: [Signature]

# Calibrations

## ASTM E2515, ASTM E3053

ID #	Lab Name/Purpose	Log Name	Attachment Type
132	10 lb Weight	Weight Standard, 10 lb.	Calibration Certificate
16-140TT029	Platform Scale	United 1000 lb.	Calibration Certificate
283A	Audit Weights	Troemner 21pc Msas Set	Calibration Certificate
371	Sample Box / Dry Gas Meter	Apex Automated Emissions Sampling Box	Calibration Log
372	Sample Box / Dry Gas Meter	Apex Automated Emissions Sampling Box	Calibration Log
410	Microtector	Dwyer Microtector	Calibration Certificate
265	Vaneometer	Dwyer Vaneometer	Equipment Record
592	Thermohygrometer	Omega Digital Thermohygrometer	Calibration Log
594	Combustion Gas Analyzer	CAI Gas Analyzer	See Run Sheet
637	Milligram Balance	Analytical Balance - Mettler - Toledo	Calibration Certificate



## SCALE WEIGHT CALIBRATION DATA SHEET

Weight to be calibrated: 10 pounds

ID Number: OMNI-00132

Standard Calibration Weight: 10 pounds

ID Number: OMNI-00255

Scale Used: MTW-150K

ID Number: OMNI-00353

Date: 2/23/2018

By: B. Davis

Standard Weight (A) (Lb.)	Weight Verified (B) (Lb.)	Difference (A - B)	% Error
10.0	10.0	0.0	0

\*Acceptable tolerance is 1%.

*This calibration is traceable to NIST using calibrated standard weights.*

Technician signature:  Date: 2/23/18



# QUALITY CONTROL SERVICES

LABORATORY EQUIPMENT • SALES • SERVICE • CALIBRATION • REPAIRS  
 2340 SE 11<sup>TH</sup> Ave. Portland, Oregon 97214 • Box 14831 Portland, Oregon 97293  
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Nelke Consulting LLC  
 30522 SE Leavenworth Ct.  
 Eagle Creek, OR 97022

Report Number: NELK0116-1400TT029200325

## CERTIFICATE OF CALIBRATION WITH DATA

### INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	United	1000 lb	16-1400TT029	N/A	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	0.1	QC033	3/25/20	3/27/19	3/2021

### FUNCTIONAL CHECKS

SHIFT TEST		LINEARITY		REPEATABILITY	
Test Wt:	Tol:	Test Wt:	Tol:	Test Wt:	Tol:
250	0.4	HB44	HB44	200	0.2
As-Found:		As-Found:		As-Found:	
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
700	699.9	699.9
500	499.9	499.9
200	200.0	200.0
100	100.0	100.0
50	50.0	50.0
25	25.0	25.0

### 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

#### Permanent Information Concerning this Equipment:

There is no adjustment procedure available for this scale. Stove on scale has 200 Lb Tare. Customer Range of use 0-200lbs.

#### Comments/Info Concerning this Calibration:

Technician: J. Cunningham

Signature:

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

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.

# Certificate of Calibration



**JJ Calibrations, Inc.**

7007 SE Lake Rd  
Portland, OR 97267-2105  
Phone 503.786.3005  
FAX 503.786.2994

Certificate Number: **685888**

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

PO: **180188**  
Order Date: **10/09/2018**  
Authorized By: **N/A**



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

Calibrated on: **10/26/2018**  
\*Recommended Due: **10/26/2023**  
Environment: **20 °C 57 % RH**  
\* As Received: **Within Tolerance**  
\* As Returned: **Within Tolerance**  
Action Taken: **Calibrated**  
Technician: **139**

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.

**This set meets Class F specifications.**  
**Received and returned eight (8) masses in a black case secured by a rubber band.**

### Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
723A	Rice Lake	1mg-200g (Class 0)	Mass Set,	03/23/2019	668240
800A	Sartorius	MSA225W100DI	Analytical Balance	12/11/2018	663857

### Measurement Data

Parameter	Measurement Description	Range Unit	Reference	Min	Max	*Error	UUT	Uncertainty
<b>Before/After</b>								Accredited = ✓
<b>Mass</b>								
Dot	200 mg	200.00030	199.4603	200.5403	0.0500	200.0503 mg	6.2E-01	✓
	1 g	1.0000880	0.9991088	1.0009088	0.0000000	1.000088 g	1E-03	✓
	2 g	2.00001470	1.9989147	2.0011147	0.0003250	2.0003397 g	1.3E-03	✓
	5 g	5.00000840	4.9985084	5.0015084	0.0000400	4.9999684 g	1.7E-03	✓
	10 g	10.0000100	9.998010	10.002010	0.000245	9.999765 g	2.3E-03	✓
Dot	20 g	20.0000140	19.996014	20.004014	0.000990	20.001004 g	4.6E-03	✓
	50 g	49.9999660	49.989966	50.009966	0.000595	49.999371 g	1.1E-02	✓
	100 g	100.000000	99.98000	100.02000	0.00194	99.99806 g	2.3E-02	✓

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

Reviewer

3 Issued 10/29/2018 Rev # 15


Inspector

# Thermal Metering System Calibration Y Factor

Manufacturer: Apex  
 Model: XC-60-EP  
 Serial Number: 702003  
 OMNI Tracking No.: OMNI-00371  
 Calibrated Orifice:  Yes

<b>Average Gas Meter y Factor</b>
<b>0.994</b>

<b>Orifice Meter dH@</b>
<b>N/A</b>

Calibration Date: 06/15/20  
 Calibrated by: Tony Tong  
 Calibration Frequency: Six Month  
 Next Calibration Due: 12/15/2020  
 Instrument Range: 1.000 cfm  
 Standard Temp.: 68 oF  
 Standard Press.: 29.92 "Hg  
 Barometric Press., Pb: 29.99 "Hg  
 Signature/Date:  6/29/2020

### Previous Calibration Comparison

Date	<u>1/3/2020</u>	Acceptable Deviation (5%)	Deviation
y Factor	<u>0.988</u>	0.0494	0.006
Acceptance	<b>Acceptable</b>		

### Current Calibration

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

Reference Standard *		
Standard	Model	Standard Test Meter
Calibrator	S/N	<u>OMNI-00001</u>
	Calib. Date	<u>25-Nov-19</u>
	Calib. Value	<u>0.9981</u> y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Reference Meter Pressure ("H2O), Pr	0.00	0.00	0.00
DGM Pressure ("H2O), Pd	3.00	1.70	0.90
Initial Reference Meter	145.242	151.1	157.68
Final Reference Meter	150.859	156.2	163.08
Initial DGM	0	0	0
Final DGM	5.578	5.107	5.448
Temp. Ref. Meter (°F), Tr	70.7	71.0	68.0
Temperature DGM (°F), Td	72.0	71.0	69.0
Time (min)	30.0	36.0	54.0
Net Volume Ref. Meter, Vr	5.617	5.100	5.400
Net Volume DGM, Vd	5.578	5.107	5.448
<b>Gas Meter y Factor =</b>	<b>1.000</b>	<b>0.993</b>	<b>0.989</b>
<b>Gas Meter y Factor Deviation (from avg.)</b>	0.006	0.001	0.005
<b>Orifice dH@</b>	N/A	N/A	N/A
<b>Orifice dH@ Deviation (from avg.)</b>	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|
- \*\* 2.  $y = [Vr \times (y \text{ factor (ref)}) \times (Pb + (Pr / 13.6)) \times (Td + 460)] / [Vd \times (Pb + (Pd / 13.6)) \times (Tr + 460)]$
- \*\* 3.  $dH@ = 0.0317 \times Pd / (Pb (Td + 460)) \times [(Tr + 460) \times \text{time}] / Vr]^2$

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

\*\* Equations come from EPA Method 5

The uncertainty of measurement is  $\pm 0.14 \text{ ft}^3/\text{min}$ . This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

## DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET

Instrument to be calibrated: Pressure Transducer

Maximum Range: 0 – 2" H<sub>2</sub>O

ID Number: OMNI-00371

Calibration Instrument: Digital Manometer

ID Number: OMNI-00395

Date: 06/16/2020

By: Tony Tong

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

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span*
0-20% Max. Range 0.0 – 0.4	0.37	0.34	0.03	1.5
20-40% Max. Range 0.4 – 0.8	0.46	0.44	0.02	1.0
40-60% Max. Range 0.8 – 1.2	0.84	0.82	0.02	1.0
60-80% Max. Range 1.2 – 1.6	1.25	1.23	0.02	1.0
80-100% Max. Range 1.6 – 2.0	1.87	1.85	0.02	1.0

\*Acceptable tolerance is 4%.

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

Technician signature: Tony Tong

Date: 06/16/2020

Reviewed by: 

Date: 6/29/2020

**Temperature Calibration  
EPA Method 28R, ASTM 2515**

<b>BOOTH:</b>		<b>TEMPERATURE MONITOR TYPE:</b>				<b>EQUIPMENT NUMBER:</b>	
Mobile		National Instruments Logger				00371, 00372	
<b>REFERENCE METER EQUIPMENT NUMBER: 00373</b>				<b>Calibration Due Date: 09/11/2020</b>			
<b>CALIBRATION PERFORMED BY:</b>			<b>DATE:</b>		<b>AMBIENT TEMPERATURE:</b>		<b>BAROMETRIC PRESSURE:</b>
Tony Tong			06/16/2020		71		29.95
Input Temperature (F)	Ambient	Meter A					FB Interior
			Meter B	Filter A	Filter B	Tunnel	
0	-1	-1	-1	-1	-1	0	0
100	99	99	99	99	99	100	100
300	299	299	299	299	299	300	300
500	499	499	499	499	499	500	500
700	699	699	699	699	699	700	700
1000	999	999	1000	999	999	1000	1000

Input (F)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Imp A	Imp B	Cat	Stack
0	0	0	0	0	0	-1	-1	-1	-1
100	100	100	100	100	100	100	99	99	99
300	300	300	300	300	300	299	299	299	299
500	500	500	500	500	500	499	499	499	499
700	700	700	700	700	700	699	699	699	699
1000	1000	1000	1000	1000	1000	999	999	999	1000
1500								1499	
2000								1999	

Technician signature:     Tony Tong     Date:     06/16/2020    


Reviewed By:     *B. K. D.*     Date:     6/29/2020

# Thermal Metering System Calibration Y Factor

Manufacturer: Apex  
 Model: XC-60-EP  
 Serial Number: 702004  
 OMNI Tracking No.: OMNI-00372  
 Calibrated Orifice:  Yes

<b>Average Gas Meter y Factor</b>
<b>0.998</b>

<b>Orifice Meter dH@</b>
<b>N/A</b>

Calibration Date: 06/16/20  
 Calibrated by: Tony Tong  
 Calibration Frequency: Six Months  
 Next Calibration Due: 12/16/2020  
 Instrument Range: 1.000 cfm  
 Standard Temp.: 68 oF  
 Standard Press.: 29.92 "Hg  
 Barometric Press., Pb: 29.94 "Hg  
 Signature/Date:  6/29/2020

### Previous Calibration Comparison

Date	<u>1/6/2020</u>	Acceptable Deviation (5%)	Deviation
y Factor	<u>0.985</u>	0.04925	0.013
Acceptance	<b>Acceptable</b>		

### Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.005
Acceptable dH@ Deviation	N/A
Maximum dH@ Deviation	N/A
Acceptance	<b>Acceptable</b>

Reference Standard *		
Standard	Model	Standard Test Meter
Calibrator	S/N	<u>OMNI-00001</u>
	Calib. Date	<u>25-Nov-19</u>
	Calib. Value	<u>0.9981</u> y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Reference Meter Pressure ("H2O), Pr	0.00	0.00	0.00
DGM Pressure ("H2O), Pd	2.00	1.00	0.80
Initial Reference Meter	163.775	170.2	176.412
Final Reference Meter	169.978	175.987	183.35
Initial DGM	0	0	0
Final DGM	6.155	5.782	6.977
Temp. Ref. Meter (°F), Tr	68.0	68.0	69.0
Temperature DGM (°F), Td	69.0	69.0	70.0
Time (min)	34.9	47.2	62.2
Net Volume Ref. Meter, Vr	6.203	5.787	6.938
Net Volume DGM, Vd	6.155	5.782	6.977
<b>Gas Meter y Factor =</b>	<b>1.003</b>	<b>0.998</b>	<b>0.992</b>
<b>Gas Meter y Factor Deviation (from avg.)</b>	0.005	0.000	0.005
<b>Orifice dH@</b>	N/A	N/A	N/A
<b>Orifice dH@ Deviation (from avg.)</b>	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|
- \*\* 2.  $y = [Vr \times (y \text{ factor (ref)}) \times (Pb + (Pr / 13.6)) \times (Td + 460)] / [Vd \times (Pb + (Pd / 13.6)) \times (Tr + 460)]$
- \*\* 3.  $dH@ = 0.0317 \times Pd / (Pb (Td + 460)) \times [(Tr + 460) \times \text{time}] / Vr]^2$

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

\*\* Equations come from EPA Method 5

The uncertainty of measurement is  $\pm 0.14 \text{ ft}^3/\text{min}$ . This is based on the reference standard having a TAR (Test Accuracy Ratio) of at least 4:1.

## DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET

Instrument to be calibrated: Pressure Transducer

Maximum Range: 0 – 2" H<sub>2</sub>O

ID Number: OMNI-00372

Calibration Instrument: Digital Manometer

ID Number: OMNI-00395

Date: 06/16/2020

By: Tony Tong

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

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span*
0-20% Max. Range 0.0 – 0.4	0.25	0.22	0.03	1.5
20-40% Max. Range 0.4 – 0.8	0.48	0.47	0.01	0.5
40-60% Max. Range 0.8 – 1.2	1.01	0.98	0.03	1.5
60-80% Max. Range 1.2 – 1.6	1.44	1.43	0.01	0.5
80-100% Max. Range 1.6 – 2.0	1.78	1.77	0.01	0.5

\*Acceptable tolerance is 4%.

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

Technician signature: Tony Tong

Date: 06/16/2020

Reviewed by: 

Date: 6/29/2020



**Temperature Calibration  
EPA Method 28R, ASTM 2515**

<b>BOOTH:</b>		<b>TEMPERATURE MONITOR TYPE:</b>				<b>EQUIPMENT NUMBER:</b>	
Mobile		National Instruments Logger				00371, 00372	
<b>REFERENCE METER EQUIPMENT NUMBER: 00373</b>				<b>Calibration Due Date: 09/11/2020</b>			
<b>CALIBRATION PERFORMED BY:</b>			<b>DATE:</b>		<b>AMBIENT TEMPERATURE:</b>		<b>BAROMETRIC PRESSURE:</b>
Tony Tong			06/16/2020		71		29.95
Input Temperature (F)	Ambient	Meter A					FB Interior
			Meter B	Filter A	Filter B	Tunnel	
0	-1	-1	-1	-1	-1	0	0
100	99	99	99	99	99	100	100
300	299	299	299	299	299	300	300
500	499	499	499	499	499	500	500
700	699	699	699	699	699	700	700
1000	999	999	1000	999	999	1000	1000

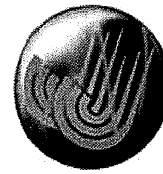
Input (F)	FB Top	FB Bottom	FB Back	FB Left	FB Right	Imp A	Imp B	Cat	Stack
0	0	0	0	0	0	-1	-1	-1	-1
100	100	100	100	100	100	100	99	99	99
300	300	300	300	300	300	299	299	299	299
500	500	500	500	500	500	499	499	499	499
700	700	700	700	700	700	699	699	699	699
1000	1000	1000	1000	1000	1000	999	999	999	1000
1500								1499	
2000								1999	

Technician signature:     Tony Tong     Date:     06/16/2020    

Reviewed By:     *B...*     Date:     6/29/2020

# Certificate of Calibration

Certificate Number: **712014**



**JJ Calibrations, Inc.**

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

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

PO: **190268**  
 Order Date: **10/29/2019**  
 Authorized By: **N/A**  
 Calibrated on: **11/07/2019**  
 \*Recommended Due: **11/07/2020**  
 Environment: **19 °C 38 % RH**  
 \* As Received: **Limited**  
 \* As Returned: **Limited**  
 Action Taken: **Calibrated**  
 Technician: **53**



Property #: **OMNI-00410**  
 User: **N/A**  
 Department: **N/A**  
 Make: **Dwyer**  
 Model: **1430**  
 Serial #: **OMNI-00410**  
 Description: **Microtector**  
 Procedure: **500364**  
 Accuracy: **±0.00025" WC**

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.

Previous limitation continued: **Calibrated micrometer head only.**

### Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
541A	Select	E8FED2	Gage Block Set, 8pc	12/30/2019	689507

### Measurement Data

Parameter	Measurement Description	Range	Unit	Reference	Min	Max	±Error	UUT	Uncertainty
<b>Before/After Length</b>			Inch	0.1300	0.129	0.131	0.000	0.130 Inch	8.1E-03 ✓
			Inch	0.3850	0.384	0.386	0.000	0.385 Inch	8.1E-03 ✓
			Inch	0.6150	0.614	0.616	0.000	0.615 Inch	8.1E-03 ✓
			Inch	0.8700	0.869	0.871	0.000	0.870 Inch	8.1E-03 ✓
			Inch	1.0000	0.999	1.001	0.000	1.000 Inch	8.1E-03 ✓

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/NC SL 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 ration (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 11/08/2019 Rev # 15

  
 Inspector



## VWR Temperature Hygrometer Calibration Procedure and Data Sheet

Frequency: Every Two Years

Step 1: Locate NIST traceable standard.

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

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

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

### Verification Data:

Date: 1/29/19  
1/29/19 Technician: B. Davis

Time in desiccator: 0840 Recording time: 1415

NIST Standard Temperature: 70.2 °F NIST Standard Humidity: 14.6

Test Unit Temperature Reading: 69.9 °F Test Unit Humidity Reading: 12.1

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

Technician Signature: [Signature]

Comments: A difference of 2.5% was found, with a full scale of 90%  
on the instrument this gives a 2.77% deviation.

# ZRE

# NDIR/O<sub>2</sub>



# USER'S

# MANUAL



1312 West Grove Avenue  
Orange, CA 92865-4134  
Phone: 714-974-5560 Fax: 714-921-2531  
[www.gasanalyzers.com](http://www.gasanalyzers.com)

# Certificate of Calibration

Certificate Number: **728321**



**JJ Calibrations, Inc.**

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

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

OnSite

PO: **200302**

Order Date: **07/09/2020**

Authorized By: **N/A**



Calibrated on: **07/09/2020**

\*Recommended Due: **01/09/2021**

Environment: **20 °C 42 % RH**

\* As Received: **Within Tolerance**

\* As Returned: **Within Tolerance**

Action Taken: **Calibrated**

Technician: **111**

Property #: **OMNI-00637**  
User: **N/A**  
Department: **N/A**  
Make: **Mettler Toledo**  
Model: **MS104TS/00**  
Serial #: **B729400181**  
Description: **Analytical Scale, 120g**  
Procedure: **DCN 500887**  
Accuracy: **±0.0005g**

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

## Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
503A	Rice Lake	1mg-200g (Class 0)	Mass Set,	08/08/2020	702709

## Measurement Data

Parameter	Measurement Description	Range	Unit	Reference	Min	Max	*Error	UUT	Uncertainty
Before/After Force									Accredited = U
			g	10.00000	9.9995	10.0005	0.0001	9.9999 g	9.7E-05 U
			g	30.00000	29.9995	30.0005	0.0000	30.0000 g	1.3E-04 U
			g	60.00000	59.9995	60.0005	0.0000	60.0000 g	2E-04 U
			g	90.00000	89.9995	90.0005	0.0002	90.0002 g	2.4E-04 U
			g	120.00000	119.9995	120.0005	0.0001	120.0001 g	3E-04 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/NC SL 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

Reviewer

3 Issued 07/15/2020 Rev # 15

Inspector

## **Example Calculations**

## Equations and Sample Calculations – ASTM E3053 & E2515

Manufacturer: GHP Group  
Model: Small Series  
Run: 2  
Category:

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.

BR – Dry burn rate, kg/hr

$V_s$  – Average gas velocity in the dilution tunnel, ft/sec

$Q_{sd}$  – Average gas flow rate in dilution tunnel, dscf/hr

$V_{m(std)}$  – Volume of gas sampled, corrected to dry standard conditions, dscf

$m_n$  – Total particulate matter collected, mg

$C_s$  - Concentration of particulate matter in tunnel gas, dry basis, corrected to standard conditions, g/dscf

$E_T$  – Total particulate emissions, g

PR - Proportional rate variation

$PM_R$  – Particulate emissions for test run, g/hr

$PM_F$  – Particulate emission factor for test run, g/dry kg of fuel burned



**BR – dry burn rate, kg/hr**

ASTM E2780 equation (5)

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

Where,

$\theta$  = Total length of test run, min

Sample Calculation:

$$M_{Bdb} = 6.80 \quad \text{kg}$$

$$\theta = 410 \quad \text{min}$$

$$BR = \frac{60 \times 6.8}{410}$$

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

**V<sub>s</sub> – 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<sub>p</sub> = Adjustment factor for center of tunnel pitot tube placement,  $F_p = \frac{V_{strav}}{V_{scent}}$ , ASTM E2515 Equation (1)
- V<sub>scent</sub> = Dilution tunnel velocity calculated after the multi-point pitot traverse at the center, ft/sec
- V<sub>strav</sub> = Dilution tunnel velocity calculated after the multi-point pitot traverse, ft/sec
- k<sub>p</sub> = Pitot tube constant, 85.49
- C<sub>p</sub> = Pitot tube coefficient: 0.99, unitless
- ΔP\* = Velocity pressure in the dilution tunnel, in H<sub>2</sub>O
- T<sub>s</sub> = Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)
- P<sub>s</sub> = Absolute average gas static pressure in dilution tunnel, = P<sub>bar</sub> + P<sub>g</sub>, in Hg
- P<sub>bar</sub> = Barometric pressure at test site, in. Hg
- P<sub>g</sub> = Static pressure of tunnel, in. H<sub>2</sub>O; (in Hg = in H<sub>2</sub>O/13.6)
- M<sub>s</sub> = \*\*The dilution tunnel wet molecular weight; M<sub>s</sub> = 28.78 assuming a dry weight of 29 lb/lb-mole

Sample calculation:

$$F_p = \frac{20.85}{21.39} = 0.975$$

$$V_s = 0.975 \times 85.49 \times 0.99 \times 0.316 \times \left( \frac{92.7 + 460}{\left( \frac{29.43 + \frac{-0.26}{13.6}}{28.78} \right)^{1/2}} \right)$$

$$V_s = \mathbf{21.06 \text{ ft/s}}$$

\*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<sub>s</sub> as the dry molecular weight. It should be the wet molecular weight as indicated in EPA Method 2.

**Q<sub>sd</sub> – 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<sub>ws</sub> = Water vapor in gas stream, proportion by volume; assume 2%
- A = Cross sectional area of dilution tunnel, ft<sup>2</sup>
- T<sub>std</sub> = Standard absolute temperature, 528 °R
- P<sub>s</sub> = Absolute average gas static pressure in dilution tunnel, = P<sub>bar</sub> + P<sub>g</sub>, in Hg
- T<sub>s(avg)</sub> = Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)
- P<sub>std</sub> = Standard absolute pressure, 29.92 in Hg

Sample calculation:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 21.06 \times 0.196 \times \frac{528}{92.7 + 460} \times \frac{29.4 + \frac{-0.26}{13.6}}{29.92}$$

Q<sub>sd</sub> = **13703.2** 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
- $\Delta H$  = Average pressure differential across the orifice meter, in. H<sub>2</sub>O
- $T_m$  = Absolute average dry gas meter temperature, °R

Sample Calculation:

Using equation for Train 1:

$$V_{m(std)} = 17.64 \times 68.897 \times 0.994 \times \frac{\left( 29.43 + \frac{2.34}{13.6} \right)}{\left( 84.7 + 460 \right)}$$

$$V_{m(std)} = \mathbf{65.653} \text{ dscf}$$

Using equation for Train 2:

$$V_{m(std)} = 17.64 \times 70.607 \times 0.998 \times \frac{\left( 29.43 + \frac{1.78}{13.6} \right)}{\left( 84.5 + 460 \right)}$$

$$V_{m(std)} = \mathbf{67.479} \text{ dscf}$$

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 0.00 \times 0 \times \frac{\left( 29.43 + \frac{0.00}{13.6} \right)}{\left( 78.2 + 460 \right)}$$

$$V_{m(std)} = \mathbf{0} \text{ dscf}$$

**$m_n$  – 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 1 (first hour):

$$m_n = 0.0 + 3.4 + 0.0$$

$$m_n = 3.4 \text{ mg}$$

Using equation for Train 1 (post-first hour):

$$m_n = 1.1 + -1.5 + 2.6$$

$$m_n = 2.2 \text{ mg}$$

Train 1 aggregate:

$$m_n = 3.4 + 2.2$$

$$m_n = \mathbf{5.6} \text{ mg}$$

Using equation for Train 2:

$$m_n = 0.6 + 0.8 + 3.7$$

$$m_n = \mathbf{5.1} \text{ mg}$$

**C<sub>s</sub> - Concentration of particulate matter in tunnel gas, dry basis, corrected to standard conditions, g/dsc**  
ASTM E2515 equation (13)

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

Where:

K<sub>2</sub> = Constant, 0.001 g/mg

m<sub>n</sub> = Total mass of particulate matter collected in the sampling train, mg

V<sub>m(std)</sub> = Volume of gas sampled corrected to dry standard conditions, dscf

Sample calculation:

For Train 1:

$$C_s = 0.001 \times \frac{5.6}{65.65}$$

$$C_s = \mathbf{0.00009} \text{ g/dscf}$$

For Train 2

$$C_s = 0.001 \times \frac{5.1}{67.48}$$

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

For Ambient Train

$$C_r = 0.001 \times \frac{0.0}{0}$$

$$C_r = \mathbf{0} \text{ g/dscf}$$

**$E_T$  – 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
- $\theta$  = Total time of test run, minutes

Sample calculation:

For Train 1

$$E_T = ( \underline{0.000085} - 0 ) \times \underline{13703.2} \times \underline{410} / 60$$
$$E_T = \underline{7.99} \text{ g}$$

For Train 2

$$E_T = ( \underline{0.000076} - 0 ) \times \underline{13703.2} \times \underline{410} / 60$$
$$E_T = \underline{7.08} \text{ g}$$

Average

$$E = \underline{7.53} \text{ g}$$

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

$$7.5\% \text{ of the average} = \underline{0.56}$$

$$\text{Train 1 difference} = \underline{0.45}$$

$$\text{Train 2 difference} = \underline{0.45}$$

**PR - Proportional Rate Variation**

ASTM E2515 equation (16)

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

Where:

- $\theta$  = Total sampling time, min
- $\theta_i$  = 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):

$$PR = \left( \frac{410 \times 0.815 \times 21.06 \times (135.0 + 460) \times (84.7 + 460)}{5 \times 68.9 \times 20.75 \times (92.7 + 460) \times (90.0 + 460)} \right) \times 100$$

$$PR = \underline{105} \%$$



**PM<sub>R</sub> – Particulate emissions for test run, g/hr**

ASTM E2780 equation (6)

$$PM_R = 60 (E_T/\theta)$$

Where,

E<sub>T</sub> = Total particulate emissions, grams

θ = Total length of full integrated test run, min

Sample Calculation:

$$E_T (\text{Dual train average}) = 7.53 \text{ g}$$

$$\theta = 410 \text{ min}$$

$$PM_R = 60 \times ( 7.53 / 410 )$$

$$PM_R = 1.10 \text{ g/hr}$$

**PM<sub>F</sub>** – Particulate emission factor for test run, g/dry kg of fuel burned  
ASTM E2780 equation (7)

$$PM_F = E_T / M_{FTAdb}$$

Sample Calculation:

$$E_T \text{ (Dual train average)} = 7.53 \text{ g}$$

$$M_{Bdb} = 6.80 \text{ kg}$$

$$PM_F = 7.53 / 6.80$$

$$PM_F = 1.11 \text{ g/kg}$$

# **Appendix A**

## **Manufacturer's Installation/Operation Instructions - Labels**

**LISTED SOLID FUEL BURNING SPACE HEATER  
POÊLE A COMBUSTIBLES SOLIDES HOMOLOGUE  
CALENTADOR A COMBUSTIBLE SÓLIDO**



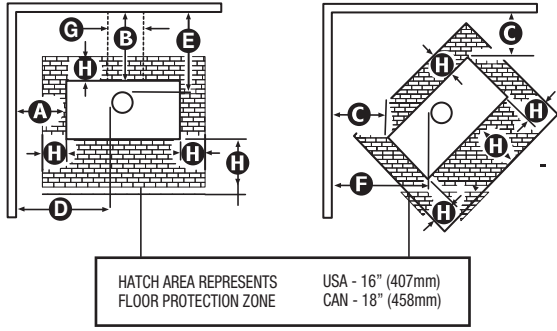
SERIAL NO. \_\_\_\_\_

TESTED TO: UL 1482-11 (R2015) / ULC-S627-00  
 REPORT NOS: 0418WS019E / 0418WS019S  
 TESTED EMISSIONS VALUE: 1.98 G/HR  
 TEST METHOD: EPA METHOD 28R FOR CERTIFICATION AND AUDITING OF WOOD HEATERS.  
**CONTACT LOCAL BUILDING OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION IN YOUR AREA. A MINIMUM CLEARANCE OF 18" (457mm) TO THE CHIMNEY CONNECTOR MAY BE REQUIRED BY THE AUTHORITY HAVING JURISDICTION.**  
 ROOM HEATER, SOLID FUEL TYPE, ALSO FOR USE IN MOBILE HOMES IN THE USA ONLY.

MIS L'ÉPREUVE SELON : UL 1482-11 (R2015) / ULC-S627-00  
 RAPPORT NOS : 0418WS019E / 0418WS019S  
 LA VALEUR DES ÉMISSIONS TESTÉ : 1.98 G/HR  
 MÉTHODE D'ESSAI: MÉTHODE EPA 28R POUR LA CERTIFICATION ET LA VÉRIFICATION DES APPAREILS DE CHAUFFAGE À BOIS.  
**RESEIGNEZ-VOUS AUPRES DES RESPONSABLES LOCAUX DE LA CONSTRUCTION ET DE LA PREVENTION DES INCENDIES AU SUJET DES RESTRICTIONS ET INSPECTIONS D'INSTALLATION DANS VOTRE SECTEUR. UN ESPACE DE 457mm (18") JUSQU'AU RACCORD DE LE CHIMENEE PEUT ÊTRE EXIGÉ PAR LE CORPS CONSTITUÉ AYANT JURISDICTION.**  
 CHAUFFE-PIÈCE, CARBURANT SOLIDE, ÉGALEMENT POUR USAGE DANS LES MAISONS MOBILES AUX ÉTATS UNIS SEULEMENT.

CUMPLE CON PRUEBAS: UL 1482-11 (R2015) / ULC-S627-00  
 INFORME NO.: 0418WS019E / 0418WS019S  
 VALOR DE LAS EMISIONS ANALIZADAS: 1.98 G/HR  
 MÉTODO DE ENSAYO : MÉTODO EPA 28R PARA LA CERTIFICACIÓN Y AUDITORÍA DE CALENTADORES DE MADERA .  
**CONTACTE SUS AUTORIDADES LOCALES DE CONSTRUCCIÓN SOBRE RESTRICCIONES E INSPECCIONES DE INSTALACIÓN EN SU AREA. ES POSIBLE QUE LAS AUTORIDADES COMPETENTES EXLIJAN UN ESPACIAMIENTO MINIMO DE 18" (457mm) CON RESPECTO AL CONECTOR DE LA CHIMENEA.**  
 CALEFACTOR, DE COMBUSTIBLE SÓLIDO, TAMBIÉN PARA SU USO EN CASAS RODANTES EN LOS ESTADOS UNIDOS SOLAMENTE.

MINIMUM CLEARANCE TO COMBUSTIBLES / DEGAGEMENTS MINIMUM AUX COMBUSTIBLES / SEPARACIONES MINIMAS A LOS COMBUSTIBLES	SINGLE WALL CONNECTORS / RACCORDS À SIMPLES PAROIS / CONECTORES SENCILLOS DE PARED	DOUBLE WALL CONNECTORS / RACCORDS À DOUBLES PAROIS / CONECTORES DOBLES DE PARED
A) SIDE OF STOVE TO SIDE WALL / DISTANCE ENTRE LE CÔTÉ DU POÊLE ET LE MUR LATÉRAL / LATERAL DE LA ESTUFA HASTA LA PARED LATERAL	18" (457mm)	9" (229mm)
B) REAR OF STOVE TO BACK WALL / DISTANCE ENTRE L'ARRIÈRE DU POÊLE ET LE MUR DU FOND / PARTE TRASERA DE LA ESTUFA HASTA LA PARED POSTERIOR	9" (229mm)	6.5" (165mm)
C) CORNER OF STOVE TOP TO SIDE WALL / DISTANCE ENTRE LE COIN SUPÉRIEUR DU POÊLE ET LE MUR LATÉRAL / ESQUINA SUPERIOR DE LA ESTUFA HASTA LA PARED LATERAL	10" (254mm)	4" (102mm)
D) FLUE TO SIDE WALL / DISTANCE ENTRE LE CONDUIT ET LE MUR LATÉRAL / CHIMENEA HASTA LA PARED LATERAL	26" (660mm)	17" (432mm)
E) FLUE TO BACK WALL / DISTANCE ENTRE LE CONDUIT ET LE MUR DU FOND / CHIMENEA HASTA LA PARED POSTERIOR	10.5" (267mm)	8" (203mm)
F) FLUE TO CORNER / DISTANCE ENTRE LE CONDUIT ET LE COIN / CHIMENEA HASTA LA ESQUINA	18" (457mm)	12" (305mm)
G) BEYOND PIPE WHEN PIPE EXITS HORIZONTALLY THROUGH WALL / DISTANCE AU-DELÀ DU TUYAU LORSQUE LE TUYAU SORT HORIZONTALEMENT PAR UN MUR / SOBRE LA TUBERÍA, CUANDO ESTA SALE HORIZONTALEMENT DE LA PARED	2" (51mm) ON EACH SIDE / DE CHAQUE CÔTÉ / EN CADA LATERAL	2" (51mm) ON EACH SIDE / DE CHAQUE CÔTÉ / EN CADA LATERAL
H) FLOOR PROTECTION / DISTANCE DE PROTECTION POUR LE SOL / PROTECCIÓN DEL PISO - REAR / ARRIERE / POSTERIOR	8" (203mm)	8" (203mm)
- SIDES / COTE / LADO	8" (203mm)	8" (203mm)
- FRONT / DE FACE / FRENTE	18" (457mm)	18" (457mm)
I) TOP OF STOVE TO CEILING / DISTANCE ENTRE LE HAUT DU POÊLE ET LE PLAFOND / PARTE SUPERIOR DE LA ESTUFA HASTA EL TECHO	56.8" (1441mm)	53.5" (1353mm)



**CAUTION: COMBUSTION AIR OPENINGS ARE NOT TO BE OBSTRUCTED.**  
**MISE EN GARDE : LES BOUCHES D'AIR DE COMBUSTION NE DOIVENT PAS ÊTRE OBSTRUÉES.**  
**PRECAUCIÓN: NO DEBE DE OBSTRUIRSE LAS ABERTURAS DE AIRE DE COMBUSTIÓN.**

DATE OF MANUFACTURE / DATE DE FABRICATION / FECHA DE FABRICACIÓN

2020	2021	2022	2023	2024	2025	2026
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

U.S. ENVIRONMENTAL PROTECTION AGENCY CERTIFIED TO COMPLY WITH 2020 PARTICULATE EMISSION STANDARDS USING CORDWOOD.  
 MADE IN U.S.A. BY / FABRIQUE AU ETATS UNIS PAR / HECHO EN LOS EE.UU. POR GHP GROUP INC., 6440 W HOWARD ST., NILES IL 60714

- MODEL SERIES / MODELE SÉRIE / MODELO SERIE:  
 "SMALL WOOD STOVE / PETIT POÊLE À BOIS / ESTUFA PEQUEÑA PARA LEÑA"
- SWS-1200
  - PH1200WS
  - WSL-1200
  - PWS-1200
  - SWS-1200-B
  - PH1200WS-B
  - WSL-1200-B
  - HWS-1200
  - GWS-1200
  - WS-1200
  - HWS-1200-B
  - GWS-1200-B
  - WS-1200-B

FUEL: FOR USE WITH SOLID WOOD FUEL ONLY. DO NOT USE GRATE OR ELEVATE FIRE - BUILD FIRE DIRECTLY ON HEARTH. DO NOT OBSTRUCT SPACE UNDER HEATER. SPECIAL METHODS ARE REQUIRED WHEN PASSING THROUGH A COMBUSTIBLE WALL OR CEILING. SEE INSTRUCTIONS AND BUILDING CODES. DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE. FOR SAFE OPERATION, INSTALL IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS. KEEP HEATER DOOR CLOSED WHILE IN OPERATION.

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.

**PREVENT HOUSE FIRES**

INSTALL AND USE ONLY IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND LOCAL BUILDING CODES. FLOOR PROTECTION: UNIT MUST BE PLACED ON NONCOMBUSTIBLE FLOOR ONLY EXTENDING 18" (457mm) FOR CANADA 16" (408mm) FOR USA IN FRONT AND 8" (203mm) TO THE SIDES AND BACK OF UNIT.

CHIMNEY TYPE: UL 103 / ULC S629  
 MINIMUM 6" (152mm) DIAMETER  
 CHIMNEY CONNECTOR: 6" (152 mm) DIAMETER MINIMUM 24 GAUGE STEEL  
 HEATER MUST BE INSTALLED WITH LEGS OR PEDESTAL PROVIDED. ATTACH AS SHOWN IN INSTALLATION INSTRUCTIONS.

GLASS REPLACEMENT - REPLACE ONLY WITH GHP REPLACEMENT CERAMIC GLASS PART #75-23-511

OPTIONAL BLOWER: MODEL PBAR-2427  
 120 VOLTS FREQ 60 Hz 1.0 AMPS 2900 RPM

DANGER: RISK OF ELECTRIC SHOCK.  
 DISCONNECT POWER BEFORE SERVICING UNIT.

COMBUSTIBLE: PUR USAGE AVEC BOIS SEULEMENT. NE PAS UTILISER DE CHENETS POUR ÉLEVER LE FEU CONSTRUIT LE FEU DIRECTEMENT SUR LES BRIQUES. NE RIEN ENTREPOSER SOUS L'APPAREIL. DES METHODES SPECIALES SONT REQUISES LORS DU PERÇAGE D'UN MUR OU PLAFOND COMBUSTIBLE. VÉRIFIER LES DIRECTIVES ET LES CODES DE CONSTRUCTION. NE PAS ACCORDER A LA CHIMENEE D'UN AUTRE APPAREIL. POUR UTILISATION SECURITAIRE, SUIVRE ATTENTIVEMENT LES INSTRUCTIONS DU FABRICANT. GARDEZ LA PORTE DU POELE FERMEE PENDANT LE FONCTIONNEMENT.

CE CHAUFFAGE À BOIS DOIT ÊTRE INSPECTÉ ET RÉPARÉ PÉRIODIQUEMENT POUR FONCTIONNER CORRECTEMENT. CONSULTER LE MANUEL DU PROPRIÉTAIRE POUR PLUS D'INFORMATIONS. SELON LES RÈGLEMENTS FÉDÉRAUX, IL EST INTERDIT D'UTILISER CET APPAREIL DE CHAUFFAGE À BOIS D'UNE MANIÈRE INCOMPATIBLE AVEC LES INSTRUCTIONS DANS LE MANUEL DU PROPRIÉTAIRE.

**PREVENTION DES INCENDIES**

POUR INSTALLATION ET UTILISATION CONFORMEZ AUX INSTRUCTIONS DU FABRICANT ET AUX CODES LOCAUX DU BATIMENT. PROTECTION DES PLANCHERS: IL FAUT INSTALLER L'APPAREIL SUR UN PLANCHER NONCOMBUSTIBLE SEULEMENT S'ÉTENDANT 457mm (18") AU CANADA ET 408mm (16") POUR LES ETET-UNIS AL'AVANT ET 203mm (8") A L'ARRIERE ET SUR LES COTES DE VL' APPAREIL.

TYPE DE CHIMENEE : UL 103 / ULC S629  
 DIAMETRE MINIMAL 152mm (6")  
 RACCORD DE CHIMENEE : DIAMETRE 152mm (6") CALIBRE DE 24 ACIER  
 L'APPAREIL DOIT ÊTRE INSTALLER AVEC LES PIED OU LE SOCLE FOURNI.  
 ATTACHEZ COMME MONTRER DANS LES INSTRUCTIONS D'INSTALLATION.

REPLACEMENT DU VERRE-REMPLECEZ SEULEMENT AVEC LE  
 REMPLACEMENT GHP. NUMERO DE PARTIE DU VERRE 75-23-511

SOUFFLERIE FACULTAIVE : MODEL PBAR-2427  
 120 VOLTS FREQ 60Hz 1.0 AMPS 2900 RPM

DANGER : RISQUE DE SECOURSSE ELECTRIQUE.  
 DEDRANCHEZ AVANT DE PROCEDER A L'ENTRETIEN.

COMBUSTIBLE: PARA USO CON MADERA UNICAMENTE. NO UTILICE PARRILLA PARA ELEVAR EL FUEGO - GENERE EL FUEGO DIRECTAMENTE DENTRO DEL CALENTADOR. DEJE LIBRE EL ESPACIO DEBAJO DEL CALENTADOR. SE REQUIEREN METODOS ESPECIALES PARA HACER INSTALACION A TRAVES DE UNA PARED COMBUSTIBLE O DEL TECHO. CONSULTE LAS INSTRUCCIONES Y LAS NORMAS DE CONSTRUCCION. NO CONECTE ESTA UNIDAD A UN TUBO DE CHIMENEA CORRESPONDIENTE A OTRO APARATO. PARA UNA OPERACION SEGURA, LA INSTALACION DEBE SER HECHA DE ACUERDO CON LAS INSTRUCCIONES DEL FABRICANTE. MANTENGA CERRADA LA PUERTA DEL CALENTADOR MIENTRAS ESTE EN FUNCIONAMIENTO.

ESTA CALEFACCION DE LEÑA NECESITA INSPECCION Y REPARACION PERIODICAS PARA SU CORRECTO FUNCIONAMIENTO. CONSULTE EL MANUAL DEL PROPIETARIO PARA OBTENER MAS INFORMACION. OPERAR ESTA CALEFACCION DE LEÑA DE FORMA INCONSISTENTE CON LAS INSTRUCCIONES EN EL MANUAL DEL PROPIETARIO VA EN CONTRA DE LAS REGULACIONES FEDERALES.

**COMO PREVENIR UN INCENDIO EN LA CASA**

INSTALE Y UTILICE EL CALEN TADOR UNICAMENTE DE ACUERDO CON LAS INSTRUCCIONES DEL FABRICANTE Y CON LAS NORMAS LOCALES DE CONSTRUCCION. PROTECCION DEL PISO: LA UNIDAD DEBE SER COLOCADA PISO NO INFLAMABLE SOLAMENTE EXTENDIENDOSE POR DELANTE 18" (457mm) EN CANADA Y 16" (408mm) EN LOS EE.UU., Y 8" (203mm) A LOS

TIPO DE CHIMENEA: UL 103 / ULC S629  
 DIAMETRO MINIMO DE 6" (152 mm). APROBADO PARA USO RESIDENCIAL  
 CONECTOR DE CHIMENEA: 6 Pulg. (152mm) DE DIAMETRO. ACERO DE CALIBRE 24 MINIMO.

EL CALEN TADOR DEBE INSTALARSE CON LAS PATAS O EL PEDESTAL SUMINISTRADO. HAGA EL MONTUE COMO SE MUESTRA EN LAS INSTRUCCIONES DE INSTALACION.

PARA REEMPLAZAR VIDRIO - CAMBIELO UNICAMENTE POR EL VIDRIO GHP DE REPUESTO - NUMERO DE PIEZA 75-23-511

VENTILADOR OPCIONAL: MODELO PBAR-2427  
 120 VOLTIOS; FREQ. 60 HZ; 1.0 AMPS; 2900 RPM

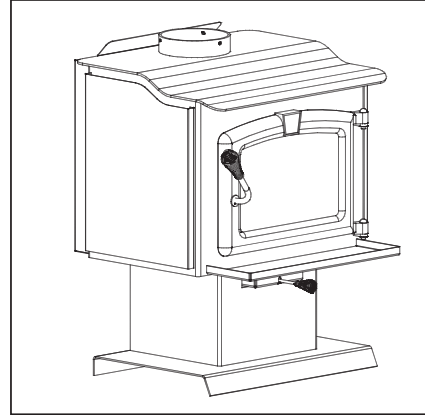
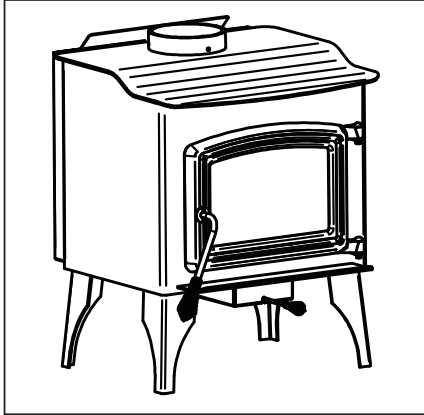
PELIGRO: RIESGO DE DESCARGA ELECTRICA.  
 DESCONECTE LA UNIDAD DE LA CORRIENTE ANTES DE HACER MANTENIMIENTO A LA MISMA.

# Pleasant Hearth



Warming Your Home. Warming Your Heart.

## High Efficiency Wood Stove - Small



Español p. 21

Français p. 43

**Model Series:**

PH1200WS, PH1200WS-B, GWS-1200,  
GWS-1200-B, WSL-1200, WSL-1200-B,  
WS-1200, WS-1200-B

Non-Mobile Home rated with Legs

**Model Series:**

SWS-1200, HWS-1200, HWS-1200-B

Mobile Home Approved in USA Only

Not for use in Mobile Homes in Canada

**SAFETY NOTICE: IF THIS WOOD BURNING APPLIANCE IS NOT PROPERLY INSTALLED, OPERATED, AND MAINTAINED, A HOUSE FIRE MAY RESULT. TO REDUCE THE RISK OF FIRE, FOLLOW THE INSTALLATION INSTRUCTIONS. FAILURE TO FOLLOW THE INSTALLATION INSTRUCTIONS MAY RESULT IN PROPERTY DAMAGE, BODILY INJURY OR EVEN DEATH. CONTACT LOCAL BUILDING OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION REQUIREMENTS IN YOUR AREA.**

### WARNING

BEFORE LIGHTING YOUR FIRST FIRE, REMOVE PLASTIC FILM OFF TRIM AND CLEAN THE PLATED SURFACES WITH DENATURED ALCOHOL OR A GOOD QUALITY, NON-ABRASIVE LIQUID GLASS CLEANER. APPLY WITH A VERY SOFT, CLEAN CLOTH. DO NOT USE PAPER TOWELS TO CLEAN THE PLATED PARTS. FAILURE TO CLEAN ALL MARKS AND FINGERPRINTS FROM THE PLATED SURFACES WILL CAUSE PERMANENT DAMAGE.

NOTE: Some states and provinces do not allow the exclusion or limitation of incidental or consequential damages. The above limitations may not apply to you.

US Environmental Protection agency certified to comply with 2020 particulate emissions standards using cordwood. Please read this entire manual before you install and use your new room heater. This wood heater needs periodic inspection and repair for proper operation. It is against federal regulations to operate this wood heater in a manner inconsistent with operating instructions in this manual. Please read this entire manual before you install and use your new room heater. Failure to follow instructions may result in property damage, bodily injury, or even death.

This stove is listed by OMNI-Test Laboratories of Portland, Oregon using Test Method ASTM 3053 and Tested to UL-1482-11 (R2015)/ULC-S627-00 (UM) 84 HUD, mobile home approved.

**6" Flue  
required**



OMNI-Test Laboratories, Inc.

REPORT NO. 0418WS019E/0418WS019S

**Save These Instructions**

**Do Not Discard This Manual: Retain for Future Use**



6440 W. Howard St.  
Niles, IL 60714-3302  
877-447-4768

Questions, problems, missing parts? Before returning to your retailer, call our customer service department at 877-447-4768 8:00 a.m. - 4:30 p.m. CST, Monday - Friday or e-mail us at [customerservice@ghpgroupinc.com](mailto:customerservice@ghpgroupinc.com).

80-10-635  
Rev. 3/30/2022

The sum of weighted particular emissions = 1.89 grams/ h

The weighted average HHV efficiency = 77.7%

The Heat Output range = 15,963 to 56,107 BTU/ Hr

## CAUTION

After reading these instructions, if you have any doubt about your ability to complete your installation in a professional like manner you should obtain the services of an installer versed in all aspects as to the correct and safe installation. Do not use temporary makeshift compromises during installation.

### BEFORE INSTALLATION OF YOUR APPLIANCE

1. Check with the building inspector's office for compliance with local codes; a permit may be required.
2. The room heater must be connected to 1) a chimney complying with the requirements for Type HT chimneys in the standard for Chimneys, Factory-Built, Residential Type and Building Heating Appliance, UL 103, or in Canada CAN/ULC-S629 Standard for 650 degree C Factory Built Chimneys and applicable building codes or 2) a code-approved masonry chimney with a flue liner.
3. A 6" (152mm) diameter, 24 gauge Black Steel flue is required for proper performance.
4. Always connect this unit to a chimney and NEVER vent to another room or inside a building.
5. DO NOT connect this unit to any duct work to which another appliance is connected such as a furnace.
6. **DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.**
7. The connector pipe and chimney should be inspected periodically and cleaned if necessary.
8. Remember the clearance distances when you place furniture or other objects within the area. **DO NOT** store wood, flammable liquids or other combustible materials too close to the unit.

**Refer to certification label on back of your unit for required clearances.**

9. Contact your local municipal or provincial fire authority for information on how to handle a chimney fire. Have a clearly understood plan to handle a chimney fire. In the event of a Chimney fire, turn air control to closed position and **CALL THE FIRE DEPARTMENT.**
10. **DO NOT** tamper with combustion air control beyond normal adjustment.
11. **DO NOT CONNECT TO ANY AIR DISTRIBUTION DUCT OR SYSTEM.**
12. When installing a solid fuel appliance, it is also recommended to install Smoke and Carbon Monoxide Detectors on every level of the house. During the initial firing of the appliance, some smoke or odor may occur due to paint curing. You may want to keep some windows open for ventilation during the first few hours of burning to prevent smoke detector activation. Test your smoke and carbon monoxide detectors regularly.



## CAUTION

**DO NOT** operate heater if glass window is broken.



## OPERATION

### WHY THE CORRECT FLUE SIZE IS IMPORTANT - 6"

Draft is the force which moves air from the appliance up through the chimney. The amount of draft in your chimney depends on the length of the chimney, local geography, nearby obstructions, and other factors. Too much draft may cause excessive temperatures in the appliance. An uncontrolled burn or a glowing red part or chimney connector indicates excessive draft. Inadequate draft may cause back puffing into the room and "plugging" of the chimney and/or cause the appliance to leak smoke into the room through appliance and chimney connector joints. Today's solid fuel appliances are more efficient than in the past. The units are designed to give you controlled combustion, and maximum heat transfer, using less fuel to do so.

The design of your new appliance is such that the exhaust smoke is now at lower temperatures than in the past, therefore requiring proper chimney size to give adequate draft. If your chimney is too large, the heating appliance will have a difficult time to raise the chimney flue temperature to give adequate draft, therefore causing a smoke back up, poor burn, or both.

**Should you experience such a problem call in a local chimney expert.**

With the door closed, the rate of burning is regulated by the amount of air allowed to enter the unit through the air control. With experience you will be able to set the control for heat and burning time desired.

Once the required chimney draft is obtained, operate only with doors closed and open doors slowly when re-fueling. (This will reduce or eliminate smoke from entering the room).

Attempts to achieve higher output rates that exceed heater design specifications can result in permanent damage to the heater. The recommended wood load is level with the top of the firebricks.

Overloading may prevent sufficient air entering the heater to properly fuel the fire.

Operate this heater only with the door closed.

**DO NOT BURN GARBAGE OR FLAMMABLE FLUIDS, SUCH AS GASOLINE, NAPHTHA, OR ENGINE OIL DO NOT USE CHEMICALS OR FLUIDS TO START THE FIRE.**

**IMPORTANT:** It is highly recommended that the wood stove and chimney be installed by a qualified installer. (A qualified installer is a person or entity who regularly installs wood heating products and chimneys, in the ordinary course of their regular business.)

This wood heater has a manufacturer-set minimum low burn rate that must not be altered. It is against federal regulations to alter this setting or otherwise operate this wood heater in a manner inconsistent with operating instructions in this manual.

**ALWAYS PROVIDE A SOURCE OF FRESH AIR INTO THE ROOM WHERE THE UNIT IS INSTALLED. FAILURE TO DO SO MAY RESULT IN AIR STARVATION OF OTHER FUEL BURNING APPLIANCES AND THE POSSIBLE DEVELOPMENT OF HAZARDOUS CONDITIONS.**

**HOT WHILE IN OPERATION. KEEP CHILDREN, CLOTHING AND FURNITURE AWAY. CONTACT MAY CAUSE SKIN BURNS.**



OPTIONAL BLOWER: MODEL PBAR-2427, 120 VOLTS, 60Hz, 1.0 AMPS, 2900 RPM  
**DANGER:** RISK OF ELECTRIC SHOCK. DISCONNECT POWER BEFORE SERVICING UNIT.  
**IMPORTANT:** FOR OPTIMUM HEATER PERFORMANCE AT LOW BURN RATE, OPERATE THE FAN AT LOW SPEED.

For installation information on optional blower PBAR-2427, please refer to the Wood Stove Blower Installation and Operating Instructions supplied with the blower.

**⚠ WARNING**

This product and the fuels used to operate this product (charcoal or 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](http://www.p65Warnings.ca.gov)

**MOBILE HOME APPROVED**

This appliance, excluding Model # WS-2417 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 and use only listed double-wall connector pipe. An Outside Air Kit must be installed in a mobile home installation.

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 CAN/ULC-S629 and CAN/CSA-B365 Installation Codes in Canada.

**OUTSIDE AIR KIT INSTALLATION**

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.

**Items Needed for Installation**

- Pipe clamp, termination cap, (2) wire ties, and fasteners
- 4 inch flex aluminum pipe, or if using alternate material, then it shall be made from durable, non-combustible, heat resistant material up to 350°F. Cut the pipe to the required length for your installation.

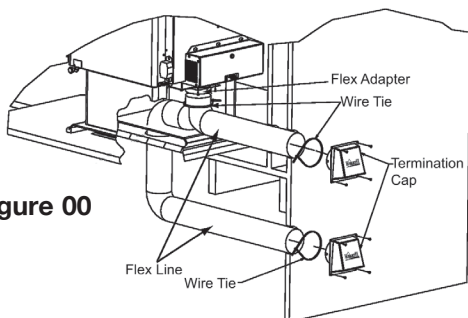


Figure 00



- Electric screw driver with bits
- Silicone sealant
- Drills and saws necessary for cutting holes through the wall or flooring in your home

**AN OUTSIDE AIR KIT (ITEM NO: OAK-MH) IS AVAILABLE FOR PURCHASE BY CALLING GHP GROUP CUSTOMER SERVICE AT 1-877-447-4768.**

1. Remove all materials from packing boxes.
2. **Floor & Rear Installation:** Cut a 4 inch (102mm) hole in outside wall or floor to accommodate outside air piping. Use 4 inch (102mm) aluminum metal flex or rigid piping to directly connect outside air to appliance intake. Use a termination cap with a rodent screen. Seal between the wall (or floor) and the pipe with silicone to prevent moisture penetration.
3. Using a #2 Phillips screw driver attach the flex pipe to the flex adaptor on the stove using a pipe clamp.

Figure 00.

**⚠ 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 odors may result

**⚠ WARNING**



**Asphyxiation Risk.**

Outside air inlet must be located to prevent blockage from:

- Leaves
- Snow or ice
- Other debris

Block 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.

- Fire will not burn properly.
- Smoke spillage occurs when door is open due to air starvation.

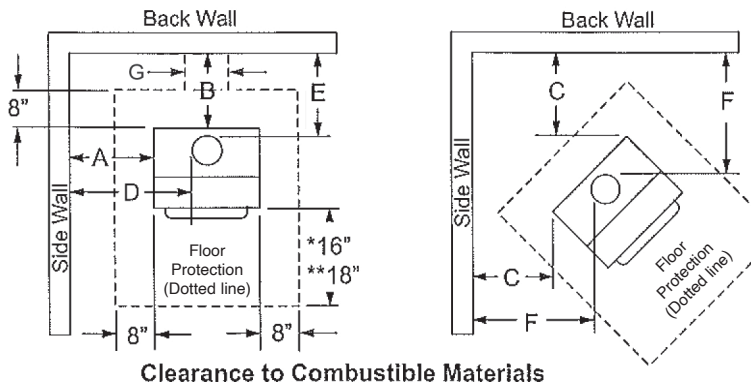
# INSTALLATION

Contact your local building inspector prior to installation. A permit may be required in your area.

1. Remove all parts from inside the stove body.
2. Select the proper location for the stove. These appliances must not be installed any closer than the minimum clearance to combustible materials shown in Brick pattern (Figure 1). The stove must be installed on a non combustible surface as shown in Figure 1.

**Figure 1**

## Clearance from Combustible Materials



A minimum clearance of 18" (457 mm) to the chimney connector may be required by the authority having jurisdiction.

### SINGLE WALL PIPE

#### From Heater

A. Sidewall 18" (457mm)  
 B. Back Wall 9" (229mm)  
 C. Corner 10" (254mm)  
 Minimum height to ceiling

\*16" (406 mm) US

#### From Chimney Connector

D. Sidewall 26" (660mm)  
 E. Back Wall 12" (305mm)  
 F. Corner 18" (457mm)  
 Minimum height to ceiling

\*\*18" (457 mm) Canada

### DOUBLE WALL PIPE (Mobile Home)

#### From Heater

A. Sidewall 9" (229mm)  
 B. Back Wall 5" (127mm)  
 C. Corner 4" (102mm)  
 Minimum height to ceiling

\*16" (406 mm) US

#### From Chimney Connector

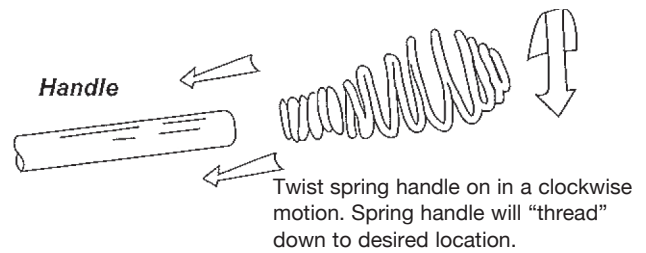
D. Sidewall 17" (432mm)  
 E. Back Wall 8" (203mm)  
 F. Corner 12" (305mm)  
 Minimum height to ceiling

\*\*18" (457 mm) Canada

G. 2" beyond pipe when pipe exits horizontally through a wall (4" greater than pipe diameter).

**Note:** Clearances may only be reduced by means approved by the regulatory authority.

3. If noncombustible materials have been installed on the walls, obtain the minimum clearances from either the manufacturer of these materials or the local building inspectors office.
4. Install the stovepipe INSIDE the flue collar on the top of the stove between the stove and chimney.
5. DO NOT use a grate to elevate the fire.



# STOVE PIPE

1. A clearance of 18 inches (457mm) between the stovepipe and combustible materials may be required. Check with authorities having jurisdiction in your area.
2. All pipe sections must be connected with the male end (crimped end) toward the stove.
3. Fasten the stove pipe to the flue collar by the use of three sheet metal screws. Do the same at each additional joint to make the entire installation rigid.
4. Maintain the required diameter flue for the entire installation.
5. If you are connecting the stove to an old masonry flue, be sure to have it inspected for cracks and general condition. Resizing with a stainless steel liner may be required.
6. It is recommended that no more than two (2) 90° bends be used in the stove pipe installation. More than two (2) 90° bends may decrease the amount of draw and possibly cause smoke spillage.
7. A damper is not required in this installation. Remove damper plate in the chimney or secure in OPEN position.
8. Single wall flue pipe assemblies must not exceed 10 feet (3 m) in overall length.

**CAUTION: DO NOT** open fire-door to a point where it would be in contact with the combustible sidewall.

**Optional Fan** - An optional heat exchange blower is available for this wood burning appliance. To order please see the local dealer where you purchased the appliance.

**IMPORTANT:** It is highly recommended that the wood stove and chimney be installed by a qualified installer. (A qualified installer is a person or entity who regularly installs wood heating products and chimneys, in the ordinary course of their regular business.)



## FLOOR PROTECTION

### INSTALLATION ON A CONCRETE FLOOR

An appliance installed on a concrete floor does not require floor protection. If carpeting or any other combustible floor covering is installed, a clearance around the stove must be maintained equivalent to the size of the floor protector described in the following section.

### INSTALLATION ON A COMBUSTIBLE FLOOR

If the appliance is to be installed on a combustible floor or floor covering, a floor protector must be inserted under the stove and project beyond the front of the stove a minimum of 16" (406mm) in the US or 18" (457mm) in Canada and 8" (203mm) on all other sides. In the US the floor protector must also be positioned under any horizontal chimney run and project beyond the pipe a minimum of 2" (51mm) on both sides. The floor protector must be a durable noncombustible material with an "R" value of 0 (no thermal protection required).

## CHIMNEY

Where passing through a wall or partition of combustible construction is desired, the installation shall conform to CAN/CSA-B365.

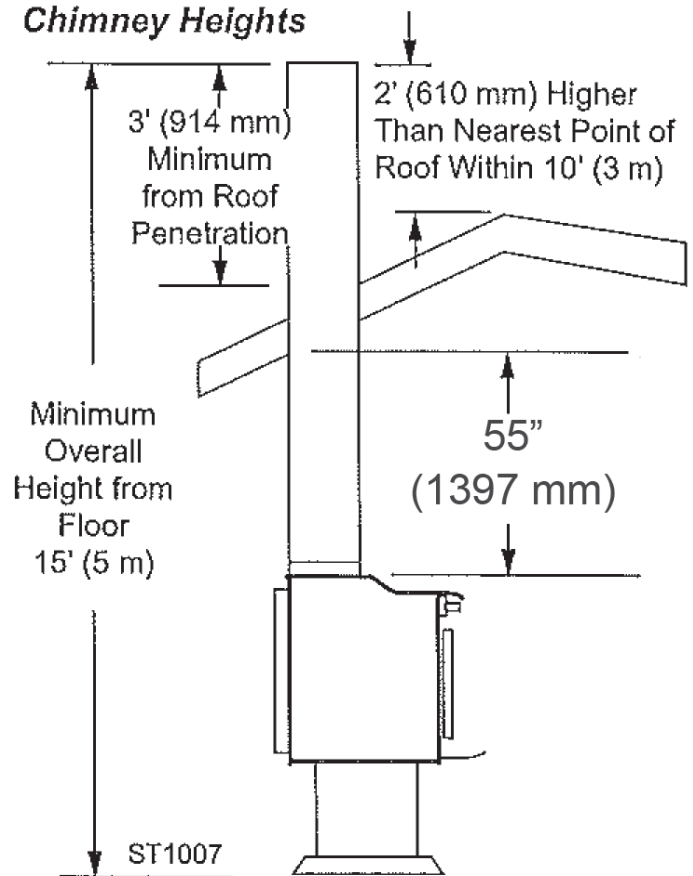
CONTACT YOUR LOCAL BUILDING AUTHORITY FOR APPROVED METHODS OF INSTALLATION

1. This appliance requires a masonry or pre-manufactured chimney listed to CAN/ULC-S629 (Canada) and UL103HT (USA) sized correctly.
2. If a masonry chimney is used it is advisable to have your chimney inspected for cracks and check the general condition before you install your unit. Relining may be required to reduce flue diameter to the appropriate functional size.
3. To help ensure a good draft, the top of the chimney should be at least 3 feet (914mm) above the point of penetration through the roof, and be at least 2 (610mm) feet higher than any point of the roof within 10 feet (3M).
4. The chimney connector shall not pass through an attic, roof space, closet, concealed space, floor, ceiling, wall, or any partition of combustible construction.
5. The minimum overall height of your chimney should be 15 feet (5 m) from the floor (Figure 3).
6. Do not use makeshift compromises during installation.

REFER TO CHIMNEY MANUFACTURER'S INSTRUCTIONS

Figure 3

### Chimney Heights



### FLUE DRAFT CONSIDERATIONS

Location of the appliance and chimney will affect performance. The chimney should:

- 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.

Exterior conditions such as roof line, surrounding trees, prevailing winds and nearby hills can influence stove performance. 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.

NOTE: These are guidelines only, and may vary somewhat for individual installations.

## VENTING SYSTEMS

The venting system consists of a chimney connector (also known as stove pipe) and a chimney. These get extremely hot during use. Temperatures inside the chimney may exceed 2000°F (1100°C) in the event of a creosote fire. To protect against the possibility of a house fire, the chimney connector and chimney **must be properly installed and maintained**. An approved thimble must be used when a connection is made through a combustible wall to a chimney. A chimney support package must be used when a connection is made through the ceiling to a prefabricated chimney. These accessories are **absolutely necessary** to provide safe clearances to combustible wall and ceiling material. Follow venting manufacturer's clearances when installing venting system.

## TOOLS AND SUPPLIES NEEDED

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

Reciprocating saw	Framing Material
Pliers	Hi-Temp Caulking Material
Hammer	Gloves
Phillips Head Screwdriver	Framing Square
Flat Blade Screwdriver	Electric Drill & Bits (1/4")
Plumb Line	Safety Glasses
Level	1/2 in. - 3/4 in. length, #6 or
Tape Measure	#8 self drilling screws (need per pipe section connection)

## INSPECT APPLIANCE & COMPONENTS AND PRE-USE CHECK LIST

1.	Place the appliance in a location near the final installation area and follow the procedures below:
2.	Open the appliance and remove all the parts and articles packed inside the Component Pack. Inspect all the parts and glass for shipping damage. Contact your dealer if any irregularities are noticed.
3.	All safety warnings have been read and followed.
4.	This Owner's Manual has been read.
5.	Floor protection requirements have been met.
6.	Venting is properly installed.
7.	The proper clearances from the appliance and chimney to combustible materials have been met.
8.	The masonry chimney is inspected by a professional and is clean, or the factory built metal chimney is installed according to manufacturer's instructions and clearances.
9.	The chimney meets the required minimum height.
10.	All labels have been removed from the glass door.
11.	A power outlet is available nearby if installing optional blower assembly.

### 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.

### WARNING



#### Fire Risk.

- Inspect appliance and components for damage. Damaged parts may impair safe operation.
- Do NOT install damaged components.
  - Do NOT install incomplete components.
  - Do NOT install substitute components.
- Report damaged parts to dealer.

### Typical Stove Systems

Stove system with masonry chimney consists of:

- Stove
- Chimney Connector (stove pipe)
- Thimble
- Masonry Chimney
- Hearth Pad Floor Protection

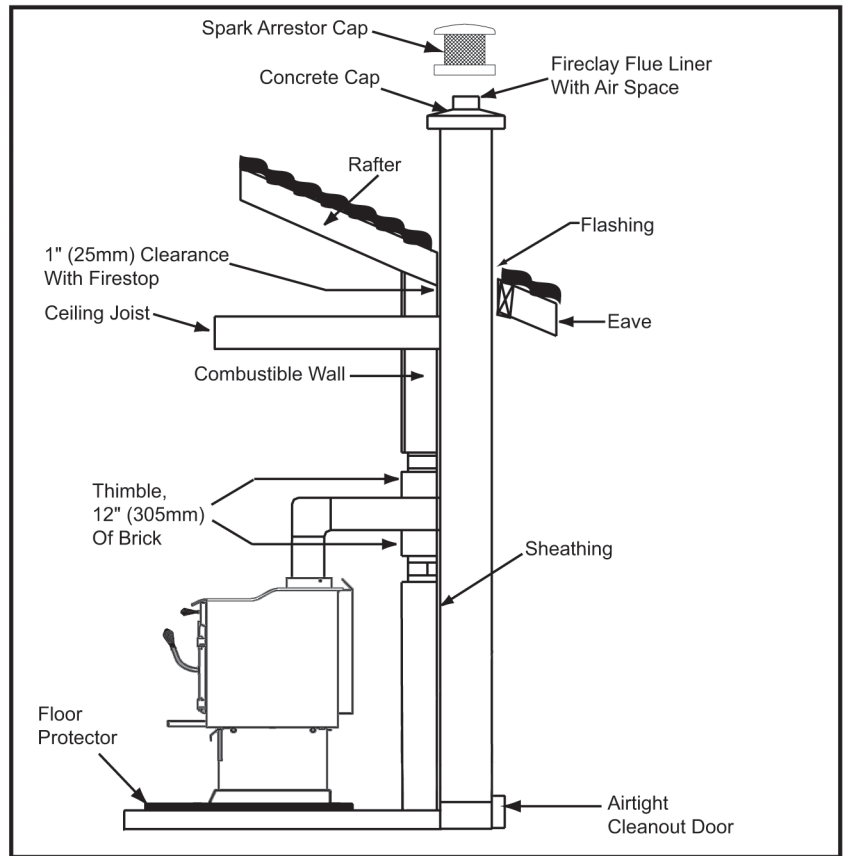


Figure 4.1 Masonry Chimney

Stove system with prefabricated metal chimney consists of:

- Stove
- Chimney Connector (stove pipe)
- Thimble (for exterior chimney)
- Firestops
- Insulations Shields
- Storm Collar and Flashing
- Termination Cap
- Hearth Pad Floor Protection

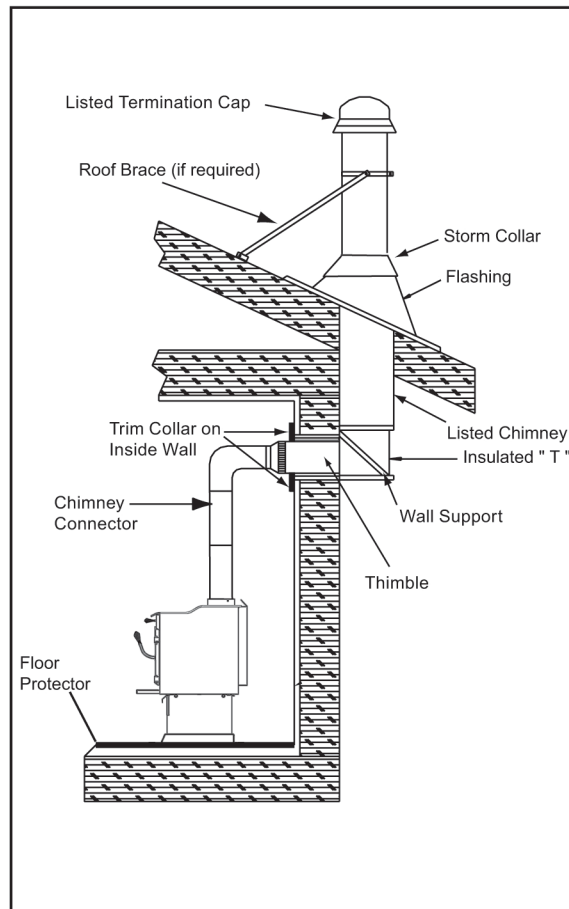


Figure 4.2 Exterior Prefabricated Chimney

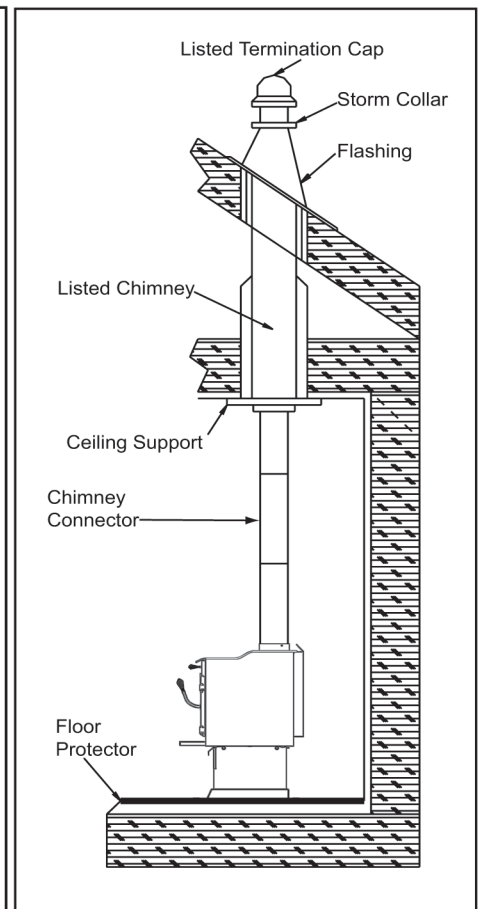


Figure 4.3 Interior Prefab. Chimney

# CHIMNEY REQUIREMENTS

## VENTING COMPONENTS

### Chimney Connector:

It is also known as flue pipe or stove pipe. The chimney connector joins the stove to the chimney. It must be a 6 inch (152mm) minimum diameter 24 gauge mild steel black steel, or an approved air-insulated double wall venting pipe.

### Thimble:

A manufactured or site-constructed device installed in combustible walls through which the chimney connector passes to the chimney. It is intended to keep the walls from igniting. Site constructed thimbles must meet NFPA 211 Standards. Prefabricated must be suitable for use with selected chimney and meet UL103 Type HT Standards. Follow instructions provided by the manufacturer for manufactured thimbles for masonry chimney and prefabricated chimneys.

### Chimney:

The chimney can be new or existing, masonry or prefabricated and must meet the following minimum requirements specified in Section 5B.B.

## CHIMNEY SYSTEMS

### Prefabricated Metal Chimney

- Must be a 6 inch (152mm) diameter (ID) high temperature chimney listed to UL 103HT (2100°F) or CAN/ULC-S629.
- Must use components required by the manufacturer for installation.
- Must maintain clearances required by the manufacturer for installation.

**NOTE:** In Canada when using a factory-built chimney it must be safety listed, **Type UL103 HT (2100°F) CLASS "A"** or conforming to **CAN/ULC-S629, STANDARD FOR 650°C FACTORY-BUILT CHIMNEYS.**

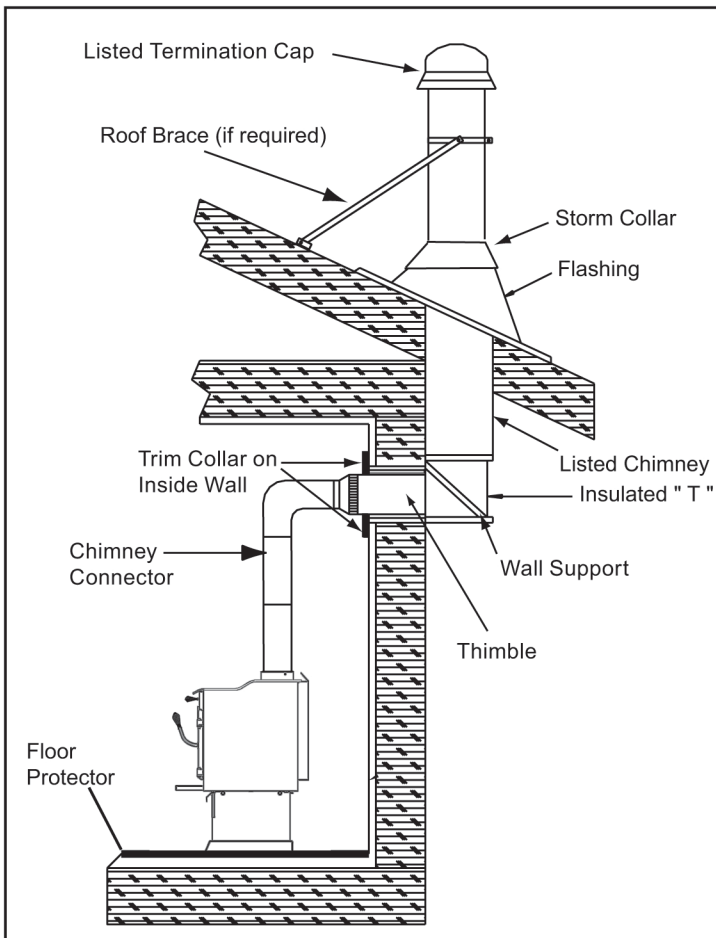


Figure 5.1 Prefabricated Exterior Chimney

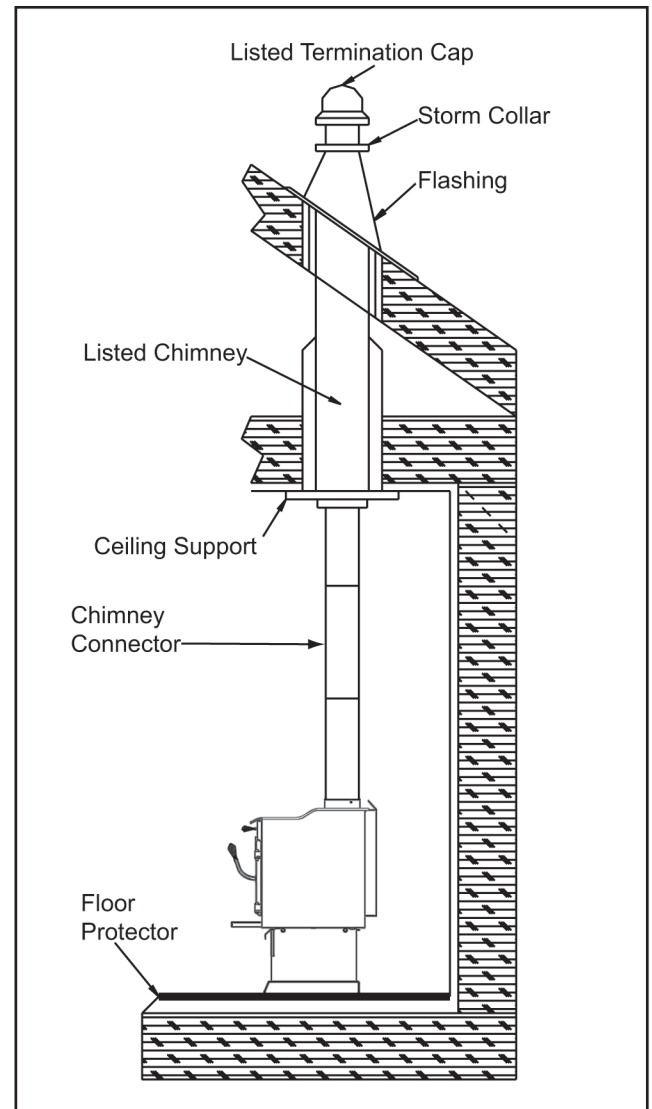


Figure 5.2 Prefabricated Interior Chimney

- Refer to manufacturers instructions for installation.

### Thimble

Site constructed for masonry chimney installation:

### Components

- A minimum length of 12 inches [05mm] (longer for thicker walls) of solid insulated factory-built chimney length constructed to UL 103 Type HT 6 inch (152mm) inside diameter. Chimney needs to extend a minimum of 2 inches (51mm) from the interior wall and a minimum of 1 inch (25mm) from the exterior wall.

- Wall spacer, trim collar and wall band to fit solid pack chimney selected.

- Minimum 8 inch (20mm) diameter clay liner section (if not already present in chimney) and refractory mortar.

### Air Clearances

- Masonry chimney clearance must meet NFPA 211 minimum requirement of 2 inches (51mm) to sheet metal supports and combustibles.

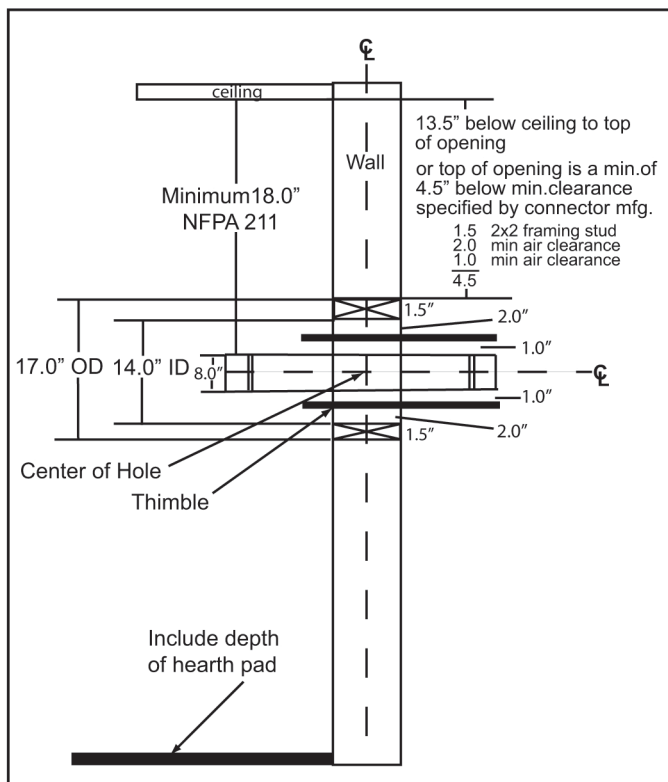
- Minimum of 1 inch (25mm) clearance around the chimney connector.

- Top of wall opening is a minimum of 1-1/2 inches (4mm) from ceiling or 4-1/2 inches (114mm) below minimum clearance specified by chimney connector manufacturer.

- NFPA 211 minimum vertical clearance of 18 inches (457mm) from chimney connector and ceiling or minimum recommended by chimney connector manufacturer. **Figure 6.1.**

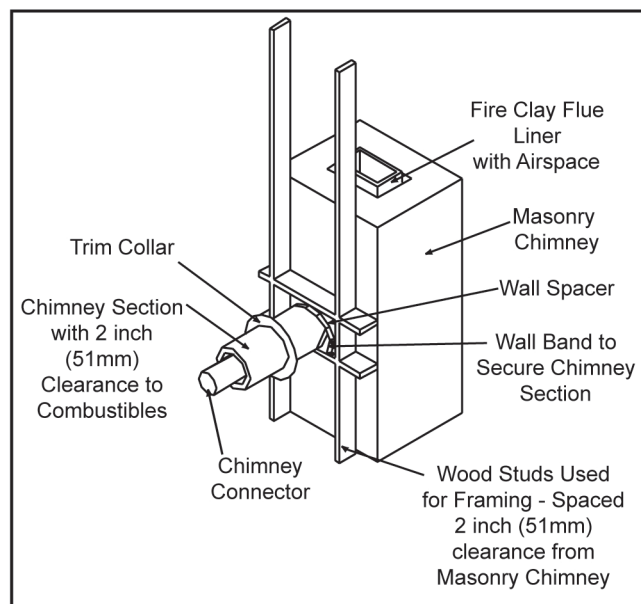
### Instructions:

1. Open inside wall at proper height for the chimney connector to entry the masonry chimney. **Figure 6.1.**
2. Entry hole to masonry chimney must be lined with an 8 inch (20mm) minimum diameter clay liner, or equivalent, secured with refractory mortar.
3. Construct a 17 inch x 17 inch (42mm x 42mm) outside dimension frame from 2 x 2 framing lumber to fit into wall opening. Inside opening of frame should be no less than 14 inch x 14 inch (56mm x 56mm). **Figure 6.1.**
4. Attach the wall spacer to the chimney side of the frame.
5. Nail the frame into the wall opening. The spacer should be on the chimney side.
6. Insert the section of the solid insulated chimney into the outer wall of the masonry chimney.
7. Tightly secure the length of the solid insulated chimney with the wall band to the masonry chimney.
8. Insert a section of chimney connector into the chimney. Make sure it does not protrude past the edge of the clay chimney liner inside the chimney.
9. Seal the end of the chimney connector to the clay liner with refractory mortar.



**Figure 6.1**

### Solid Pack Chimney with Metal Supports as a Thimble



**Figure 7.1**

### WARNING

#### Fire Risk.

Do NOT pack insulation or other combustibles between spacers.

- ALWAYS maintain specified clearances around venting and spacers.
- Install spacers as specified.

Failure to keep insulation or other material away from vent pipe may cause fire.

10. Install trim collar around the solid pack chimney section.

### Solid Pack Chimney with Metal Supports as a Thimble

(Cont'd)

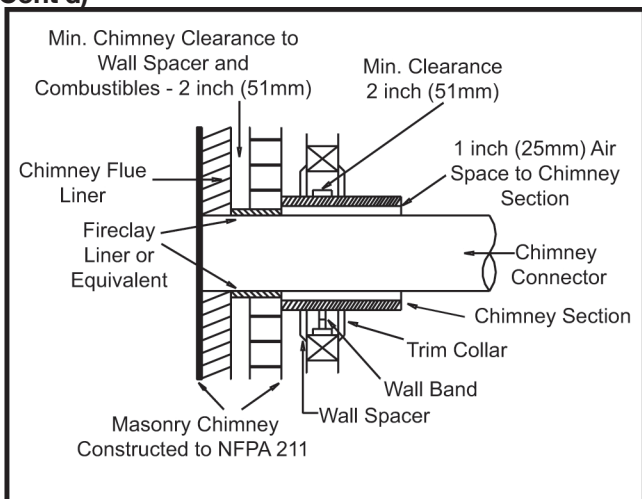


Figure 7.2

### 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 stove height) measured from the base of the appliance. The further your stack height or diameter varies from this configuration, the possibility of performance problems exists. Chimney height may need to be increased by 2% 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.

## INSTALLING CHIMNEY COMPONENTS

### Chimney Connector

Single wall connector or stove pipe.

This must be at least 24 gauge mild steel. The sections must be attached to the appliance and to each other with the crimped (male) end pointing toward the stove. All joints, including the connection at the flue collar, should be secured with sheet metal screws. Make sure to follow the minimum clearances to combustibles. Where passage through the wall, or partition of combustible construction is desired in Canada, the installation shall conform to CAN/CSA-B365.

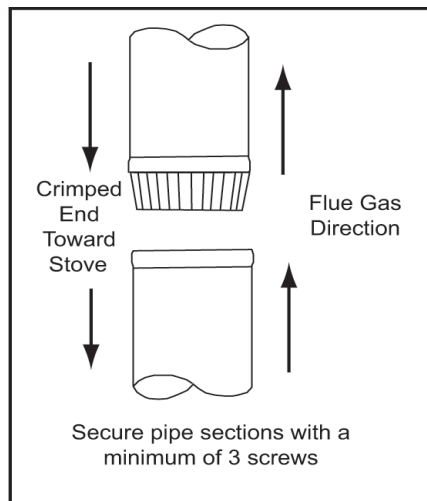





Figure 8


 **WARNING**

 **Fire Risk.**

Inspection of Chimney:

- Chimney must be in good condition.
- Meets minimum standard of NFPA 211
- Factory-built chimney must be 6 inch (152mm) UL103HT.

 **WARNING**

 **Fire Risk.**

Follow Chimney Connector Manufacturer's Instructions for Proper Installation.


ONLY use connector:


- Within the room, between appliance and ceiling or wall.

Connector shall NOT pass through:

- Attic or roof space
- Closet or similar concealed space
- Floor or ceiling


Maintain minimum clearances to combustibles

 **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.

 **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.



## Chimney Termination Requirements

Follow manufacturer's instructions for clearance, securing flashing and terminating the chimney.

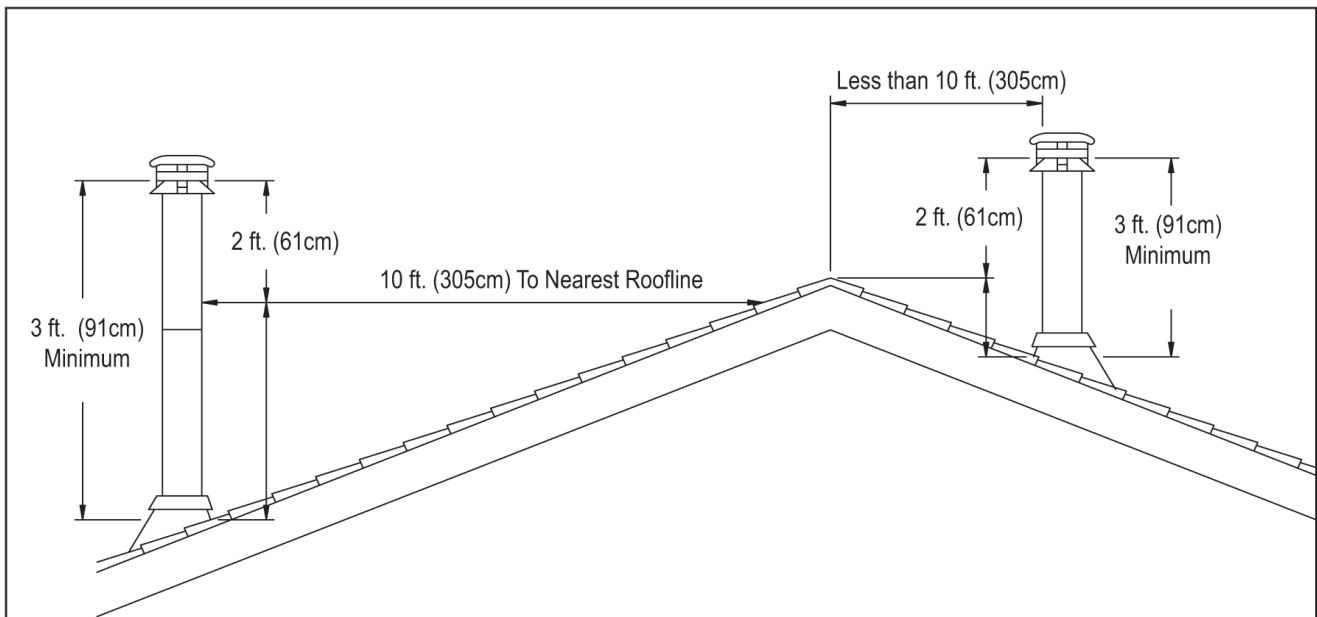
- Must have an approved and listed cap
- Must not be located where it will become plugged by snow or other material
- Must terminate at least 3 feet (91cm) above the roof and at least 2 feet (61cm) above any portion of the roof within 10 feet (305cm).
- Must be located away from trees or other structures

### NOTE:

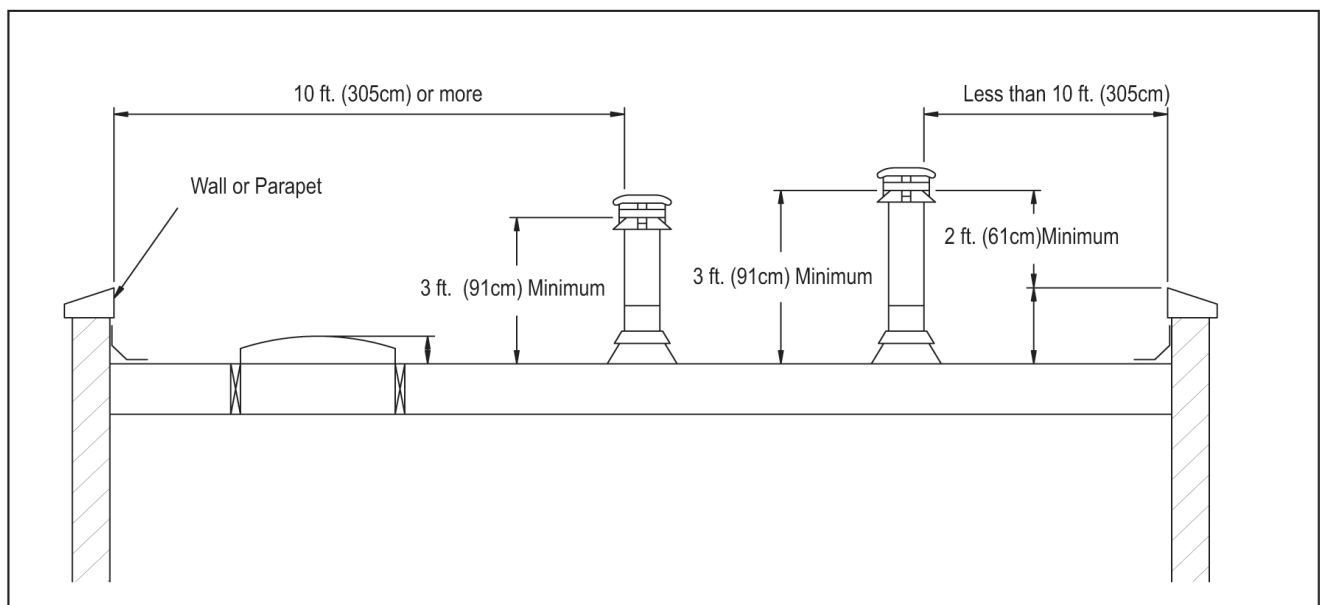
- Chimney performance may vary.
- Trees, buildings, roof lines and wind conditions affect performance.
- Chimney height may need adjustment if smoking or overdraft occurs.

### 2-10-3 Rule

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



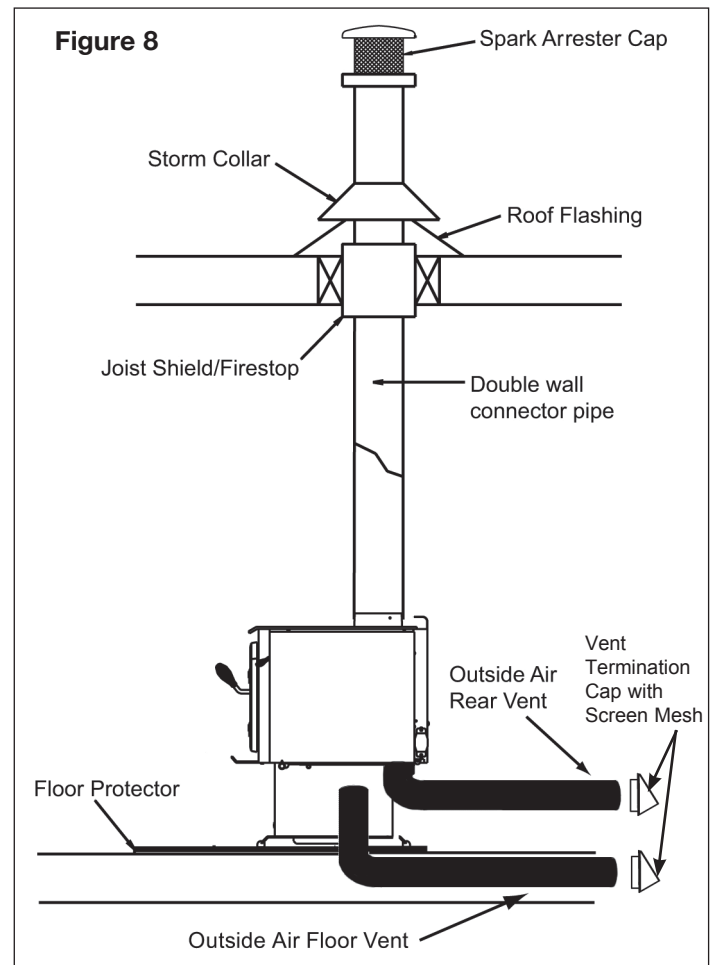
Pitched Roof



Flat Roof

## MOBILE HOME INSTALLATION

1. An outside air inlet must be provided for combustion when installing in a mobile home. See page 2 for installation information.
  2. Appliance must be secured to the mobile home structure by bolting the pedestal through hearth pad and into floor.
  3. Appliance must be grounded with #8 solid copper grounding wire or equivalent and terminated at each end with N.E.C. approved grounding device.
  4. Appliance must be installed with an approved UL10 HT ventilated chimney connector, UL10 HT chimney, and terminal cap with spark arrester. Never use a single wall connector (stove pipe) in a mobile home installation. Use only double-wall connector pipe, Dura-Vent DVL, Selkirk metalbestos DS or Security DL double-wall connector or any listed double-wall connector pipe.
  5. Follow the chimney and chimney connector manufacturer's instructions when installing the flue system for use in a mobile home.
  6. Maintain clearance to combustibles.
  7. Floor protection requirements must be followed precisely.
  8. Use silicone to create an effective vapor barrier at the location where the chimney or other component penetrates to the exterior of the structure.
- NOTE:** 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. NOTE: Top sections of chimney must be removable to allow maximum clearance of 1.5 feet (411cm) from ground level for transportation purposes.
9. Burn wood only. Other types of fuels may generate poisonous gases (e.g., carbon monoxide).
  10. If unit burns poorly while an exhaust blower is on in home, (i.e., range hood), increase combustion air.
  11. Installation shall be in accordance with the Manufacturers Home & Safety Standard (HUD) CFR 280, Part 24.



### CAUTION

MAINTAIN STRUCTURAL INTEGRITY OF MOBILE HOME  
• FLOOR, WALL, CEILING, AND/OR ROOF.

DO NOT CUT THROUGH:

- FLOOR JOIST, WALLS, STUDS, OR CEILING TRUSSES.
- ANY SUPPORTING MATERIAL THAT WOULD AFFECT THE STRUCTURAL INTEGRITY.

### WARNING



#### ASPHYXIATION RISK

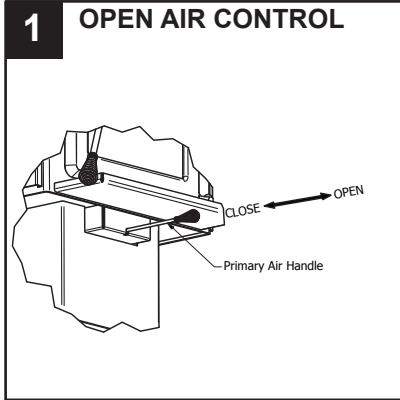
- DO NOT INSTALL IN A SLEEPING ROOM.  
CONSUMES OXYGEN IN THE ROOM.



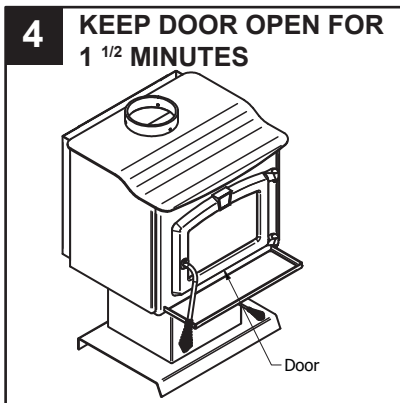
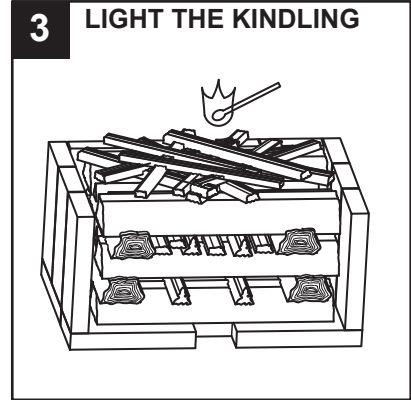
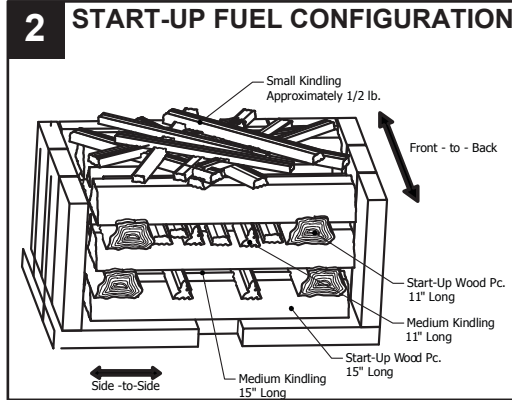
# WOOD STOVE QUICK START GUIDE

## ITEMS NEEDED FOR FIRST FIRE:

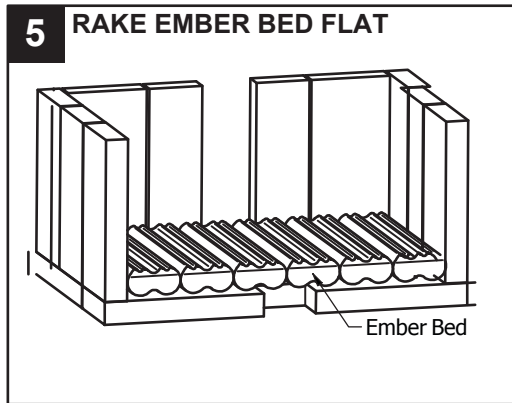
- Approximately 1/2 lb. of small kindling
- 6 pcs. of medium kindling 11" long
- 6 pcs. of medium kindling 15" long
- 6 pcs. of start up logs 11" long
- 6 pcs. of start up logs 15" long
- 5 pcs. of logs 12" to 14" long



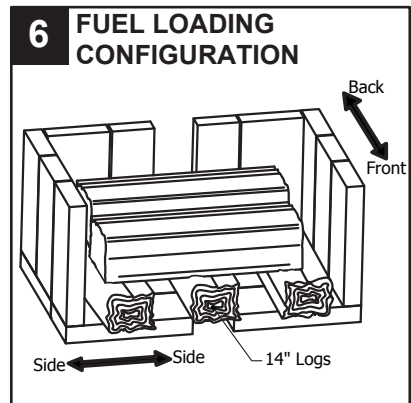
Pull damper control all the way toward you to completely open the damper.



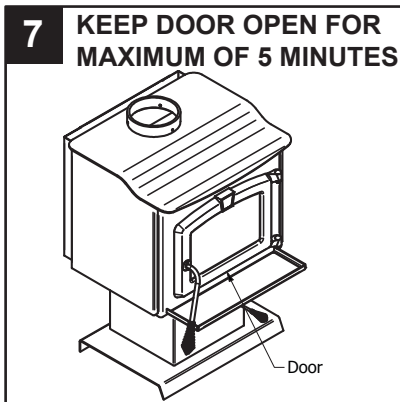
- Keep door open for 1 1/2 Minutes.
- Latch door securely and monitor fire. Reposition logs if fire starts to go out.
- Burn until there is a layer of glowing embers.



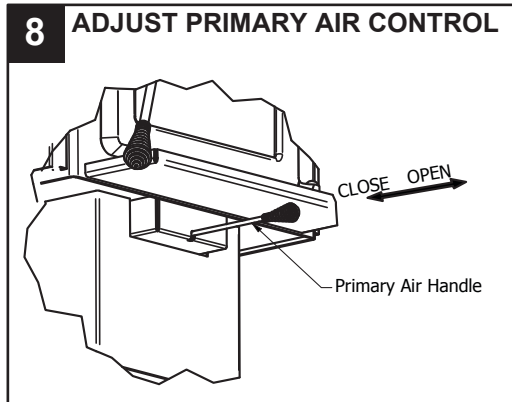
- Rake embers into a flat bed covering the complete bottom.



- The normal Fuel Loading Configuration consists of Five 14" Logs. Three Logs placed evenly on the bottom Front to Back and Two 14" Logs placed on the second row Side to Side.



- Keep door open for 5 minutes then latch door securely.



- Adjust Primary Air Control to desired level for your comfort.
  - Pull "Out" to increase run rate.
  - Push "In" to decrease run rate.
- Congratulations! Your Wood Stove is ready for operation.

**9 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 stove unattended with the door open.

Starting a fire may not require an open door to draft. The air control should supply adequate draft.

Questions, problems, missing parts? Before returning to your retailer, call our customer service department at 877-447-4768 8:30 a.m. – 4:30 pm CST, Monday – Friday. or email us at [customerservice@ghpgroupinc.com](mailto:customerservice@ghpgroupinc.com)

## OPERATION

Do not use a grate or elevate fire. Never burn with door open as this may result in fire. Build wood fire directly on hearth. When the stove is used for the first time the solvents in the paint will smoke off.

### WOOD

This heater is designed to burn natural wood only. Higher efficiency and lower emissions generally result when burning air dried seasoned hardwood, as compared to softwood or to green or freshly cut hardwood. Only use dry seasoned wood. Green wood, besides burning at only 60 percent of the fuel value of dry wood, deposits creosote on the inside of your stove and along the chimney. This can cause an extreme danger of chimney fire. To be called seasoned, wood must be dried for a year. Regardless of whether the wood is green or seasoned, it should be stored in a well-sheltered, ventilated area to allow proper drying during the year to come. Wood should be stored beyond recommended clearance from combustibles.

### DO NOT BURN:

- Treated Wood • Solvents • Trash • Coal
- Garbage • Cardboard • Coloured Papers

Burning of these items can generate excessive levels of carbon monoxide.

### INSTRUCTIONS FOR FIRST BURN - CURING THE STOVE PAINT

Your stove has been painted with the highest quality stove paint and has special break-in procedures. The heat generated by the normal operation of the stove, will serve to harden the paint. Ventilate the house during the first three times the stove is used. The paint on the stove will give off smoke, carbon dioxide and an odor. Without adequate ventilation, concentrations of smoke could irritate you or cause damage to person and/or property. Open doors and windows and use a fan if necessary. After the initial burns, the paint will be cured and there should be no more smoke.

Each of the initial burns should be conducted as follows:

1. The first and second burns should be at approximately 250 deg F (120 deg C) for approximately 20 minutes.
2. The third burn should be between 500 deg F (260 to 370 deg C) for at least 45 minutes. The important fact is the paint should be cured slowly. Avoid hot fires during the curing process. During the curing process the paint will be gummy. Once cured the paint will remain hard. It is normal to see flat spots on painted surfaces of the stove. The flat spots on the paint surface indicate the hotter surfaces of the stove, and is caused by the heat radiating through the paint. It is also expected that shiny spots caused by friction from the packaging materials, will disappear during the curing of the stove.

### SO:

1. Remember to Ventilate well.
2. Allow the stove to cure before burning for long periods at high temperatures.
3. Flat spots on the painted surfaces are normal.
4. Shiny spots on the paint surface before burning is normal.
5. Call your dealer if you have any questions.

## BUILDING A FIRE

1. Open inlet air control fully.
2. Place a small amount of crumpled paper in the stove.
3. Cover the paper with a generous amount of kindling in a teepee fashion and a few small pieces of wood.
4. Ignite the kindling and close door. If fire dies down substantially, open door slightly.
5. Add wood as instructed in the "start up instructions" above.  
Do not fill firebox beyond firebrick area. An ideal coal bed of 1" to 2" should be established to achieve optimum performance.
6. This unit is designed to function most effectively when air is allowed to circulate to all areas of the firebox. An ideal means of achieving this is to rake the coal bed evenly along the entire bottom of the firebox. prior to loading the fuel.
7. Load the remaining fuel as stated in "Step 6" in the "Quick Start Guide" above, then close door and open air inlet control fully until fire is well established (approx. 10 minutes) being careful not to overfire.
8. Readjust air inlet control to desired burn rate. If excessive smoke fills firebox, open air inlet control slightly until flames resume and wood is sufficiently ignited. A basic rule of thumb is "closed-low", "approximately 1/16 inch( 1.6 mm) opened for medium" and "fully open-high".
9. When refuelling, adjust air control to the fully open position. When fire brightens, slowly and carefully open the door. This procedure will prevent gases from igniting causing smoke and flame spillage.
10. Add fuel being careful not to overload.
11. Do not build fire close to glass. May result in glass breakage.



**NEVER USE GASOLINE, GASOLINE-TYPE LANTERN FUEL, KEROSENE, CHARCOAL LIGHTER FLUID, OR SIMILAR LIQUIDS TO START OR FRESHEN UP A FIRE IN THIS HEATER. KEEP ALL SUCH LIQUIDS WELL AWAY FROM THE HEATER WHILE IT IS IN USE.**

The following use and safety tips should be observed:

1. Inspect the glass regularly for cracks and breaks. If you detect a crack or break, extinguish the fire immediately, and contact your dealer for replacement.
2. Do not slam door or otherwise impact the glass. When closing doors, make sure that logs or other objects do not protrude and impact the glass.
3. Do not clean the glass with materials which may scratch (or otherwise damage) the glass. Scratches on the glass can develop into cracks or breaks.
4. Never attempt to clean the glass while unit is hot. If the deposit is not very heavy, normal glass cleaners are adequate with a plain, non-abrasive scouring pad. Heavier deposits may be removed with the use of a readily available oven cleaner.
5. Never put substances which can ignite explosively in the unit since even small explosions in confined areas can blow out the glass.
6. This unit has an airwash system, designed to reduce deposits on glass.
7. Deposits may build on the glass during normal operation and use. Normal glass cleaners work well to remove these deposits. Heavier deposits may be removed by using a damp cloth dipped in wood ashes or by using a commercially available oven cleaner.

REPLACE GLASS ONLY WITH GHP GROUP 5MM CERAMIC GLASS (SEE REPLACEMENT

**CAUTION:** Make sure fire is out and stove is completely cool to the touch.

1. Find an area that will ensure safe removal and no damage to surface of door frame or decorative home furnishing.
2. Wearing a pair of protective gloves, remove the push nuts that retain the door pins from being pulled out and then lift the door off of the hinges.
3. Lay the door face down on a protective surface located in Step 2.
4. Remove the screws from all glass retainers and remove the broken glass, ensuring that the door frame is free from any slivers. (If even small slivers are left, the new glass will not seal correctly causing the stove to



burn improperly.)

5. Attach glass gasket (from GHP Group replacement parts page 18) to new glass and install in door frame.
6. Replace glass retainers with screws making sure not to cross thread or overtighten.
7. Place door on hinges and replace new push nuts, purchased from GHP Group, on door pins to ensure door does not move after reinstallation.

After extensive use, the sealing material which provides glass and door seal may need to be replaced if it fails to sustain its resilience. Inspect glass and door seal periodically to ensure for proper seal. If gaskets become frayed or worn, replace immediately.

Contact your dealer or GHP Group Customer Service for approved replacement parts. The following steps should be followed for glass gasket replacement:

1. Ensure appliance is not in operation and is thoroughly cooled.
2. Remove screw and glass clip.
3. Lift glass out from glass clip.
4. Remove old gasket and clean glass.
5. Replace new gasket starting at the bottom of glass working along edges, being sure to centre gasket channel on glass.
6. Trim to length and butt ends together.
7. Replace glass in door, being sure not to over-tighten screw and clip.

The following steps should be followed for door gasket replacement:

1. Ensure appliance is not in operation and is thoroughly cooled.
2. Remove old door gasket and clean channel.
3. Using an approved high temperature gasket cement, apply a thin coat in bottom of channel.
4. Starting at hinge side of door, work into channel around door unit, end butt and trim to length.
5. Close door and allow three to four hours for cement to set before restarting appliance.

#### Creosote - Formation and Need for Removal

When wood is burned slowly, it produces tar and other organic vapors, which combine with expelled moisture to form creosote. The creosote vapors condense in the relatively cool chimney flue of a slow-burning fire. As a result, creosote residue accumulates on the flue lining. When ignited this creosote makes an extremely hot fire.

The chimney connector and chimney should be inspected at least once every two months during the heating season to determine if a creosote buildup has occurred.

If creosote has accumulated (3 mm or more) it should be

removed to reduce the risk of a chimney fire.

this container.

## WAYS TO PREVENT AND KEEP UNIT FREE OF CREOSOTE

1. Burn with air control open for several minutes at numerous intervals throughout the day during the heating season, being careful not to over-fire unit. This removes the slight film of creosote accumulated during low burn periods.
2. Burn stove with draft control wide open for several minutes every time you apply fresh wood. This allows wood to achieve the charcoal stage faster and burns wood vapours which might otherwise be deposited within the system.
3. BURN ONLY SEASONED WOOD. Avoid burning wet or green wood. Seasoned wood has been dried for at least one year.
4. A small hot fire is preferable to a large smouldering one that can deposit creosote within the system.
5. Establish a routine for the fuel, wood burner and firing technique. Check daily for creosote build-up until experience shows how often you need to clean to be safe. Be aware that the hotter the fire, the less creosote is deposited and weekly cleanings may be necessary in mild weather even though monthly cleanings may be enough in the coldest months. Contact your local municipal authority for information on how to handle a chimney fire. Have a clearly understood plan to handle a chimney fire..

### **WARNING: Things to remember in case of chimney fire:**

**1. CLOSE DRAFT CONTROL.**

**2. CALL THE FIRE DEPARTMENT.**

This unit features a convenient ash lip for easy removal of ash. During constant use, ashes should be removed every few days, or whenever ashes get to three to four inches deep in the firebox. Remove ashes only when the fire has died down and the ashes have cooled. Even then, expect to find a few hot embers.

### **Disposal of Ashes:**

Ashes should be placed in a steel container with a tight-fitting lid. The container of ashes should be moved outdoors immediately and placed on a noncombustible floor or on the ground, well away from 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. Other waste shall not be placed in

### **1. What type of wood is best to use as Firewood?**

Dry seasoned hardwood should be used. Avoid green unseasoned wood. Green wood, besides burning at only 60 percent of the fuel value of dry seasoned wood, will deposit creosote on the inside of your stove and along the inside of your chimney.

### **2. What does dry seasoned wood mean, and what is considered hardwood?**

Wood that has been dried for a period of one year in a well-ventilated and sheltered area would be considered dry seasoned wood. Hardwoods are generally from slow growth trees (Example: Oak and Fir). Softwoods are generally from fast growth trees. (Example: Pine and Spruce)

### **3. Will following the above listed steps for starting a fire result in perfect results all the time?**

The quick answer is most of the time. There are many variables that may affect your success rate when starting a fire. Most of those variables and how to deal with them will be learned through experience. Your ability to start a good fire will significantly increase with time and patience. Some of the reasons for poor stove performance will be covered in the next section of these instructions.

### **4. Why can't I get the fire lit?**

Damp or wet wood and poor draft are the main reasons for poor results in starting a fire. Always use dry seasoned wood for your fire. Even wood dried for two years will be difficult to ignite, if it has become wet.

### **5. Why is there always a large quantity of thick black smoke present in the firebox?**

A large quantity of thick black smoke in the firebox, is a good indication that the draft is poor.

### **6. Is it normal for soot to cover the glass at the beginning of a fire?**

Your stove has been built with an air wash system that will help keep the glass clear when the firebox has reached a good operating temperature, and has a good draft. Cold firebox temperature and poor draft cause sooting of the glass. Once the firebox temperature and the draft increases, the soot will burn off.

### **7. What is draft?**

Draft is the ability of the chimney to exhaust draw by-products produced during the normal combustion process.

### **8. What can cause a poor draft?**

The most common factors for poor draft are:

- a) Atmospheric pressure and air supply
- b) Environmental conditions
- c) Cold chimney temperature
- d) Poor chimney installation and maintenance





### **Atmospheric Pressure and Air Supply**

Atmospheric pressure affecting the draft from a chimney can be either outside the home, inside the home or both. Outside the home, a high-pressure day (clear and cool) generally creates a better draft in the chimney than a low-pressure day (overcast and damp). Inside the home, normal household appliances, such as clothes dryers and forced air furnaces compete for air resulting in inadequate amounts of air available to fuel a fire and create a condition known as negative pressure. Under extreme conditions of negative pressure the combustion by-products can be drawn from the chimney and into the house. This condition is commonly referred to as down drafting. There are several factors that impact the amount of air available in the home. Increased amounts of insulation vinyl windows, extra caulking in various places and door seals can all keep heat in but may also make a home too airtight. If you are in doubt about whether or not there is sufficient air in your home for your stove, refrain from using those appliances known to consume the air where possible, or open a window or door to allow air to enter the home.

### **Environmental Conditions**

High trees, low lying house location such as in a valley, tall buildings or structures surrounding your house and windy conditions can cause pool draft or down drafting.

### **Cold Chimney Temperature**

Avoid cold chimney temperatures by burning a hot fire for the first fifteen to forty minutes, being careful not to over fire. If any part of the chimney or parts of the stove start to glow, you are over firing the stove. Where possible, install a temperature gauge on the chimney so temperature drops can be seen.

### **Chimney Installation and Maintenance**

Avoid using too many elbows or long horizontal runs. If in doubt, contact a chimney expert and/or chimney manufacturer for help. Clean chimney, rain caps and especially spark arrester regularly, to prevent creosote build-up, which will significantly reduce chimney draw and may cause a chimney fire.

## **9. Should I close or open the air control fully when shutting down the stove?**

When shutting down the stove, fully open the air control. This allows the chimney temperatures to remain as high as possible for as long as possible.

Cold chimney temperatures create creosote.

**NOTE:** This sheet is intended as an aid and does not supersede any local, provincial or state requirements. Check with officials or authorities having jurisdiction in your area.

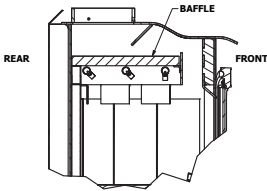
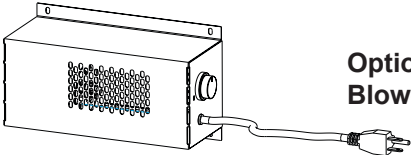
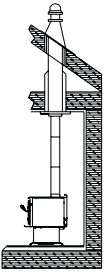
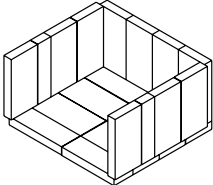
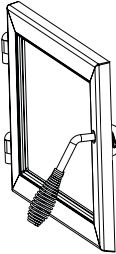
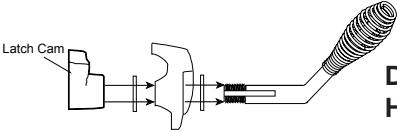


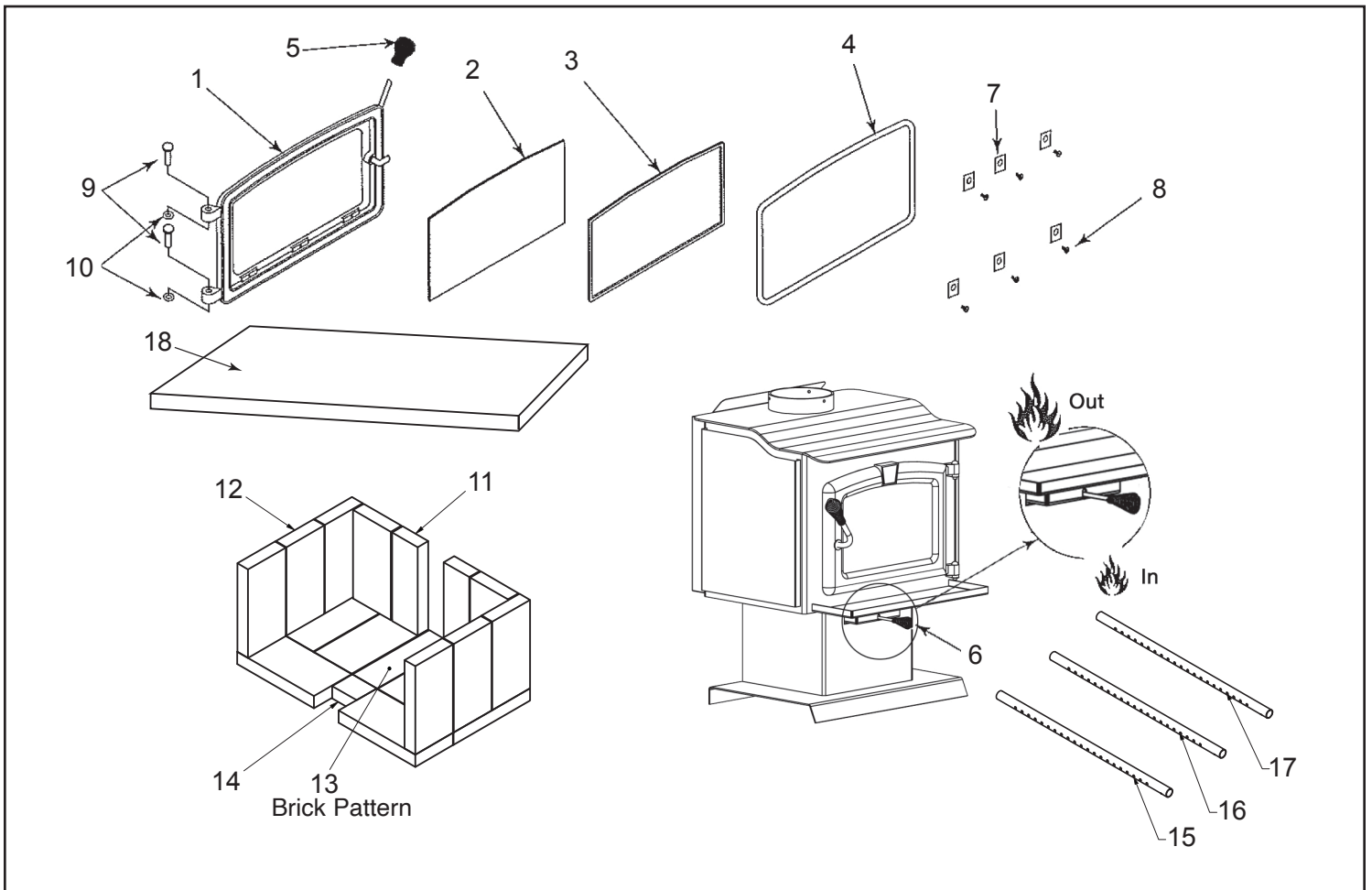
## QUICK REFERENCE MAINTENANCE GUIDE



**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.

AREA OF MAINTENANCE	FREQUENCY	TASK
 <p><b>Baffle &amp; Blanket</b></p>	<p>MONTHLY or After Every Cord of Wood</p>	<p>Baffle placement is critical to heat output, efficiency and overall life of the unit. Make sure the baffle is centered on the secondary air manifold and is laying flat. Inspect baffle for cracks.</p>
 <p><b>Optional Blower</b></p>	<p>YEARLY or After Every 4 Cords of Wood</p>	<p>Vacuum the blower impellers.</p>
 <p><b>Chimney System</b></p>	<p>EVERY 2 MONTHS or After Every 4 Cords of Wood</p>	<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. 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><b>Firebrick &amp; Ash Removal</b></p>	<p>WEEKLY or After Every 25 Loads of Wood</p>	<p>Ashes must be cool before you can dispose of the ashes in a non-combustible container.  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><b>Door &amp; Glass Assemblies</b></p>	<p>WEEKLY or After Every 25 Loads of Wood</p>	<p>Keep door and glass gasket in good shape to maintain good burn times on a low burn setting. To test: place a dollar bill between the stove and door and then shut the door. If you can pull the dollar out, replace the door gasket.  Check the glass frame for loose screws to prevent air leakage. Check glass for cracks.</p>
 <p><b>Door Handle</b></p>	<p>WEEKLY or After Every 25 Loads of Wood</p>	<p>Check the door latch for proper adjustment. This is very important especially after the door rope has formed to the stove face. Check door handle for smooth cam operation.</p>



GHP Group reserves the right to make changes in design, materials, specifications, prices and discontinue colors and products at any time, without notice.

Item No.	Description	Qty.	Part No.
1.	Door Assembly	1	75-23-115
2. & 3.	Glass (13.00"W x 8.38"H) and Gasket	1	75-23-511
3.	1/8" Glass Gasket	1	75-23-117
4.	5/8" Door Gasket	1	75-23-124
5.	Spring Handle	1	75-20-140
6.	Air Control Spring Handle	1	75-20-141
7.	Glass Clip	6	75-25-131
8.	Screw	6	75-21-141
9.	Hinge Pin	2	75-20-132
10.	Push Nut	2	75-21-150
11.	Fire Brick, 9" x 3" x 1 1/8"	2	75-23-512
12.	Fire Brick Lt. 9" x 4 7/16" x 1 1/4"	8	75-21-147
13.	Fire Brick, 9" x 2 7/8" x 1 1/8"	4	75-23-513
14.	Fire Brick, 2 7/8" x 2 3/8" x 1 1/8"	4	75-23-514
15.	Air Tube, Front	1	75-23-134
16.	Air Tube, Middle	1	75-23-132
17.	Air Tube, Rear	1	75-23-133
18.	Insulation Baffle	1	75-23-001

# 5 Year Warranty

GHP Group warrants that your new wood-burning stove, pellet-burning stove, or masonry wood insert is free from manufacturing and material defects for a period of five years from the date of sale, subject to the following conditions and limitations.

1. This warranty is extended to the original owner only, for residential use, and is subject to proof of purchase.
2. The new GHP Group product must be installed and operated at all times in accordance with the installation and operation instructions supplied with the appliance, and installation must be to local and national codes. Any alterations, willful abuse, accident, over firing or misuse will not be covered under warranty. NOTE: Some minor movement of certain parts is normal and is not a defect and therefore, not covered under warranty.
3. The warranty is non-transferable, and is made to the original owner, provided that the purchase was made through an authorized GHP Group supplier. The serial number must be supplied along with the Bill of Sale, showing the date of purchase, at the time the claim is submitted.
4. This warranty is limited to the repair or replacement of parts only, found to be defective in material or construction, provided that such parts have been subjected to normal conditions of use and service, after a said defect has been confirmed by GHP Group, or an authorized representative's inspection. Defective parts must be shipped back (at GHP Group discretion), transportation prepaid, to the manufacturer. Credits will be issued upon receipt of return of the defective product to GHP Group.
5. GHP Group, at its discretion, can fully discharge all obligation with respect to this warranty by refunding the wholesale price of the defective part(s).
6. Any installation, labor, construction, transportation or other related costs or expenses arising from defective parts, repair, replacement or otherwise of same, will not be covered by this warranty nor will GHP Group assume responsibility for same. Further, GHP Group will not be responsible for any incidental, indirect or consequent damages, except as provided by law, and in no event shall they exceed the original purchase price.
7. All other warranties - expressed or implied - with respect to the product, its components and accessories, or any obligations/liabilities on the part of GHP Group are hereby expressly excluded.
8. GHP Group neither assumes, nor authorizes any third party to assume, on GHP Group's behalf, any other liabilities with respect to the sale of this GHP Group product.
9. The warranties as outlined within this document do not apply to chimney components or other products made by other manufacturers when used in conjunction with the installation of this product. Improper use or the use of non-approved components may nullify your warranty. If in doubt, contact your nearest GHP Group supplier or GHP Group Customer Service Department.
10. GHP Group will not be responsible for:
  - Downdrafts or spillage caused by environmental conditions such as nearby trees, buildings, rooftops, hills, mountains, or ineffective

chimney design.

- Inadequate ventilation, excessive offsets or negative air pressure caused by mechanical systems such as furnaces, clothes dryers, fans, etc.
11. This warranty is void if:
- The appliance has been operated in atmospheres contaminated by chlorine, fluorine, or other damaging chemicals.
  - This appliance has been subjected to prolonged periods of dampness or condensation.
  - The appliance has any damage due to water, or weather damage that is the result of, but not limited to, improper chimney/venting installation.
  - The appliance has been subjected to willfull or accidental abuse or misuse.
  - Corrosive driftwood, manufactured logs or other fuels are used other than as outlined in the installation and operating instructions.
  - The appliance is not maintained in good condition, including firebrick and gaskets.

## Doors with Glass and Plated Parts

Glass is warranted against thermal breakage only. To clean glass, use a ceramic/glass cleaner or polish. Do not use ammonia based cleaners. A suitable cleaner is available at your nearest Pleasant Hearth dealer.

## DO NOT CLEAN GLASS WHILE HOT AND DO NOT USE ABRASIVE CLEANERS.

Plated parts will not be covered under this warranty. Plated parts should be cleaned by using denatured alcohol only and rubbed lightly with a lint-free non-abrasive cloth. Excessive rubbing or polishing may remove the plated finish. Plated parts may also be damaged by external chemicals.

## Further Exclusions

### WOOD-BURNING STOVE

Electrical components, such as the blower, are covered for five (5) years from the date of purchase if they are included with the purchase of your stove.

This warranty will not include or extend to paint, gaskets or firebrick components, and does not cover any removable firebox components such as brick retainers or stainless steel air tubes.

### PELLET-BURNING STOVE:

Five Year Period:

1. Carbon steel and welded seams in the firebox are covered for five (5) years against splitting.

2. The steel door and hinges are covered for five (5) years against cracking.  
One Year Period:

1. Component parts such as the hopper, auger, burn-pot, baffle plate, auger shaft and fasteners are covered for one (1) year against cracking, breakage and welded seam separation.

2. Electrical components, accessory items, glass and the painted surface of the stove are covered for one (1) year from the date of purchase.

TO REGISTER THE WARRANTY ON YOUR HEATER, PLEASE FILL OUT THIS CARD COMPLETELY AND MAIL WITHIN 14 DAYS FROM DATE OF PURCHASE OR REGISTER ON-LINE AT [www.ghpgrrouponc.com](http://www.ghpgrrouponc.com)

NAME: \_\_\_\_\_ PHONE: (     ) \_\_\_\_\_ EMAIL: \_\_\_\_\_  
 ADDRESS: \_\_\_\_\_ CITY: \_\_\_\_\_ STATE: \_\_\_\_\_ ZIP: \_\_\_\_\_  
 MODEL: \_\_\_\_\_ SERIAL #: \_\_\_\_\_ DATE PURCHASED: \_\_\_\_\_  
 DEALER PURCHASED FROM: \_\_\_\_\_ TYPE OF STORE: \_\_\_\_\_  
 CITY & STATE WHERE PURCHASED: \_\_\_\_\_ PRICE PAID: \_\_\_\_\_

**Please Take a Minute To Give Us Your Answers To The Following Questions.**

**All Responses Are Used Solely For Market Research And Are Held In Strict Confidence.**

Who primarily decided this purchase?  Male  Female     18-24  25-39  40-59  60 and over

Purpose of Purchase? \_\_\_\_\_

Do you own any other portable heaters?  Yes  No If yes, type \_\_\_\_\_ brand \_\_\_\_\_

How do you intend to use your new heater?  Construction Site  Farm  Warehouse/Commercial  Garage/Outbuilding  Other

How did you become aware of this heater?  In-Store Display  Newspaper Ad  Magazine Ad  Friend/Relative

TV Commercial  Store Salesperson  Other \_\_\_\_\_

What made you select this heater?  Style  Size/Portability  Price  Package  Brand  Other \_\_\_\_\_

Do you:  own  rent Would you recommend this heater to a friend?  Yes  No

Please give us your comments: \_\_\_\_\_

THANK YOU FOR COMPLETING THIS FORM!

Information will be held confidential.



**IF WARRANTY SERVICE IS REQUIRED**

Contact GHP Group Customer Service. Make sure you have your sales receipt and the model/serial number of your GHP Group product.

Do not attempt to do any service work yourself, unless pre-approved by GHP Group in writing as this will void the warranty.

GHP Group must authorize service and provide a Warranty Claim Number prior to any warranty related service calls. Without an authorization number, any service work will not be deemed warranty.

**WARRANTY REGISTRATION**

**IMPORTANT:** We urge you to fill out your warranty registration card within fourteen (14) days of date of purchase. You can also register your warranty on the internet at [www.ghpgroupinc.com](http://www.ghpgroupinc.com). Complete the entire serial number. Retain this portion of the card for your records.



**GHP Group, Inc.**  
6440 W. Howard St.  
Niles, IL 60714-3302

Tel: (877) 447-4768  
[www.ghpgroupinc.com](http://www.ghpgroupinc.com)

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*GHP Group, Inc.  
Model: Small Wood Stove  
Report Number:0418WS019E*

# **Appendix B**

## **Alt-125 E3053 Letter**



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
RESEARCH TRIANGLE PARK, NC 27711

FEB 28 2018

Mr. Justin White

OFFICE OF  
AIR QUALITY PLANNING  
AND STANDARDS

Dear Mr. White,

I am writing in response to your letter dated January 12, 2018, regarding wood heaters manufactured by Hearthstone QHPP, Inc. (Hearthstone). This response, dated February 28, 2018, supercedes our previous response (dated February 26, 2018) to correct an inaccuracy regarding required changes to ASTM E3053-17.

You are requesting to use an alternative test method, using cord wood, as referenced in section 60.532(c) of 40 CFR part 60, Subpart AAA, Standards of Performance for New Residential Wood Heaters (Subpart AAA) to meet the 2020 cord wood alternative compliance option. The 2020 cord wood alternative compliance option states that each affected wood heater manufactured or sold at retail for use in the United States on or after May 15, 2020, must not discharge into the atmosphere any gases that contain particulate matter in excess of 2.5 g/hr. Compliance must be determined by a cord wood test method approved by the Administrator along with the procedures in 40 CFR 60.534. You have requested approval to use the procedures and specifications found in ASTM Method E3053-17, a cord wood test method titled, "Standard Test Method for Determining Particulate Matter Emissions from Wood Heaters using Cordwood Test Fuel," in conjunction with ASTM E2515-11 and Canadian Standards Administration (CSA) Method CSA-B415.1-10, which are specified in 40 CFR 60.534.

We understand that Hearthstone is also requesting that the alternative method proposed above be approved to apply broadly to all wood heaters manufactured by Hearthstone meeting the requirements of Subpart AAA, from the approval date of this request until such time that Subpart AAA is revised or replaced to require a different cord wood certification method, providing all requirements of section 60.533 of Subpart AAA are met.

With the caveats set forth below, we approve your alternative test method request for certifying wood heaters using ASTM E3053-17 in conjunction with section 60.534 of Subpart AAA to meet the 2020 cord wood compliance option until such time that Subpart AAA is revised or replaced to require a different cord wood certification method. We also approve application of this alternative method to all wood heaters manufactured by Hearthstone meeting the requirements of Subpart AAA.

As required in Subpart AAA, section 60.354(d), you or your approved test laboratory must also measure the first hour of particulate matter emissions for each test run using a separate filter in one of the two parallel sampling trains. These results must be reported separately and also included in the total particulate matter emissions per run. Also, as required by Subpart AAA, section 60.534(e), you must have your approved laboratory measure the efficiency, heat output, and carbon monoxide emissions of the tested wood heater using CSA-B415.1-10. For measurement of particulate matter emission concentrations, ASTM 2515-11 must be used.

The following change to ASTM E3053-17 must be followed:

1. Coal bed conditions prior to loading test fuel. The coal bed shall be a level plane without valleys or ridges for all test runs in the high, low, and medium burn rate categories.

The following changes to ASTM E2515-11 must be followed:

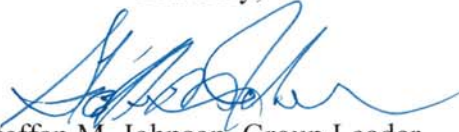
1. The filter temperature must be maintained between 80 and 90 degrees F during testing.
2. Filters must be weighed in pairs to reduce weighing error propagation; see ASTM 2515-11, Section 10.2.1 Analytical Procedure.
3. Sample filters must be Pall TX-40 or equivalent Teflon-coated glass fiber, and of 47 mm, 90 mm, 100 mm, or 110 mm in diameter.
4. Only one point is allowed outside the +/- 10 percent proportionality range per test run.

A copy of this letter must be included in each certification test report where this alternative test method is utilized.

It is reasonable that this alternative test method approval be broadly applicable to all wood heaters subject to the requirements of 40 CFR part 60, Subpart AAA. For this reason, we will post this letter as ALT-125 on our website at <http://www3.epa.gov/ttn/emc/approalt.html> for use by other interested parties. As noted earlier in this letter, this alternative method approval is valid until such time that Subpart AAA is revised or replaced to require a different cord wood certification method, and at such time, this alternative will be reconsidered and possibly withdrawn.

If you have additional questions regarding this approval, please contact Michael Toney of my staff at 919-541-5247 or [toney.mike@epa.gov](mailto:toney.mike@epa.gov).

Sincerely,

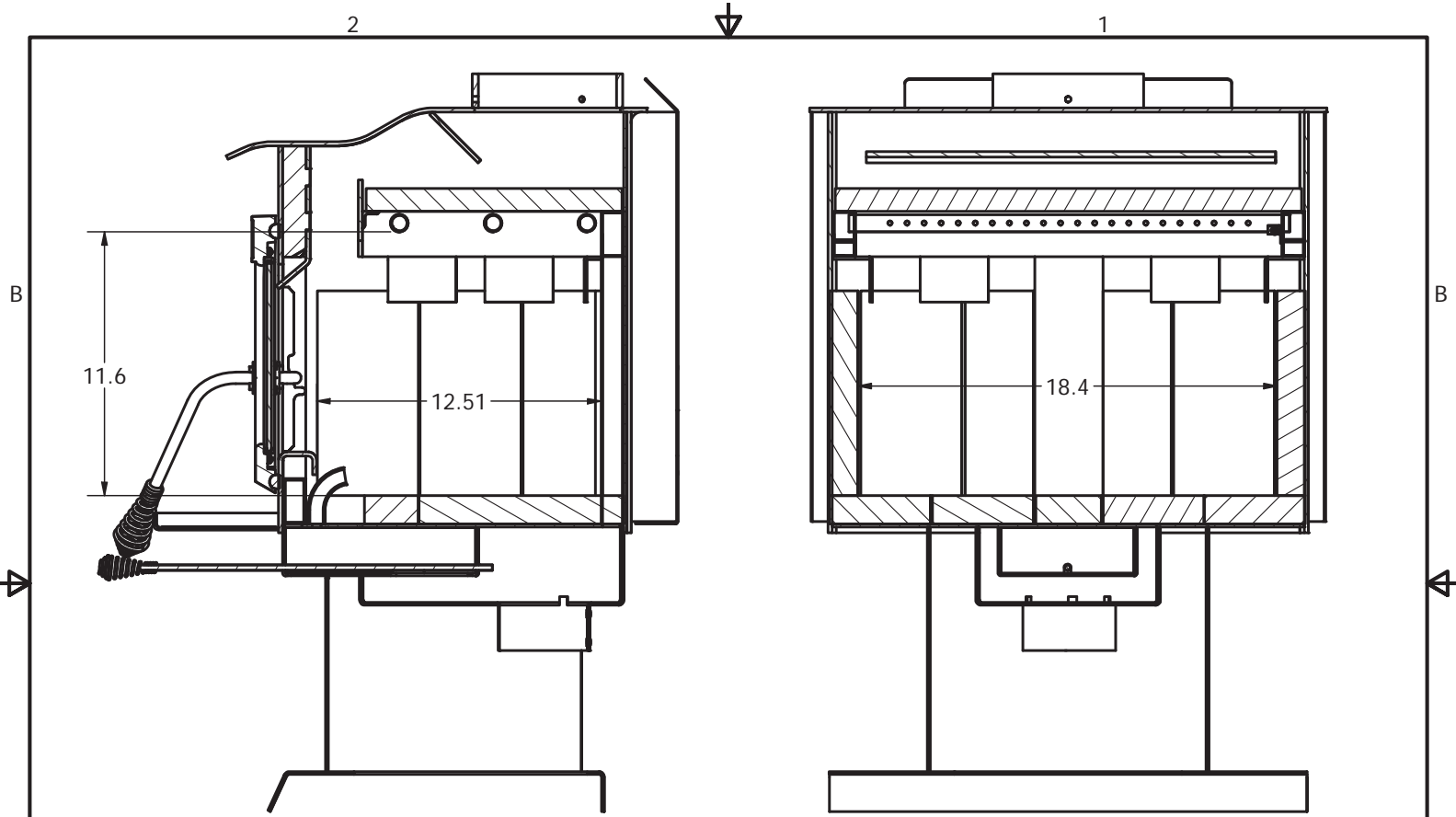


Steffan M. Johnson, Group Leader  
Measurement Technology Group

cc: Amanda Aldridge, EPA/OAQPS/OID  
Adam Baumgart-Getz, EPA/OAQPS/OID  
Rafael Sanchez, EPA/OECA  
Michael Toney, EPA/OAQPS/AQAD

# **Appendix C**

## **Firebox Volume**



**FIREBOX VOLUME:**

11.6" x 12.5" x 18.4" = 2390 cubic in  
 2668 cubic in/ 1728 cubic in/cubic ft = 1.54 cubic ft

DRAWN DanDowning	8/24/2020
MFG	
MATERIAL	
TOLERANCES	
X.XXX = +/- 0.010"	
X.XX = +/- 0.030"	
X.X = +/- 0.060"	
ANGLES = +/- 2 Degrees	



**GHP GROUP INC.**  
 6440 W Howard St., Nilas, IL 60714

TITLE		
Firebox Volume Calculation 2020 2.5 Small Wood Stove		
SIZE A	DWG NO EXP-A30000-3 Firebox Volume	REV
SCALE 1/6	SHEET 1 OF 1	

# **Appendix D**

## **Revision History**



Date	Project No.	Tech. & Evaluator	Report Sect.	Summary of Changes
10/13/2020	0418WS019E	Bruce Davis	All	Original report was generated
3/29/22	0418WS019E Edition 001	Bruce Davis	1	<p>Added information on Ambient filter, and B415 efficiency example calculations to sample procedure on page 5.</p> <p>Added the word appropriate to tests 1, 2, and 4 in the Individual Run Summary on page 6.</p> <p>Changed firebox volume from 1.53 to 1.54 in table 6 on page 9. Added table 8 showing fuel load dimensions to page 9.</p>
			3	<p>Added fuel weight, fuel moisture, and statement showing operated for 50 hours with fuel moisture between 18 and 28% db. to conditioning data on page 26. Added train precision data to pages 33, 50, and 68. Updated 1<sup>st</sup> hour g/kg result on page 33, changed from a negative value to 1.81 g/kg. Firebox volume changed from 1.53 to 1.54 on pages 34, 42, 52, 61, and 70.</p>
			Appendix A	<p>Added updated manual to show medium burn air setting matching that used during testing.</p>
			Appendix C	<p>Added firebox volume calculation.</p>
			Appendix D	<p>Added revision history</p>