

**Non-Confidential Business Information
(Non-CBI)
Certification Test Report**

GHP Group, Inc.

Model Name: Large Wood Stove, Legs
Large Wood Stove, Pedestal

Models: GWS-2200, GWS-2200-B, WSL-2200, WSL-2200-B,
LWS-2200, WS-2200, WS-2200-B, PH2200WS, PH2200WS-B,
SWS-2200, SWS-2200-B, HWS-2200, HWS-2200-B, PWS-2200-B

Wood-Fired Freestanding Room Heater

Prepared for: GHP Group, Inc.
6440 W Howard St
Niles, IL 60714
USA

Prepared by: OMNI-Test Laboratories, Inc.
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Portland, OR 97230
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Test Period: May 5, 2020 – May 6, 2020

Report Issued: June 22, 2020

Report Number: 0418WS018E

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AUTHORIZED SIGNATORIES

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

Evaluator:


Bruce Davis
Testing Manager

Reviewer:

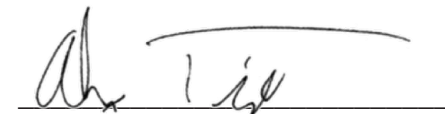

Alex Tiegs
President

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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 Large Wood Stove Freestanding woodstove. The Large 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 2.00 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 5/4/20, then assigned and labeled with *OMNI* ID #2409. *OMNI* representative Bruce Davis conducted the certification testing and completed all testing by May 6, 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 Large 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 Large Wood Stove was tested for thermal efficiency and carbon monoxide (CO) emissions in accordance with CSA B415.1-10 using Cherry cordwood.

SUMMARY OF RESULTS

The weighted average emissions of the three test runs included in the results indicate a particulate emission rate of 1.48 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 Large 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

- Run 1 -** Test procedures followed to produce a high burn rate with a primary air setting of fully open. Observed burn rate was calculated at 5.18 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 for inclusion in the weighted average.
- Run 2 -** Test procedures were followed to produce a medium burn rate with a primary air setting of 0.03" from full closed. Observed burn rate was calculated at 1.18 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 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 4.84 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 low burn rate with a primary air setting of fully closed. Observed burn rate was calculated at 1.17 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 three was used. No sampling anomalies occurred; this test run was determined to be valid for inclusion in the weighted average.

Table 1 – Particulate Emissions

Run	Burn Rate Calculated from a Hot to Hot burn cycle (kg/h dry)	ASTM E2515 Emissions (g/h)	ASTM E3053 Weighting Factor (%)	ASTM E3053 Weighted Emissions (g/h)
1	5.18	¹ 4.65	20	0.930
2	1.18	0.84	40	0.336
4	1.17	0.53	40	0.212
The sum of weighted particulate emission of 3 test runs, tests 1,2, and 4: $0.930 + 0.336 + 0.212 = \mathbf{1.48}$ grams per hour.				

Note: ¹ Based on a cold start including kindling and start-up fuel.

Table 2 – Particulate Emissions (First Hour)

Run	ASTM E2515 Emissions – First Hour (g/h)
1	5.49
2	5.24
4	3.32

Table 3 – B415.1 Efficiency and CO Emissions

Run	Heat Output (BTU/h)	HHV Efficiency (%)	LHV Efficiency (%)	CO Emissions (g/MJ Output)	CO Emissions (g/kg Dry Fuel)	CO Emissions (g/min)
1	70,045	71.8	77.0	2.73	37.91	3.357
2	16,461	75.8	81.3	3.88	56.86	1.121
4	16,394	76.6	82.1	4.63	68.62	1.334
Weighted average HHV efficiency of three test runs: $14.36 + 30.32 + 30.64 = \mathbf{75.3\%}$.						
Average CO Emissions of three tests: $(3.357 + 1.121 + 1.334) / 3 = \mathbf{1.937 \text{ g/min}}$						

Table 4 – Test Facility Conditions

Run	Room Temperature (°F)		Barometric Pressure (Hg)		Air Velocity (ft/min)	
	Before	After	Before	After	Before	After
1	75	78	29.43	29.41	<50	<50
2	76	75	29.35	29.45	<50	<50
3	68	78	29.74	29.74	<50	<50
4	77	77	29.74	29.76	<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	4.00	6.0	2.2
3	3.80	5.50	2.1

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 (ft³)	Fuel Loading Density Wet Basis (lbs/ft³)	Test Fuel Dry Basis (lbs)	Test Fuel Consumed During Test Dry Basis (lbs)	Piece Length (in)
1	20.6	2.00	10.3	16.86 + 8.56	21.2	<u>3@15.0</u> 2@16.0
2	25.1	2.00	12.6	20.6	20.6	<u>3@15.0</u> 3@16.0
3	19.6	2.00	9.8	16.03 + 8.05	20.1	<u>3@15.0</u> 2@16.0
4	25.1	2.00	12.6	20.6	20.6	<u>3@15.0</u> 3@16.0

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	123	20.14	200.0	143
2	475	20.62	221.6	97
4	480	19.95	218.7	92

Table 10 – 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 20 seconds to establish a fire. At 45 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 30 seconds. Test fuel load: fuel loading door was closed by 1:00 minute and 35 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> Open until 20 seconds after lighting kindling, not used for test fuel load loading.</p>	Fully open for entire test.
2	<p><u>Fuel Loading:</u> Test fuel loaded onto coal bed generated by test number 1 by 53 seconds.</p> <p><u>Door:</u> Closed by 3 minutes and 32 seconds.</p> <p><u>Primary Air:</u> Fully open until 5 minutes and 36 seconds then set to half open. At 12 minutes and 14 seconds set to 0.03” from fully closed.</p> <p><u>Fan:</u> Off for first 12 minutes and 14 seconds, then turned to high for remainder of test.</p> <p><u>Bypass:</u> Not used.</p>	Fully open for first 5 minutes 36 seconds, then set to half open. At 12 minutes 14 seconds set to 0.03” from full closed.
3	<p><u>Fuel Loading:</u> Kindling and start-up fuel loaded together; a torch was used for 30 seconds to establish a fire. At 41 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 35 seconds. Test fuel load: fuel loading door was closed by 1:00 minute and 30 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> Open until 35 seconds after lighting kindling, not used for test fuel load loading.</p>	Fully open for entire test.
4	<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 3 minutes and 30 seconds.</p> <p><u>Primary Air:</u> Fully open until 4 minutes and 45 seconds then set to half open. At 10 minutes and 45 seconds set to fully closed.</p> <p><u>Fan:</u> Off for first 10 minutes and 45 seconds, then turned to high for remainder of test.</p> <p><u>Bypass:</u> Not used.</p>	Fully open for first 3 minutes 30 seconds, then set to half open. At 10 minutes 45 seconds set to full closed.

Section 2

Photographs/Appliance Description/Drawings

GHP Group, Inc.
Model Large Wood Stove
Test Dates: May 5, 2020 – May 6, 2020

Front Left View



Rear View

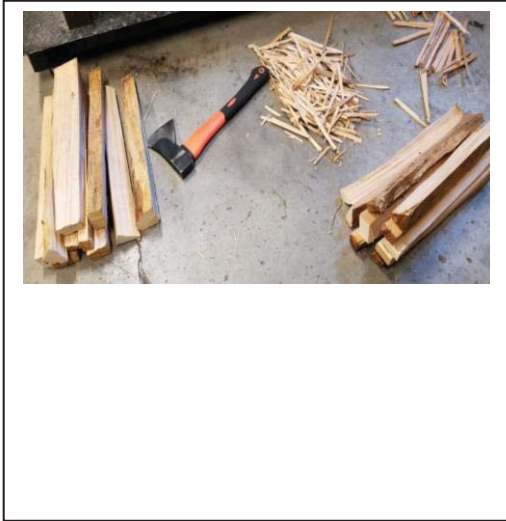


Front Right View



GHP Group, Inc. Model Large Wood Stove

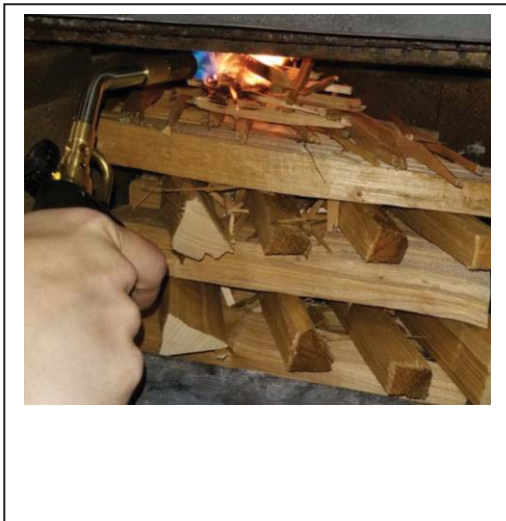
Run 1 – Kindling and start-up fuel



Run 1 – Kindling and start-up fuel



Run 1 – Ignition of kindling



Run 1 – Fuel load

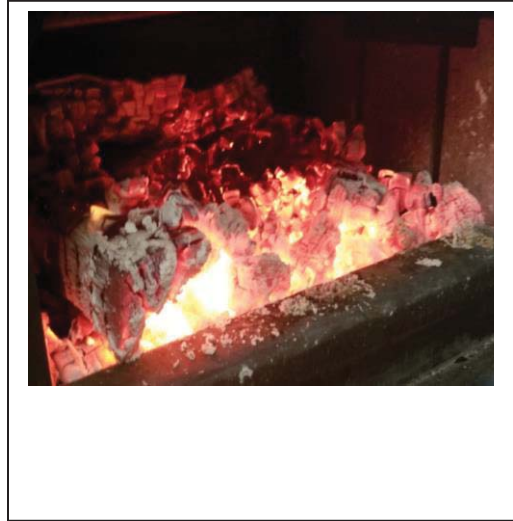


GHP Group, Inc. Model Large Wood Stove

Run 1 – Test Fuel Load In Stove



Run 1 – Remaining Coal After Test



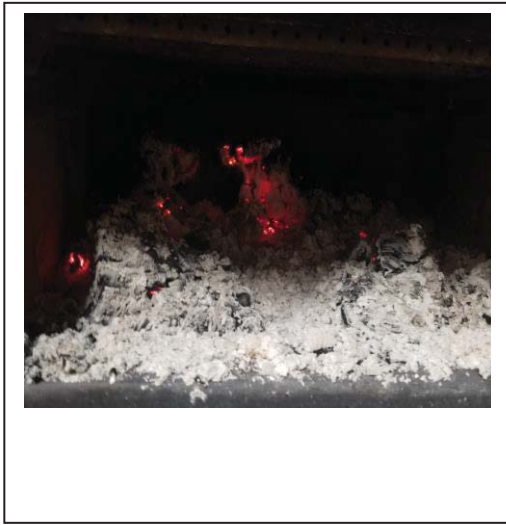
Run 2 – Test Fuel Load



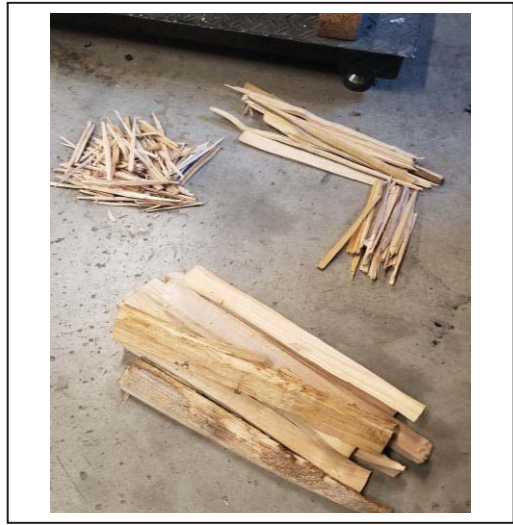
Run 2 – Test Fuel Loaded into Stove



Run 2 – Remaining Coal After Test



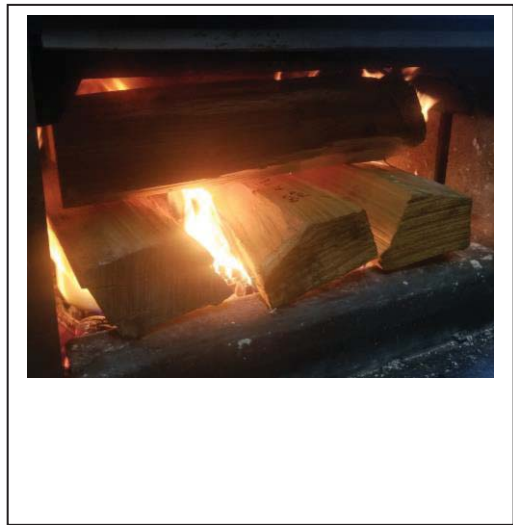
Run 3 – Kindling and start-up fuel



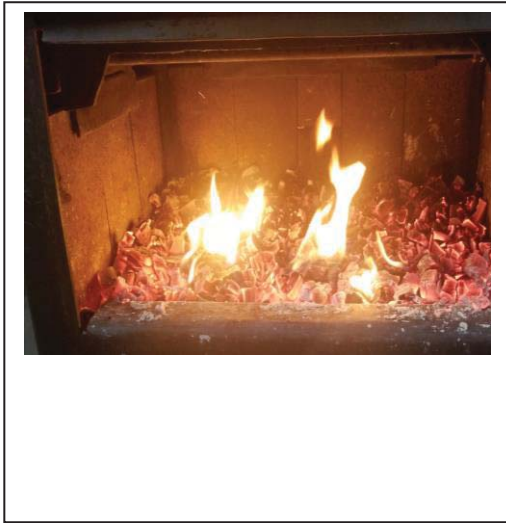
Run 3 – Test Fuel Load



Run 3 – Test Fuel Loaded into Stove



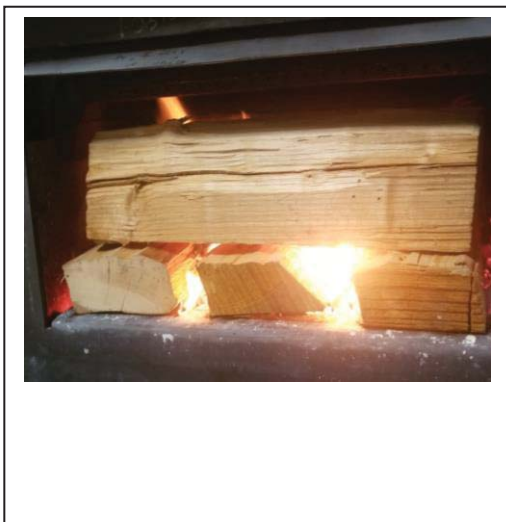
Run 3 - Remaining Coal After Test



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: Large 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 4-7/16" on the back, sides and hearth. The feed door has a 17.0 x 9.50 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 two 1.25" x 0.75" openings. A single 0.18" round opening is always open, regardless of air slide position.

Combustor: N/A

Internal Baffles: A two-piece vermiculite baffle is located above the secondary air tubes, a sliding vermiculite panel used as a flue gas bypass is mounted near the rear of the baffle.

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

Large Wood Stove, Legs;

GWS-2200
GWS-2200-B
WSL-2200
WSL-2200-B
LWS-2200
WS-2200
WS-2200-B

Large Wood Stove, Pedestal;

PH2200WS
PH2200WS-B
SWS-2200
SWS-2200-B
HWS-2200
HWS-2200-B
PWS-2200-B

Besides "Leg" vs. "Pedestal" parts for the base, all models have exactly the same firebox design and overall dimensions. The different model numbers are used for different sales channels.

Section 3

Test Data by Run

GHP Large with By-Pass High Burn Procedure

Kindling:

Kindling weight in total should be 3.5lbs (± 0.5 bs) ten pieces in total of equal size, 15-17" 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 5.5lbs (± 0.5 lbs) and a length of 15-17".

Test Fuel:

The test fuel consists of five pieces with a nominal length of 16". 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 as follows. 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. This comes from the 0.9-1.0lbs of the total kindling weight.

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

2nd: Two kindling and two start-up pieces North/South

3rd: Two kindling and two start-up pieces East/West

4th: Two kindling and two start-up pieces North/South

5th: Two kindling and two start-up pieces East/West

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

Kindling and Start-up:



Open the by-pass and 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 and by-pass as soon as the torch is done being used. 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 30-35 minutes. If the flames on top start to go out, open the door and grab 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 15" are to be placed in a north/south direction on the bottom with gaps between the pieces. The remaining two pieces 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 and a half to two and a half 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 Large with By-Pass 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 six pieces in total. The nominal length is 16”.



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

four minutes. Use the by-pass at the start of the test if needed. There should be minimal gaps between all fuel pieces. Three smaller pieces in a North/South direction and the remaining three pieces on top in an East/West direction (see test fuel picture above). Keep the primary control open until six to seven 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 0.030" 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.

Conditioning Data - ASTM E2780/ ASTM E2515

Manufacturer: GHP Group
 Model: GHP Large
 Tracking No.: 2409
 Project No.: 0418WS018E
 Test Date: February 2020
 Technician: Nelke Consulting
 Operation Category: _____

Elapsed Time (hr)	Flue Gas Temp (° F)	
0	450.0	
1	425.0	
2	420.0	
3	424.0	
4	463.0	
5	262.0	
6	402.0	
7	337.0	
8	258.0	
9	197.0	
10	140.0	
11	109.0	
12	94.0	
13	400.9	
14	466.0	
15	316.0	
16	321.0	
17	355.0	
18	327.0	
19	252.0	
20	256.0	
21	451.0	
22	266.0	
23	316.0	
24	421.0	
25	304.0	

Elapsed Time (hr)	Flue Gas Temp (° F)	
26	245.0	
27	199.0	
28	157.0	
29	129.0	
30	119.0	
31	106.0	
32	97.0	
33	94.0	
34	88.0	
35	82.0	
36	77.0	
37	73.0	
38	73.0	
39	172.7	
40	336.0	
41	296.0	
42	322.0	
43	328.0	
44	351.0	
45	245.0	
46	375.0	
47	324.0	
48	261.0	
49	366.0	
50	243.0	

Technician Signature: _____



Twin Ports Testing, Inc.
 1301 North 3rd Street
 Superior, WI 54880
 p: 715-392-7114
 p: 800-373-2562
 f: 715-392-7163
 www.twinportstesting.com

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

Test Results

	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 ₂	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
Chlorine	ASTM D6721	mg/kg		
Fluorine	ASTM D3761	mg/kg		
Mercury	ASTM D6722	mg/kg		
Density	ASTM E873	ka/m ³		611

kg/kg: 19,340

*Note: As received values do not include hydrogen and oxygen in the total moisture.

Comments:



Accreditation #60243

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Run 1

High Burn 1-minute data

Emissions Results (Cold to Hot Cycle)

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1
 Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 24100(S)18E
 Test Date: 25 May 2024
 Beginning Clock Time: 10:26
 Meter Box Y Factor: 0.988 (1) 0.985 (2)
 Barometric Pressure: Begin Middle End Average
 29.43 29.41 29.42 Hg
 OMNI Equipment Numbers:

PM Control Modules: 371 372
 Dilution Tunnel MW(wet): 29.90
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: -0.238 H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 20.14 ft/sec
 Initial Tunnel Flow: 218.2 scfm
 Average Tunnel Flow: 200.0 scfm
 Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 14 in. Hg
 Average Test Piece Fuel Moisture: 20.43 Dry Basis %

Technician Signature: *B. K. P.*

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP	0.074	0.096	0.096	0.088	0.070	0.080	0.096	0.088	0.098
Temp.	87	87	87	87	87	87	87	87	87
V _{trav}	20.07 ft/sec			V _{vac}			21.30 ft/sec		
F _p	0.942								

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)		Temperature Data (°F)										Stack Gas Data										
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH1 (H ₂ O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH2 (H ₂ 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 ₂ O)	CO ₂ (%)	CO (%)		
0	0.000	0.000															71	62	64	66	66	66		80	83	66	65	66	75	-0.015	0.03	0	
1	0.157	0.170	0.16	0.17	2.26	72	0.24	1.78	72	-2.1	87	0.100	87	89	10.0	0	75	63	64	66	66	67		97	83	65	84	64	64	76	-0.027	0.99	0.06
2	0.322	0.342	0.17	0.17	2.31	72	-0.26	1.75	72	-2.1	90	0.100	92	90	9.9	-0.1	102	63	65	66	66	72		126	83	65	84	64	76	-0.049	6.34	0.65	
3	0.487	0.516	0.17	0.17	2.25	72	0.01	1.76	72	-2.5	96	0.100	92	92	9.7	-0.2	142	63	66	66	66	67	81		181	83	65	84	65	76	-0.065	7.57	0.28
4	0.650	0.687	0.16	0.17	2.28	72	0.11	1.76	72	-2.5	104	0.100	92	91	9.5	-0.2	102	63	68	67	69	92		245	83	65	84	65	76	-0.078	8.35	0.36	
5	0.814	0.860	0.16	0.17	2.24	73	-0.22	1.78	72	-2.3	115	0.090	98	98	9.3	-0.24	257	63	73	68	72	107		306	84	68	85	65	77	-0.085	11.34	0.44	
6	0.977	1.022	0.16	0.17	2.22	73	-0.34	1.75	72	-2.4	122	0.090	98	98	9.0	-0.3	327	63	77	71	77	123		363	84	68	85	65	76	-0.093	12.89	0.3	
7	1.142	1.208	0.17	0.17	2.30	73	-0.26	1.82	72	-2.6	127	0.090	100	99	8.7	-0.3	388	63	81	73	82	137		399	85	68	86	65	77	-0.094	13.05	0.37	
8	1.306	1.381	0.16	0.18	2.27	73	-0.08	1.82	72	-2.5	132	0.090	100	100	8.3	-0.36	438	63	85	77	89	150		423	85	65	86	65	77	-0.098	13.28	0.33	
9	1.471	1.556	0.17	0.18	2.27	73	-0.41	1.80	73	-2.7	132	0.090	100	100	8.0	-0.28	489	64	89	81	96	164		441	85	64	87	64	78	-0.096	13.7	0.28	
10	1.634	1.729	0.16	0.17	2.24	73	-0.21	1.78	73	-2.4	136	0.090	100	99	7.8	-0.22	521	64	94	87	103	174		452	87	63	87	63	78	-0.099	12.47	0.24	
11	1.797	1.903	0.16	0.17	2.23	73	-0.45	1.76	73	-2.5	137	0.090	100	100	7.5	-0.3	547	65	97	93	111	183		459	86	62	87	63	78	-0.098	12.64	0.2	
12	1.960	2.075	0.16	0.17	2.23	73	0.08	1.78	73	-2.4	139	0.090	100	99	7.2	-0.3	571	66	101	99	119	191		468	86	62	87	62	79	-0.099	12.51	0.22	
13	2.123	2.248	0.16	0.17	2.28	73	-0.48	1.77	73	-2.7	143	0.090	100	100	6.9	-0.3	592	67	103	106	127	199		484	86	61	86	61	79	-0.101	12.95	0.19	
14	2.287	2.420	0.16	0.17	2.26	74	-0.44	1.77	73	-2.7	145	0.090	101	100	6.6	-0.3	619	68	108	113	135	209		498	85	60	86	61	79	-0.102	13.6	0.19	
15	2.451	2.592	0.16	0.17	2.25	74	-0.41	1.75	73	-2.6	148	0.090	101	100	6.3	-0.3	644	70	112	121	143	218		511	86	59	86	60	79	-0.102	13.88	0.19	
16	2.615	2.764	0.16	0.17	2.22	74	-0.34	1.73	73	-2.7	150	0.090	101	100	6.0	-0.3	668	72	115	130	151	227		524	86	59	86	59	79	-0.103	14.32	0.17	
17	2.778	2.934	0.16	0.17	2.22	74	-0.47	1.75	73	-2.7	150	0.090	100	99	5.8	-0.2	692	75	120	140	159	237		530	86	58	86	59	79	-0.103	14.29	0.15	
18	2.941	3.106	0.16	0.17	2.23	74	-0.31	1.74	74	-2.6	148	0.090	100	100	5.5	-0.3	693	78	124	150	168	243		520	86	58	85	58	78	-0.101	13.33	0.14	
19	3.106	3.280	0.17	0.17	2.27	74	-0.5	1.82	74	-2.7	145	0.090	101	101	5.3	-0.2	680	81	128	159	178	245		507	86	57	85	58	78	-0.099	12.07	0.16	
20	3.270	3.455	0.16	0.18	2.27	74	-0.5	1.81	74	-2.6	142	0.090	100	101	5.1	-0.2	664	85	133	169	184	247		484	86	57	85	57	79	-0.096	11.32	0.17	
21	3.435	3.630	0.17	0.18	2.27	74	-0.33	1.82	74	-2.6	141	0.090	101	101	4.9	-0.2	642	89	137	178	192	248		482	86	56	85	57	79	-0.096	10.58	0.17	
22	3.599	3.805	0.16	0.18	2.27	75	-0.5	1.81	74	-2.6	140	0.090	100	101	4.7	-0.2	629	94	142	187	202	251		475	86	56	85	56	78	-0.095	10.5	0.23	
23	3.764	3.980	0.17	0.18	2.28	75	-0.44	1.81	74	-2.8	138	0.090	101	101	4.5	-0.2	617	99	146	195	213	254		470	86	55	85	56	79	-0.095	10.52	0.27	
24	3.928	4.154	0.16	0.17	2.24	75	-0.37	1.81	74	-2.7	136	0.090	100	100	4.4	-0.1	603	104	150	204	223	257		459	86	55	85	55	78	-0.093	9.23	0.28	
25	4.092	4.330	0.16	0.18	2.27	75	-0.16	1.81	74	-2.8	134	0.090	100	101	4.2	-0.2	594	110	153	213	233	261		448	86	55	85	55	78	-0.091	8.91	0.38	
26	4.257	4.504	0.17	0.17	2.27	75	-0.07	1.80	75	-2.6	132	0.090	100	99	4.1	-0.1	578	115	155	223	243	263		436	86	54	84	55	78	-0.090	8.06	0.35	
27	4.421	4.679	0.16	0.18	2.26	75	-0.31	1.81	75	-2.6	130	0.090	99	100	4.0	-0.1	565	121	158	232	252	268		425	86	54	84	55	79	-0.088	7.58	0.31	
28	4.585	4.854	0.16	0.18	2.25	75	-0.38	1.81	75	-2.7	129	0.090	99	100	3.8	-0.2	548	127	162	240	261	288		416	86	54	84	54	78	-0.088	7.52	0.33	
29	4.750	5.029	0.17	0.18	2.26	75	-0.25	1.80	75	-2.6	128	0.090	99	100	3.7	-0.1	534	133	166	249	269	270		408	86	54	84	54	78	-0.087	7.55	0.31	
30	4.914	5.204	0.16	0.18	2.25	76	-0.03	1.81	75	-2.8	127	0.090	99	100	3.6	-0.1	528	139	171	257	277	274		403	86	53	84	54	78	-0.087	7.39	0.29	
31	5.078	5.380	0.16	0.18	2.23	76	-0.51	1.81	75	-2.9	127	0.090	99	100	3.5	-0.1	514	145	175	265	284	277		399	86	53	84	54	78	-0.087	7.1	0.39	
32	5.242	5.555	0.16	0.18	2.25	76	-0.26	1.80	75	-2.8	125	0.090	99	99	3.4	-0.1	505	152	178	273	291	280		394	86	53	84	54	78	-0.084	7.13	0.41	
33	5.407	5.730	0.17	0.18	2.25	76	-0.15	1.79	75	-2.8	124	0.090	99	99	3.3	-0.1	495	158	181	280	297	282		383	85	53	83	54	78	-0.083	6.54	0.47	
34	5.571	5.904	0.16	0.17	2.23	76	0.01	1.81	76	-2.8	122	0.090	98	98	3.3	-0.04	488	164	185	287	302	285		376	85	53	83	54	78	-0.083	6.36	0.52	
35	5.734	6.079	0.16	0.18	2.28	77	-0.28	1.80	76	-2.9	122	0.090	98	99	3.1	-0.16	478	171	190	293	308	288		373	85	53	83	53	77	-0.083	6.67	0.47	

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1
 Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 24100(S)18E
 Test Date: 25 May 20
 Beginning Clock Time: 10:26
 Meter Box Y Factor: 0.988 (1) 0.985 (2) (Amb)
 Barometric Pressure: Begin Middle End Average
 29.43 29.41 29.42 "Hg
 OMNI Equipment Numbers:

PM Control Modules: 371, 372
 Dilution Tunnel MW(wet): 25.00 lb/bt-mole
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: -0.258 "H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 20.14 ft/sec
 Initial Tunnel Flow: 218.2 scfm
 Average Tunnel Flow: 200.0 scfm
 Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 14 in. Hg
 Average Test Piece Fuel Moisture: 20.43 Dry Basis %

Technician Signature: *B. K.*

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP	0.074	0.096	0.096	0.088	0.070	0.080	0.096	0.088	0.098
Temp.	87	87	87	87	87	87	87	87	87
V _{aver}	20.07		ft/sec		V _{vacnt}		21.30		ft/sec
F _p	0.942								

Elapsed Time (min)	Particulate Sampling Data												Fuel Weight (lb)				Temperature Data (°F)										Stack Gas Data				
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H ₂ O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH 2 (H ₂ 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 ₂ O)	CO ₂ (%)	CO (%)
36	5.902	6.254	0.17	0.18	2.36	77	-0.43	1.78	76	-2.8	121	0.000	101	99	3.0	-0.1	474	177	193	296	313	291	372	85	52	83	53	77	-0.083	6.77	0.39
37	6.071	6.429	0.17	0.18	2.36	77	-0.34	1.80	76	-2.8	121	0.000	101	99	2.9	-0.1	470	184	197	303	318	294	372	85	52	83	53	77	-0.083	7.16	0.32
38	6.238	6.604	0.17	0.18	2.29	77	-0.24	1.79	76	-2.6	121	0.000	100	99	2.8	-0.1	465	190	202	307	324	298	371	85	52	83	53	77	-0.084	7.16	0.34
39	6.403	6.779	0.16	0.18	2.26	77	-0.09	1.79	76	-2.8	120	0.000	99	99	2.7	-0.1	463	196	207	311	329	301	368	85	52	83	53	78	-0.082	7.49	0.4
40	6.568	6.953	0.17	0.17	2.26	77	-0.36	1.79	76	-2.8	121	0.000	99	99	2.6	-0.1	456	202	212	315	333	304	366	85	52	83	53	77	-0.081	7.46	0.39
41	6.732	7.128	0.16	0.19	2.25	77	-0.07	1.78	76	-2.7	120	0.000	98	99	2.5	-0.1	455	208	219	318	339	308	365	84	52	82	53	77	-0.081	7.46	0.4
42	6.897	7.301	0.17	0.17	2.24	77	-0.29	1.78	77	-2.9	119	0.000	98	97	2.4	-0.1	453	214	225	322	343	311	366	84	52	82	53	77	-0.082	7.42	0.33
43	7.061	7.476	0.16	0.18	2.22	77	-0.28	1.79	77	-2.9	119	0.000	98	98	2.3	-0.1	452	221	230	325	348	315	365	84	52	82	53	77	-0.082	7.23	0.28
44	7.224	7.650	0.16	0.17	2.23	76	-0.89	1.78	77	-2.9	119	0.000	97	98	2.2	-0.1	449	227	231	328	353	316	364	84	52	82	53	77	-0.082	7.27	0.22
45	7.378	7.817	0.15	0.17	2.02	76	-2.08	1.61	77	-4.4	172	0.000	96	98	20.4	-18.2	435	233	234	332	357	318	343	85	52	83	53	77	-0.064	4.73	0.13
46	7.544	7.990	0.17	0.17	2.36	76	-4.67	1.61	77	-7.3	138	0.000	101	99	20.1	-3.2	427	240	232	335	362	319	348	85	52	83	53	78	-0.099	2.72	0.26
47	7.708	8.163	0.16	0.17	2.13	76	-4.76	1.64	77	-7.9	143	0.000	100	99	19.8	-0.3	484	247	224	338	365	332	421	85	52	83	54	77	-0.099	10.71	0.9
48	7.865	8.319	0.16	0.16	1.38	76	-10.17	0.93	77	-13.8	150	0.000	96	90	18.4	-0.38	553	254	220	341	368	347	473	84	53	82	53	78	-0.103	12.69	0.94
49	7.987	8.426	0.12	0.11	1.26	78	-14.31	1.20	77	-12.2	155	0.000	75	62	19.0	-0.4	615	260	215	343	371	361	512	84	53	81	54	78	-0.106	12.75	1.08
50	8.105	8.599	0.12	0.17	2.18	78	-10.55	1.74	77	-2.6	161	0.000	73	101	18.6	-0.44	669	267	213	344	374	373	545	83	54	83	54	78	-0.106	12.67	1.2
51	8.278	8.772	0.17	0.17	2.12	78	0.11	1.77	77	-2.6	164	0.000	107	101	18.2	-0.36	721	273	210	345	376	385	569	85	53	85	54	78	-0.107	12.56	1.25
52	8.442	8.945	0.16	0.17	2.21	78	-0.1	1.73	77	-2.8	168	0.000	108	108	17.8	-0.32	750	278	208	345	379	392	585	86	53	85	54	78	-0.109	12.62	1.26
53	8.606	9.146	0.17	0.17	2.27	78	-0.22	1.76	77	-2.9	170	0.000	103	102	17.5	-0.42	779	283	206	345	381	398	598	87	53	86	54	78	-0.108	12.76	1.23
54	8.772	9.291	0.16	0.17	2.23	79	-0.45	1.74	77	-2.7	173	0.000	102	102	17.1	-0.4	798	287	208	344	384	404	608	87	53	86	54	78	-0.109	12.94	1.19
55	8.936	9.464	0.16	0.17	2.27	79	-0.29	1.76	76	-2.9	174	0.000	108	108	16.7	-0.36	813	291	205	345	387	406	616	87	53	86	54	78	-0.108	13.06	1.21
56	9.102	9.639	0.17	0.17	2.25	79	-0.13	1.76	78	-2.9	175	0.000	110	109	16.3	-0.4	831	295	208	345	390	414	622	87	53	86	54	78	-0.110	13.96	0.75
57	9.266	9.811	0.16	0.17	2.24	79	-0.05	1.75	78	-2.8	176	0.000	108	108	15.9	-0.4	834	298	207	345	393	415	627	87	53	86	54	78	-0.110	16.14	1.16
58	9.430	9.983	0.16	0.17	2.23	79	-0.1	1.74	78	-2.9	176	0.000	102	101	15.2	-0.4	847	302	209	346	397	420	629	87	53	86	54	78	-0.111	16.08	1.04
59	9.594	10.156	0.16	0.17	2.28	79	-0.38	1.75	78	-2.9	175	0.000	108	107	15.2	-0.3	862	305	209	347	402	423	627	87	53	86	54	78	-0.109	16.78	0.93
60	9.760	10.331	0.17	0.18	2.27	79	-0.45	1.80	78	-3.3	174	0.000	110	110	14.8	-0.4	865	308	211	348	406	426	625	87	53	86	54	78	-0.109	16.58	0.75
61	9.925	10.506	0.17	0.17	2.24	79	-0.6	1.79	78	-3.3	175	0.000	109	109	14.5	-0.32	866	312	213	349	411	428	625	88	53	86	54	79	-0.110	16.82	0.76
62	10.089	10.680	0.16	0.17	2.25	79	-0.23	1.79	78	-3.1	175	0.000	108	109	14.1	-0.38	861	315	216	350	415	431	626	88	54	86	54	79	-0.109	15.84	0.7
63	10.254	10.854	0.16	0.17	2.25	80	-0.45	1.78	78	-3.2	175	0.000	109	109	13.7	-0.36	861	319	217	352	421	434	625	88	54	86	55	78	-0.109	15.77	0.59
64	10.418	11.028	0.16	0.17	2.24	80	-0.46	1.78	78	-3.1	174	0.000	108	108	13.4	-0.34	859	323	221	354	426	437	624	88	54	86	55	79	-0.108	15.65	0.5
65	10.582	11.202	0.16	0.17	2.22	80	-0.12	1.78	79	-3.2	173	0.000	102	102	13.1	-0.3	864	326	223	357	431	440	622	88	54	86	55	79	-0.108	15.59	0.44
66	10.746	11.376	0.16	0.17	2.23	80	-0.31	1.78	79	-3.4	173	0.000	102	101	12.7	-0.4	864	330	227	359	436	443	621	87	54	86	55	78	-0.108	15.34	0.4
67	10.911	11.549	0.16	0.17	2.22	80	-0.54	1.78	79	-3.4	172	0.000	102	102	12.4	-0.3	867	334	234	361	442	446	617	87	54	86	55	78	-0.108	15.14	0.38
68	11.074	11.722	0.16	0.17	2.21	80	-0.28	1.75	79	-3.1	171	0.000	101	101	12.1	-0.3	869	339	237	363	446	448	614	87	54	87	55	79	-0.107	15.01	0.32
69	11.237	11.896	0.16	0.17	2.27	80	-0.2	1.78	79	-3.2	170	0.000	101	102	11.8	-0.3	861	343	242	367	452	453	613	87	55	87	55	79	-0.108	15.09	0.31
70	11.403	12.070	0.17	0.17	2.27	81	-0.3	1.78	79	-3.2	169	0.000	103	102	11.5	-0.3	863	347	246	369	455	454	609	87	55	87	55	79	-0.108	15	0.26
71	11.569	12.244	0.17	0.17	2.27	81	-0.66	1.78	79	-3.2	169	0.000	103	102	11.1	-0.4	855	352	251	372	461	458	605	87	55	87	55	79	-0.107	14.96	0.24

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1
 Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 04100(S)18E
 Test Date: 05/09/20
 Beginning Clock Time: 10:26
 Meter Box Y Factor: 0.988 (1) 0.985 (2) (Amb)
 Total Sampling Time: 123 min
 Recording Interval: 1 min
 Background Sample Volume: cubic feet
 Barometric Pressure: Begin Middle End Average
 29.43 29.41 29.42 "Hg
 OMNI Equipment Numbers:

PM Control Modules: 371.372
 Dilution Tunnel MW(wt): 25.90 lb/bt-mole
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Sulfur: 0.238 %H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 20.14 ft/sec
 Initial Tunnel Flow: 218.2 scfm
 Average Tunnel Flow: 200.0 scfm
 Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 14 in. Hg
 Average Test Piece Fuel Moisture: 20.43 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	0.074	0.096	0.096	0.088	0.070	0.080	0.096	0.088	0.098
Temp.	87	87	87	87	87	87	87	87	87
V _{aver}	20.07 ft/sec			V _{aver}			21.30 ft/sec		
F _p	0.942								

Elapsed Time (min)	Particulate Sampling Data											Fuel Weight (lb)										Temperature Data (°F)										Stack Gas Data		
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH1 (H ₂ O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH2 (H ₂ 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 ₂ O)	CO ₂ (%)	CO (%)			
72	11.734	12.418	0.16	0.17	2.25	81	-0.26	1.76	79	-3.5	169	0.000	102	102	10.8	-0.3	861	366	266	375	465	461	602	87	55	87	55	78	-0.107	14.88	0.22			
73	11.898	12.591	0.16	0.17	2.25	81	-0.17	1.76	80	-3.5	168	0.000	101	101	10.5	-0.3	861	361	261	379	471	465	600	87	55	87	55	78	-0.106	14.86	0.2			
74	12.063	12.765	0.17	0.17	2.24	81	-0.17	1.76	80	-3.4	167	0.000	102	101	10.2	-0.28	848	365	266	381	475	467	598	87	55	87	56	78	-0.107	14.79	0.2			
75	12.227	12.938	0.16	0.17	2.22	81	-0.89	1.75	80	-3.4	166	0.000	107	107	10.0	-0.22	841	370	270	385	480	469	594	87	55	87	56	79	-0.106	14.78	0.2			
76	12.391	13.111	0.16	0.17	2.25	81	-0.7	1.74	80	-3.3	166	0.000	101	101	9.6	-0.4	842	375	272	388	485	472	593	87	55	88	56	78	-0.107	14.76	0.18			
77	12.556	13.283	0.16	0.17	2.25	82	-0.59	1.74	80	-3.3	165	0.000	108	108	9.4	-0.24	833	380	278	391	490	474	591	87	55	88	56	78	-0.106	14.69	0.14			
78	12.722	13.455	0.17	0.17	2.24	82	-0.35	1.72	80	-3.4	163	0.000	102	100	9.1	-0.26	833	384	285	394	492	478	587	87	56	88	56	79	-0.107	14.38	0.12			
79	12.886	13.628	0.16	0.17	2.24	82	-0.72	1.67	80	-3.5	163	0.000	101	99	8.8	-0.3	829	389	288	397	498	480	582	87	56	88	56	79	-0.106	14.28	0.1			
80	13.050	13.798	0.16	0.17	2.23	82	-0.65	1.76	80	-3.6	162	0.000	101	100	8.5	-0.28	823	394	290	400	504	482	576	86	56	88	56	79	-0.105	14.16	0.1			
81	13.215	13.973	0.16	0.18	2.24	82	-0.24	1.80	81	-3.8	160	0.000	101	101	8.3	-0.22	820	398	297	403	508	485	573	86	56	89	57	79	-0.104	13.98	0.09			
82	13.383	14.149	0.17	0.18	2.29	82	-0.72	1.82	81	-3.7	158	0.000	103	102	8.0	-0.3	812	403	300	407	514	487	569	86	56	88	57	78	-0.103	13.84	0.08			
83	13.548	14.325	0.17	0.18	2.25	82	-0.29	1.81	81	-3.8	158	0.000	101	102	7.8	-0.2	813	408	305	410	518	491	565	86	56	87	57	78	-0.103	13.68	0.09			
84	13.712	14.502	0.16	0.18	2.23	83	-0.3	1.81	81	-3.6	157	0.000	100	102	7.5	-0.3	803	412	309	412	520	491	561	86	56	87	57	78	-0.103	13.62	0.08			
85	13.877	14.678	0.17	0.18	2.23	83	-0.27	1.80	81	-3.9	156	0.000	101	101	7.3	-0.2	798	417	313	415	524	493	556	86	57	87	57	78	-0.103	13.36	0.08			
86	14.042	14.853	0.16	0.17	2.20	83	-0.75	1.80	81	-3.6	155	0.000	100	101	7.1	-0.2	790	422	318	418	528	495	551	86	57	86	57	78	-0.102	13.33	0.07			
87	14.206	15.030	0.16	0.18	2.19	83	-0.6	1.81	81	-3.6	154	0.000	100	102	6.9	-0.2	788	426	320	420	532	497	548	86	57	86	57	78	-0.102	13.32	0.06			
88	14.369	15.206	0.16	0.19	2.22	83	-0.3	1.81	81	-3.6	153	0.000	99	101	6.6	-0.3	785	431	324	424	535	500	544	86	57	86	57	78	-0.102	13.2	0.07			
89	14.534	15.382	0.17	0.18	2.22	83	-0.77	1.81	82	-3.6	151	0.000	100	101	6.4	-0.2	776	436	327	427	539	501	541	86	57	86	58	78	-0.101	13.03	0.06			
90	14.698	15.558	0.16	0.18	2.22	83	-0.28	1.81	82	-3.6	151	0.000	100	101	6.2	-0.2	769	441	329	430	543	502	536	86	57	86	58	78	-0.101	12.93	0.04			
91	14.863	15.735	0.16	0.18	2.28	84	-0.54	1.80	82	-3.9	150	0.000	100	101	6.0	-0.2	761	445	335	433	547	504	532	85	56	85	58	78	-0.101	12.87	0.04			
92	15.029	15.912	0.17	0.18	2.28	84	-0.39	1.82	82	-3.8	149	0.000	100	101	5.8	-0.2	756	450	339	436	552	507	530	85	58	85	58	78	-0.101	12.79	0.05			
93	15.195	16.089	0.17	0.18	2.29	84	-0.33	1.83	82	-3.6	147	0.000	100	101	5.6	-0.2	747	455	344	440	555	508	526	85	58	85	58	78	-0.101	12.77	0.02			
94	15.363	16.268	0.17	0.18	2.25	84	-0.5	1.83	82	-3.7	147	0.000	101	101	5.4	-0.2	741	459	350	442	557	510	522	85	58	85	58	78	-0.100	12.59	0.01			
95	15.528	16.444	0.17	0.18	2.25	84	-0.5	1.83	82	-3.8	146	0.000	100	102	5.2	-0.2	737	463	354	444	561	512	518	85	58	85	59	78	-0.100	12.55	0.01			
96	15.694	16.622	0.17	0.18	2.27	84	-0.82	1.83	82	-3.5	145	0.000	100	101	5.0	-0.2	729	467	359	446	565	513	515	85	58	85	59	78	-0.099	12.05	0.01			
97	15.860	16.799	0.17	0.18	2.26	84	-0.83	1.82	82	-3.7	144	0.000	100	101	4.9	-0.1	725	471	363	449	568	515	510	85	58	84	59	79	-0.099	11.89	0.01			
98	16.027	16.978	0.17	0.18	2.25	84	-0.82	1.83	83	-3.8	143	0.000	100	102	4.7	-0.2	713	475	365	452	571	515	504	85	59	84	59	78	-0.098	11.66	0			
99	16.194	17.158	0.17	0.18	2.25	85	-0.31	1.84	83	-3.8	142	0.000	100	101	4.5	-0.2	709	478	369	454	572	516	499	85	59	84	59	78	-0.098	11.35	0			
100	16.360	17.335	0.17	0.18	2.25	85	-0.4	1.79	83	-3.6	142	0.000	100	102	4.4	-0.1	695	482	370	457	576	518	496	84	59	84	60	77	-0.098	11.19	0			
101	16.526	17.510	0.17	0.18	2.28	85	-0.59	1.79	83	-3.4	140	0.000	99	99	4.2	-0.2	690	485	375	458	576	517	496	84	59	84	60	77	-0.097	11.24	0.01			
102	16.693	17.686	0.17	0.17	2.29	85	-0.35	1.80	83	-3.5	140	0.000	100	99	4.1	-0.14	682	489	380	460	577	518	491	84	59	84	60	77	-0.096	11.07	0.01			
103	16.860	17.862	0.17	0.18	2.28	85	-0.54	1.80	83	-3.5	138	0.000	100	100	3.9	-0.16	674	492	382	463	580	518	485	84	59	84	60	77	-0.096	10.45	0			
104	17.028	18.038	0.17	0.18	2.28	85	-0.46	1.81	83	-3.3	137	0.000	100	99	3.8	-0.1	668	495	386	465	581	519	480	84	59	84	60	78	-0.096	10.28	0.01			
105	17.194	18.215	0.17	0.18	2.27	85	-0.46	1.81	83	-3.3	136	0.000	99	100	3.7	-0.1	668	497	391	467	582	519	476	84	60	83	61	77	-0.095	10.21	0.01			
106	17.361	18.392	0.17	0.18	2.28	85	-0.8	1.81	83	-3.6	135	0.000	100	100	3.5	-0.2	648	500	392	469	582	518	472	84	60	83	61	77	-0.095	10.11	0			
107	17.528	18.569	0.17	0.18	2.28	85	-0.81	1.83	83	-3.3	135	0.000	100	100	3.4	-0.1	640	502	396	471	581	518	469	84	60	83	61	78	-0.095	9.96	0			

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1
 Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 24100/S018E
 Test Date: 25 May 20
 Beginning Clock Time: 10:26
 Meter Box Y Factor: 0.988 (1) 0.985 (2)
 Total Sampling Time: 123 min
 Recording Interval: 1 min
 Background Sample Volume: cubic feet
 Barometric Pressure: Begin Middle End Average
 29.43 29.41 29.42 "Hg
 OMNI Equipment Numbers:

PM Control Modules: 271, 372
 Dilution Tunnel MW(wet): 25.90 lb/bt-mole
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: -0.238 "H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 20.14 ft/sec
 Initial Tunnel Flow: 218.2 scfm
 Average Tunnel Flow: 200.0 scfm
 Post-Test Leak Check (1): 0.000 cfm @ 14 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 14 in. Hg
 Average Test Piece Fuel Moisture: 20.43 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	0.074	0.096	0.096	0.088	0.070	0.080	0.096	0.088	0.098
Temp.	87	87	87	87	87	87	87	87	87
V _{avg}	20.07		ft/sec		V _{vac}		21.30		ft/sec
F _p	0.942								

Elapsed Time (min)	Particulate Sampling Data													Fuel Weight (lb)		Temperature Data (°F)										Stack Gas Data					
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	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. Slove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (inHg)	CO ₂ (%)	CO (%)
108	17.695	18.747	0.17	0.18	2.28	85	-0.76	1.83	83	-3.6	134	0.080	100	100	3.3	-0.1	634	504	397	473	580	518	466	84	60	83	61	78	-0.094	10	0
109	17.862	18.925	0.17	0.18	2.29	85	-0.7	1.84	83	-3.3	133	0.080	99	100	3.2	-0.1	625	507	396	475	578	516	465	83	60	83	61	78	-0.094	9.84	0
110	18.031	19.104	0.17	0.18	2.29	85	-0.47	1.85	84	-3.5	132	0.080	100	101	3.1	-0.1	621	509	389	477	578	515	462	83	60	83	62	77	-0.094	9.7	0
111	18.199	19.283	0.17	0.18	2.32	86	-0.37	1.85	84	-3.2	131	0.080	100	100	3.0	-0.1	612	511	382	479	577	512	457	83	60	83	62	78	-0.093	9.46	0
112	18.367	19.462	0.17	0.18	2.35	86	-0.6	1.86	84	-3.5	130	0.080	100	100	2.9	-0.1	605	512	377	480	575	510	453	83	60	83	62	78	-0.091	9.16	0.02
113	18.535	19.641	0.17	0.18	2.32	86	-0.69	1.87	84	-3.4	129	0.080	100	100	2.8	-0.1	596	514	373	482	574	508	448	83	61	83	62	78	-0.090	8.48	0.05
114	18.704	19.821	0.17	0.18	2.33	86	-0.88	1.87	84	-3.2	128	0.080	100	101	2.7	-0.1	591	516	367	483	573	508	439	83	61	82	62	77	-0.089	8.51	0.07
115	18.873	20.002	0.17	0.18	2.33	86	-1.1	1.90	84	-3.3	128	0.080	100	101	2.6	-0.1	579	517	363	484	571	503	435	83	61	82	63	78	-0.090	7.99	0.05
116	19.041	20.179	0.17	0.18	2.24	86	-0.88	1.75	84	-3.2	127	0.080	98	99	2.6	0	573	519	358	484	570	501	431	82	61	82	63	78	-0.088	8	0.06
117	19.207	20.352	0.17	0.17	2.25	86	-0.49	1.75	84	-2.9	127	0.080	98	97	2.5	-0.1	568	520	357	485	569	499	426	82	61	82	63	78	-0.088	7.85	0.06
118	19.373	20.527	0.17	0.18	2.25	86	-0.27	1.75	84	-2.9	126	0.080	98	98	2.4	-0.1	559	522	354	484	567	497	422	82	61	82	63	78	-0.088	7.85	0.07
119	19.538	20.701	0.16	0.17	2.25	86	-0.71	1.77	84	-3.1	126	0.080	98	97	2.3	-0.1	554	523	354	483	566	496	419	82	61	82	63	78	-0.088	7.89	0.07
120	19.704	20.876	0.17	0.18	2.25	86	-0.36	1.77	84	-3	125	0.080	98	98	2.3	0	552	524	355	483	564	496	417	82	61	82	63	78	-0.087	7.92	0.08
121	19.871	21.051	0.17	0.17	2.26	86	-0.51	1.76	84	-3	125	0.080	99	98	2.2	-0.1	549	525	356	482	562	495	414	82	61	82	63	78	-0.087	7.95	0.09
122	20.038	21.226	0.17	0.18	2.27	86	-0.61	1.78	84	-2.8	124	0.080	99	98	2.1	-0.1	539	526	351	482	561	492	409	82	61	81	64	79	-0.087	7.4	0.09
123	20.204	21.402	0.17	0.18	2.25	86	-0.18	1.78	84	-2.9	124	0.080	98	98	2.0	-0.1	534	527	351	480	558	490	406	82	61	81	64	78	-0.087	7.37	0.1
Avg/Std	20.204	21.402	0.16	0.17	2.24	86		1.77	78		143	0.089	100	100								424.2		87	85	88	78	-0.095			

Wood Heater Lab Data - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group Equipment Numbers: _____
 Model: Large _____
 Tracking No.: 2409 _____
 Project No.: 0418WS018E _____
 Run #: 1 _____
 Date: 5/5/20 _____

TRAIN 1 (First Hour emissions)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T245S	103.3	99.0	4.3
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe				0.0
E. Filter seals catch*	Seals				0.0

Sub-Total Total Particulate, mg: 4.3

TRAIN 1 (Post First Hour Change-out)

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
B. Front filter catch	Filter	T226AP	184.5	182.0	2.5
C. Rear filter catch	Filter				0.0
D. Probe catch*	Probe	6	115348.7	115348.3	0.4
E. Filter seals catch*	Seals	R974	3320.3	3320.0	0.3

Sub-Total Total Particulate, mg: 3.2

Train 1 Aggregate Total Particulate, mg: 7.5

TRAIN 2

Sample Component	Reagent	Filter, Probe or Dish #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	T226BP	188.1	183.8	4.3
B. Rear filter catch	Filter	T246S	101.5	99.1	2.4
C. Probe catch*	Probe	OES 6	113711.9	113711.2	0.7
D. Filter seals catch*	Seals	R975	3576.6	3576.1	0.5

Total Particulate, mg: 7.9

AMBIENT

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

Total Particulate, mg: 0.0

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

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

Technician Signature: 

Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group
 Model: Large
 Project No.: 0418WS018E
 Tracking No.: 2409
 Run: 1
 Test Date: 05/05/20

Burn Rate	4.69 kg/hr dry
Average Tunnel Temperature	143 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	20.14 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	11998.3 dscf/hour
Average Delta p	0.089 inches H2O
Total Time of Test	123 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	20.204 cubic feet	21.402 cubic feet	9.760 cubic feet
Average Gas Meter Temperature	78 degrees Fahrenheit	80 degrees Fahrenheit	78 degrees Fahrenheit	76 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	19.307 dscf	20.412 dscf	9.394 dscf
Total Particulates - m _n	0 mg	7.5 mg	7.9 mg	4.3 mg
Particulate Concentration (dry-standard) - C _p /C _s	0.000000 grams/dscf	0.00039 grams/dscf	0.00039 grams/dscf	0.00046 grams/dscf
Total Particulate Emissions - E _T	0.00 grams	9.55 grams	9.52 grams	5.49 grams
Particulate Emission Rate	0.00 grams/hour	4.66 grams/hour	4.64 grams/hour	5.49 grams/hour
Emissions Factor		0.99 g/kg	0.99 g/kg	-3.04 g/kg
Difference from Average Total Particulate Emissions		0.02 grams	0.02 grams	

Dual Train Comparison Results Are Acceptable

	FINAL AVERAGE RESULTS
Complete Test Run	
Total Particulate Emissions - E _T	9.54 grams
Particulate Emission Rate	4.65 grams/hour
Emissions Factor	0.99 grams/kg
First Hour Emissions	
Total Particulate Emissions - E _T	5.49 grams
Particulate Emission Rate	5.49 grams/hour
Emissions Factor	-3.04 grams/kg
7.5% of Average Total Particulate Emissions	0.72 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	ECK 10 MIN. INTERVAL PRO-RAT

Technician Signature: 

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version
 Cordwood Fuel Load Calculators - 10 lb/ft³ Nominal Load Density
 Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight

Values to be input manually

For All Usable Firebox Volumes - High Fire Test Only				
Nominal Required Load Density (wet basis)	10	lb/ft ³		
Usable Firebox Volume	2.00	ft ³		
Total Nom. Load Wt. Target	20.00	lb		
Total Load Wt. Allowable Range	19.00	to 21.00	lb	
Core Target Wt. Allowable Range	9.00	to 13.00	lb	
Remainder Load Wt. Allowable Range	7.00	to 11.00	lb	
				Mid-Point
Core Load Pc. Wt. Allowable Range	3.00	to 5.00	lb	4.00
Remainder Load Pc. Wt. Allowable Range	2.00	to 11.00	lb	6.50
	Pc. #			
Core Load Piece Wt. Actual	1	4.40	lb	In Range
	2	4.00	lb	In Range
	3	3.90	lb	In Range
Core Load Total Wt. Actual		12.30	lb	In Range
	Pc. #			
Remainder Load Piece Wt.	1	4.80	lb	In Range
(1 to 3 Pcs.)	2	3.50	lb	In Range
	3		lb	NA
Remainder Load Tot. Wt. Act		8.30	lb	In Range
Total Load Wt. Actual		20.60	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		103%		In Range 95-105%
Actual Fuel Load Density		10.3	lb/ft ³	
Kindling and Start-up Fuel				
Maximum Kindling Wt. (20% of Tot. Load Wt.)		4.12	lb	
Actual Kindling Wt.		4.00	lb	In Range 19.4%
Maximum Start-up Fuel Wt. (30% of Tot. Load Wt.)		6.18	lb	
Actual Start-up Fuel Wt.		6.00	lb	In Range 29.1%
Allowable Residual Start-up Fuel Wt. Range	2.1	to 4.1	lb	Mid-Point
Actual Residual Start-up Fuel Wt.		2.2	lb	In Range 3.1
Total Wt. All Fuel Added (wet basis)		30.60	lb	
High Fire Test Run End Point Range				
Based on Fuel Load Wt. (w/tares)	Low	1.9	to 2.3	lb
Actual Fuel Load Ending Wt.		2.0	lb	In Range

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Fuel Piece Moisture Reading (%-dry basis)						
1	2	3	Ave.		Pc. Wt. Dry Basis	
22.2	18	21.1	20.4	In Range	3.65	1.66
27.9	23.3	18.2	23.1	In Range	3.25	1.47
28	26.7	22.8	25.8	In Range	3.10	1.41
27.4	21.6	18.6	22.5	In Range	3.92	1.78
20.6	18	18.1	18.9	In Range	2.94	1.34
			NA	NA	NA	NA
			22.2	In Range		
Total Load Ave. MC (%-dry basis)						
Total Load Ave. MC % (wet basis)				18.1		
Total Test Load Weight (dry basis)					16.86	7.65
Kindling Moisture (%-dry basis)						
11.5	11.9	11.1	11.5	In Range	3.59	1.63
Start-up Fuel Moisture Readings (%-dry basis)						
23.3	20.8	18	20.7	In Range	4.97	2.25
Total Wt. All Fuel Added (dry basis)					25.42	11.53
Total Wt. All Fuel Burned (dry basis)					21.2	9.6

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 1
 Model: GHP Large Tracking Number: 2409 Date: 5/5/20
 Test Crew: B. Davis
 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
Ø	Torch used for 20 seconds for a top down burn, bypass and door closed by 30 seconds. Combustion Air fully open. FAN off for first 5 minutes then turned to High.

Test Notes

Sketch test fuel configuration:

see photo

Start up procedures & Timeline:

Bypass: Not used

Fuel loaded by: 35 seconds

Door closed at: 95 seconds

Primary air: Fully open entire test

Notes: FAN on high entire test.

Time	Notes
50	Front filter changed i- Both A and B filter. tra-.

Technician Signature: B. Davis

Date: 5/21/20

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 1
 Model: GHP Large Tracking Number: 2409 Date: 5/5/20
 Test Crew: B.D.A.
 OMNI Equipment ID numbers: _____

Wood Heater Supplemental Data

Start Time: 0940 Booth #: N/A

Stop Time: 1143

Stack Gas Leak Check:

Initial: good Final: see end of run 2

Sample Train Leak Check:

A: 0.0 @ 14 "Hg
 B: 0.0 @ 14 "Hg

Calibrations: Span Gas CO₂: 16.94 CO: 4.32

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>0907</u>	<u>0907</u>	<u>see end of Run 2</u>	
CO ₂	<u>00.0</u>	<u>16.94</u>		
CO	<u>0.0</u>	<u>4.32</u>		

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

Scale Audit (lbs): Initial: 100 Final: 100

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: 4/29/20 Initials: BD

	Initial	Middle	Ending
P _b (in/Hg)	<u>29.43</u>		<u>29.41</u>
RH (%)	<u>52</u>		<u>47</u>
Ambient (°F)	<u>75</u>		<u>78</u>

Tunnel Traverse		
Microtector Reading	dP (in H ₂ O)	T(°F)
	<u>.074</u>	<u>87</u>
	<u>.096</u>	<u>87</u>
	<u>.096</u>	<u>87</u>
	<u>.088</u>	<u>87</u>
	<u>.070</u>	<u>87</u>
	<u>.080</u>	<u>87</u>
	<u>.096</u>	<u>87</u>
	<u>.088</u>	<u>87</u>
Center:		
	<u>.098</u>	<u>87</u>

Background Filter Volume: N/A

Tunnel Static Pressure (in H ₂ O):	
Beginning of Test	End of Test
<u>-.248</u>	<u>-.248</u>

Technician Signature: B.D.A.

Date: 5/4/20

Run 1

High Burn 1-minute data

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

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1
 Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 24100/S018E
 Test Date: 25 May 20
 Beginning Clock Time: 10:28
 Meter Box Y Factor: 0.988 (1) 0.985 (2)
 Total Sampling Time: 78 min
 Recording Interval: 1 min
 Background Sample Volume: _____ cubic feet
 Barometric Pressure: Begin Middle End Average
 29.43 29.41 29.42 "Hg
 OMNI Equipment Numbers: _____

PM Control Modules: 271, 372
 Dilution Tunnel MW(gly): 229.00
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: -0.2382 "H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 18.00 ft/sec
 Initial Tunnel Flow: 18.00 scfm
 Average Tunnel Flow: 18.00 scfm
 Post-Test Leak Check (1): 0.000 cfm @ 1 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 14 in. Hg
 Average Test Piece Fuel Moisture: 22.17 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									
Temp.									

V_{meter} _____ ft/sec V_{vacant} _____ ft/sec F_p _____

Elapsed Time (min)	Particulate Sampling Data										Temperature Data (°F)										Stack Gas Data												
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	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 Temp (°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 (inHg)	CO ₂ (%)	CO (%)		
0																18.6	435	233	234	332	357	318		343	85	52	83	53	77	-0.064	4.73	0.13	
1																18.1	0.5	427	240	232	335	362	319		348	85	52	83	53	78	-0.089	2.72	0.26
2																17.8	0.3	484	247	224	338	365	332		421	85	52	83	54	77	-0.099	10.71	0.9
3																17.4	0.4	553	254	220	341	368	347		473	84	53	82	53	78	-0.103	12.89	0.94
4																17.0	0.4	615	260	215	343	371	361		512	84	53	81	54	78	-0.106	12.75	1.08
5																16.8	0.4	669	267	213	344	374	373		545	83	54	83	54	79	-0.106	12.87	1.2
6																16.2	0.4	721	273	210	345	376	385		589	85	53	85	54	78	-0.107	12.58	1.25
7																15.9	0.3	750	278	208	345	379	392		585	86	53	85	54	78	-0.109	12.82	1.28
8																15.5	0.4	779	283	206	345	381	399		588	87	53	86	54	78	-0.108	12.78	1.23
9																15.1	0.4	798	287	206	344	384	404		608	87	53	86	54	78	-0.109	12.94	1.19
10																14.7	0.4	813	291	205	345	387	408		616	87	53	86	54	78	-0.109	13.09	1.21
11																14.3	0.4	831	295	208	345	390	414		622	87	53	86	54	78	-0.110	9.96	0.75
12																13.9	0.4	834	298	207	345	393	415		627	87	53	86	54	78	-0.110	16.14	1.16
13																13.5	0.4	847	302	209	346	397	420		629	87	53	86	54	78	-0.111	16.08	1.04
14																13.2	0.3	852	305	209	347	402	423		627	87	53	86	54	78	-0.109	15.78	0.93
15																12.8	0.4	855	308	211	348	406	428		625	87	53	86	54	78	-0.109	15.58	0.75
16																12.5	0.3	856	312	213	349	411	428		625	88	53	86	54	79	-0.110	15.82	0.76
17																12.1	0.4	861	315	216	350	415	431		628	88	54	86	54	79	-0.109	15.84	0.7
18																11.7	0.4	861	319	217	352	421	434		625	88	54	86	55	78	-0.109	15.77	0.59
19																11.4	0.3	869	323	221	354	428	437		624	88	54	86	55	79	-0.108	15.65	0.5
20																11.1	0.3	864	326	223	357	431	440		622	88	54	86	56	79	-0.109	15.56	0.44
21																10.7	0.4	864	330	227	359	436	443		621	87	54	86	55	78	-0.109	15.34	0.4
22																10.4	0.3	867	334	234	361	442	448		617	87	54	86	55	78	-0.108	15.14	0.38
23																10.1	0.3	856	339	237	363	446	448		614	87	54	87	55	79	-0.107	15.01	0.32
24																9.8	0.3	861	343	242	367	452	453		613	87	55	87	55	79	-0.108	15.09	0.31
25																9.5	0.3	853	347	246	369	455	454		609	87	55	87	55	79	-0.108	15	0.26
26																9.1	0.4	855	352	251	372	461	458		605	87	55	87	55	79	-0.107	14.96	0.24
27																8.8	0.3	851	356	256	375	465	461		602	87	55	87	55	78	-0.107	14.88	0.22
28																8.5	0.3	851	361	261	379	471	465		600	87	55	87	55	78	-0.106	14.86	0.2
29																8.2	0.3	848	365	266	381	475	467		598	87	55	87	56	78	-0.107	14.79	0.2
30																8.0	0.2	841	370	270	385	480	469		594	87	55	87	56	79	-0.106	14.78	0.2
31																7.8	0.4	842	375	272	388	485	472		593	87	55	88	56	78	-0.107	14.76	0.18
32																7.4	0.2	833	380	278	391	490	474		591	87	55	88	56	78	-0.106	14.69	0.14
33																7.1	0.3	833	384	285	394	492	478		587	87	56	88	56	79	-0.107	14.38	0.12
34																6.8	0.3	829	389	288	397	498	480		582	87	56	88	56	79	-0.106	14.28	0.1
35																6.5	0.3	823	394	290	400	504	482		578	86	56	88	56	79	-0.105	14.16	0.1

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1
 Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 54100/S018E
 Test Date: 25 May 20
 Beginning Clock Time: 10:28
 Meter Box Y Factor: 0.888 (1) 0.985 (2) _____ (Amb)
 Total Sampling Time: 78 min
 Recording Interval: 1 min
 Background Sample Volume: _____ cubic feet
 Barometric Pressure: Begin Middle End Average
29.43 29.41 29.42 "Hg
 OMNI Equipment Numbers: _____

PM Control Modules: 371.372
 Dilution Tunnel MW(dry): 29.00 lb/bt-mole
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: -0.238 "H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 18.00 ft/sec
 Initial Tunnel Flow: 18.00 scfm
 Average Tunnel Flow: 18.00 scfm
 Post-Test Leak Check (1): 0.000 cfm @ 1 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 14 in. Hg
 Average Test Piece Fuel Moisture: 22.17 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_{meter} _____ ft/sec V_{vacant} _____ ft/sec F_p _____

Elapsed Time (min)	Particulate Sampling Data											Temperature Data (°F)											Stack Gas Data									
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	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. Slove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (inHg)	CO ₂ (%)	CO (%)	
36															6.3	0.2	820	398	297	403	508	485		573	86	56	88	57	79	-0.104	13.84	0.09
37															6.0	0.3	812	403	300	407	514	487		569	86	56	88	57	78	-0.104	13.84	0.08
38															5.8	0.2	813	408	305	410	518	491		565	86	56	87	57	78	-0.103	13.68	0.09
39															5.5	0.3	803	412	309	412	520	491		561	86	56	87	57	78	-0.103	13.52	0.08
40															5.3	0.2	798	417	313	415	524	483		556	86	57	87	57	78	-0.103	13.36	0.08
41															5.1	0.2	790	422	318	418	528	485		551	86	57	86	57	78	-0.102	13.33	0.07
42															4.9	0.2	788	426	320	420	532	487		548	86	57	86	57	78	-0.102	13.32	0.06
43															4.6	0.3	785	431	324	424	535	500		544	86	57	86	57	78	-0.102	13.2	0.07
44															4.4	0.2	776	436	327	427	538	501		541	86	57	86	58	78	-0.101	13.03	0.06
45															4.2	0.2	769	441	329	430	543	502		536	86	57	86	58	78	-0.101	12.93	0.04
46															4.0	0.2	761	445	335	433	547	504		532	85	58	85	58	78	-0.101	12.87	0.04
47															3.8	0.2	756	450	339	436	552	507		530	85	58	85	58	78	-0.101	12.79	0.05
48															3.6	0.2	747	455	344	440	555	508		528	85	58	85	58	78	-0.101	12.77	0.02
49															3.4	0.2	741	459	350	442	557	510		522	85	58	85	58	78	-0.100	12.59	0.01
50															3.2	0.2	737	463	354	444	561	512		518	85	58	85	59	78	-0.100	12.35	0.01
51															3.0	0.2	729	467	359	446	565	513		515	85	58	85	59	78	-0.099	12.05	0.01
52															2.9	0.1	725	471	363	449	568	515		510	85	58	84	59	79	-0.099	11.89	0.01
53															2.7	0.2	713	475	365	452	571	515		504	85	59	84	59	78	-0.098	11.86	0
54															2.5	0.2	709	478	369	454	572	516		499	85	59	84	59	78	-0.098	11.35	0
55															2.4	0.1	695	482	370	457	576	516		496	84	59	84	60	77	-0.098	11.19	0
56															2.2	0.2	690	485	375	458	578	517		496	84	59	84	60	77	-0.097	11.24	0.01
57															2.1	0.1	682	489	380	460	577	518		491	84	59	84	60	77	-0.096	11.07	0.01
58															1.9	0.2	674	492	382	463	580	518		485	84	59	84	60	77	-0.096	10.45	0
59															1.8	0.1	666	495	386	465	581	519		480	84	59	84	60	78	-0.096	10.28	0.01
60															1.7	0.1	658	497	391	467	582	519		476	84	60	83	60	77	-0.095	10.02	0.01
61															1.5	0.2	648	500	392	469	582	518		472	84	60	83	61	77	-0.095	10.11	0
62															1.4	0.1	640	502	396	471	581	518		469	84	60	83	61	78	-0.095	9.96	0
63															1.3	0.1	634	504	397	473	580	518		466	84	60	83	61	78	-0.094	10	0
64															1.2	0.1	625	507	399	475	578	518		465	83	60	83	61	78	-0.094	9.84	0
65															1.1	0.1	621	509	399	477	578	518		462	83	60	83	62	77	-0.094	9.7	0
66															1.0	0.1	612	511	392	479	577	512		457	83	60	83	62	78	-0.093	9.46	0
67															0.9	0.1	605	512	377	480	575	510		453	83	60	83	62	78	-0.091	9.16	0.02
68															0.8	0.1	598	514	373	482	574	508		448	83	61	83	62	78	-0.090	8.48	0.05
69															0.7	0.1	591	516	367	483	573	506		439	83	61	82	62	77	-0.089	8.01	0.07
70															0.6	0.1	579	517	363	484	571	503		435	83	61	82	63	78	-0.090	7.99	0.05
71															0.6	0.0	573	519	358	484	570	501		431	82	61	82	63	78	-0.089	8	0.08

Control No. P-SSAR-0003


Page 4 of 8

High Burn Run 1_Efficiency

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1
 Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 24100/S018E
 Test Date: 25 May 20
 Beginning Clock Time: 10:28
 Meter Box Y Factor: 0.988 (1) 0.985 (2)
 Total Sampling Time: 78 min
 Recording Interval: 1 min
 Background Sample Volume: cubic feet
 Barometric Pressure: Begin Middle End Average
 29.43 29.41 29.42 "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 H₂O: 2.00 percent
 Dilution Tunnel Static: -0.2382 "H₂O
 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): 0.000 cfm @ 1 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 14 in. Hg
 Average Test Piece Fuel Moisture: 22.17 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									"H ₂ O
Temp.									"F
V _{traverse}	ft/sec			V _{vacant}			ft/sec		
F _p									

Elapsed Time (min)	Particulate Sampling Data												Fuel Weight (lb)										Temperature Data (°F)										Stack Gas Data		
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H ₂ O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH 2 (H ₂ 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 ₂ O)	CO ₂ (%)	CO (%)				
72															0.5	0.1	566	520	357	485	569	499		426	82	61	82	63	78	-0.088	7.85	0.06			
73															0.4	0.1	559	522	354	484	567	497		422	82	61	82	63	78	-0.088	7.85	0.07			
74															0.3	0.1	554	523	354	483	566	496		419	82	61	82	63	78	-0.088	7.89	0.07			
75															0.3	0.0	552	524	355	483	564	496		417	82	61	82	63	78	-0.087	7.92	0.08			
76															0.2	0.1	549	525	356	482	562	495		414	82	61	82	63	78	-0.087	7.95	0.09			
77															0.1	0.1	539	526	351	482	561	492		409	82	61	81	84	79	-0.087	7.4	0.09			
78															0.0	0.1	534	527	351	480	558	490		406	82	61	81	84	78	-0.087	7.37	0.1			
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!	0.0							171.8			57	85	58	78	-0.100						

Wood Heater Efficiency Results - CSA B415.1

Manufacturer: GHP Group
Model: Large
Date: 05/05/20
Run: 1
Control #: 0418WS018E
Test Duration: 78
Output Category: IV

Technician Signature: 

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	71.8%	77.0%
Combustion Efficiency	97.4%	97.4%
Heat Transfer Efficiency	74%	79.1%

Output Rate (kJ/h)	73,839	70,045	(Btu/h)
Burn Rate (kg/h)	5.31	11.71	(lb/h)
Input (kJ/h)	102,769	97,487	(Btu/h)

Test Load Weight (dry kg)	6.91	15.23	dry lb
MC wet (%)	18.14461119		
MC dry (%)	22.17		
CO (g)	262		
Test Duration (h)	1.30		

Emissions	Particulate	CO
g/MJ Output		2.73
g/kg Dry Fuel		37.91
g/h		201.43
lb/MM Btu Output		6.34

Air/Fuel Ratio (A/F)	8.88
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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 - 10 lb/ft³ Nominal Load Density
 Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight

Values to be input manually

For All Usable Firebox Volumes - High Fire Test Only				
Nominal Required Load Density (wet basis)	10	lb/ft ³		
Usable Firebox Volume	2.00	ft ³		
Total Nom. Load Wt. Target	20.00	lb		
Total Load Wt. Allowable Range	19.00	to 21.00	lb	
Core Target Wt. Allowable Range	9.00	to 13.00	lb	
Remainder Load Wt. Allowable Range	7.00	to 11.00	lb	
				Mid-Point
Core Load Pc. Wt. Allowable Range	3.00	to 5.00	lb	4.00
Remainder Load Pc. Wt. Allowable Range	2.00	to 11.00	lb	6.50
	Pc. #			
Core Load Piece Wt. Actual	1	4.40	lb	In Range
	2	4.00	lb	In Range
	3	3.90	lb	In Range
Core Load Total Wt. Actual		12.30	lb	In Range
	Pc. #			
Remainder Load Piece Wt.	1	4.80	lb	In Range
(1 to 3 Pcs.)	2	3.50	lb	In Range
	3		lb	NA
Remainder Load Tot. Wt. Act		8.30	lb	In Range
Total Load Wt. Actual		20.60	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		103%		In Range 95-105%
Actual Fuel Load Density		10.3	lb/ft ³	
Kindling and Start-up Fuel				
Maximum Kindling Wt. (20% of Tot. Load Wt.)		4.12	lb	
Actual Kindling Wt.		4.00	lb	In Range 19.4%
Maximum Start-up Fuel Wt. (30% of Tot. Load Wt.)		6.18	lb	
Actual Start-up Fuel Wt.		6.00	lb	In Range 29.1%
Allowable Residual Start-up Fuel Wt. Range	2.1	to 4.1	lb	Mid-Point
Actual Residual Start-up Fuel Wt.		2.2	lb	In Range 3.1
Total Wt. All Fuel Added (wet basis)		30.60	lb	
High Fire Test Run End Point Range				
Based on Fuel Load Wt. (w/tares)	Low	1.9	to 2.3	lb
Actual Fuel Load Ending Wt.		2.0	lb	In Range

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Fuel Piece Moisture Reading (%-dry basis)							
1	2	3	Ave.		Pc. Wt. Dry Basis		
22.2	18	21.1	20.4	In Range	3.65	1.66	
27.9	23.3	18.2	23.1	In Range	3.25	1.47	
28	26.7	22.8	25.8	In Range	3.10	1.41	
27.4	21.6	18.6	22.5	In Range	3.92	1.78	
20.6	18	18.1	18.9	In Range	2.94	1.34	
			NA	NA	NA	NA	
Total Load Ave. MC (%-dry basis)				22.2	In Range		
Total Load Ave. MC % (wet basis)				18.1			
Total Test Load Weight (dry basis)						16.86	7.65
Kindling Moisture (%-dry basis)							
11.5	11.9	11.1	11.5	In Range	3.59	1.63	
Start-up Fuel Moisture Readings (%-dry basis)							
23.3	20.8	18	20.7	In Range	4.97	2.25	
Total Wt. All Fuel Added (dry basis)						25.42	11.53
Total Wt. All Fuel Burned (dry basis)						21.2	9.6

Run 1

High Burn 10-minute data

Proportional Rate Verification

This data set is presented to verify that when proportional rates are calculated at the required 10-minute interval, required specification that only one reading can be outside of the 90% to 110% are maintained.

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 1
 Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 24100/S018E
 Test Date: 25 May 20
 Beginning Clock Time: 29:40
 Meter Box Y Factor: 0.988 (1) 0.985 (2)
 Background Sample Volume: _____ cubic feet
 Barometric Pressure: Begin Middle End Average
 29.43 29.41 29.42 "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 H₂O: 2.00 percent
 Dilution Tunnel Static: -0.2383 "H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 20.14 ft/sec
 Initial Tunnel Flow: 218.2 scfm
 Average Tunnel Flow: 201.2 scfm
 Post-Test Leak Check (1): 0.000 cfm @ 1 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 14 in. Hg
 Average Test Piece Fuel Moisture: 20.43 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	0.074	0.096	0.096	0.088	0.070	0.080	0.096	0.088	0.098
Temp.	87	87	87	87	87	87	87	87	87
V _{aver}	20.07 ft/sec			V _{cent} 21.30 ft/sec			F _p 0.942		

Elapsed Time (min)	Particulate Sampling Data												Fuel Weight (lb)		Temperature Data (°F)										Stack Gas Data							
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	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. Slove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (H ₂ O)	CO ₂ (%)	CO (%)	
0	0.000	0.000			2.02	72	0.22	1.69	72	-0.8	86	0.100			10.0		71	62	64	66	66	66	80	83	66	85	66	75	-0.015	0.03	0	
10	1.634	1.729	0.16	0.17	2.24	73	-0.21	1.78	73	-2.4	136	0.090	100	100	7.8	-2.2	521	64	84	84	87	103	174	452	87	63	87	63	78	-0.099	12.47	0.24
20	3.270	3.455	0.16	0.17	2.27	74	-0.5	1.81	74	-2.6	142	0.090	101	100	5.1	-2.7	604	85	133	169	184	247	494	86	57	85	57	79	-0.096	11.32	0.17	
30	4.914	5.204	0.16	0.17	2.25	76	-0.03	1.81	75	-2.8	127	0.090	100	100	3.6	-1.5	528	139	171	171	257	277	274	403	86	53	84	54	78	-0.087	7.39	0.29
40	6.568	6.953	0.17	0.17	2.26	77	-0.36	1.79	76	-2.8	121	0.090	100	89	2.6	-1.1	458	202	212	212	315	333	304	366	85	52	83	53	77	-0.081	7.46	0.39
50	8.105	8.599	0.16	0.16	2.19	78	-0.55	1.74	77	-2.6	161	0.090	96	97	10.8	16.98	699	267	215	344	374	373	545	83	54	83	54	76	-0.106	12.87	1.2	
60	9.760	10.331	0.17	0.17	2.27	79	-0.45	1.80	79	-3.3	174	0.090	110	109	14.0	3.76	855	308	211	348	406	428	625	87	53	86	54	78	-0.109	15.58	0.75	
70	11.403	12.070	0.16	0.17	2.27	81	-0.3	1.79	79	-3.2	169	0.090	102	102	11.5	-3.3	853	347	246	389	455	454	609	87	55	87	55	79	-0.108	15	0.26	
80	13.050	13.738	0.16	0.17	2.25	82	-0.55	1.78	80	-3.6	162	0.090	102	101	8.5	-2.88	823	394	290	400	504	482	578	86	56	88	56	79	-0.105	14.16	0.1	
90	14.698	15.558	0.16	0.18	2.22	83	-0.28	1.81	82	-3.6	151	0.090	101	101	8.2	-2.32	769	441	329	430	543	502	536	86	57	86	58	78	-0.101	12.93	0.04	
100	16.360	17.335	0.17	0.18	2.26	85	-0.4	1.78	83	-3.6	142	0.090	100	102	4.4	-1.8	695	482	370	457	576	516	496	84	59	84	60	77	-0.099	11.19	0	
110	18.031	19.104	0.17	0.18	2.29	86	-0.47	1.85	84	-3.5	132	0.090	100	100	3.1	-1.3	621	509	389	477	578	515	462	83	60	83	62	77	-0.094	9.7	0	
120	19.704	20.876	0.17	0.18	2.25	86	-0.36	1.77	84	-3	125	0.090	99	100	2.3	-0.8	552	524	355	483	564	496	417	82	61	82	63	78	-0.087	7.92	0.08	
123	20.204	21.402	0.05	0.05	2.26	86	-0.18	1.78	84	-2.9	124	0.090	99	98	2.0	-0.3	534	527	351	480	558	490	406	82	61	81	64	78	-0.087	7.37	0.1	
AvgTot	20.204	21.402	0.16	0.16	2.24	80		1.78	79		139	0.090	101	101								424.2			88	85	89	78	-0.091			

Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group
 Model: Large
 Project No.: 0418WS018E
 Tracking No.: 2409
 Run: 1
 Test Date: 05/05/20

Burn Rate	4.69 kg/hr dry
Average Tunnel Temperature	139 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	20.14 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	12073.6 dscf/hour
Average Delta p	0.090 inches H2O
Total Time of Test	123 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	20.204 cubic feet	21.402 cubic feet	9.760 cubic feet
Average Gas Meter Temperature	78 degrees Fahrenheit	80 degrees Fahrenheit	79 degrees Fahrenheit	80 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	19.296 dscf	20.401 dscf	9.322 dscf
Total Particulates - m _n	0 mg	7.5 mg	7.9 mg	4.3 mg
Particulate Concentration (dry-standard) - C _p /C _s	0.000000 grams/dscf	0.00039 grams/dscf	0.00039 grams/dscf	0.00046 grams/dscf
Total Particulate Emissions - E _T	0.00 grams	9.62 grams	9.58 grams	5.57 grams
Particulate Emission Rate	0.00 grams/hour	4.69 grams/hour	4.68 grams/hour	5.57 grams/hour
Emissions Factor		1.00 g/kg	1.00 g/kg	-3.08 g/kg
Difference from Average Total Particulate Emissions		0.02 grams	0.02 grams	

Dual Train Comparison Results Are Acceptable

	FINAL AVERAGE RESULTS
Complete Test Run	
Total Particulate Emissions - E _T	9.60 grams
Particulate Emission Rate	4.68 grams/hour
Emissions Factor	1.00 grams/kg
First Hour Emissions	
Total Particulate Emissions - E _T	5.57 grams
Particulate Emission Rate	5.57 grams/hour
Emissions Factor	-3.08 grams/kg
7.5% of Average Total Particulate Emissions	0.72 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

Technician Signature: 

Run 2

Medium Burn

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 2
 Manufacturer: GHP Group
 Model: GHP Large
 Tracking No.: 2405
 Project No.: 24100(S)18E
 Test Date: 25 May 20
 Beginning Clock Time: 12:10
 Meter Box Y Factor: 0.988 (1) 0.985 (2) _____ (Amb)
 Total Sampling Time: 475 min
 Recording Interval: 5 min
 Background Sample Volume: _____ cubic feet
 Barometric Pressure: Begin Middle End Average
29.41 29.38 29.40 "Hg
 OMNI Equipment Numbers: _____

PM Control Modules: 371.372
 Dilution Tunnel MW(g/dry): 29.00 lb/bt-mole
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: -0.258 "H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 20.82 ft/sec
 Initial Tunnel Flow: 224.9 scfm
 Average Tunnel Flow: 221.8 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: 21.59 Dry Basis %

Technician Signature: B. K. R.

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP	0.076	0.096	0.100	0.082	0.084	0.094	0.098	0.092	0.100
Temp.	82	82	82	82	82	82	82	82	82
V _{trav}	20.48		ft/sec		V _{vac}		21.42		ft/sec
F _p	0.958								

Elapsed Time (min)	Particulate Sampling Data														Fuel Weight (lb)		Temperature Data (°F)											Stack Gas Data				
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH1 (H ₂ O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH2 (H ₂ 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 ₂ O)	CO ₂ (%)	CO (%)	
0	0.000	0.000			1.96	85	-0.26	1.98	84	-1.3	112	0.100			25.1		410	540	332	478	520	456		325	81	67	82	67	76	-0.080	2.98	0.38
5	0.808	0.868	0.16	0.17	2.25	86	0.13	1.78	84	-2.3	156	0.090	106	108	23.8	-1.3	492	541	420	464	499	483		469	85	62	84	63	77	-0.112	10.12	0.8
10	1.638	1.738	0.17	0.17	2.24	86	0.03	1.77	84	-2.4	147	0.090	108	108	22.1	-1.7	738	538	412	446	481	523		539	84	62	82	63	77	-0.112	12.71	1.07
15	2.468	2.608	0.17	0.17	2.26	86	-0.05	1.75	84	-2.6	125	0.090	106	105	20.7	-1.4	749	532	295	424	469	494		474	83	63	80	62	78	-0.101	10.27	0.24
20	3.301	3.477	0.17	0.17	2.26	86	0.1	1.75	84	-2.5	119	0.090	106	105	19.8	-0.9	688	524	258	407	458	467		416	84	63	82	63	78	-0.096	8.83	0.41
25	4.131	4.344	0.17	0.17	2.25	86	0.1	1.74	84	-2.7	118	0.090	106	104	18.2	-1.0	675	517	240	380	446	454		404	87	63	86	63	78	-0.096	10.48	0.23
30	4.970	5.226	0.17	0.18	2.26	86	-0.4	1.81	84	-2.8	117	0.090	107	106	17.0	-0.9	674	510	228	376	434	445		397	87	63	88	63	79	-0.095	10.78	0.19
35	5.804	6.110	0.17	0.18	2.25	86	0.1	1.80	84	-2.8	116	0.090	106	106	17.0	-0.9	672	505	218	368	424	438		394	87	64	88	64	78	-0.094	10.74	0.22
40	6.639	6.993	0.17	0.18	2.25	86	-0.18	1.81	84	-2.9	116	0.090	106	106	16.1	-0.9	678	500	213	380	417	434		394	86	64	88	65	80	-0.095	11.38	0.26
45	7.474	7.876	0.17	0.18	2.27	86	-0.18	1.79	85	-2.9	116	0.090	106	106	15.2	-0.9	690	498	207	359	411	432		396	85	64	88	66	79	-0.095	11.52	0.26
50	8.309	8.758	0.17	0.18	2.27	87	-0.1	1.79	85	-2.7	116	0.090	106	106	14.2	-1.0	680	492	206	354	405	429		394	86	65	87	66	79	-0.095	11.38	0.29
55	9.144	9.637	0.17	0.18	2.27	87	0	1.79	85	-2.7	116	0.090	106	106	13.4	-0.8	688	488	204	354	406	430		394	86	65	87	67	80	-0.094	11.76	0.28
60	9.979	10.519	0.17	0.18	2.32	87	-0.08	1.79	85	-2.9	115	0.090	106	106	12.4	-1.0	700	484	204	354	404	429		394	85	66	87	67	79	-0.094	11.92	0.24
65	10.817	11.403	0.17	0.18	2.22	87	0.2	1.80	85	-2.9	115	0.100	101	100	11.6	-0.8	692	480	206	355	405	428		388	86	66	88	68	79	-0.092	11.73	0.19
70	11.646	12.288	0.17	0.18	2.25	87	-0.29	1.81	85	-2.8	115	0.100	100	101	10.8	-0.8	684	476	208	357	409	427		383	87	66	88	68	80	-0.092	11.91	0.2
75	12.479	13.176	0.17	0.18	2.25	88	-0.3	1.80	86	-2.7	114	0.090	105	106	10.0	-0.8	678	472	210	363	412	427		381	87	67	87	69	80	-0.091	11.99	0.27
80	13.312	14.062	0.17	0.18	2.24	88	-0.22	1.81	88	-2.6	113	0.100	100	100	9.3	-0.7	681	467	217	366	414	429		381	86	67	88	69	80	-0.090	12.17	0.26
85	14.145	14.950	0.17	0.18	2.24	88	-0.28	1.81	88	-2.6	113	0.100	101	8.8	-0.7	688	463	220	371	419	428		371	86	67	87	69	80	-0.089	11.53	0.12	
90	14.977	15.838	0.17	0.18	2.24	88	0.16	1.82	88	-2.8	111	0.100	100	8.0	-0.6	641	460	223	376	428	425		355	86	67	88	69	80	-0.088	10.85	0.1	
95	15.810	16.727	0.17	0.18	2.24	88	0.2	1.82	86	-2.6	110	0.100	100	7.4	-0.6	628	458	228	380	432	425		345	85	68	87	70	81	-0.085	10.44	0.11	
100	16.642	17.616	0.17	0.18	2.24	88	0.21	1.81	87	-2.6	109	0.100	99	100	7.0	-0.5	598	457	231	383	435	421		330	86	68	87	70	81	-0.082	9.62	0.2
105	17.475	18.505	0.17	0.18	2.23	89	0.02	1.81	87	-2.7	107	0.100	99	100	6.5	-0.5	576	457	237	386	438	419		320	85	68	87	70	81	-0.081	9.42	0.22
110	18.308	19.394	0.17	0.18	2.23	89	0.22	1.81	87	-2.8	106	0.100	99	100	6.1	-0.4	560	457	244	387	438	417		311	85	68	87	70	80	-0.080	9.19	0.2
115	19.142	20.283	0.17	0.18	2.23	89	0.07	1.82	87	-2.6	105	0.100	99	100	5.7	-0.4	549	457	249	388	439	416		308	85	68	87	70	80	-0.080	9.32	0.23
120	19.976	21.173	0.17	0.18	2.25	89	0.22	1.82	87	-2.9	105	0.100	99	100	5.3	-0.4	529	458	256	390	439	414		309	85	68	87	70	80	-0.080	9.41	0.18
125	20.810	22.063	0.17	0.18	2.25	89	0.12	1.81	87	-2.7	103	0.100	99	100	5.0	-0.3	503	458	258	391	440	410		296	84	68	87	70	81	-0.077	8.34	0.19
130	21.645	22.953	0.17	0.18	2.24	89	-0.12	1.81	87	-2.6	101	0.100	99	100	4.8	-0.2	479	459	262	392	439	406		281	84	68	86	70	82	-0.074	7.77	0.17
135	22.479	23.843	0.17	0.18	2.26	89	-0.3	1.82	87	-2.9	101	0.100	99	100	4.6	-0.2	456	461	263	392	437	402		267	84	68	86	70	81	-0.071	7.42	0.18
140	23.312	24.732	0.17	0.18	2.25	89	-0.28	1.82	87	-2.9	100	0.100	99	99	4.5	-0.1	431	463	263	393	434	397		254	84	68	86	69	81	-0.068	6.56	0.4
145	24.147	25.623	0.17	0.18	2.25	89	-0.21	1.81	87	-2.9	99	0.100	99	99	4.3	-0.2	411	468	258	391	430	391		244	84	68	86	69	81	-0.068	6.45	0.84
150	24.981	26.513	0.17	0.18	2.25	89	-0.1	1.81	87	-2.7	99	0.100	99	99	4.2	-0.1	392	468	258	388	425	386		237	84	68	86	69	82	-0.065	6.9	0.48
155	25.815	27.403	0.17	0.18	2.24	89	-0.16	1.82	87	-2.6	98	0.100	99	99	4.1	-0.1	381	471	259	385	422	384		232	84	68	86	69	82	-0.063	6.87	0.47
160	26.650	28.293	0.17	0.18	2.23	89	-0.28	1.83	87	-2.6	97	0.100	99	99	4.0	-0.1	372	474	255	384	418	381		226	84	68	86	69	81	-0.063	6.76	0.48
165	27.485	29.185	0.17	0.18	2.24	89	-0.25	1.81	87	-2.6	97	0.100	99	99	3.9	-0.1	361	476	255	383	415	378		221	84	68	86	69	81	-0.062	6.62	0.51
170	28.319	30.074	0.17	0.18	2.24	89	0.14	1.81	87	-2.8	97	0.100	88	99	3.8	-0.1	355	481	254	380	411	376		218	84	68	86	69	82	-0.061	6.46	0.54
175	29.153	30.966	0.17	0.18	2.24	89	0.13	1.81	87	-2.8	96	0.100	88	99	3.8	-0.2	348	483	254	378	407	373		214	84	68	86	69	81	-0.060	6.38	0.57

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 2
 Manufacturer: GHP Group
 Model: GHP Large
 Tracking No.: 2405
 Project No.: 54100/S018E
 Test Date: 25 May 20
 Beginning Clock Time: 12:10
 Meter Box Y Factor: 0.988 (1) 0.985 (2) _____ (Amb)
 Total Sampling Time: 475 min
 Recording Interval: 5 min
 Background Sample Volume: _____ cubic feet
 Barometric Pressure: Begin Middle End Average
29.41 29.38 29.40 "Hg
 OMNI Equipment Numbers: _____

PM Control Modules: 371, 372
 Dilution Tunnel MW(wt): 22.90 lb/bt-mole
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: -0.258 "H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 20.82 ft/sec
 Initial Tunnel Flow: 224.9 scfm
 Average Tunnel Flow: 221.8 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: 21.59 Dry Basis %

Technician Signature: B. K. P.

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP	0.076	0.096	0.100	0.082	0.084	0.094	0.098	0.092	0.100
Temp.	82	82	82	82	82	82	82	82	82
V _{avg}	20.48			ft/sec			V _{vac}	21.42	
F _p	0.958								

Elapsed Time (min)	Particulate Sampling Data												Fuel Weight (lb)				Temperature Data (°F)										Stack Gas Data				
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	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 Temp (°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 ₂ (%)	CO (%)
180	29.986	31.856	0.17	0.18	2.24	89	-0.3	1.82	87	-2.6	95	0.100	98	99	3.6	0.0	339	484	249	375	403	370	211	84	68	85	69	82	-0.060	5.78	0.64
185	30.820	32.747	0.17	0.18	2.25	89	-0.29	1.82	87	-2.6	95	0.100	98	99	3.5	-0.1	331	484	247	373	400	367	208	84	68	85	69	82	-0.059	5.72	0.75
190	31.653	33.638	0.17	0.18	2.24	89	-0.07	1.82	87	-2.6	95	0.100	98	99	3.4	-0.1	324	480	245	370	397	363	204	83	69	85	69	81	-0.058	5.7	0.73
195	32.486	34.529	0.17	0.18	2.25	89	-0.3	1.82	87	-2.6	95	0.100	98	99	3.3	-0.1	318	476	241	367	393	359	202	84	69	86	70	82	-0.058	5.74	0.73
200	33.319	35.420	0.17	0.18	2.26	89	-0.29	1.82	87	-2.6	95	0.100	98	99	3.2	-0.1	314	473	238	365	389	356	200	83	69	85	70	82	-0.058	5.56	0.73
205	34.152	36.311	0.17	0.18	2.24	89	-0.13	1.82	87	-2.6	95	0.100	98	99	3.1	-0.1	307	470	236	361	385	352	197	84	69	85	70	81	-0.057	5.4	0.76
210	34.985	37.203	0.17	0.18	2.24	89	-0.08	1.81	87	-2.6	94	0.100	98	99	3.0	0.1	305	466	235	358	382	349	194	84	70	85	70	81	-0.057	5.46	0.82
215	35.818	38.094	0.17	0.18	2.24	89	0.05	1.83	87	-2.6	93	0.100	98	99	3.0	0.0	299	463	235	354	377	346	191	84	70	85	70	82	-0.056	5.34	0.84
220	36.651	38.986	0.17	0.18	2.24	89	-0.1	1.82	87	-2.6	93	0.100	98	99	2.9	-0.1	292	458	232	352	375	342	189	85	70	85	71	82	-0.055	5.25	0.86
225	37.484	39.877	0.17	0.18	2.24	89	-0.26	1.81	87	-2.6	93	0.100	98	99	2.8	-0.1	287	454	231	347	371	338	185	84	70	85	71	82	-0.054	5.25	0.91
230	38.317	40.769	0.17	0.18	2.24	89	-0.26	1.81	87	-2.6	93	0.100	98	99	2.7	-0.1	282	449	229	344	368	334	184	85	71	85	71	82	-0.054	5.2	0.88
235	39.150	41.660	0.17	0.18	2.23	89	0.21	1.82	87	-2.6	93	0.100	98	99	2.6	-0.1	281	444	228	340	366	332	182	84	71	85	72	81	-0.054	5.24	0.84
240	39.982	42.552	0.17	0.18	2.24	88	0.18	1.82	87	-2.7	92	0.100	98	99	2.6	0.0	277	440	227	337	363	329	180	85	71	85	72	80	-0.053	5.25	0.82
245	40.815	43.444	0.17	0.18	2.24	88	-0.3	1.81	87	-2.9	91	0.100	98	99	2.5	-0.1	274	437	226	334	361	326	180	84	72	85	72	80	-0.054	5.23	0.81
250	41.648	44.336	0.17	0.18	2.23	88	-0.22	1.82	87	-2.8	91	0.100	98	99	2.4	-0.1	272	435	225	333	359	325	179	84	72	85	72	81	-0.053	5.28	0.85
255	42.487	45.229	0.17	0.18	2.23	88	-0.19	1.83	87	-2.6	91	0.100	99	99	2.3	-0.1	271	432	224	332	356	323	178	84	72	85	73	80	-0.053	5.23	0.82
260	43.333	46.121	0.17	0.18	2.23	88	0.09	1.82	87	-2.9	91	0.100	100	99	2.2	-0.1	270	430	221	330	353	321	178	84	72	85	73	80	-0.053	5.07	0.77
265	44.169	47.012	0.17	0.18	2.23	88	0.13	1.82	87	-2.9	90	0.100	100	99	2.2	0.0	268	428	221	330	351	320	177	84	73	85	73	80	-0.052	5.01	0.76
270	45.024	47.905	0.17	0.18	2.23	88	-0.08	1.82	87	-2.6	90	0.100	99	99	2.2	0.0	268	427	220	331	348	318	176	84	73	85	73	79	-0.052	4.99	0.76
275	45.870	48.797	0.17	0.18	2.23	88	-0.21	1.82	86	-2.6	90	0.100	99	99	2.1	-0.1	267	425	219	332	344	317	176	84	73	84	74	79	-0.051	4.9	0.76
280	46.716	49.688	0.17	0.18	2.20	87	0.14	1.83	86	-2.8	90	0.100	100	99	2.0	-0.1	262	423	218	332	340	315	175	84	73	85	74	80	-0.051	4.91	0.8
285	47.561	50.580	0.17	0.18	2.23	87	0.07	1.82	86	-2.7	90	0.100	100	99	1.9	-0.1	262	421	218	332	338	314	175	84	74	84	74	80	-0.052	4.79	0.82
290	48.406	51.471	0.17	0.18	2.23	87	0.13	1.82	86	-2.6	90	0.100	100	99	1.9	0.0	261	419	219	331	336	313	175	84	74	85	74	80	-0.052	4.53	0.83
295	49.250	52.362	0.17	0.18	2.20	87	-0.32	1.82	86	-2.9	90	0.100	99	99	1.8	-0.1	256	417	218	331	335	311	171	84	74	84	74	80	-0.051	4.47	0.81
300	50.095	53.253	0.17	0.18	2.29	87	0.07	1.82	86	-2.6	90	0.100	100	99	1.8	0.0	252	414	219	328	332	309	170	84	74	84	75	81	-0.051	4.36	0.8
305	50.939	54.144	0.17	0.18	2.30	87	0	1.82	86	-2.8	90	0.100	99	99	1.7	-0.1	250	412	218	328	331	307	168	84	74	85	75	80	-0.050	4.43	0.82
310	51.784	55.035	0.17	0.18	2.30	87	-0.19	1.81	86	-2.7	89	0.100	99	99	1.6	-0.1	248	409	218	324	328	305	167	84	75	84	75	81	-0.050	4.42	0.82
315	52.627	55.926	0.17	0.18	2.31	87	0.15	1.81	86	-2.8	89	0.100	99	99	1.5	-0.1	246	406	220	322	326	304	166	84	75	85	75	80	-0.049	4.44	0.83
320	53.472	56.817	0.17	0.18	2.30	87	-0.26	1.82	86	-2.9	89	0.100	98	99	1.5	0.0	243	404	218	319	324	302	165	84	75	84	76	79	-0.048	4.46	0.86
325	54.316	57.708	0.17	0.18	2.31	87	-0.29	1.82	86	-2.9	89	0.100	98	99	1.5	0.0	241	401	218	318	322	300	165	84	75	84	76	79	-0.048	4.41	0.83
330	55.160	58.598	0.17	0.18	2.29	87	-0.01	1.82	86	-2.7	88	0.100	98	99	1.4	-0.1	242	399	218	316	320	299	164	84	75	84	76	80	-0.048	4.31	0.84
335	56.004	59.490	0.17	0.18	2.31	87	0.17	1.83	85	-2.6	88	0.100	99	99	1.3	-0.1	238	396	218	315	318	297	164	84	76	84	76	79	-0.048	4.29	0.83
340	56.848	60.381	0.17	0.18	2.29	87	0	1.82	85	-2.6	89	0.100	99	99	1.3	0.0	239	393	216	315	318	296	163	84	76	84	76	80	-0.048	4.26	0.83
345	57.692	61.272	0.17	0.18	2.30	87	0.05	1.82	85	-2.9	88	0.100	99	99	1.2	-0.1	234	389	216	313	317	294	162	84	76	84	76	80	-0.048	3.96	0.79
350	58.536	62.163	0.17	0.18	2.29	86	0.2	1.82	85	-2.6	88	0.100	99	99	1.1	-0.1	233	386	213	312	317	292	161	83	76	84	76	80	-0.048	3.94	0.8
355	59.379	63.054	0.17	0.18	2.31	86	0.18	1.82	85	-2.6	88	0.100	99	99	1.1	0.0	232	382	213	309	315	290	160	84	71	84	73	79	-0.048	3.98	0.81

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 2
 Manufacturer: GHP Group
 Model: GHP Large
 Tracking No: 2405
 Project No: 24100/S018E
 Test Date: 25 May 20
 Beginning Clock Time: 12:10
 Meter Box Y Factor: 0.988 (1) 0.985 (2) (Amb)
 Barometric Pressure: Begin Middle End Average
 29.41 29.38 29.40 "Hg
 OMNI Equipment Numbers:

PM Control Modules: 271, 372
 Dilution Tunnel MW(wet): 229.00 lb/bt-mole
 Dilution Tunnel MW(wet): 28.78 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: -0.2582 "H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 20.82 ft/sec
 Initial Tunnel Flow: 224.9 scfm
 Average Tunnel Flow: 221.8 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: 21.59 Dry Basis %

Technician Signature: *B. K. R.*

Velocity Traverse Data									
	PI.1	PI.2	PI.3	PI.4	PI.5	PI.6	PI.7	PI.8	Center
Initial dP	0.076	0.096	0.100	0.082	0.084	0.094	0.098	0.092	0.100
Temp.	82	82	82	82	82	82	82	82	82
V _{aver}	20.48		ft/sec		V _{vacnt}		21.42		ft/sec
F _p	0.958								

Elapsed Time (min)	Particulate Sampling Data														Fuel Weight (lb)										Temperature Data (°F)										Stack Gas Data		
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	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. Slove Surface	Stack	Filter 1	Dryer Exit 1	Filter 2	Dryer Exit 2	Ambient	Draft (inHg)	CO ₂ (%)	CO (%)						
360	60.223	63.946	0.17	0.18	2.30	86	-0.25	1.82	85	-2.8	86	0.100	99	99	1.0	-0.1	229	379	213	306	315	288	159	83	66	84	70	79	-0.047	3.98	0.81						
365	61.066	64.836	0.17	0.18	2.31	86	-0.21	1.81	85	-2.6	87	0.100	99	99	1.0	0.0	229	376	213	304	313	287	157	83	63	84	66	79	-0.048	3.98	0.81						
370	61.911	65.727	0.17	0.18	2.29	86	0.18	1.82	85	-2.6	87	0.100	99	99	1.0	0.0	225	373	212	302	311	285	157	83	61	84	64	78	-0.049	3.96	0.81						
375	62.755	66.617	0.17	0.18	2.32	86	-0.25	1.82	85	-2.8	86	0.100	99	99	0.9	-0.1	226	371	212	301	310	284	156	83	59	84	61	79	-0.048	3.95	0.8						
380	63.599	67.509	0.17	0.18	2.30	86	-0.03	1.83	85	-2.7	86	0.100	99	99	0.8	-0.1	225	368	211	301	309	283	156	83	57	84	60	78	-0.048	3.91	0.8						
385	64.443	68.400	0.17	0.18	2.32	86	-0.32	1.82	85	-2.9	86	0.100	99	99	0.8	0.0	223	366	209	300	308	281	155	83	56	84	59	78	-0.048	3.91	0.81						
390	65.287	69.291	0.17	0.18	2.30	86	-0.32	1.83	84	-2.6	86	0.100	99	99	0.7	0.1	222	364	211	299	306	280	154	83	55	84	58	78	-0.048	3.91	0.79						
395	66.131	70.182	0.17	0.18	2.31	85	-0.14	1.83	84	-2.7	86	0.100	99	99	0.7	0.0	223	362	209	298	305	279	154	83	54	84	57	78	-0.048	3.71	0.79						
400	66.975	71.073	0.17	0.18	2.30	85	-0.17	1.83	84	-2.9	85	0.100	99	99	0.7	0.0	220	360	208	297	303	278	153	83	54	84	56	77	-0.048	3.65	0.79						
405	67.819	71.964	0.17	0.18	2.31	85	0.14	1.82	84	-2.6	85	0.100	99	99	0.8	-0.1	219	358	208	296	302	277	153	83	54	83	56	77	-0.048	3.59	0.77						
410	68.662	72.854	0.17	0.18	2.31	85	-0.04	1.83	84	-2.8	85	0.100	99	99	0.5	-0.1	217	356	207	294	299	275	152	83	54	84	56	77	-0.048	3.51	0.75						
415	69.506	73.745	0.17	0.18	2.32	85	-0.32	1.83	84	-2.9	85	0.100	99	99	0.5	0.0	215	354	207	292	296	273	151	83	54	84	56	77	-0.048	3.42	0.73						
420	70.349	74.635	0.17	0.18	2.31	85	-0.09	1.83	84	-2.7	84	0.100	99	99	0.5	0.0	214	352	206	291	293	271	150	83	54	84	55	76	-0.047	3.4	0.73						
425	71.194	75.526	0.17	0.18	2.29	85	0.2	1.82	83	-2.6	84	0.100	99	99	0.4	-0.1	212	350	207	289	289	269	150	83	54	84	55	76	-0.048	3.36	0.72						
430	72.036	76.416	0.17	0.18	2.32	85	0.19	1.83	83	-2.6	83	0.100	99	99	0.4	0.0	211	348	206	288	285	268	150	83	54	83	55	77	-0.047	3.39	0.73						
435	72.881	77.308	0.17	0.18	2.31	84	0.17	1.83	83	-2.9	83	0.100	99	99	0.3	-0.1	209	346	206	287	282	266	149	83	55	84	56	76	-0.047	3.26	0.71						
440	73.723	78.198	0.17	0.18	2.30	84	-0.03	1.82	83	-2.6	82	0.100	99	99	0.3	0.0	208	344	207	286	278	265	149	82	55	83	56	77	-0.047	3.17	0.69						
445	74.567	79.089	0.17	0.18	2.31	84	0.01	1.83	83	-2.8	82	0.100	99	99	0.3	0.0	205	342	208	285	273	263	147	82	55	83	56	76	-0.047	3.1	0.67						
450	75.410	79.980	0.17	0.18	2.32	84	-0.21	1.82	83	-2.6	82	0.100	99	99	0.3	0.0	204	340	207	285	271	261	146	82	56	83	56	76	-0.047	3.12	0.67						
455	76.254	80.871	0.17	0.18	2.29	84	-0.04	1.82	83	-2.5	82	0.100	99	99	0.2	-0.1	202	338	205	286	268	260	145	82	56	83	57	76	-0.047	3.08	0.66						
460	77.098	81.762	0.17	0.18	2.32	84	0.12	1.82	82	-2.9	81	0.100	99	99	0.1	-0.1	202	337	205	285	264	259	144	82	57	83	57	76	-0.046	3.06	0.66						
465	77.943	82.652	0.17	0.18	2.31	83	-0.32	1.82	82	-2.6	81	0.100	99	99	0.1	0.0	198	336	205	284	261	257	143	82	57	83	58	75	-0.046	3.07	0.65						
470	78.786	83.541	0.17	0.18	2.31	83	-0.2	1.83	82	-2.8	81	0.100	99	99	0.1	0.0	197	335	204	283	258	255	143	82	57	83	58	75	-0.047	3.05	0.65						
475	79.621	84.432	0.17	0.18	2.30	83	-0.08	1.82	82	-2.6	81	0.100	99	99	0.0	-0.1	196	333	202	283	255	254	142	82	58	83	58	75	-0.046	3.01	0.64						
AvgTot	79.621	84.432	0.17	0.18	2.27	87		1.82	85		97	0.099	100	100								202.2		66	85	67	79	-0.063									

Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group
 Model: GHP Large
 Project No.: 0418WS018E
 Tracking No.: 2409
 Run: 2
 Test Date: 05/05/20

Burn Rate	1.18 kg/hr dry
Average Tunnel Temperature	97 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	20.62 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	13295.6 dscf/hour
Average Delta p	0.099 inches H2O
Total Time of Test	475 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	79.621 cubic feet	84.432 cubic feet	9.979 cubic feet
Average Gas Meter Temperature	79 degrees Fahrenheit	87 degrees Fahrenheit	85 degrees Fahrenheit	88 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	74.992 dscf	79.417 dscf	9.383 dscf
Total Particulates - m _n	0 mg	5.1 mg	4.6 mg	3.7 mg
Particulate Concentration (dry-standard) - C _p /C _s	0.000000 grams/dscf	0.00007 grams/dscf	0.00006 grams/dscf	0.00039 grams/dscf
Total Particulate Emissions - E _T	0.00 grams	7.16 grams	6.10 grams	5.24 grams
Particulate Emission Rate	0.00 grams/hour	0.90 grams/hour	0.77 grams/hour	5.24 grams/hour
Emissions Factor		0.77 g/kg	0.65 g/kg	1.11 g/kg
Difference from Average Total Particulate Emissions		0.53 grams	0.53 grams	

Dual Train Comparison Results Are Acceptable


FINAL AVERAGE RESULTS	
Complete Test Run	
Total Particulate Emissions - E _T	6.63 grams
Particulate Emission Rate	0.84 grams/hour
Emissions Factor	0.71 grams/kg
First Hour Emissions	
Total Particulate Emissions - E _T	5.24 grams
Particulate Emission Rate	5.24 grams/hour
Emissions Factor	1.11 grams/kg
7.5% of Average Total Particulate Emissions	0.50 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

Technician Signature: 

Wood Heater Efficiency Results - CSA B415.1

Manufacturer: GHP Group
Model: GHP Large
Date: 05/05/20
Run: 2
Control #: 0418WS018E
Test Duration: 475
Output Category: II

Technician Signature: 

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	75.8%	81.3%
Combustion Efficiency	96.1%	96.1%
Heat Transfer Efficiency	79%	84.6%

Output Rate (kJ/h)	17,353	16,461	(Btu/h)
Burn Rate (kg/h)	1.18	2.61	(lb/h)
Input (kJ/h)	22,880	21,704	(Btu/h)

Test Load Weight (dry kg)	9.37	20.64	dry lb
MC wet (%)	17.75940056		
MC dry (%)	21.59		
Particulate (g)	0.84		
CO (g)	533		
Test Duration (h)	7.92		

Emissions	Particulate	CO
g/MJ Output	0.01	3.88
g/kg Dry Fuel	0.09	56.86
g/h	0.11	67.27
lb/MM Btu Output	0.01	9.01

Air/Fuel Ratio (A/F)	14.86
----------------------	-------

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/ft³ 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 ³ - Low and Medium Fire						
Nominal Required Load Density (wet basis)	12	lb/ft ³				
Usable Firebox Volume	2.00	ft ³				
Total Nom. Load Wt. Target	24	lb				
Total Load Wt. Allowable Range	22.80	to	25.20	lb		
Core Target Wt. Allowable Range	10.8	to	15.60	lb		
Remainder Load Wt. Allowable Range	8.40	to	13.20	lb		
Core Load Fuel Pc. Wt. Allowable Range	3.60	to	6.00	lb	Mid-Point	4.80
Remainder Load Pc. Wt. Allowable Range	2.40	to	7.20	lb		4.80
Core Load Piece Wt. Actual	Pc. #					
	1	4.20	lb	In Range		
	2	3.70	lb	In Range		
	3	5.30	lb	In Range		
Core Load Total. Wt. Actual		13.20	lb	In Range		
Remainder Load Piece Wt.	Pc. #					
	1	5.40	lb	In Range		
	2	3.00	lb	In Range		
	3	3.50	lb	In Range		
Remainder Load Piece Weight Ratio - Small/Large		56%		In Range		≤ 67%
Remainder Load Tot. Wt. Act		11.90	lb	In Range		
Total Load Wt. Actual		25.10	lb	In Range		
Core % of Total Wt.		53%		In Range		45-65%
Remainder % of Total Wt.		47%		In Range		35-55%
Actual Load % of Nominal Target		105%		In Range		95-105%
Actual Fuel Load Density		12.6	lb/ft ³			
Allowable Charcoal Bed Wt. Range (lb)	2.6	to	5.0		Mid-Point	
Actual Charcoal Bed Wt.		2.6	lb	In Range		3.8
Actual Fuel Load Ending Wt.		0.0	lb	Valid Test		≥ 90%
Total Wt. of Fuel Burned During Test Run lb.		25.1	lb			

Fuel Piece Moisture Reading (%-dry basis)							
1	2	3	Ave.		Pc. Wt. Dry Basis		
19.7	20.1	20	19.9	In Range	3.50	1.59	
20.5	28	24.8	24.4	In Range	2.97	1.35	
28	21.1	19.6	22.9	In Range	4.31	1.96	
22.1	18.2	21.2	20.5	In Range	4.48	2.03	
24.4	18.3	18.6	20.4	In Range	2.49	1.13	
23	21.1	20	21.4	In Range	2.88	1.31	
Total Load Ave. MC % (dry basis)				21.6	In Range		
Total Load Ave. MC % (wet basis)				17.8			
Total Test Load Weight (dry basis)						20.64	9.36
Total Fuel Weight Burned During Test Run (dry basis)						20.6	9.36

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 2
 Model: GHP Large Tracking Number: 2409 Date: 5/5/20
 Test Crew: B. Orr
 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
	N/A

Test Notes

Sketch test fuel configuration:

See photo

Start up procedures & Timeline:

Bypass: Not used
 Fuel loaded by: 53 seconds
 Door closed at: 3:32 Fully open from 0-3:32
 Primary air: fully open until 5:36 then set
to 1/2 open then
set to full closed @ 12:14
 Notes: FAN off for first 12:14 then
turned to high for remainder of
test.

Time	Notes
60	changed front filter in tank A.

Technician Signature: B. Orr

Date: 5/21/20

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 2
 Model: GHP Large Tracking Number: 2409 Date: 5/5/20
 Test Crew: D. Davis
 OMNI Equipment ID numbers: _____

Wood Heater Supplemental Data

Start Time: 12:10 Booth #: _____

Stop Time: 2:05

Stack Gas Leak Check:

Initial: _____ Final: good

Sample Train Leak Check:

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

Calibrations: Span Gas CO₂: 16.99 CO: 4.32

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>see run 1</u>		<u>2018</u>	<u>2018</u>
CO ₂			<u>0.01</u>	<u>16.82</u>
CO			<u>-0.002</u>	<u>4.21</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: 4/29/20 Initials: MC

	Initial	Middle	Ending
P _b (in/Hg)	<u>29.41</u>		<u>29.38</u>
RH (%)	<u>47</u>		<u>37</u>
Ambient (°F)	<u>76</u>		<u>75</u>

Tunnel Traverse		
Microtector Reading	dP (in H ₂ O)	T (°F)
	<u>.076</u>	<u>82</u>
	<u>.098</u>	<u>82</u>
	<u>.100</u>	<u>82</u>
	<u>.082</u>	<u>82</u>
	<u>.084</u>	<u>82</u>
	<u>.094</u>	<u>82</u>
	<u>.098</u>	<u>82</u>
	<u>.072</u>	<u>82</u>
Center:		
	<u>100</u>	<u>82</u>

Background Filter Volume: N/A

Tunnel Static Pressure (in H ₂ O):	
Beginning of Test	End of Test
<u>-.256</u>	<u>-.256</u>

Technician Signature: [Signature]

Date: 5/21/20

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

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 3
 Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 24100(S)18E
 Test Date: 23 May 20
 Beginning Clock Time: 09:55
 Meter Box Y Factor: 0.988 (1) 0.985 (2) (Amb)
 Barometric Pressure: Begin Middle End Average
 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 H₂O: 2.00 percent
 Dilution Tunnel Static: H₂O
 Tunnel Area: 0.19635 R2
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 18.00 ft/sec
 Initial Tunnel Flow: 18.00 scfm
 Average Tunnel Flow: 2.00 scfm @ 0.000 in. Hg
 Post-Test Leak Check (1): 0.000 cfm @ 0.000 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 0.000 in. Hg
 Average Test Piece Fuel Moisture: 20.14 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 ₂ O
Temp.									F

V_{meter} _____ ft/sec V_{vacant} _____ ft/sec F_p _____

Elapsed Time (min)	Particulate Sampling Data											Temperature Data (°F)											Stack Gas Data									
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H ₂ O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH 2 (H ₂ 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 ₂ O)	CO ₂ (%)	CO (%)	
36															2.6	0.1	476	169	205	274	307	284		379	66	61	65	66	77	-0.084		
37															2.5	0.1	475	165	210	279	312	288		379	66	62	65	67	77	-0.085		
38															2.3	0.2	471	171	218	285	317	292		382	66	62	65	67	76	-0.085		
39															2.2	0.1	468	177	227	291	323	297		380	66	62	65	67	77	-0.084		
40															2.1	0.1	468	184	231	296	329	301		379	66	62	65	67	77	-0.084		
41															19.6	-17.5	464	190	236	301	336	305		396	67	62	65	67	76	-0.070		
42															19.0	0.6	458	196	233	307	341	307		400	67	63	65	67	76	-0.101		
43															18.6	0.4	533	203	228	312	347	324		481	68	63	65	67	76	-0.107		
44															18.1	0.5	601	211	220	318	352	340		530	69	63	65	67	77	-0.106		
45															17.7	0.4	665	218	215	323	357	356		566	70	63	65	67	78	-0.110		
46															17.2	0.4	718	225	211	327	361	368		592	72	63	65	67	79	-0.111		
47															16.8	0.4	758	232	209	331	365	379		615	73	63	65	67	79	-0.112		
48															16.4	0.4	789	238	207	334	370	388		624	74	63	65	67	79	-0.112		
49															16.1	0.3	812	245	205	337	373	394		632	75	64	66	67	79	-0.112		
50															15.6	0.4	834	251	203	340	377	401		633	77	64	66	67	78	-0.112		
51															15.3	0.3	841	257	204	343	381	405		634	78	64	66	68	79	-0.112		
52															14.9	0.4	851	264	203	346	385	410		633	79	64	66	68	79	-0.111		
53															14.5	0.4	855	270	203	350	389	413		630	80	64	66	68	78	-0.110		
54															14.2	0.3	859	277	204	353	393	417		628	80	64	66	68	79	-0.110		
55															13.9	0.3	854	284	204	356	397	419		628	81	65	66	68	80	-0.110		
56															13.5	0.4	853	291	206	360	401	422		626	81	65	66	68	78	-0.110		
57															13.2	0.3	857	299	207	363	405	426		622	81	65	66	68	80	-0.110		
58															12.8	0.4	856	307	211	367	410	430		618	81	65	66	68	79	-0.110		
59															12.5	0.3	844	316	213	371	414	432		614	81	65	66	68	78	-0.109		
60															12.2	0.3	837	324	215	375	419	434		608	81	65	66	68	79	-0.108		
61															11.8	0.4	830	333	219	379	424	437		602	81	66	66	68	80	-0.107		
62															11.5	0.3	824	341	223	383	428	440		596	82	66	66	68	79	-0.107		
63															11.3	0.2	814	350	224	387	433	442		591	82	66	66	68	79	-0.107		
64															10.9	0.4	802	359	228	392	438	444		586	82	66	66	68	80	-0.107		
65															10.6	0.3	796	367	232	397	443	447		580	82	66	66	68	80	-0.106		
66															10.4	0.2	787	376	235	401	448	449		576	82	66	66	68	80	-0.106		
67															10.1	0.3	782	384	239	406	452	453		572	82	66	66	68	79	-0.106		
68															9.8	0.3	773	393	242	411	457	455		568	82	66	66	68	79	-0.105		
69															9.5	0.3	774	401	243	415	461	459		564	82	67	65	68	78	-0.105		
70															9.3	0.2	765	410	247	420	466	462		559	82	67	65	68	79	-0.104		
71															9.0	0.3	758	418	252	425	469	464		555	82	67	65	68	78	-0.103		

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 3

Manufacturer: GHP Group
 Model: Large
 Tracking No.: 2405
 Project No.: 24100/S018E
 Test Date: 25 May 20
 Beginning Clock Time: 09:55
 Meter Box Y Factor: 0.988 (1) 0.985 (2) (Amb)
 Barometric Pressure: Begin Middle End Average
 OMNI Equipment Numbers:

PM Control Modules: 271, 372
 Dilution Tunnel MW(dry): 2290 lb/bt-mole
 Dilution Tunnel MW(wet): 2878 lb/bt-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: H₂O
 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): 0.000 cfm @ in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ in. Hg
 Average Test Piece Fuel Moisture: 20.14 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									H ₂ O
Temp.									F
	V _{trav} _____ ft/sec			V _{cent} _____ ft/sec			F _p _____		

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)										Temperature Data (°F)										Stack Gas Data		
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H ₂ O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH 2 (H ₂ 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 ₂ O)	CO ₂ (%)	CO (%)		
108															2.3	0.1	580	603	349	539	548	524		438	82	69				78	-0.091		
109															2.2	0.1	573	605	351	536	548	523		434	82	69				78	-0.091		
110															2.2	0.0	565	607	351	535	549	521		430	82	69				78	-0.089		
111															2.1	0.1	558	608	349	534	550	520		425	82	69				78	-0.090		
112															2.0	0.1	554	610	348	532	551	519		424	82	70				77	-0.089		
113															1.9	0.1	545	611	346	530	551	517		421	82	70				78	-0.088		
Avg Test	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!																			

Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group
 Model: Large
 Project No.: 0418WS018E
 Tracking No.: 2409
 Run: 3
 Test Date: 05/06/20

Burn Rate	4.84 kg/hr dry
Total Time of Test	113 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

Technician Signature: 

Adjunct to ASTM E XXXX Wood Heater Cordwood Test Method - May 10, 2017 Version
 Cordwood Fuel Load Calculators - 10 lb/ft³ Nominal Load Density
 Core 45-65% of Total Load Weight, Remainder 35-55% of Total Load Weight

Values to be input manually

For All Usable Firebox Volumes - High Fire Test Only				
Nominal Required Load Density (wet basis)	10	lb/ft ³		
Usable Firebox Volume	2.00	ft ³		
Total Nom. Load Wt. Target	20.00	lb		
Total Load Wt. Allowable Range	19.00	to 21.00	lb	
Core Target Wt. Allowable Range	9.00	to 13.00	lb	
Remainder Load Wt. Allowable Range	7.00	to 11.00	lb	
				Mid-Point
Core Load Pc. Wt. Allowable Range	3.00	to 5.00	lb	4.00
Remainder Load Pc. Wt. Allowable Range	2.00	to 11.00	lb	6.50
	Pc. #			
Core Load Piece Wt. Actual	1	4.50	lb	In Range
	2	3.90	lb	In Range
	3	3.80	lb	In Range
Core Load Total Wt. Actual		12.20	lb	In Range
	Pc. #			
Remainder Load Piece Wt.	1	4.10	lb	In Range
(1 to 3 Pcs.)	2	3.30	lb	In Range
	3		lb	NA
Remainder Load Tot. Wt. Act		7.40	lb	In Range
Total Load Wt. Actual		19.60	lb	In Range
Core % of Total Wt.		62%		In Range 45-65%
Remainder % of Total Wt.		38%		In Range 35-55%
Actual Load % of Nominal Target		98%		In Range 95-105%
Actual Fuel Load Density		9.8	lb/ft ³	
Kindling and Start-up Fuel				
Maximum Kindling Wt. (20% of Tot. Load Wt.)		3.92	lb	
Actual Kindling Wt.		3.80	lb	In Range 19.4%
Maximum Start-up Fuel Wt. (30% of Tot. Load Wt.)		5.88	lb	
Actual Start-up Fuel Wt.		5.50	lb	In Range 28.1%
Allowable Residual Start-up Fuel Wt. Range	2.0	to 3.9	lb	Mid-Point
Actual Residual Start-up Fuel Wt.		2.1	lb	In Range 2.9
Total Wt. All Fuel Added (wet basis)		28.90	lb	
High Fire Test Run End Point Range				
Based on Fuel Load Wt. (w/tares)	Low	1.8	to 2.2	lb
Actual Fuel Load Ending Wt.		1.9	lb	In Range 2.0

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Fuel Piece Moisture Reading (%-dry basis)							
1	2	3	Ave.		Pc. Wt. Dry Basis		
19.7	19.8	25.9	21.8	In Range	3.69	1.68	
22.4	18.3	22.3	21.0	In Range	3.22	1.46	
20.5	23.9	24	22.8	In Range	3.09	1.40	
20.2	24.7	23.1	22.7	In Range	3.34	1.52	
27.6	21.6	20.7	23.3	In Range	2.68	1.21	
			NA	NA	NA	NA	
Total Load Ave. MC (%-dry basis)				22.3	In Range		
Total Load Ave. MC % (wet basis)				18.2			
Total Test Load Weight (dry basis)						16.03	7.27
Kindling Moisture (%-dry basis)							
6.2	11.2	10.8	9.4	In Range	3.47	1.58	
Start-up Fuel Moisture Readings (%-dry basis)							
23	18	19	20.0	In Range	4.58	2.08	
Total Wt. All Fuel Added (dry basis)						24.09	10.93
Total Wt. All Fuel Burned (dry basis)						20.1	9.1

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 3
 Model: GHP Large Tracking Number: 2409 Date: 5/6/20
 Test Crew: B Davis
 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
Ø	Torch used for 30 seconds for a top down burn, bypass and door closed by 35 seconds. Comb. Air fully open FAN off for first 5 min then turned to high Tared 2.1 lbs

Test Notes

Sketch test fuel configuration:

see photos

Start up procedures & Timeline:

Bypass: Not used
 Fuel loaded by: 30 seconds
 Door closed at: 90 seconds
 Primary air: Fully open e-he test

Notes: FAN on High on fire test

Time	Notes
	N/A

Technician Signature: B Davis

Date: 5/21/20

Run 4

Low Burn

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 4
 Manufacturer: GHP Group
 Model: GHP L450
 Tracking No.: 3405
 Project No.: 04100/0018E
 Test Date: 03/09/20
 Beginning Clock Time: 12:04
 Meter Box Y Factor: 0.988 (1) 0.985 (2)
 Barometric Pressure: Begin Middle End Average
 29.74 29.76 29.75 Hg
 OMNI Equipment Numbers:

PM Control Module: 371.972
 Dilution Tunnel MW(wet): 29.02
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Sulfate: 0.029 H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 19.95 ft/sec
 Initial Tunnel Flow: 222.8 acfm
 Average Tunnel Flow: 218.7 acfm
 Post-Test Leak Check (1): 0.000 cfm @ 7 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 6 in. Hg
 Average Test Piece Fuel Moisture: 22.06 Dry Basis %

Technician Signature: *[Signature]*

Velocity Traverse Data							
	PT.1	PT.2	PT.3	PT.4	PT.5	PT.6	Center
Initial dP	0.072	0.092	0.098	0.088	0.072	0.096	0.102
Temp	84	84	84	84	84	84	84
V _{area}	20.19 ft/sec			V _{vac}			0.936
				21.56 ft/sec			F _p
							0.936

Elapsed Time (min)	Particulate Sampling Data														Temperature Data (°F)										Stack Gas Data						
	Gas Meter 1 (m ³)	Gas Meter 2 (m ³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H ₂ O)	Temp (°F)	Meter 1 Vacuum (H ₂ O)	Orifice dH 2 (H ₂ O)	Meter 2 Temp (°F)	Meter 2 Vacuum (H ₂ O)	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 ₂ O)	CO ₂ (%)	CO (%)
0	0.000	0.000			1.43	82	-0.21	2.03	81	-1.4	124	0.090			25.1		497	629	350	506	542	503	381	82	88	85	87	77	-0.084	2.99	0.14
10	1.618	1.719	0.16	0.17	2.23	83	-0.25	1.78	81	-2.6	149	0.090	107	108	21.9	-3.2	749	625	435	480	515	561	553	83	86	85	86	75	-0.108	16.83	2.25
20	3.286	3.461	0.17	0.17	2.29	83	-0.4	1.78	81	-2.7	119	0.090	108	107	19.4	-2.5	733	602	263	444	495	507	438	82	84	84	84	75	-0.096	15.5	0.42
30	4.939	5.189	0.17	0.17	2.24	84	-0.05	1.75	81	-3	115	0.090	106	106	17.3	-2.1	729	580	234	422	473	488	421	83	83	83	83	76	-0.096	15.59	0.42
40	6.588	6.922	0.16	0.17	2.22	84	-0.07	1.81	82	-2.9	112	0.090	106	106	15.2	-2.1	718	552	218	410	458	473	408	84	83	81	83	75	-0.095	14.72	0.29
50	8.231	8.675	0.16	0.16	2.23	84	-0.59	1.65	82	-2.8	110	0.090	105	107	13.4	-1.8	699	546	211	406	445	460	395	83	83	82	84	76	-0.092	14.03	0.29
60	9.873	10.424	0.16	0.17	2.34	84	-0.35	1.79	82	-3	108	0.090	105	106	11.7	-1.7	699	537	211	406	439	452	379	83	84	83	85	76	-0.091	13.72	0.22
70	11.542	12.168	0.17	0.17	2.25	84	0.07	1.78	82	-3	107	0.100	101	100	10.2	-1.5	652	528	213	406	437	447	372	84	85	84	86	75	-0.089	13.98	0.35
80	13.198	13.907	0.17	0.17	2.26	85	-0.13	1.79	82	-3.1	106	0.100	100	100	8.7	-1.4	633	522	218	411	441	445	381	84	85	84	87	76	-0.088	13.15	0.22
90	14.850	15.653	0.17	0.17	2.24	85	-0.15	1.80	82	-3.1	104	0.090	105	106	7.7	-1.0	588	517	228	416	446	439	337	83	87	84	88	75	-0.082	11.61	0.15
100	16.505	17.406	0.17	0.18	2.26	85	-0.08	1.80	83	-3	100	0.090	105	105	6.7	-1.0	552	515	233	420	446	433	320	83	88	84	80	76	-0.078	11.28	0.21
110	18.163	19.163	0.17	0.18	2.27	85	0	1.80	83	-3.1	95	0.100	99	100	5.9	-0.8	519	516	237	422	444	428	296	82	89	83	80	73	-0.076	9.97	0.27
120	19.823	20.922	0.17	0.18	2.27	85	0.16	1.81	82	-3.1	93	0.100	99	100	5.4	-0.5	464	515	240	422	440	416	269	81	89	82	81	73	-0.070	9.16	0.31
130	21.482	22.675	0.17	0.18	2.25	84	0.16	1.80	82	-2.9	92	0.100	99	100	4.8	-0.6	444	516	248	416	436	412	258	81	89	82	80	74	-0.069	9.18	0.18
140	23.139	24.424	0.17	0.17	2.26	84	-0.23	1.77	82	-3.1	92	0.100	99	99	4.4	-0.4	423	517	251	411	434	407	246	83	89	85	80	75	-0.066	8.48	0.32
150	24.794	26.167	0.17	0.17	2.25	84	0.09	1.77	81	-2.8	91	0.100	99	99	4.1	-0.3	384	511	255	405	429	397	229	84	89	86	81	75	-0.062	6.76	0.82
160	26.448	27.928	0.17	0.17	2.24	84	-0.23	1.77	81	-3	90	0.100	99	99	3.3	-0.2	354	500	255	395	417	384	216	84	90	85	81	76	-0.058	6.28	0.39
170	28.101	29.648	0.17	0.17	2.25	84	0.12	1.77	81	-2.8	89	0.100	99	99	3.7	-0.2	330	491	254	383	405	373	204	83	81	85	81	76	-0.056	6	0.92
180	29.754	31.368	0.17	0.17	2.24	84	0	1.78	81	-3.1	89	0.100	99	99	3.5	-0.2	316	483	250	372	393	363	198	83	81	85	82	75	-0.054	5.94	0.91
190	31.408	33.129	0.17	0.17	2.25	84	-0.02	1.79	81	-3.1	88	0.100	98	99	3.4	-0.1	304	477	247	361	382	354	191	83	82	85	83	75	-0.053	5.82	0.88
200	33.060	34.872	0.17	0.17	2.25	84	-0.37	1.79	81	-3	87	0.100	98	99	3.3	-0.1	294	476	245	352	371	348	187	83	82	85	83	75	-0.053	5.72	0.87
210	34.713	36.614	0.17	0.17	2.24	84	-0.09	1.78	81	-2.8	86	0.100	98	99	3.1	-0.2	287	474	242	344	361	342	184	83	83	85	84	76	-0.051	5.64	0.89
220	36.366	38.356	0.17	0.17	2.25	84	0.04	1.77	81	-3.1	86	0.100	98	99	2.9	-0.2	280	468	243	340	354	337	181	82	84	84	84	76	-0.051	5.49	0.88
230	38.017	40.098	0.17	0.17	2.25	83	-0.21	1.77	81	-2.9	86	0.100	98	99	2.8	-0.1	275	462	245	335	347	333	178	83	84	85	85	76	-0.050	5.32	0.87
240	39.667	41.839	0.17	0.17	2.24	83	-0.12	1.77	81	-3.1	86	0.100	98	99	2.6	-0.2	269	456	244	331	340	328	176	83	85	85	85	75	-0.050	5.23	0.89
250	41.317	43.579	0.17	0.17	2.25	83	-0.04	1.78	81	-3.1	85	0.100	98	98	2.5	-0.1	264	453	242	328	334	324	174	83	85	84	86	75	-0.050	5.23	0.73
260	42.967	45.320	0.17	0.17	2.24	83	-0.04	1.78	81	-2.9	84	0.100	98	98	2.3	-0.2	262	454	241	326	326	322	171	82	86	84	86	74	-0.049	4.95	0.82
270	44.617	47.060	0.17	0.17	2.25	83	-0.05	1.77	81	-3	84	0.100	98	98	2.3	0.0	255	451	238	321	320	317	168	82	86	85	87	74	-0.048	4.77	0.85
280	46.267	48.798	0.17	0.17	2.23	83	-0.04	1.77	81	-3.1	84	0.100	98	98	2.2	-0.1	248	441	234	319	319	312	164	83	86	85	87	74	-0.047	4.62	0.82
290	47.916	50.533	0.16	0.17	2.23	83	0.01	1.77	80	-3.1	83	0.100	98	98	2.0	-0.2	240	432	231	315	314	308	162	82	87	84	87	74	-0.047	4.63	0.83
300	49.564	52.268	0.16	0.17	2.24	82	-0.02	1.75	80	-3.1	83	0.100	98	98	1.9	-0.1	237	425	230	312	310	303	159	82	87	84	88	74	-0.046	4.68	0.84
310	51.212	54.001	0.16	0.17	2.23	82	0.06	1.77	80	-2.8	84	0.100	98	98	1.8	-0.1	235	418	232	310	308	300	159	82	88	85	88	74	-0.046	4.71	0.82
320	52.859	55.733	0.16	0.17	2.23	82	-0.33	1.75	80	-3	83	0.100	98	98	1.7	-0.1	234	413	230	309	304	298	158	83	88	84	88	74	-0.044	4.59	0.85
330	54.505	57.465	0.16	0.17	2.25	82	-0.11	1.77	80	-3.1	83	0.100	98	98	1.6	-0.1	231	407	226	307	302	295	156	82	88	84	89	74	-0.043	4.39	0.82
340	56.156	59.197	0.17	0.17	2.28	82	-0.14	1.78	80	-2.9	83	0.100	98	98	1.5	-0.1	230	402	223	305	301	292	154	82	89	84	89	74	-0.043	4.29	0.82
350	57.815	60.929	0.17	0.17	2.27	82	-0.07	1.74	80	-2.8	82	0.100	99	98	1.3	-0.2	227	395	220	303	302	289	153	82	89	85	89	74	-0.046	4.22	0.83

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - ASTM E3053 / ASTM E2515

Run: 4
 Manufacturer: GHP Group
 Model: SHP Large
 Tracking No.: 3409
 Project No.: S1100/S018E
 Test Date: 26 May 20
 Beginning Clock Time: 12:04
 Meter Box Y Factor: 0.988 (1) 0.985 (2) (Amb)
 Barometric Pressure: Begin Middle End Average
 29.74 29.76 29.75 Hg
 OMNI Equipment Numbers:

PM Control Module: 371.372
 Dilution Tunnel MW(dry): 29.03 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H₂O: 2.00 percent
 Dilution Tunnel Static: -0.282 H₂O
 Tunnel Area: 0.19635 ft²
 Pilot Tube Cp: 0.99
 Avg. Tunnel Velocity: 19.95 ft/sec
 Initial Tunnel Flow: 222.8 scfm
 Average Tunnel Flow: 218.7 scfm
 Post-Test Leak Check (1): 0.000 cfm @ 7 in. Hg
 Post-Test Leak Check (2): 0.000 cfm @ 6 in. Hg
 Average Test Piece Fuel Moisture: 22.06 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	0.072	0.092	0.098	0.088	0.072	0.096	0.100	0.088	0.102		
Temp	84	84	84	84	84	84	84	84	84		
V _{avg}	20.19 ft/sec			V _{vac}			21.56 ft/sec			F _p	0.936

Elapsed Time (min)	Particulate Sampling Data										Fuel Weight (lb)										Temperature Data (°F)										Stack Gas Data		
	Gas Meter 1 (ft ³)	Gas Meter 2 (ft ³)	Sample Rate 1 (cfm)	Sample Rate 2 (cfm)	Orifice dH 1 (H ₂ O)	Meter 1 Temp (°F)	Meter 1 Vacuum (Hg)	Orifice dH 2 (H ₂ 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 ₂ O)	CO ₂ (%)	CO (%)		
360	59.475	62.660	0.17	0.17	2.28	82	-0.31	1.76	80	-2.8	82	0.100	99	98	1.2	-0.1	227	389	218	300	301	287	154	82	69	84	69	74	-0.046	4.13	0.83		
370	61.134	64.392	0.17	0.17	2.28	82	-0.24	1.76	80	-2.8	82	0.100	99	98	1.1	-0.1	224	383	214	298	299	284	155	82	69	84	69	74	-0.045	4.28	0.87		
380	62.793	66.123	0.17	0.17	2.27	82	-0.28	1.76	79	-2.8	82	0.100	99	98	1.0	-0.1	221	379	207	298	298	281	154	82	69	84	70	74	-0.046	4.28	0.87		
390	64.450	67.854	0.17	0.17	2.25	82	-0.37	1.75	79	-2.8	82	0.100	99	98	0.9	-0.1	220	373	202	299	298	278	154	82	70	85	70	74	-0.045	4.28	0.86		
400	66.107	69.588	0.17	0.17	2.27	82	-0.31	1.77	79	-2.8	84	0.100	99	98	0.8	-0.1	218	368	202	301	297	277	154	82	70	84	70	77	-0.044	4.35	0.86		
410	67.762	71.317	0.17	0.17	2.27	82	-0.35	1.76	80	-3	88	0.100	99	98	0.7	-0.1	219	365	201	303	297	277	153	83	70	84	70	76	-0.044	4.34	0.85		
420	69.418	73.059	0.17	0.17	2.26	82	-0.32	1.76	80	-3.1	89	0.100	99	99	0.6	-0.1	218	362	200	304	295	276	153	83	71	85	71	79	-0.043	4.15	0.83		
430	71.073	74.800	0.17	0.17	2.26	82	0.08	1.76	80	-3.1	89	0.100	99	99	0.4	-0.2	217	359	201	304	292	275	152	83	71	85	71	79	-0.042	4.08	0.84		
440	72.728	76.542	0.17	0.17	2.27	83	0	1.75	81	-3.2	88	0.100	99	99	0.4	0.0	214	356	201	301	288	272	151	83	71	85	71	79	-0.042	3.95	0.82		
450	74.386	78.286	0.17	0.17	2.26	83	-0.37	1.77	81	-3.1	88	0.100	99	99	0.3	-0.1	212	353	205	297	287	271	149	83	71	85	71	79	-0.042	3.83	0.84		
460	76.043	80.031	0.17	0.17	2.27	83	-0.02	1.79	81	-2.9	86	0.100	99	99	0.2	-0.1	209	349	207	291	284	268	148	83	72	85	71	78	-0.042	3.68	0.81		
470	77.701	81.776	0.17	0.17	2.26	83	-0.19	1.79	81	-2.9	85	0.100	99	99	0.1	-0.1	206	345	203	286	280	264	147	83	72	84	72	77	-0.041	3.68	0.83		
480	79.360	83.523	0.17	0.17	2.28	83	-0.23	1.79	81	-2.9	84	0.100	99	99	0.0	-0.1	204	342	200	282	276	261	146	83	72	85	72	77	-0.040	3.63	0.82		
AvgTot	79.360	83.523	0.17	0.17	2.24	83		1.78	81		82	0.098	100	100								242.0											

Wood Heater Test Results - ASTM E3053 / ASTM E2515

Manufacturer: GHP Group
 Model: GHP Large
 Project No.: 0418WS018E
 Tracking No.: 2409
 Run: 4
 Test Date: 05/06/20

Burn Rate	1.17 kg/hr dry
Average Tunnel Temperature	92 degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	19.95 feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	13124.0 dscf/hour
Average Delta p	0.098 inches H2O
Total Time of Test	480 minutes

	AMBIENT	SAMPLE TRAIN 1	SAMPLE TRAIN 2	FIRST HOUR FILTER (TRAIN 1)
Total Sample Volume - Vm	0.000 cubic feet	79.360 cubic feet	83.523 cubic feet	9.873 cubic feet
Average Gas Meter Temperature	75 degrees Fahrenheit	83 degrees Fahrenheit	81 degrees Fahrenheit	83 degrees Fahrenheit
Total Sample Volume (Standard Conditions) - Vmstd	0.000 dscf	76.169 dscf	80.172 dscf	9.476 dscf
Total Particulates - m _n	0 mg	3.5 mg	2.8 mg	2.4 mg
Particulate Concentration (dry-standard) - C _p /C _s	0.000000 grams/dscf	0.00005 grams/dscf	0.00003 grams/dscf	0.00025 grams/dscf
Total Particulate Emissions - E _T	0.00 grams	4.82 grams	3.67 grams	3.32 grams
Particulate Emission Rate	0.00 grams/hour	0.60 grams/hour	0.46 grams/hour	3.32 grams/hour
Emissions Factor		0.52 g/kg	0.39 g/kg	0.67 g/kg
Difference from Average Total Particulate Emissions		0.58 grams	0.58 grams	

Dual Train Comparison Results Are Acceptable


	FINAL AVERAGE RESULTS
Complete Test Run	
Total Particulate Emissions - E _T	4.25 grams
Particulate Emission Rate	0.53 grams/hour
Emissions Factor	0.45 grams/kg
First Hour Emissions	
Total Particulate Emissions - E _T	3.32 grams
Particulate Emission Rate	3.32 grams/hour
Emissions Factor	0.67 grams/kg
7.5% of Average Total Particulate Emissions	0.32 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

Technician Signature: 

Wood Heater Efficiency Results - CSA B415.1

Manufacturer: GHP Group
Model: GHP Large
Date: 05/06/20
Run: 4
Control #: 0418WS018E
Test Duration: 480
Output Category: II

Technician Signature: 

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	76.6%	82.1%
Combustion Efficiency	95.1%	95.1%
Heat Transfer Efficiency	81%	86.3%

Output Rate (kJ/h)	17,282	16,394	(Btu/h)
Burn Rate (kg/h)	1.17	2.57	(lb/h)
Input (kJ/h)	22,556	21,397	(Btu/h)

Test Load Weight (dry kg)	9.33	20.56	dry lb
MC wet (%)	18.07009558		
MC dry (%)	22.06		
Particulate (g)	0.53		
CO (g)	640		
Test Duration (h)	8.00		

Emissions	Particulate	CO
g/MJ Output	0.00	4.63
g/kg Dry Fuel	0.06	68.62
g/h	0.07	80.03
lb/MM Btu Output	0.01	10.76

Air/Fuel Ratio (A/F)	13.47
-----------------------------	-------

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/ft³ 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 ³ - Low and Medium Fire										
Nominal Required Load Density (wet basis)	12	lb/ft ³								
Usable Firebox Volume	2.00	ft ³								
Total Nom. Load Wt. Target	24	lb								
Total Load Wt. Allowable Range	22.80	to	25.20	lb						
Core Target Wt. Allowable Range	10.8	to	15.60	lb						
Remainder Load Wt. Allowable Range	8.40	to	13.20	lb						
Core Load Fuel Pc. Wt. Allowable Range	3.60	to	6.00	lb			Mid-Point	4.80		
Remainder Load Pc. Wt. Allowable Range	2.40	to	7.20	lb			Mid-Point	4.80		
Core Load Piece Wt. Actual	Pc. #									
	1	4.60	lb	In Range						
	2	4.40	lb	In Range						
	3	3.90	lb	In Range						
Core Load Total. Wt. Actual		12.90	lb	In Range						
Remainder Load Piece Wt.	Pc. #									
	1	5.60	lb	In Range						
	2	3.10	lb	In Range						
	3	3.50	lb	In Range						
Remainder Load Piece Weight Ratio - Small/Large		55%		In Range				≤ 67%		
Remainder Load Tot. Wt. Act		12.20	lb	In Range						
Total Load Wt. Actual		25.10	lb	In Range						
Core % of Total Wt.		51%		In Range				45-65%		
Remainder % of Total Wt.		49%		In Range				35-55%		
Actual Load % of Nominal Target		105%		In Range				95-105%		
Actual Fuel Load Density		12.6	lb/ft ³							
Allowable Charcoal Bed Wt. Range (lb)	2.6	to	5.0				Mid-Point	3.8		
Actual Charcoal Bed Wt.		2.6	lb	In Range						
Actual Fuel Load Ending Wt.		0.0	lb	Valid Test				≥ 90%		
Total Wt. of Fuel Burned During Test Run lb.		25.1	lb							

Fuel Piece Moisture Reading (%-dry basis)										
	1	2	3	Ave.		Pc. Wt. Dry Basis				
	25.6	19.3	18.9	21.3	In Range	3.79	lb	1.72	kg	
	23.1	18.3	18.5	20.0	In Range	3.67	lb	1.66	kg	
	27.9	27.8	24.4	26.7	In Range	3.08	lb	1.40	kg	
	23.6	22	18.2	21.3	In Range	4.62	lb	2.09	kg	
	23.4	22	19.7	21.7	In Range	2.55	lb	1.16	kg	
	27.2	18.6	18.5	21.4	In Range	2.88	lb	1.31	kg	
Total Load Ave. MC % (dry basis)				21.9	In Range					
Total Load Ave. MC % (wet basis)				18.0						
Total Test Load Weight (dry basis)						20.59	lb	9.34	kg	
Total Fuel Weight Burned During Test Run (dry basis)						20.6	lb	9.34	kg	

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 4
 Model: GHP Large Tracking Number: 2409 Date: 5/6/20
 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
	See Run 3

Test Notes

Sketch test fuel configuration:

See photo

Start up procedures & Timeline:

Bypass: Not used
 Fuel loaded by: 1:00 minutes
 Door closed at: 3:30 minutes
 Primary air: fully open until 4:45 then set to \approx 1/2 open. At 10:45 Air was fully closed.
 Notes: FAN on High entire test at 10:45

Time	Notes
60	changed filter in train 4.

Technician Signature: [Signature]

Date: 5/21/20

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 4
 Model: GHP Large Tracking Number: 2409 Date: 5/6/20
 Test Crew: B. Davis
 OMNI Equipment ID numbers: _____

Wood Heater Supplemental Data

Start Time: 12:04 Booth #: N/A

Stop Time: 20:07

Stack Gas Leak Check:

Initial: good Final: good

Sample Train Leak Check:

A: 0.0 @ 7 "Hg
 B: 0.0 @ 6 "Hg

Calibrations: Span Gas CO₂: 16.94 CO: 4.37

	Pre Test		Post Test	
	Zero	Span	Zero	Span
Time	<u>1145</u>	<u>1145</u>	<u>2016</u>	<u>2016</u>
CO ₂	<u>0.00</u>	<u>16.94</u>	<u>0.05</u>	<u>16.90</u>
CO	<u>0.00</u>	<u>4.22</u>	<u>-0.040</u>	<u>4.27</u>

Air Velocity (ft/min): Initial: 450 Final: 450

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: 4/29/20 Initials: RL

	Initial	Middle	Ending
P _b (in/Hg)	<u>29.74</u>		<u>29.76</u>
RH (%)	<u>41</u>		<u>30</u>
Ambient (°F)	<u>77</u>		<u>77</u>

Tunnel Traverse		
Microtector Reading	dP (in H ₂ O)	T(°F)
	<u>.072</u>	<u>84</u>
	<u>.092</u>	<u>84</u>
	<u>.098</u>	<u>84</u>
	<u>.088</u>	<u>84</u>
	<u>.072</u>	<u>84</u>
	<u>.096</u>	<u>84</u>
	<u>.100</u>	<u>84</u>
	<u>.088</u>	<u>84</u>
Center:		
	<u>.102</u>	<u>84</u>

Background Filter Volume: N/A

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

Technician Signature: [Signature]

Date: 5/21/20

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 Large 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.

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

Sample Analysis

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

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 1
 Model: GHP Large Tracking Number: 2409 Date: 5/5/20
 Test Crew: B. Davis
 OMNI Equipment ID numbers: _____

ASTM E2515 Lab Sheet

Assembled By: _____

B. Davis

Date/Time in Dessicator: _____

5/7/20 0920

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>05/11/2020 8:30</u>	Date/Time: <u>05/13/2020 8:00</u>	Date/Time: <u>05/14/2020 9:45</u>	Date/Time:	Date/Time:
R/H %: <u>13.5</u>	R/H %: <u>9.0</u>	R/H %: <u>8.9</u>	R/H %:	R/H %:
Temp: <u>75.2</u>	Temp: <u>70.7</u>	Temp: <u>70.7</u>	Temp:	Temp:
200 mg Audit: <u>200.1</u>	200 mg Audit: <u>200.2</u>	200 mg Audit:	200 mg Audit:	200 mg Audit:
2 g Audit: <u>2000.3</u>	2 g Audit: <u>2000.4</u>	2 g Audit:	2 g Audit:	2 g Audit:
100 g Audit: <u>99997.9</u>	100 g Audit: <u>99998.1</u>	100 g Audit: <u>99997.9</u>	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)
A (First Hour)	Front Filter	<u>T245S</u>	<u>99.0</u>	<u>103.5</u>	<u>103.3</u>			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	<u>T224AP</u>	<u>182.0</u>	<u>184.4</u>	<u>184.5</u>			
	Rear Filter							
	Probe	<u>6</u>	<u>115348.3</u>	<u>115349.3</u>	<u>115348.8</u>	<u>115348.7</u>		
	O-Ring Set	<u>R974</u>	<u>3320.0</u> 3319.9	<u>3320.5</u>	<u>3320.3</u>			
B	Front Filter	<u>T224BP</u>	<u>183.8</u>	<u>188.3</u>	<u>188.1</u>			
	Rear Filter	<u>T246S</u>	<u>99.1</u>	<u>101.5</u>	<u>101.5</u>			
	Probe	<u>OES 6</u>	<u>113711.2</u>	<u>113712.1</u>	<u>113711.9</u>			
	O-Ring Set	<u>R975</u>	<u>3576.1</u> 3575.9	<u>3576.6</u>	<u>3576.6</u>			
BG	Filter							

Technician Signature: Fony Teng

Date: _____

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 2
 Model: GHP Large Tracking Number: 2409 Date: 5/5/20
 Test Crew: ADAMS
 OMNI Equipment ID numbers: _____

ASTM E2515 Lab Sheet

Assembled By: _____

ADAMS

Date/Time in Dessicator: _____

5/7/20 0920

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>05/11/2020</u> <u>8:30</u>	Date/Time: <u>05/13/2020</u> <u>8:00</u>	Date/Time: <u>05/14/2020</u> <u>9:45</u>	Date/Time:	Date/Time:
R/H %: <u>13.5</u>	R/H %: <u>9.0</u>	R/H %: <u>8.9</u>	R/H %:	R/H %:
Temp: <u>75.2</u>	Temp: <u>70.7</u>	Temp: <u>70.7</u>	Temp:	Temp:
200 mg Audit: <u>200.1</u>	200 mg Audit: <u>200.2</u>	200 mg Audit:	200 mg Audit:	200 mg Audit:
2 g Audit: <u>2000.3</u>	2 g Audit: <u>2000.4</u>	2 g Audit:	2 g Audit:	2 g Audit:
100 g Audit: <u>99997.9</u>	100 g Audit: <u>99998.1</u>	100 g Audit: <u>99997.9</u>	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)
A (First Hour)	Front Filter	<u>T247S</u>	<u>99.4</u>	<u>102.9</u>	<u>103.1</u>			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	<u>T225AP</u>	<u>182.2</u>	<u>180.8</u> 91.4	<u>180.8</u>			
	Rear Filter							
	Probe	<u>7</u>	<u>11498.7</u>	<u>11498.5</u>	<u>11498.5</u>			
	O-Ring Set	<u>R976</u>	<u>3352.7</u>	<u>3355.0</u>	<u>3354.9</u>			
B	Front Filter	<u>T225BP</u>	<u>180.0</u>	<u>181.8</u> 40.3	<u>182.0</u>			
	Rear Filter							
	Probe	<u>8</u>	<u>115598.1</u>	<u>115598.9</u>	<u>115598.6</u>	<u>115598.7</u>		
	O-Ring Set	<u>R977</u>	<u>3398.6</u>	<u>3401.0</u>	<u>3400.9</u>			
BG	Filter							

Technician Signature: Tony Tony

Date: _____

Wood Heater Run Sheets

Client: GHP Group Project Number: 0418WS018E Run Number: 4
 Model: GHP Large Tracking Number: 2409 Date: 5/6/20
 Test Crew: B. Davis
 OMNI Equipment ID numbers: _____

ASTM E2515 Lab Sheet

Assembled By: _____

Date/Time in Dessicator: _____

Weighing #1	Weighing #2	Weighing #3	Weighing #4	Weighing #5
Date/Time: <u>05/11/2020</u> <u>8:30</u>	Date/Time: <u>05/13/2020</u> <u>8:00</u>	Date/Time: <u>05/14/2020</u> <u>9:45</u>	Date/Time:	Date/Time:
R/H %: <u>13.5</u>	R/H %: <u>9.0</u>	R/H %: <u>8.9</u>	R/H %:	R/H %:
Temp: <u>75.2</u>	Temp: <u>70.7</u>	Temp: <u>70.7</u>	Temp:	Temp:
200 mg Audit: <u>200.1</u>	200 mg Audit: <u>200.2</u>	200 mg Audit:	200 mg Audit:	200 mg Audit:
2 g Audit: <u>2000.3</u>	2 g Audit: <u>2000.4</u>	2 g Audit:	2 g Audit:	2 g Audit:
100 g Audit: <u>99997.9</u>	100 g Audit: <u>99998.1</u>	100 g Audit: <u>99997.9</u>	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)
A (First Hour)	Front Filter	<u>T2485</u>	<u>100.6</u>	<u>102.8</u>	<u>103.0</u>			
	Rear Filter							
	Probe							
	O-Ring Set							
A (Remainder)	Front Filter	<u>T232AP</u>	<u>197.8</u>	<u>198.5</u>	<u>198.5</u>			
	Rear Filter							
	Probe	<u>9</u>	<u>115695.7</u>	<u>115696.3</u>	<u>115696.1</u>			
	O-Ring Set	<u>R978</u>	<u>3534.9</u>	<u>3535.2</u>	<u>3535.0</u>			
B	Front Filter	<u>T232BP</u>	<u>199.6</u>	<u>200.7</u>	<u>200.6</u>			
	Rear Filter							
	Probe	<u>11</u>	<u>114188.6</u>	<u>114189.3</u>	<u>114188.8</u>	<u>114188.6</u>		
	O-Ring Set	<u>R979</u>	<u>4116.9</u>	<u>4118.6</u>	<u>4118.7</u>			
BG	Filter							

Technician Signature: Tony Teag

Date: _____

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

Placed in Dessicator: Date: <u>03/12/2020</u> Time: <u>13:40</u>	Date: <u>03/16/2020</u> Time: <u>09:10</u> RH %: <u>12.3</u> T (°F): <u>73.7</u> Audit: <u>200.0</u>	Date: <u>03/17/2020</u> Time: <u>09:00</u> RH %: <u>11.5</u> T (°F): <u>73.5</u> Audit: <u>200.1</u>	Date: _____ Time: _____ RH %: _____ T (°F): _____ Audit: _____	Date: _____ Time: _____ RH %: _____ T (°F): _____ Audit: _____	Date Used	Project Number	Run No.
T233S	99.2	99.3	✓				
T234S	100.2	100.1	✓				
T235S	98.8	98.9	✓				
T236S	98.1	98.3	✓				
T237S	98.6	98.6	✓				
T238S	98.5	98.4	✓				
T239S	100.3	100.3	✓				
T240S	98.6	98.5	✓				
T241S	99.0	99.2	✓				
T242S	99.4	99.4	✓				
T243S	97.9	97.9	✓				
T244S	100.1	100.0	✓				
T245S	98.9	99.0	✓		5-5-20	041xWS018E	1
T246S	99.3	99.1	✓		↓	↓	1
T247S	99.4	99.4	✓				2
T248S	100.7	100.6	✓		5-6-20	↓	4
T249S	98.9	99.0	✓				
T250S	98.7	98.7	✓				
T251S	100.3	100.3	✓				
T252S	97.8	97.7	✓				
Initials: <u>TT</u>	Initials: <u>TT</u>	Initials: _____	Initials: _____				

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

Date: 03/17/2020
 81 of 142

Evaluator signature: [Signature] 4/21/20

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

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 2340 SE 11TH 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"/>	Fail:	<input 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"/>	Fail:	<input 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**

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**

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**

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

Parameter

Measurement Data

Measurement Description	Range Unit	Reference	Min	Max	*Error	UUT	Uncertainty
Before/After							Accredited = ✓
Mass							
Dot	200 mg	200.00030	199.4603	200.5403	0.0500	200.0503 mg	6.2E-01 ✓
	1 g	1.00000880	0.9991088	1.0009088	0.0000000	1.0000088 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/NCCL 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: 0702003
 OMNI Tracking No.: OMNI-00371
 Calibrated Orifice: Yes

Average Gas Meter y Factor
0.988

Orifice Meter dH@
N/A

Calibration Date: 01/03/20
 Calibrated by: B. Davis
 Calibration Frequency: 6 months
 Next Calibration Due: 7/3/2020
 Instrument Range: 1.000 cfm
 Standard Temp.: 68 oF
 Standard Press.: 29.92 "Hg
 Barometric Press., Pb: 30.2 "Hg
 Signature/Date: [Signature] 1/16/2020

[Signature] 1/17/20

Previous Calibration Comparison

Date	<u>7/2/2019</u>	Acceptable Deviation (5%)	Deviation
y Factor	<u>0.992</u>	0.0496	0.004
Acceptance	Acceptable		

Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.008
Acceptable dH@ Deviation	N/A
Maximum dH@ Deviation	N/A
Acceptance	Acceptable

Reference Standard *

Standard Calibrator	Model	Standard Test Meter
	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	644.9	636.8	631.5
Final Reference Meter	650.008	644.805	636.604
Initial DGM	0	0	0
Final DGM	5.112	8.045	5.184
Temp. Ref. Meter (°F), Tr	76.0	79.0	75.0
Temperature DGM (°F), Td	79.0	75.0	78.0
Time (min)	26.3	49.3	50.3
Net Volume Ref. Meter, Vr	5.108	8.005	5.104
Net Volume DGM, Vd	5.112	8.045	5.184
Gas Meter y Factor =	0.996	0.982	0.986
Gas Meter y Factor Deviation (from avg.)	0.008	0.006	0.002
Orifice dH@	N/A	N/A	N/A
Orifice dH@ Deviation (from avg.)	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|
- ** 2. $y = [Vr \times (y \text{ factor (ref)}) \times (Pb + (Pr / 13.6)) \times (Td + 460)] / [Vd \times (Pb + (Pd / 13.6)) \times (Tr + 460)]$
- ** 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" WC ID Number: OMNI-00371

Calibration Instrument: Digital Manometer ID Number: OMNI-00633

Date: 1/13/20 By: B. Davis

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

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span*
0-20% Max. Range 0 - 0.4	0.068	0.073	0.005	0.25
20-40% Max. Range 0.4 - 0.8	0.555	0.561	0.006	0.30
40-60% Max. Range 0.8 - 1.2	0.946	0.950	0.004	0.20
60-80% Max. Range 1.2 - 1.6	1.223	1.230	0.007	0.35
80-100% Max. Range 1.6 - 2.0	1.734	1.735	0.001	0.05

*Acceptable tolerance is 4%.

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

Technician signature:  Date: 1/13/2020

Reviewed by:  Date: 1/17/20

Temperature Calibration EPA Method 28R, ASTM 2515							
BOOTH:		TEMPERATURE MONITOR TYPE:				EQUIPMENT NUMBER:	
Mobile		National Instruments Logger				00371, 00372	
REFERENCE METER EQUIPMENT NUMBER: 00373				Calibration Due Date: 9/11/20			
CALIBRATION PERFORMED BY:		DATE:		AMBIENT TEMPERATURE:		BAROMETRIC PRESSURE:	
B. Davis		1/13/20		70		29.95	
Input Temperature (F)	Ambient	Meter A					FB Interior
			Meter B	Filter A	Filter B	Tunnel	
0	-1	0	0	-1	-1	0	0
100	99	100	100	99	99	100	99
300	299	300	300	299	299	300	299
500	499	500	500	499	499	500	499
700	699	700	700	699	699	700	699
1000	999	1000	1000	999	999	1000	999

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

Technician signature:  Date: 1/13/20

Reviewed By:  Date: 1/23/2020

Thermal Metering System Calibration Y Factor

Manufacturer: Apex
 Model: XC-60-EP
 Serial Number: 0702004
 OMNI Tracking No.: OMNI-00372
 Calibrated Orifice: Yes

Average Gas Meter y Factor
0.985

Orifice Meter dH@
N/A

Calibration Date: 01/06/20
 Calibrated by: B. Davis
 Calibration Frequency: 6 months
 Next Calibration Due: 7/6/2020
 Instrument Range: 1.000 cfm
 Standard Temp.: 68 oF
 Standard Press.: 29.92 "Hg
 Barometric Press., Pb: 30.33 "Hg
 Signature/Date: [Signature] 1/16/2020

[Signature] 1/17/20

Previous Calibration Comparison

Date	<u>7/2/2019</u>	Acceptable Deviation (5%)	Deviation
y Factor	<u>0.989</u>	0.04945	0.004
Acceptance	Acceptable		

Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.014
Acceptable dH@ Deviation	N/A
Maximum dH@ Deviation	N/A
Acceptance	Acceptable

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	663.4	672.9	682.6
Final Reference Meter	672.8	682.505	688.3
Initial DGM	0	0	0
Final DGM	9.416	9.712	5.872
Temp. Ref. Meter (°F), Tr	74.0	74.0	75.0
Temperature DGM (°F), Td	76.0	76.0	77.0
Time (min)	53.8	30.3	51.8
Net Volume Ref. Meter, Vr	9.400	9.605	5.700
Net Volume DGM, Vd	9.416	9.712	5.872
Gas Meter y Factor =	0.995	0.988	0.971
Gas Meter y Factor Deviation (from avg.)	0.011	0.004	0.014
Orifice dH@	N/A	N/A	N/A
Orifice dH@ Deviation (from avg.)	N/A	N/A	N/A

where:

1. Deviation = |Average value for all runs - current run value|
- ** 2. $y = [Vr \times (y \text{ factor (ref)}) \times (Pb + (Pr / 13.6)) \times (Td + 460)] / [Vd \times (Pb + (Pd / 13.6)) \times (Tr + 460)]$
- ** 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" WC ID Number: OMNI-00372

Calibration Instrument: Digital Manometer ID Number: OMNI-00633

Date: 1/13/20 By: B. Davis

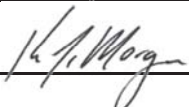
This form is to be used only in conjunction with Standard Procedure C-SPC.

Range of Calibration Point ("WC)	Digital Manometer Input ("WC)	Pressure Gauge Response ("WC)	Difference (Input - Response)	% Error of Full Span*
0-20% Max. Range 0 - 0.4	0.018	0.017	0.001	0.05
20-40% Max. Range 0.4 - 0.8	0.733	0.732	0.001	0.05
40-60% Max. Range 0.8 - 1.2	1.002	1.001	0.001	0.05
60-80% Max. Range 1.2 - 1.6	1.370	1.368	0.002	0.10
80-100% Max. Range 1.6 - 2.0	1.850	1.851	0.001	0.05

*Acceptable tolerance is 4%.

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

Technician signature:  Date: 1/13/2020

Reviewed by:  Date: 1/17/20

Temperature Calibration EPA Method 28R, ASTM 2515							
BOOTH:		TEMPERATURE MONITOR TYPE:				EQUIPMENT NUMBER:	
Mobile		National Instruments Logger				00371, 00372	
REFERENCE METER EQUIPMENT NUMBER: 00373				Calibration Due Date: 9/11/20			
CALIBRATION PERFORMED BY:		DATE:		AMBIENT TEMPERATURE:		BAROMETRIC PRESSURE:	
B. Davis		1/13/20		70		29.95	
Input Temperature (F)	Ambient	Meter A					FB Interior
			Meter B	Filter A	Filter B	Tunnel	
0	-1	0	0	-1	-1	0	0
100	99	100	100	99	99	100	99
300	299	300	300	299	299	300	299
500	499	500	500	499	499	500	499
700	699	700	700	699	699	700	699
1000	999	1000	1000	999	999	1000	999

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

Technician signature:  Date: 1/13/20

Reviewed By:  Date: 1/23/2020

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**



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

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**

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
Before/After Length			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/NCSL 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 desiccate box on the same shelf with the NIST traceable standard.

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

Step 4: If the unit to be calibrated matches the NIST standard within $\pm 4\%$, 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 desiccate: 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.

Certificate of Calibration

Certificate Number: **716748**



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: **190269**

Order Date: **01/20/2020**

Authorized By: **N/A**

Calibrated on: **01/20/2020**

*Recommended Due: **07/20/2020**

Environment: **20 °C 40 % RH**

* As Received: **Within Tolerance**

* As Returned: **Within Tolerance**

Action Taken: **Calibrated**

Technician: **135**



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
723A	Rice Lake	1mg-200g (Class 0)	Mass Set,	05/22/2020	694890

Measurement Data

Parameter	Measurement Description	Range	Unit	Reference	Min	Max	*Error	UUT	Uncertainty
Before/After Force									Accredited = ✓
			g	10.00000	9.9995	10.0005	0.0001	10.0001 g	9.7E-05 ✓
			g	30.00000	29.9995	30.0005	0.0003	30.0003 g	1.2E-04 ✓
			g	60.00000	59.9995	60.0005	0.0002	60.0002 g	1.8E-04 ✓
			g	90.00000	89.9995	90.0005	0.0001	90.0001 g	2.4E-04 ✓
			g	120.00000	119.9995	120.0005	0.0000	120.0000 g	3E-04 ✓

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 01/22/2020 Rev # 15


Inspector

Example Calculations

Equations and Sample Calculations – ASTM E3053 & E2515

Manufacturer: GHP Group
Model: GHP Large
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,

θ = Total length of test run, min

Sample Calculation:

$$M_{Bdb} = 9.36 \quad \text{kg}$$

$$\theta = 475 \quad \text{min}$$

$$BR = \frac{60 \times 9.36}{475}$$

$$BR = \mathbf{1.18} \quad \text{kg/hr}$$

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

ASTM E2515 equations (9)

$$V_s = F_p \times k_p \times C_p \times (\sqrt{\Delta P})_{avg} \times \sqrt{\frac{T_{s(avg)}}{P_s \times M_s}}$$

Where:

- F_p = Adjustment factor for center of tunnel pitot tube placement, $F_p = \frac{V_{strav}}{V_{scent}}$, ASTM E2515 Equation (1)
- V_{scent} = Dilution tunnel velocity calculated after the multi-point pitot traverse at the center, ft/sec
- V_{strav} = Dilution tunnel velocity calculated after the multi-point pitot traverse, ft/sec
- k_p = Pitot tube constant, 85.49
- C_p = Pitot tube coefficient: 0.99, unitless
- ΔP* = Velocity pressure in the dilution tunnel, in H₂O
- T_s = Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)
- P_s = Absolute average gas static pressure in dilution tunnel, = P_{bar} + P_g, in Hg
- P_{bar} = Barometric pressure at test site, in. Hg
- P_g = Static pressure of tunnel, in. H₂O; (in Hg = in H₂O/13.6)
- M_s = **The dilution tunnel wet molecular weight; M_s = 28.78 assuming a dry weight of 29 lb/lb-mole

Sample calculation:

$$F_p = \frac{20.48}{21.42} = 0.956$$

$$V_s = 0.956 \times 85.49 \times 0.99 \times 0.314 \times \left(\frac{96.9 + 460}{\left(\frac{29.40 + \frac{-0.26}{13.6}}{28.78} \right)^{1/2}} \right)$$

$$V_s = \mathbf{20.62 \text{ ft/s}}$$

*The ASTM test standard mistakenly has the square root of the average delta p instead of the average of the square root of delta p. The current EPA Method 2 is also incorrect. This was verified by Mike Toney at EPA.

**The ASTM test standard mistakenly identifies M_s as the dry molecular weight. It should be the wet molecular weight as indicated in EPA Method 2.

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

ASTM E2515 equation (3)

$$Q_{sd} = 3600 \times (1 - B_{ws}) \times v_s \times A \times \frac{T_{std}}{T_{s(avg)}} \times \frac{P_s}{P_{std}}$$

Where:

- 3600 = Conversion from seconds to hours (ASTM method uses 60 to convert in minutes)
- B_{ws} = Water vapor in gas stream, proportion by volume; assume 2%
- A = Cross sectional area of dilution tunnel, ft²
- T_{std} = Standard absolute temperature, 528 °R
- P_s = Absolute average gas static pressure in dilution tunnel, = P_{bar} + P_g, in Hg
- T_{s(avg)} = Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)
- P_{std} = Standard absolute pressure, 29.92 in Hg

Sample calculation:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 20.62 \times 0.196 \times \frac{528}{96.9 + 460} \times \frac{29.4 + \frac{-0.26}{13.6}}{29.92}$$

Q_{sd} = **13295.6** dscf/hr

$V_{m(std)}$ – Volume of Gas Sampled Corrected to Dry Standard Conditions, dscf
 ASTM E2515 equation (6)

$$V_{m(std)} = K_1 V_m Y \frac{P_{bar} + \left(\frac{\Delta H}{13.6}\right)}{T_m}$$

Where:

- K_1 = 17.64 °R/in. Hg
- V_m = Volume of gas sample measured at the dry gas meter, dcf
- Y = Dry gas meter calibration factor, dimensionless
- P_{bar} = Barometric pressure at the testing site, in. Hg
- ΔH = Average pressure differential across the orifice meter, in. H₂O
- T_m = Absolute average dry gas meter temperature, °R

Sample Calculation:

Using equation for Train 1:

$$V_{m(std)} = 17.64 \times 79.621 \times 0.988 \times \frac{\left(29.4 + \frac{2.27}{13.6} \right)}{\left(87.0 + 460 \right)}$$

$$V_{m(std)} = \mathbf{74.992} \text{ dscf}$$

Using equation for Train 2:

$$V_{m(std)} = 17.64 \times 84.432 \times 0.985 \times \frac{\left(29.4 + \frac{1.82}{13.6} \right)}{\left(85.5 + 460 \right)}$$

$$V_{m(std)} = \mathbf{79.417} \text{ dscf}$$

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 0.00 \times 0 \times \frac{\left(29.4 + \frac{0.00}{13.6} \right)}{\left(79.4 + 460 \right)}$$

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

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):

$$m_n = 0.0 + 3.7 + 0.0$$

$$m_n = 3.7 \text{ mg}$$

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

$$m_n = 0.8 + -1.4 + 2.0$$

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

Train 1 aggregate:

$$m_n = 3.7 + 1.4$$

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

Using equation for Train 2:

$$m_n = 0.6 + 2 + 2$$

$$m_n = \mathbf{4.6} \text{ mg}$$

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

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

Where:

K₂ = Constant, 0.001 g/mg

m_n = Total mass of particulate matter collected in the sampling train, mg

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

Sample calculation:

For Train 1:

$$C_s = 0.001 \times \frac{5.1}{74.99}$$

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

For Train 2

$$C_s = 0.001 \times \frac{4.6}{79.42}$$

$$C_s = \mathbf{0.00006} \text{ g/dscf}$$

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
- θ = Total time of test run, minutes

Sample calculation:

For Train 1

$$E_T = (\underline{0.000068} - 0) \times \underline{13295.6} \times \underline{475} / 60$$
$$E_T = \underline{7.16} \text{ g}$$

For Train 2

$$E_T = (\underline{0.000058} - 0) \times \underline{13295.6} \times \underline{475} / 60$$
$$E_T = \underline{6.10} \text{ g}$$

Average

$$E = \underline{6.63} \text{ g}$$

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

$$7.5\% \text{ of the average} = \underline{0.50}$$

$$\text{Train 1 difference} = \underline{0.53}$$

$$\text{Train 2 difference} = \underline{0.53}$$

PR - Proportional Rate Variation

ASTM E2515 equation (16)

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

Where:

- θ = Total sampling time, min
- θ_i = Length of recording interval, min
- V_{mi} = Volume of gas sample measured by the dry gas meter during the "ith" time interval, dcf
- V_m = Volume of gas sample as measured by dry gas meter, dcf
- V_{si} = Average gas velocity in the dilution tunnel during the "ith" time interval, ft/sec
- V_s = Average gas velocity in the dilution tunnel, ft/sec
- T_{mi} = Absolute average dry gas meter temperature during the "ith" time interval, °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):

$$PR = \left(\frac{475 \times 0.808 \times 20.62 \times (156.0 + 460) \times (87.0 + 460)}{5 \times 79.62 \times 20.72 \times (96.9 + 460) \times (86.0 + 460)} \right) \times 100$$

$$PR = \underline{106} \%$$

PM_R – Particulate emissions for test run, g/hr

ASTM E2780 equation (6)

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

Where,

E_T = Total particulate emissions, grams

θ = Total length of full integrated test run, min

Sample Calculation:

$$E_T (\text{Dual train average}) = 6.63 \text{ g}$$

$$\theta = 475 \text{ min}$$

$$PM_R = 60 \times (6.63 / 475)$$

$$PM_R = \mathbf{0.84} \text{ g/hr}$$

PM_F – Particulate emission factor for test run, g/dry kg of fuel burned
ASTM E2780 equation (7)

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

Sample Calculation:

$$E_T \text{ (Dual train average)} = 6.63 \text{ g}$$

$$M_{Bdb} = 9.36 \text{ kg}$$

$$PM_F = 6.63 / 9.36$$

$$PM_F = \mathbf{0.71} \text{ g/kg}$$

*GHP Group, Inc.
Model: Large Wood Stove
Report Number:0418WS018E*

Appendix A

Manufacturer's Installation/Operation Instructions - Labels

Tested & Listed By  Portland Oregon USA
OMNI-Test Laboratories, Inc.

LISTED SOLID FUEL BURNING SPACE HEATER POELE A COMBUSTIBLES SOLIDES HOMOLOGUE CALENTADOR A COMBUSTIBLE SOLIDO

Serial No. LWS

TESTED TO: UL 1482-11 (R2015)/ULC-S627-00
REPORT NO. 0418WS018S/ 0418WS018E
TESTED EMISSIONS VALUE: 1.48 G/HR
TEST METHOD: ASTM 2515, ASTM 3053

MIS A L'EPREUVE SELON: UL 1482-11 (R2015)/ULC-S627-00
RAPPORT NO 0418WS018S/ 0418WS018E
LA VALEUR DES ÉMISSIONS TESTÉ 1.48 G/HR
MÉTHODE D'ESSAI: ASTM 2515, ASTM 3053

CUMPLE CON PRUEBAS: UL 1482-11 (R2015)/ULC-S627-00
INFORME NO. 0418WS018S/ 0418WS018E
VALOR DE LAS EMISIONES ANALIZADAS: 1.48 G/HR
MÉTODO DE ENSAYO : ASTM 2515, ASTM 3053

CONTACT LOCAL BUILDING OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION IN YOUR AREA. A MINIMUM CLEARANCE OF 18 INCHES (457 mm) TO THE CHIMNEY CONNECTOR MAY BE REQUIRED BY THE AUTHORITY HAVING JURISDICTION.

LOCALS DE LA CONSTRUCTION ET DE LA PREVENTION DES INCENDIES AU SUJET DES RESTRICTIONS ET INSPECTIONS D'INSTALLATION DAND VOTRE SECTEUR. UN ESPACE DE 18 POUCES (457 mm) JUSQU'AU RACCORD DE LE CHEMINEE PEUT ETRE EXIGE PAR LE CORPS CONSTITUTE AYANT JURIDICTION.

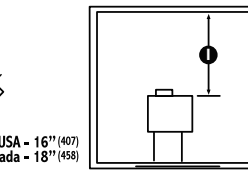
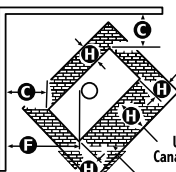
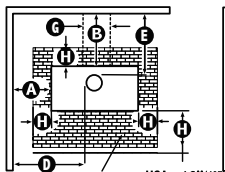
CONTACTE SUS AUTORIDADES LOCALES DE CONSTRUCCION SOBRE RESTRICCIONES E INSPECCIONES DE INSTALACION EN SU AREA. ES POSIBLE QUE LAS AUTORIDADES COMPETENTES EXIJAN UN ESPACIAMIENTO MINIMO DE 18 PULGADAS (457 mm) CON RESPECTO AL CONECTOR DE LA CHIMENEA.

DIMENSIONS: INCHES (mm)
WITH SINGLE WALL CONNECTOR

DIMENSIONS: POUCES (mm)
AVEC RACCORD DE CHEMINEE PAROI SIMPLE

DIMENSIONES: PULGADAS (mm)
CON CONECTOR DE PARED SIMPLE

MINIMUM CLEARANCES TO COMBUSTIBLES / DÉGAGEMENTS MINIMUM AUX COMBUTIBLES / SEPARACIONES MINIMAS A LOS COMBUSTIBLES



MODEL SERIES/MODELE SÉRIE/MODELO SERIE "Large Wood Stove"

- | | | | |
|-------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|
| <input type="checkbox"/> GWS-2200 | <input type="checkbox"/> LWS-2200 | <input type="checkbox"/> PH2200WS-B | <input type="checkbox"/> HWS-2200-B |
| <input type="checkbox"/> GWS-2200-B | <input type="checkbox"/> WS-2200 | <input type="checkbox"/> SWS-2200 | <input type="checkbox"/> PWS-2200-B |
| <input type="checkbox"/> WSL-2200 | <input type="checkbox"/> WS-2200-B | <input type="checkbox"/> SWS-2200-B | |
| <input type="checkbox"/> WSL-2200-B | <input type="checkbox"/> PH2200WS | <input type="checkbox"/> HWS-2200 | |

HATCH AREA REPRESENTS FLOOR PROTECTION ZONE. USA - 16" (407) Canada - 18" (458)

HATCH AREA REPRESENTS FLOOR PROTECTION ZONE. USA - 16" (407) Canada - 18" (458)

- A) Side of stove to side wall / Côté de fourneau au mur latéral / Lado de la estufa a la pared lateral _____ 23" (584mm)
 B) Rear of stove to back wall / Arrière du fourneau pour soutenir le mur / Parte posterior de la estufa para mover hacia atrás la pared _____ 16" (406mm)
 C) Corner of stove top to side wall / Le coin du dessus de fourneau au mur latéral / La esquina de la tapa de la estufa a la pared lateral _____ 14" (356mm)
 D) Flue to side wall / Conduite de cheminée au mur latéral / Tubo a la pared lateral _____ 33" (838mm)
 E) Flue to back wall / Conduite de cheminée pour soutenir le mur / Tubo para mover hacia atrás la pared _____ 19" (483mm)
 F) Flue to corner / Flue à coin / Humeros a coin _____ 24.5" (622mm)
 G) 2" beyond pipe when pipe exits horizontally through wall / 2 po au-delà du tuyau quand le tuyau sort horizontalement par un mur / 2" de separación cuando existan tuberías horizontales a lo largo de la pared
 H) Floor protection / Protection de plancher / Protección del piso
 Rear/Arrière/Parte posterior: 8"(203mm) Left/Gauche/Izquierdo: 8"(203mm) Right/Droite/La derecha: 8"(203mm) Front/Avant/Frente: USA 16"(407mm)' CAN 18"(458mm)
 I) Top of stove to ceiling / Dessus de fourneau au plafond / Tapa de la estufa al techo _____ 53.375" (1356mm)

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 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.

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 A NONCOMBUSTIBLE FLOOR PROTECTION EQUIVALENT TO 1" MILLBOARD. FLOOR PROTECTOR MUST HAVE MIN R. VALUE OF "2" EXTENDING 18 IN. (457 mm) FOR CANADA 16 IN. (408 mm) FOR USA IN FRONT AND 8 IN. (203 mm) TO THE SIDES AND BACK OF UNIT.

CHIMNEY TYPE: MINIMUM 6 IN (152mm) DIAMETER. CHIMNEY CONNECTOR: 6 IN (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 #75-21-514

OPTIONAL BLOWER: MODEL (P) (R) BAR-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 ELEVER LE FEU CONSTRUIT LE FEU DIRECTEMENT SUR LES BRIQUES. NE RIEN ENTREPOSER SOUS L'APPAREIL. DES METHODES SPECIALES SONT REQUISES SORS DU PERCAGE D'UN MUR OU PLAFOND. VERIFIER LES DIRECTIVES ET LES CODES DE CONSTRUCTION. NE PAL ACCORDER A LA CHIMENEE D'UN AUTRE APPAREL. POUR UTILISATION SECURITAIRE. SUIVRE ATTENTIVEMENT LES INSTRUCTIONS DU FABRICANT. GARDEZ LA PORTE DU POELE FERMEE PENDANT LE FONCTIONNEMENT.

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 TAPIS PROTECTEUR IMBRULABLE D'UNE EPAISSEUR COMPARABLE A L'EPAISSEUR DU CELLODERME 2,54CM. LE PROTEGE PLANCHER DOIT AVOIR UNE VALEUR RF D'AU MOINS "2" S'ETENDANT 18 PO (457mm) AU CANADA ET 16 PO (408mm) POUR LES ETET-UNIS AL'AVANT ET 8 PO (203mm) A L'ARRIERE ET SUR LES COTES DE L'APPAREIL

TYPE DE CHIMENEE: DIAMETRE MINIMAL 6 PO (152mm) RACCORD DE CHIMENEE: DIAMETRE 6 PO (152mm) CALIBRE DE 24 ACIER. L'APPAREIL DOIT ETRE INSTALLER AVEC LES PIED OU LE SOCLE FOURNI. ATTACHEZ COMME MONTRER DANS LES INSTRUCIONS D'INSTALLATION. REMPLACEMENT DU VERRE-REMPLACEZ SEULEMENT AVEC LE REMPLACEMENT GHP NUMERO DE PARTIE DU VERRE 75-21-514

SOUFFLERIE FACULTAIVE: MODEL (P) (R) BAR-2427 120 VOLTS FREQ 60Hz 1.0 AMPS 2900 RPM

DANGER: RISQUE DE SECOURSSE ELECTRIQUE.
DEBRANCHEZ 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 ES PACIO DEBAJO DEL CALENTADOR. SE REQUIEREN METODOS ESPECIALES PARA HACER INSTALACION A TRAVES DE UNA PARED O DEL TECHO. CONSULTE LAS INSTRUCCIONES Y LAS NORMAS DE CONSTRUCCION. NO CONECTE ETA 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.

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 SOBRE UN PROTECTOR DE PISO NO INFLAMABLE, EQUIVALENTE A UN CARTON PIEDRA DE 1". EL PROTECTOR DE PISO DEBE TENER UN VALOR R MINIMO DE "2". EXTENDIENDOSE POR DELANTE 18 Pulg. (457 mm) EN CANADA Y 16 Pulg. (408mm) EN LOS EE.UU. Y 8 Pulg. (203mm) A LOS LADOS Y POR DETRÁS DE LA UNIDAD.

TIPO DE CHIMENEA: DIAMETRO MINIMO DE 6 Pulg. (152 mm). APROBADO PARA USO RESIDENCIAL

CONECTOR DECHIMENEA: 6 Pulg. (152mm) DE DIAMETRO. ACERO DE CALIBRE 24 MINIMO. EL CALEN TADOR DEVE INSTALARSE CON LAS PATAS O EL PEDESTAL SUMINISTRADO. HAGA EL MOENTUE COMO SE MUESTRA EN LAS INSTRUCCIONES DE INSTALACION. PARA REEMPLAZAR VIDRIO - CAMBIELO UNICAMENTE POR EL VIDRIO GHP DE REPUESTO - NUMERO DE PIEZA 75-21-514

VENTILADOR OPCIONAL: MODELO (P) (R) BAR-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.

U.S. ENVIRONMENTAL PROTECTION AGENCY CERTIFIED TO COMPLY WITH 2020 PARTICULATE EMISSION STANDARDS USING CORDWOOD.

FABRIQUE AU ETATS UNIS PAR: GHP GROUP INC, 6440 W HOWARD ST., NILES IL 60714
HECHO EN LOS EE.UU. POR EL GRUPO GHP, INC, 6440 W HOWARD ST., NILES IL 60714

DATE OF MANUFACTURE: 2020 2021 2022 2023 2024 2025 2026
DATE DE FABRICATION: Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
FECHA DE FABRICACION: [] [] [] [] [] [] [] [] [] [] [] []

216 mm

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.

Ce poêle à bois nécessite une inspection et un entretien périodiques pour bien fonctionner. Consultez le manuel du propriétaire pour obtenir plus d'informations. La réglementation fédérale interdit d'utiliser ce poêle à bois en infraction avec le mode d'emploi décrit dans le manuel du propriétaire.

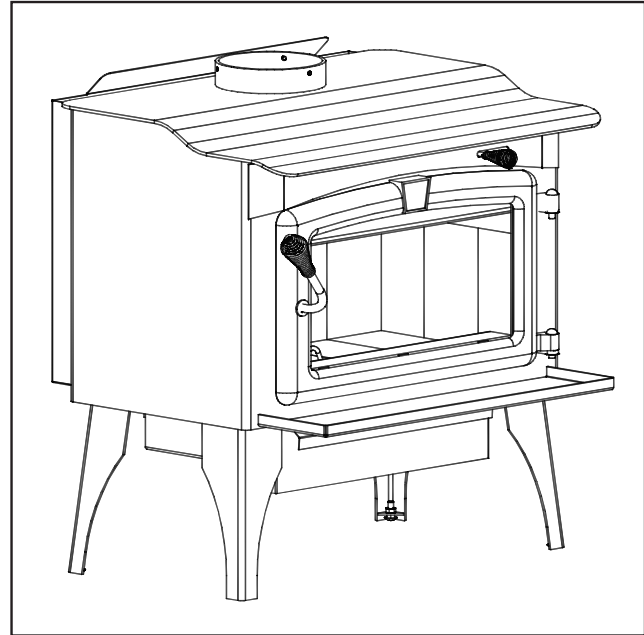
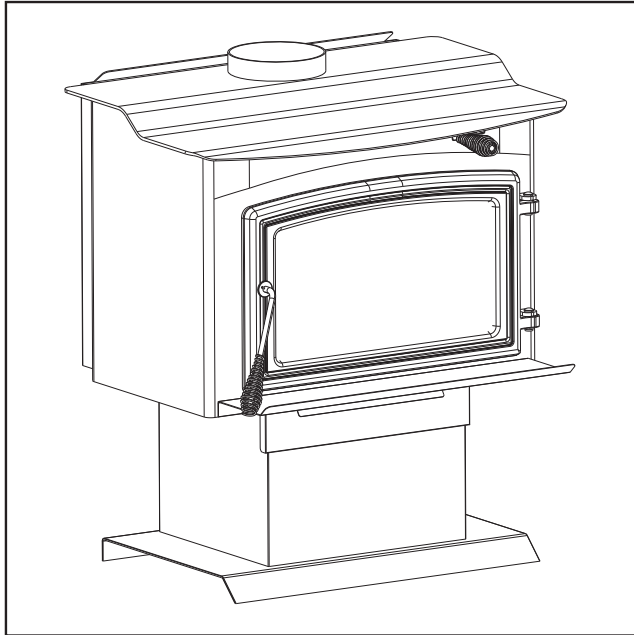
Este calefactor de leña necesita inspección y mantenimiento periódicos con un funcionamiento adecuado. Consulte el manual del propietario para más información. Está prohibido por regulaciones federales utilizar este calefactor de leña de forma inconsistente con las instrucciones de funcionamiento en el manual del propietario.

Pleasant Hearth



Warming Your Home. Warming Your Heart.

High Efficiency Wood Stove - Large



Model Series:

PH2200WS, PH2200WS-B, HWS-2200,
HWS-2200-B, PWS-2200-B, SWS-2200, SWS-2200-B

Model Series:

WSL-2200, WSL-2200-B, WS-2200, WS-2200-B,
LWS-2200, GWS-2200, GWS-2200-B

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.

This manual describes the installation and operation of the Model PH2200WS, PH2200WS-B, HWS-2200, HWS-2200-B, PWS-2200-B, SWS-2200, SWS-2200-B WSL-2200, WSL-2200-B, WS-2200, WS-2200-B, LWS-2200, GWS-2200, GWS-2200-B non-catalytic wood 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.

This stove is listed by OMNI-Test Laboratories of Portland, Oregon to meet UL1482 for the US and ULC-S627 for Canada.

**6" Flue
required**

TESTED TO: UL UL 1482-2011 (R2015)/ULC-S627-00
REPORT NO. 0418WS018S/ 0418WS018E



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 8:30 a.m. - 4:30 p.m. CST, Monday - Friday or e-mail us at customerservice@ghpgroupinc.com.

80-10-618
06/18/2020

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 INSTALL THESE UNITS IN A MOBILE HOME OR TRAILER. THESE UNITS ARE NOT MOBILE HOME APPROVED.**
 12. **DO NOT CONNECT TO ANY AIR DISTRIBUTION DUCT OR SYSTEM.**
 13. 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.

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.

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.

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.)



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

Pedestal Base and Leg Installation

Before Installing Stove, Follow These Steps for Pedestal Base and Leg Installation.

Model: HWS-230292
Large Wood Stove w/Pedestal Base

Pedestal base is pre-installed at the factory. No action is required.

Model: PH2200WS
Large Wood Stove w/Pedestal Base and Legs

Remove Ash pan and (4) bolts that secure the stove body to the pedestal as shown in Figure 0.

With assistance, lift stove off of pedestal and lay stove on its side on a safe, elevated, padded and level platform that is about 6" off the ground.

Using the bolts that were removed in step 1, bolt each leg to the bottom of the stove as shown in Figure 0.2.

With assistance, lift the stove off of the raised platform, set upright on the legs, and re-install the ash pan.

When stove is in place for installation, make sure stove is level by adjusting the leg levelers shown in Figure 0.3.

Model: LWS-2200
Large Wood Stove w/Legs

Remove ash pan and (4) bolts in angle iron bracket as shown in Figure 0.1.

With assistance, lift stove off of wooden pallet and lay stove on its side on a safe, elevated, padded and level platform that is about 6" off the ground.

Using the bolts that were removed in step 1, bolt each leg to the bottom of the stove as shown in Figure 0.2.

With assistance, lift the stove off of the raised platform, set upright on the legs and re-install the ash pan.

When stove is in place for installation, make sure stove is level by adjusting the leg levelers shown in Figure 0.3.

Figure 0

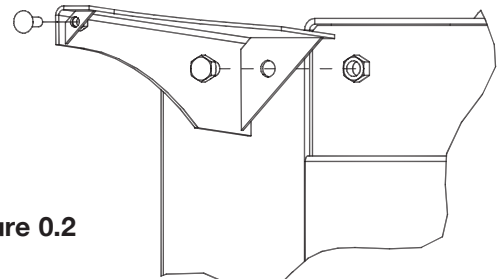
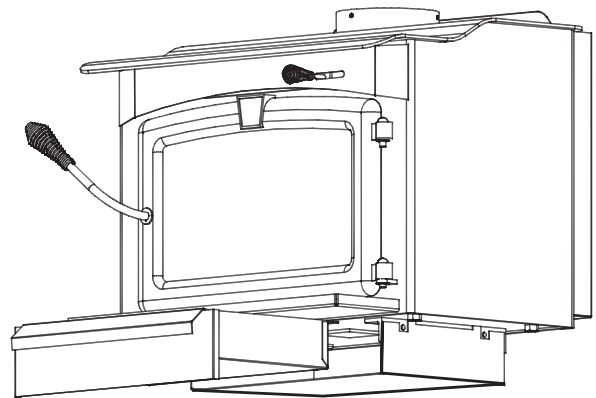
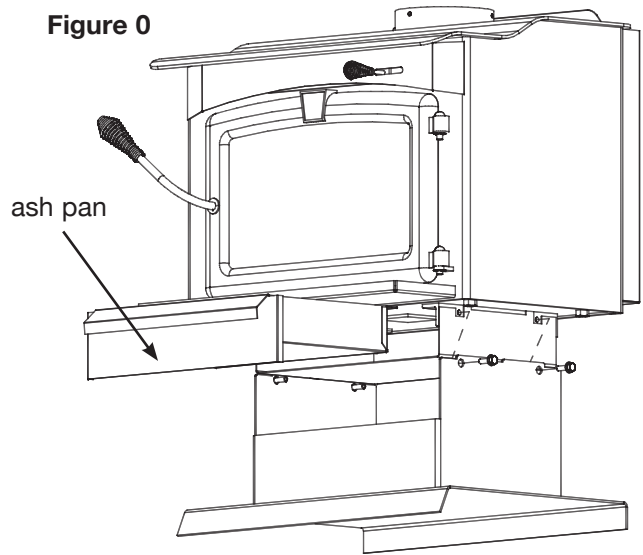


Figure 0.2

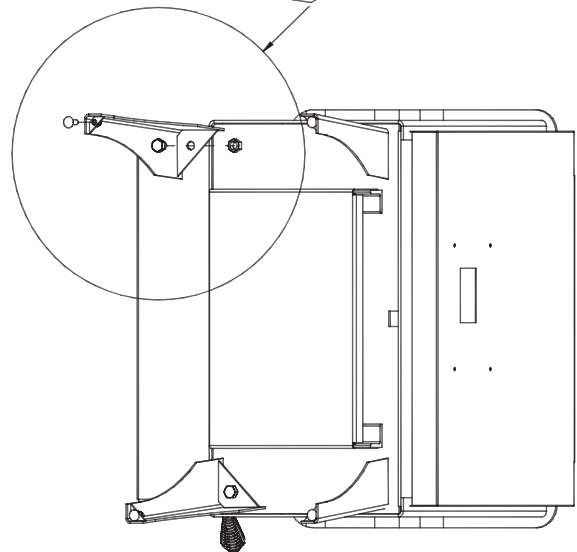
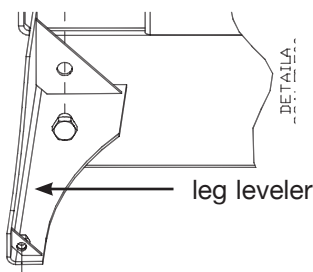


Figure 0.3

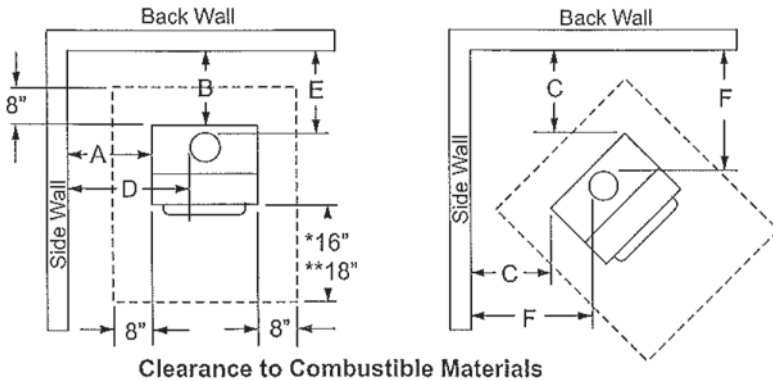


INSTALLATION

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

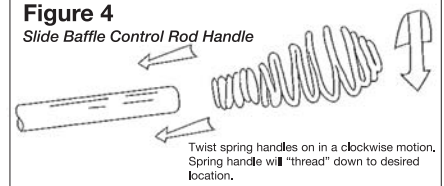
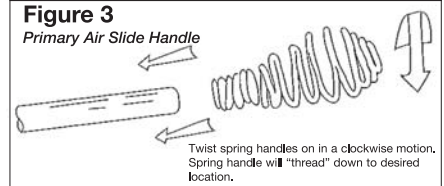
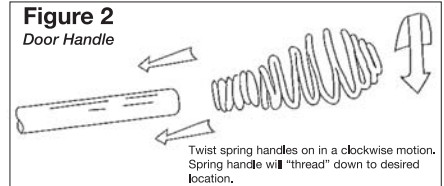


A minimum clearance of 18" (457 mm) to the chimney connector may be required by the authority having jurisdiction.

From Heater	From Chimney Connector
A. Sidewall 23" (584mm)	D. Sidewall 33" (838mm)
B. Back Wall 16" (406 mm)	E. Back Wall 19" (483mm)
C. Corner 14" (356mm)	F. Corner 24.5" (622mm)
Minimum height to ceiling	53.375" (1356mm)
*16" (406 mm) US	**18" (457 mm) Canada

We recommend Placing the Stove on a noncombustible floor protection equivalent to 1" millboard. Floor protector must have min. R value of 2". Consult your local building authorities for further information.

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.

CAUTION: Brick for ash drawer must be installed before operation of wood heater.

CAUTION: DO NOT alter the primary air damper range

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.

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 a minimum thickness of 1.0" and an R value of "2".

To determine a material's suitability use the following formulas;

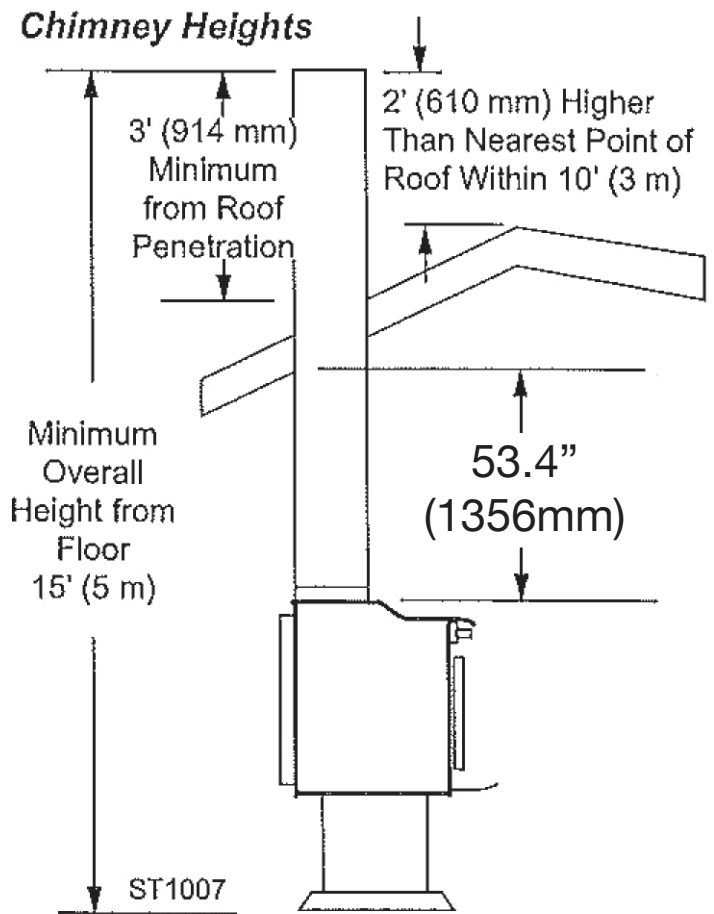
1. If the material has an R (Thermal resistance) rating use the designated thickness and no conversion is needed. R values can be added for multi-layered materials.
2. If the material has a k (Thermal conductivity) rating convert this to an R rating using the formula $R = 1/k \times t$ (t = thickness in inches)
3. If the material has a C (Thermal conductance) rating convert this to an R rating using the formula $R = 1/C$.

CHIMNEY

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.

Figure 3



REFER TO CHIMNEY MANUFACTURER'S INSTRUCTIONS 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.

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.)

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

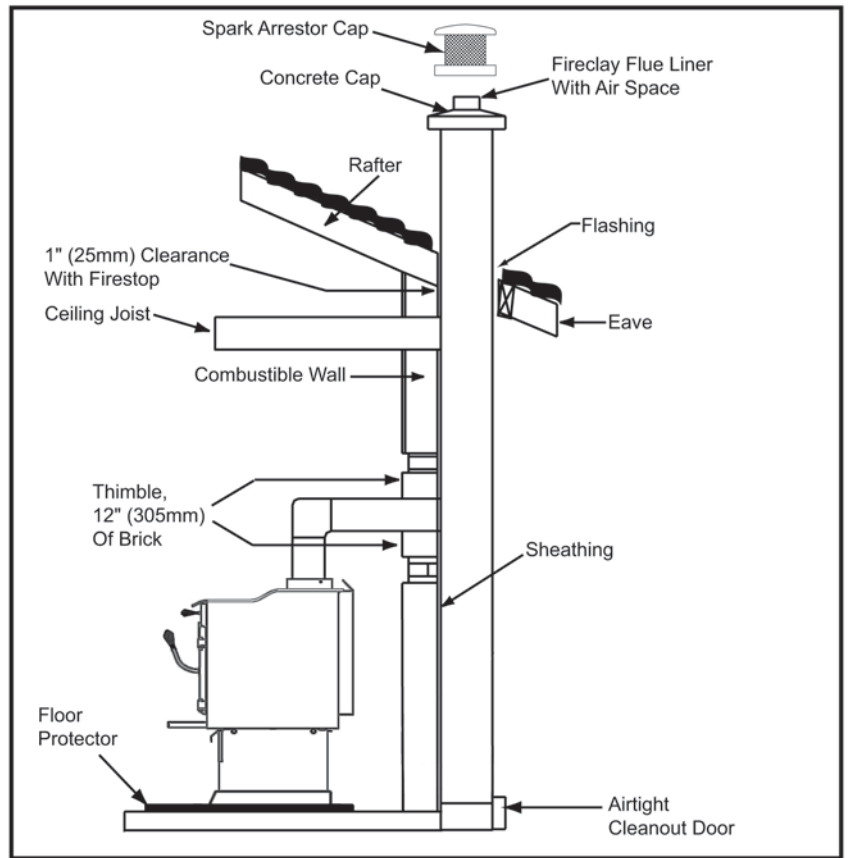


Figure 4.1 Masonry Chimney

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

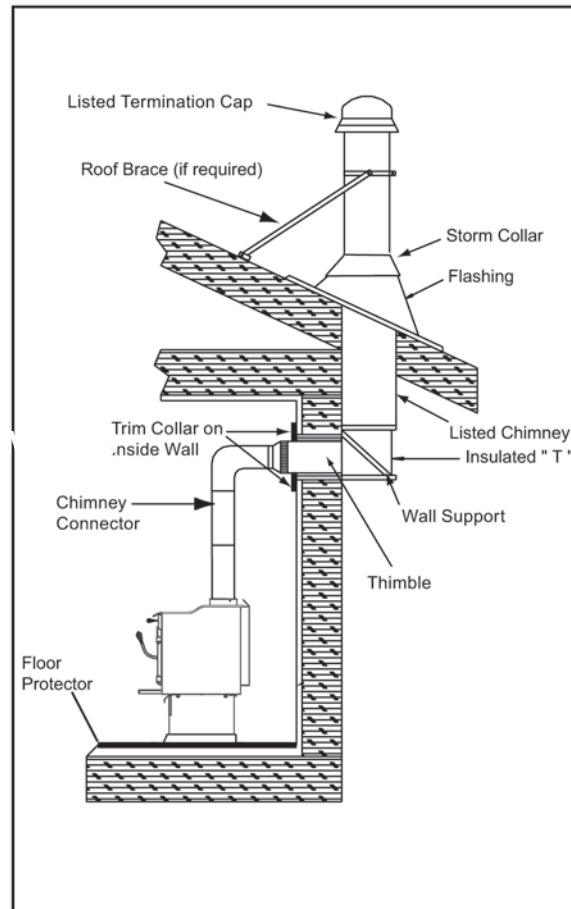


Figure 4.2 Exterior Prefabricated Chimney

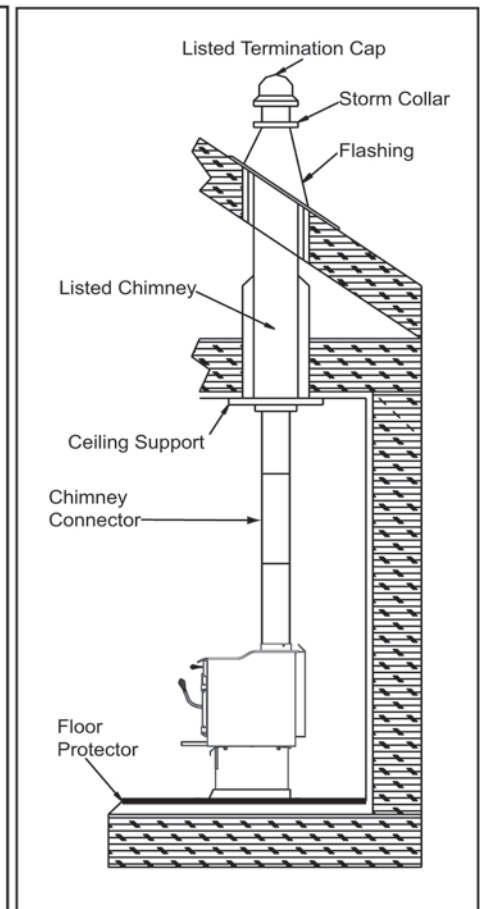


Figure 4.3 Interior Prefab. Chimney

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 ULC S627.
- Must use components required by the manufacturer for installation.
- Must maintain clearances required by the manufacturer for installation.
- Refer to manufacturers instructions 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.**

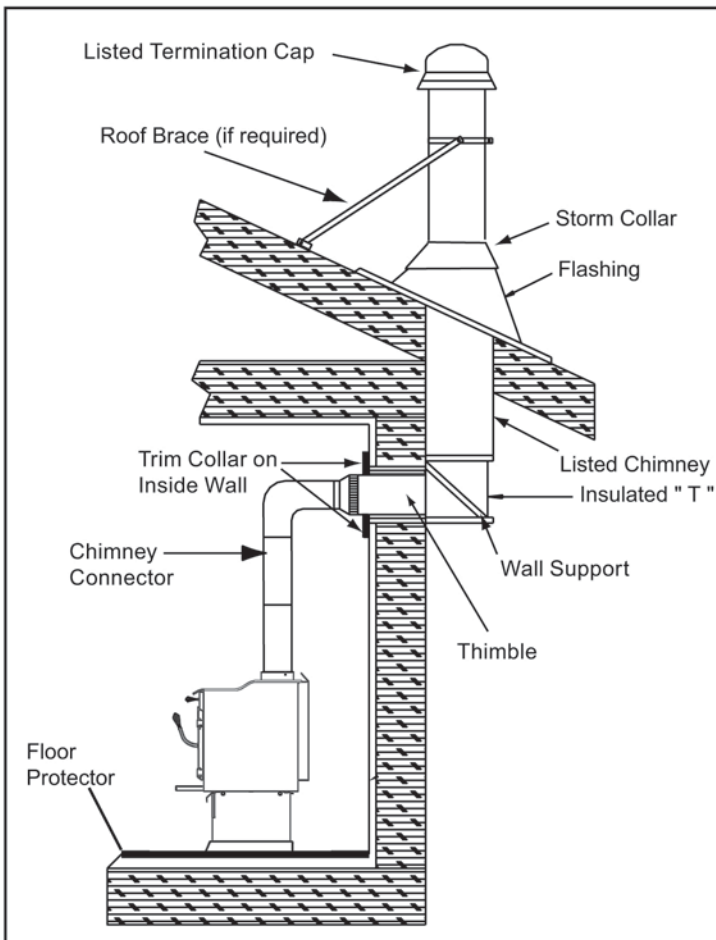


Figure 5.1 Prefabricated Exterior Chimney

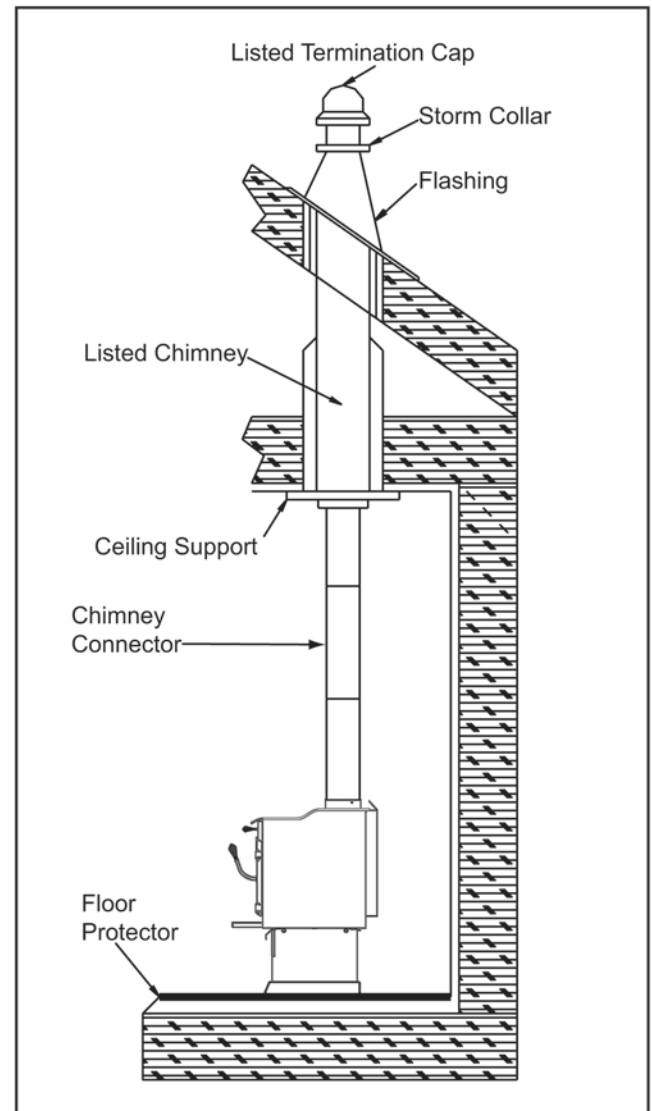


Figure 5.2 Prefabricated Interior Chimney

Thimble

Site constructed for masonry chimney installation:

Components

- A minimum length of 12 inches [305mm] (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 enter 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.
10. Install trim collar around the solid pack chimney section.

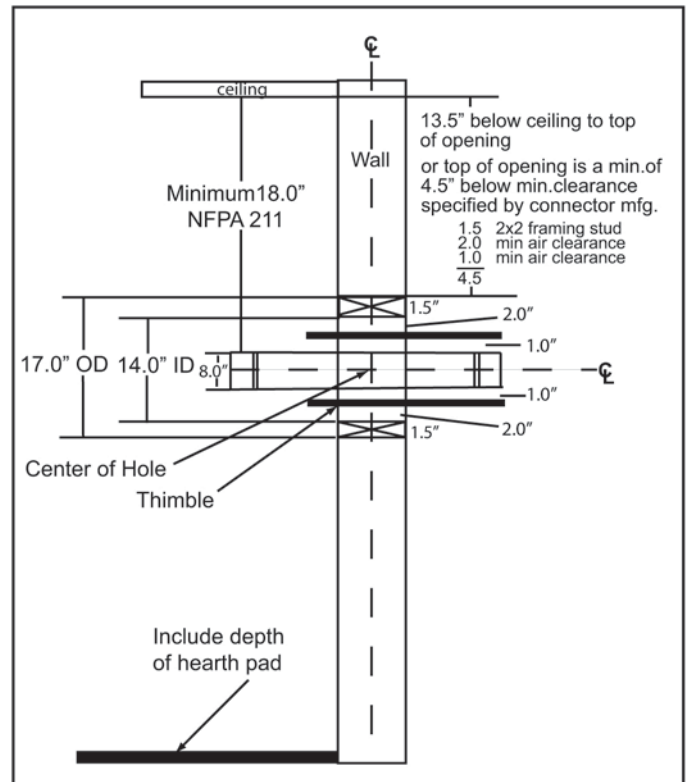


Figure 6.1

Solid Pack Chimney with Metal Supports as a Thimble

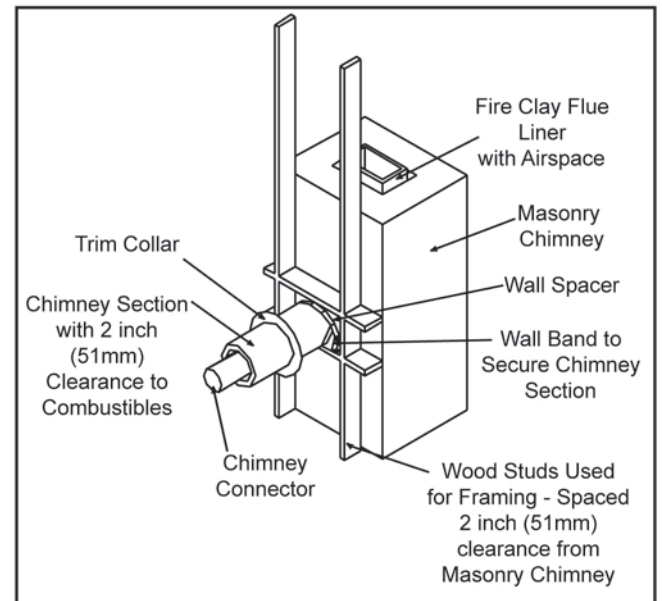


Figure 7.1

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.

Solid Pack Chimney with Metal Supports as a Thimble (Cont'd)

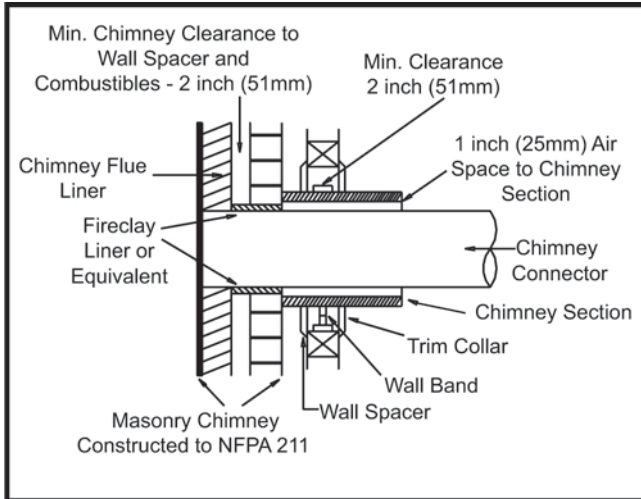


Figure 7.2

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.

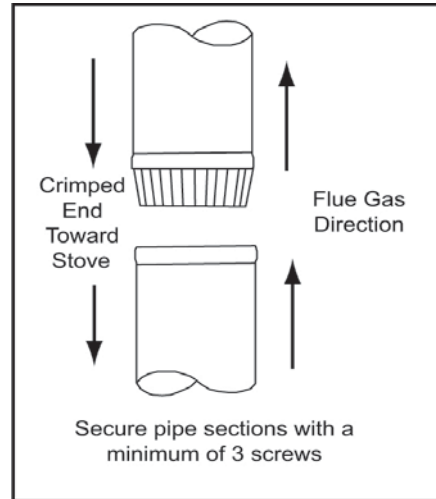


Figure 8

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.

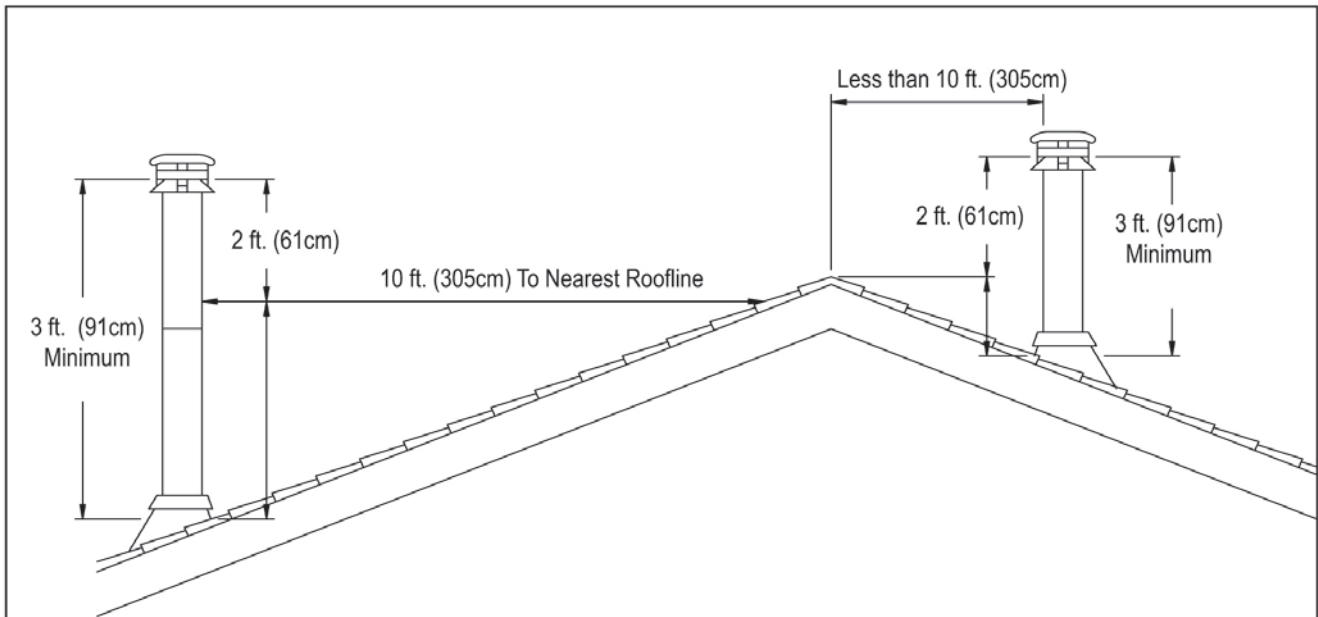
- Must have an approved and listed cap
- Must not be located where it will become plugged by snow or other material
- Must terminate at least 2 feet (61cm) above the roof and at least 3 feet (91cm) above any portion of the roof within 10 feet (305cm).
- Must be located away from trees or other structures

NOTE:

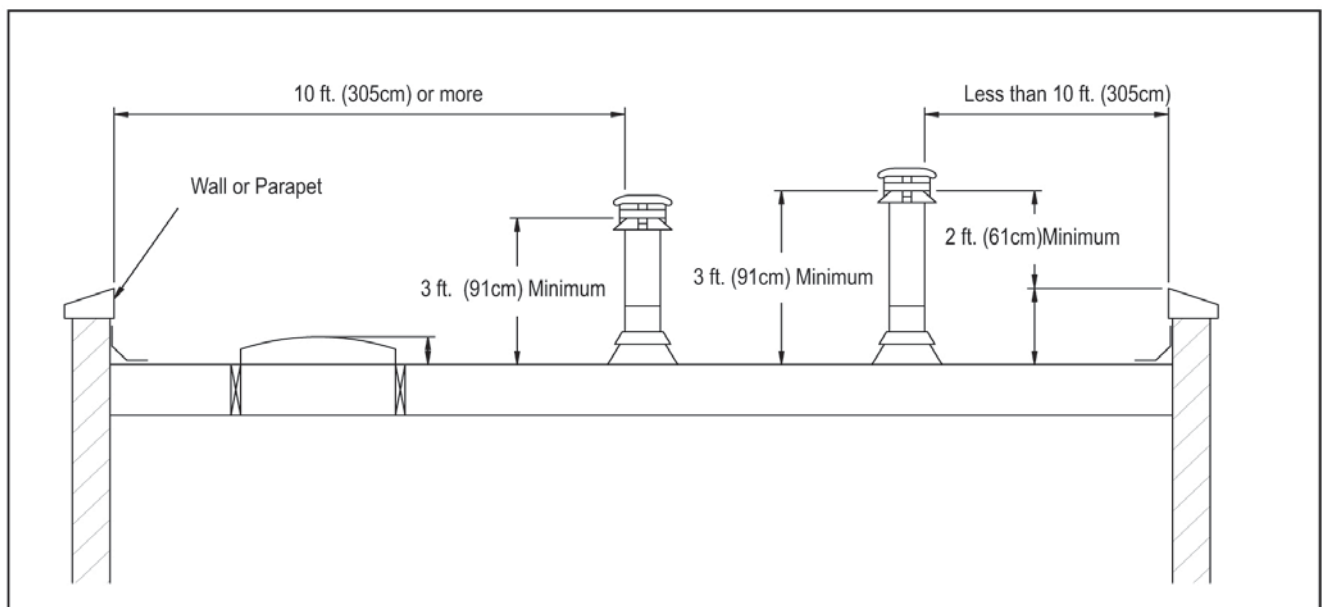
- Chimney performance may vary.
- Trees, buildings, roof lines and wind conditions affect performance.
- Chimney height may need adjustment if smoking or overdraft occurs.

2-10-3 Rule

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



Pitched Roof

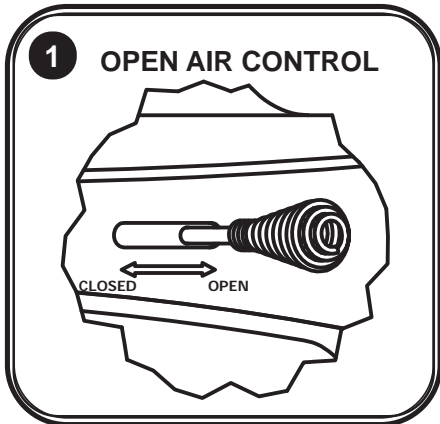


Flat Roof

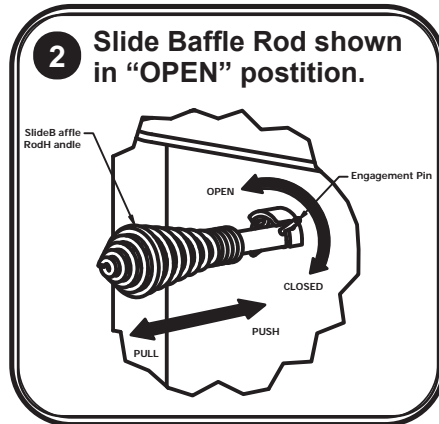
WOOD STOVE QUICK START GUIDE

ITEMS NEEDED FOR START-UP FIRE:

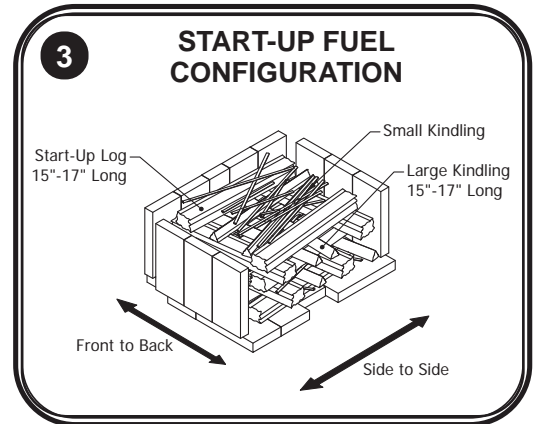
- 10 Pieces of Large Dry Kindling
- 10 Pieces of Small Seasoned Split Wood
- 1/2 lb of Small Dry Kindling



Slide damper control all the way to the right to completely open the damper.

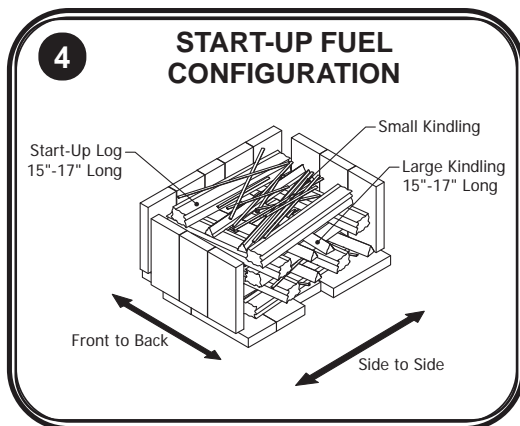


Pull Rod Handle out to rotate between "CLOSED" and "OPEN" position. "PUSH" Rod Handle in to lock in position.

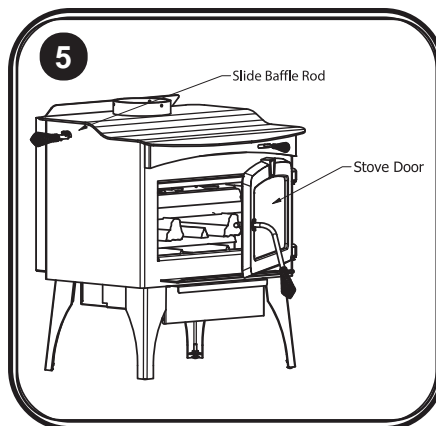


Configure the Start-Up Fuel in Six Layers as Follows;

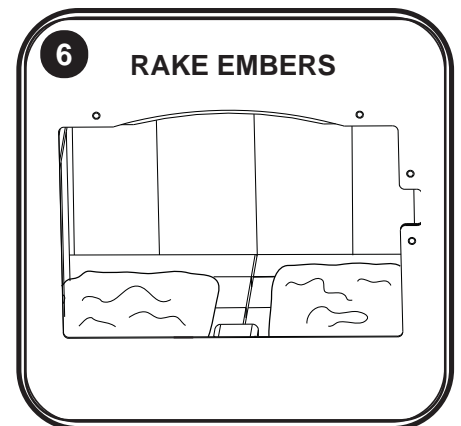
1. 2 Large Kindling Pieces and 2 Start-Up Pieces positioned
2. 2 Large Kindling Pieces and 2 Start-Up Pieces positioned
3. 2 Large Kindling Pieces and 2 Start-Up Pieces positioned
4. 2 Large Kindling Pieces and 2 Start-Up Pieces positioned
5. 2 Large Kindling Pieces and 2 Start-Up Pieces positioned
6. A Random Pile of Small Kindling on Top 3 to 5 Layers



Light the kindling sticks with a match



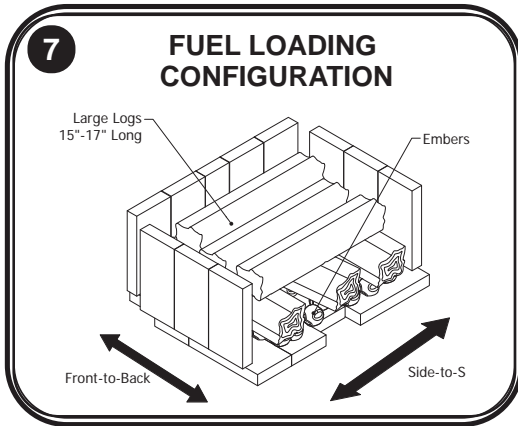
1. Leave the door open 12 in. and allow the start-up fuel to burn until the kindling and starter pieces are burning
2. Close the door and slide baffle rod and allow the fire to burn until there is a layer of coals over the bottom of the stove



1. Open the Slide Baffle Rod per Step 2
2. Open the Door
3. Rake Embers to create a level bed on the bottom of stove.

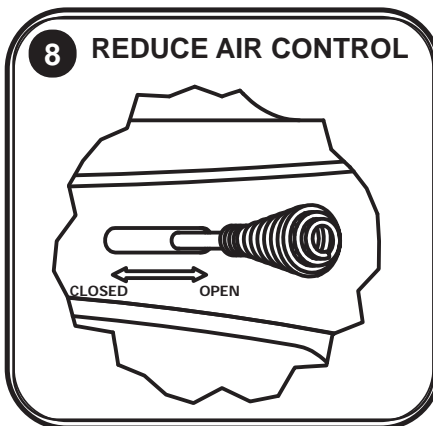
Questions, problems, missing parts? Before returning to your retailer, call our customer service department at 877-447-4768 8:30 a.m. – 4:30 pm CST, Monday – Friday. or email us at customerservice@ghpgroupinc.com

- 6 Pieces of Seasoned Split Wood 15-17 in. Long



Configure the Fuel as Follows;

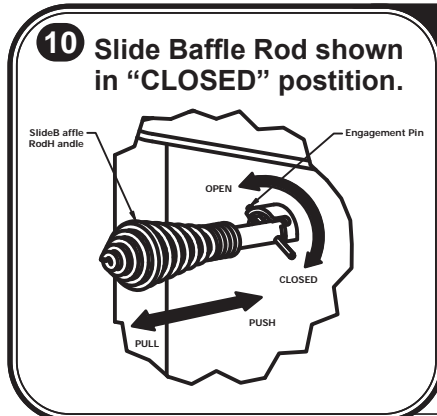
1. Position 3 Large Logs Front-to-Back on Top of the Ember Bed.
2. Position 3 Large Logs Side-to-Side on Top of the First Layer



Position Damper Slide to Fully Open Setting for 7 Minutes, then set to Desired Setting. Leave Door open approximately 12 inches for approximately 4 Minutes.



Once fire is fully burning, fully close and latch stove door.



WARNING! Risk of Fire

Always OPEN the Slide Baffle before opening the door to refuel the stove! This will prevent:

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

Insure the slide baffle is in the CLOSED position after the Door is closed to activate the Efficiency and Fuel Saving design of this stove.

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.

Pull Rod Handle out to rotate between "CLOSED" and "OPEN" position. "PUSH" Rod Handle in to lock in position. **Congratulations! Your wood stove is ready for operation.**

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.

Efficiency, Heat Output, and Particulate Emissions:

The Weighted Average HHV Efficiency = 75.3

The Sum of Weighted Particulate Emission = 1.48 grams/hour

Heat Output Range = 16,394 - 70,045 BTU/hour

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

OPERATION

Do not use a grate or elevate 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

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 paper and close door. If fire dies down substantially, open door slightly.
5. Using the lincoln log method, add larger pieces of wood as the fire progresses being careful not to overload. 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 a slight (1" to 2" wide) trough in the centre of the coal bed from front to back prior to loading the fuel.
7. Once fuel has been loaded, 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", "1 1/2 way-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.

CAUTION: There are hazards with some fuels (eg charcoal), as well as the possibility of generating carbon monoxide, which there are hazards associated with also.

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.

GLASS CARE

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 PARTS PAGE 18).

GLASS 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 reinstall.

GASKET REPLACEMENT

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

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.



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.**

ASH DISPOSAL

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 this container.

USING THE ASH DRAWER

NOTE: Coals may still be hot even though stove feels cool to the touch.

1. Make sure stove is completely cool.
2. Open glass door and lift up the firebrick for ash drawer using a fireplace poker through the metal hook raised from the top of the brick and set aside in firebox.
3. Using a small hand broom, sweep the ashes into the opening, allowing the ashes to fall into the ash pan.
4. Make sure all debris is clear of the opening. This is important to ensure the firebrick (when replaced) seals to the metal stove bottom. If the fire brick is not properly sealed, the stove will not operate correctly.
5. Using gloves, pull out the ash drawer while holding the bottom of the ash pan so it doesn't fall out onto the floor.
6. Dispose of the ashes in a metal container with a tight-fitting lid.
7. Replace ash pan drawer and firebrick to their original positions.

IMPORTANT

1. What is the correct way to start a fire?

- a) You will need small pieces of dry wood (kindling) and paper. Use only newspaper or paper that has not been coated or had unknown materials glued or applied to it. Never use coated (typically advertising flyers) or coloured paper.
- b) Open the door of the wood stove.
- c) Crumple several pieces of paper and place them in the center of the firebox and directly on to the fire bricks of the wood stove. Never use a grate to elevate the fire.
- d) Place small pieces of dry wood (kindling) over the paper in a Teepee manner. This allows for good air circulation, which is critical for good combustion.
- e) Light the crumpled paper in 2 or 3 locations.
Note: It is important to heat the air in the stovepipe for draft to start.
- f) Fully open the air control of the wood stove and close the door until it is slightly open, allowing for much needed air to be introduced into the fire box. Never leave the door fully open as sparks from the kindling may occur causing injury or property damage. As the fire begins to burn the kindling, some additional kindling may be needed to sustain the fire. **DO NOT** add more paper after the fire has started.

g) Once the kindling has started to burn, start by adding some of your smaller pieces of seasoned (dry) firewood. NOTE: Adding large pieces at the early stages will only serve to smother the fire. Continue adding small pieces of seasoned (dry) firewood, keeping the door slightly open until each piece starts to ignite. Remember to always open the door slowly between placing wood into the fire.

h) Once the wood has started to ignite and the smoke has reduced, close the wood stove door fully. The reduction of smoke, is a good indication that the draft in the chimney has started and good combustion is now possible. Larger pieces of seasoned (dry) firewood can now be added when there is sufficient space in the Firebox. Adjust the air control setting to desired setting.

I) Note: The lower the air control setting the longer the burn time of your firewood.

2. 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.

3. 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)

4. 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.

5. 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.

6. 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.

7. 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.

8. What is draft?

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

9. 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.

10. 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.

Efficiency, Heat Output, and Particulate Emissions;

The Weighted Average HHV Efficiency = 75.3%

The Sum of the Weighted Particulate Emissions = 1.48 grams/ hr

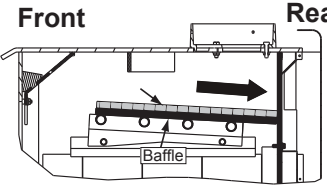
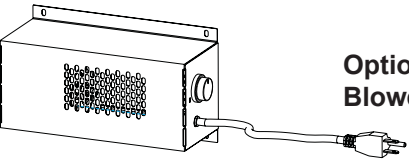
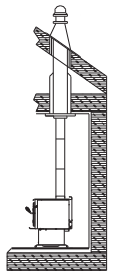
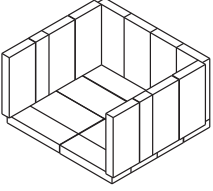
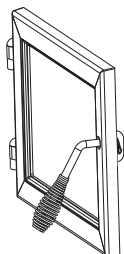
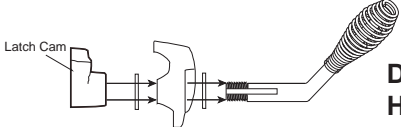
Heat Output Range = 16,394 to 70,045 BTU/ hr

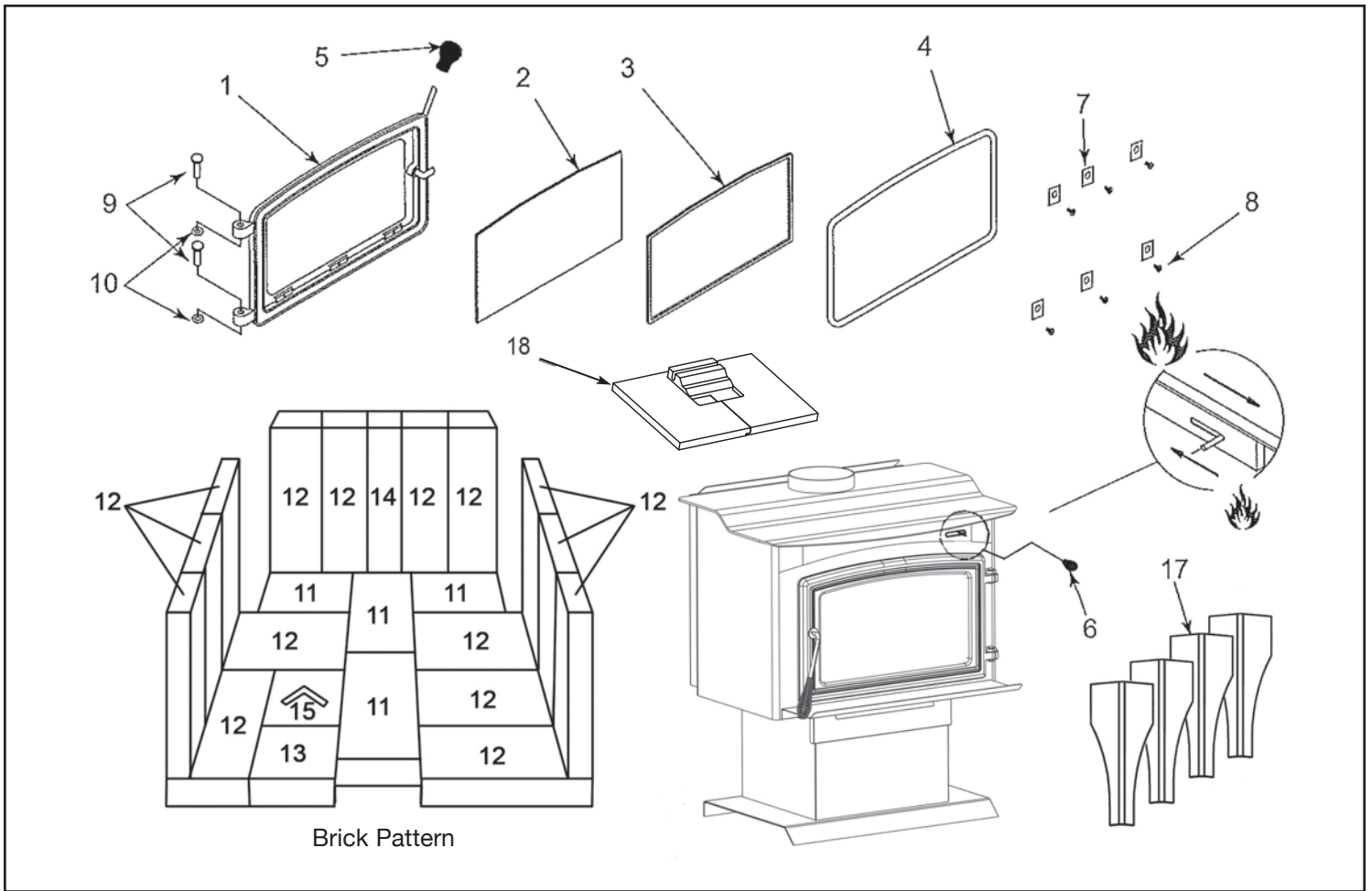
QUICK REFERENCE MAINTENANCE GUIDE



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>Baffle & Blanket</p>	<p>MONTHLY or After Every Cord of Wood</p>	<p>Baffle and blanket placement is critical to heat output, efficiency and overall life of the unit. Make sure the baffle is pushed all of the way to the back of the firebox and the blanket is laying flat. Inspect baffle for cracks.</p>
 <p>Optional Blower</p>	<p>YEARLY or After Every 4 Cords of Wood</p>	<p>Vacuum the blower impellers.</p>
 <p>Chimney System</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>Firebrick & Ash Removal</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>Door & Glass Assemblies</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>Door Handle</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	75-21-182
2 & 3	Glass (17.00" W x 9.75") and Gasket	1	75-21-514
3	1/8" Glass Gasket	4.3'	75-21-123
4	5/8" Door Gasket	5.1	75-21-143
5	Spring Handle	1	75-20-140
6	Air Control Sprint 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

Item No.	Description	Qty.	Part No.
10	Push Nut	2	75-21-150
11	Firebrick Lt. 7 3/4" x 4 7/16" x 1 1/4"	4	75-21-145
12	Firebrick Lt. 9" x 4 7/16" x 1 1/4"	15	75-21-147
13	Firebrick Lt. 4 1/2" x 4 7/16" x 1 1/4"	1	75-21-146
14	Firebrick Lt. 9" x 2 1/2" x 1 1/4"	1	75-21-148
15	Firebrick for Ash Drawer	1	75-21-149
16	Ash Drawer Assembly	1	75-21-512
17	Leg Assembly	4	75-22-510
18	Insulation Baffle	1	75-21-003 75-21-004 75-21-005

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 willful 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.ghpgroupinc.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. 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

SAVE THIS CARD!

Place
Postage
Stamp
Here

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

*GHP Group, Inc.
Model: Large Wood Stove
Report Number:0418WS018E*

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:

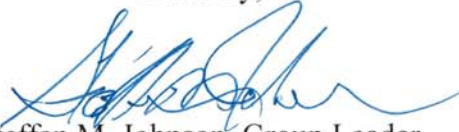
1. The filter temperature must be maintained between 80 and 90 degrees F during testing.
2. Filters must be weighed in pairs to reduce weighing error propagation; see ASTM 2515-11, Section 10.2.1 Analytical Procedure.
3. Sample filters must be Pall TX-40 or equivalent Teflon-coated glass fiber, and of 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.

Sincerely,



Steffan M. Johnson, Group Leader
Measurement Technology Group

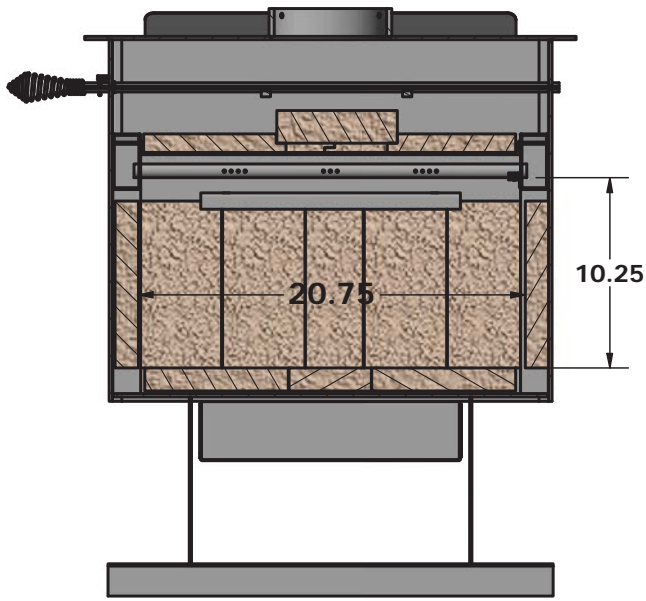
cc: Amanda Aldridge, EPA/OAQPS/OID
Adam Baumgart-Getz, EPA/OAQPS/OID
Rafael Sanchez, EPA/OECA
Michael Toney, EPA/OAQPS/AQAD

*GHP Group, Inc.
Model: Large Wood Stove
Report Number:0418WS018E*

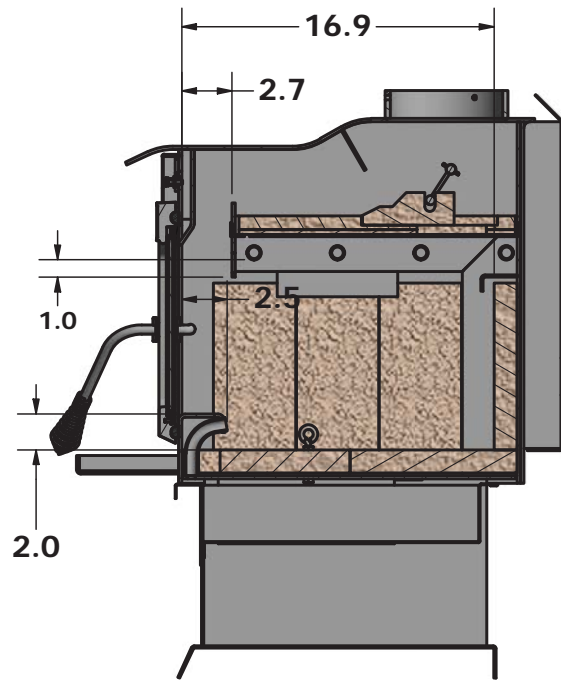
Appendix C

Firebox Volume


$V1 = (20.75 \times 10.25 \times 16.90) / 1728 = 2.08 \text{ cuft}$
 $V2 = (2.7 \times 1.0 \times 20.75) / 1728 = 0.03 \text{ cuft}$
 $V3 = (2.0 \times 2.5 \times 20.75) / 1728 = 0.06 \text{ cuft}$
 Total Usable Volume = $2.08 - (0.03 + 0.06) = 2.0 \text{ cuft}$



SECTION B-B
SCALE 1/8



SECTION A-A
SCALE 1/8

DRAWN Dan Downing		5/13/2020			GHP GROUP INC.	
MFG					6440 W Howard St., Niles, IL 60714	
MATERIAL				TITLE		
				Usable Firebox Volume 2020 Large Wood Stove		
TOLERANCES				SIZE	DWG NO	REV
X.XXX = +/- 0.030"				A		
X.XX = +/- 0.060"				Usable Firebox Volume- GHP LG		
X.X = +/- 0.125"				SCALE		
ANGLES = +/- 2 Degrees				1/8		
				SHEET 1 OF 1		