Innovative Hearth Products, LLC

Project # 21-720
Model: Ladera-D
AKA: WRT3920-B
Type: Residential Non-catalytic Wood Fired Heater
December 9, 2021

ASTM E3053 Standard Test Method for Determining Particulate Matter Emissions from Wood Heaters Using Cordwood Test Fuel (EPA ALT-125)

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Affidavit

PFS-TECO was contracted by Innovative Hearth Products, LLC (IHP) to provide testing services for the Ladera-D Wood-Fired Room Heater per ASTM E3053, *Standard Test Method for Determining Particulate Matter Emissions from Wood Heaters Using Cordwood Test Fuel*, which was approved for use under EPA ALT-125. All testing and associated procedures were conducted at PFS-TECO's Portland Laboratory on 9/14/2021. PFS-TECO's Portland Laboratory is located at 11785 SE Highway 212 – Suite 305, Clackamas, Oregon 97015. Testing procedures followed ASTM E3053 with the exception of caveats described in EPA ALT-125. Particulate sampling was performed per ASTM E2515, *Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel,* with the exception of caveats described in EPA ALT-125. A copy of EPA ALT-125 is included in Appendix A for reference, as required by the approval letter.

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

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

Aaron Kravitz, Testing Supervisor

Introduction

Innovative Hearth Products, LLC contracted with PFS-TECO to perform EPA certification testing on the Ladera-D Wood-Fired Room Heater. All testing was performed at PFS-TECO's Portland Laboratory. Testing was performed by Mr. Aaron Kravitz.

Notes

- Prior to start of testing, 50 hours of conditioning was performed per ASTM E3053.
- Prior to start of testing, the dilution tunnel was cleaned with a steel brush.
- Front filters were changed on sample train A at one hour for all 3 test runs.
- A total of 3 test runs were performed in accordance with ASTM E3053. No anomalies occurred, no further additional tests were performed, see Run Narrative section for further detail on each run.

Wood Heater Identification and Testing

- Appliance Tested: ***Ladera-D***
- Serial Number: ***Un-serialized Prototype – PFS Tracking Number 0113***
- Manufacturer*:* ***Innovative Hearth Products, LLC***
- Catalyst: ***No***
- Heat exchange blower: ***Integral***
- Type: ***Wood Stove***
- Style: ***Insert***
- Date Received: ***Thursday, September 09, 2021***
- Testing Period –
  - Start: ***Monday, September 13, 2021***
  - Finish: ***Tuesday, September 14, 2021***
- Test Location: ***PFS Facility***
  11785 SE Hwy 212 Suite 305
  Clackamas, OR 97015
- Elevation: ***≈131 Feet above sea level***
- Test Technician(s): ***Aaron Kravitz***
- Observers: ***Matthew Romanow***

Test Procedures and Equipment

All Sampling and analytical procedures were performed by Aaron Kravitz. All procedures used are directly from ASTM E3053 and ASTM E2515. See the list below for equipment used. See Appendix C submitted with this report for calibration data.

Equipment List

Equipment ID#	Equipment Description
051	10 lb audit weight
53	APEX XC-60 Digital Emissions Sampling Box A
54	APEX XC-60 Digital Emissions Sampling Box B
55	Ambient Sample Box
057	California Analytical ZRE CO2/CO/O2 IR ANALYZER
064	Digital Barometer
095	Anemometer
101	Tape Measure
107	Sartorius Analytical Balance
109A/B	Troemner 100mg/200mg Audit Weights
111	Microtector
115	Delmhorst Wood Moisture Meter
189	1000x0.02lb Platform Scale
CC106574	Gas Analyzer Calibration Span Gas
91005049	Gas Analyzer Calibration Mid Gas

Results

The weighted average emissions rate for the 3 run test series was measured to be **1.66 g/hr** with a Higher Heating Value efficiency of **59.3%.** The average CO emission rate for the 3 tests was **1.30 g/min.** The IHP Ladera-D Wood-Fired Room Heater meets the 2020 cordwood PM emission standard of ≤ 2.5 g/hr per CFR 40 part 60, §60.532 (c).

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

Summary Table

	High Fire Test	Low Fire Test	Medium Fire Test
Date	9/13/2021	9/13/2021	9/14/2021
Run Number	1	2	3
PM Emission Rate (g/hr)	2.88	0.73	1.97
Burn Rate (kg/hr)	4.97	0.97	1.70
Heat Output (BTU/hr)	53,266	12,023	18,978
HHV Efficiency (%)	54.5%	62.0%	59.1%
LHV Efficiency (%)	58.3%	66.3%	63.2%
CO Emissions (g/MJ output)	1.53	3.68	5.10
CO Emissions (g/kg dry fuel)	16.61	45.54	60.11
CO Emissions (g/min)	1.43	0.78	1.70
First Hour Emission Rate (g/hr)	2.54	4.46	5.51
Weighting Factor (%)	20%	40%	40%
Weighted particulate emission average of 3 test runs: 1.66 grams per hour.			
Weighted average HHV efficiency of 3 test runs: 59.3%.			
Average CO emission rate for 3 test runs: 1.30 grams per minute			

Test Run Narrative

Run 1

Run 1 was performed on 9/13/2021 as a high fire test run per ASTM E3053. Emissions sampling began from a cold start ignition of kindling and start-up fuel. The test fuel load was loaded 27 minutes into the test. Testing was completed when 90% of the test fuel load was consumed. Total test time was 99 minutes, main test fuel load burn time was 72 min. The particulate emissions rate from kindling ignition to test completion was 2.88 g/hr. The burn rate of the test fuel load was 4.97 kg/hr. The main test load portion of the run had an overall HHV efficiency of 54.5%. The train A filter train was changed at 1 hr. All test results were appropriate and valid. There were no anomalies, and all test criteria were met.

Run 2

Run 2 was performed on 9/13/2021 as a low fire test run per ASTM E3053, this test was a continuation of the high fire test described above. The overall test duration was 489 minutes. The burn rate for the test run was 0.97 kg/hr. The particulate emissions rate for the test run was 0.73 g/hr. The run had an overall HHV efficiency of 62.0%. The train A filter train was changed at 1 hr. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

Run 3

Run 3 was performed on 9/14/2021 as a medium fire test run per ASTM E3053, this test was a continuation of a high fire test that was not sampled. The overall test duration was 269 minutes. The burn rate for the test run was 1.70 kg/hr, therefore the medium fire category requirements were met, less than the mid-point of the high and low burn rates (2.97 kg/hr). The particulate emissions rate for the test run was 1.97 g/hr. The run had an overall HHV efficiency of 59.1%. The train A filter train was changed at 1 hr. There were no anomalies and all criteria were met.

Test Conditions Summary

Testing conditions for all runs fell within allowable specifications of ASTM E3053 and ASTM E2515. A summary of facility conditions, fuel burned, and run times is listed below.

Run	Ambient (°F)		Relative Humidity (%)		Average Barometric Pressure (In. Hg.)	Preburn Fuel Weight (lbs)	Test Fuel Weight (lbs)	Test Fuel Moisture (%DB)	Test Run Time (Min)
	Pre	Post	Pre	Post					
1	68	74.2	45.3	40.1	30.21	8.18[1]	17.79	20.5%	99[2]
2	74	70.8	40.1	49.5	30.18	17.79	20.91	19.9%	489
3	74	77.2	21.9	28.5	30.06	17.52	20.22	20.1%	269

[1]This is the weight of the kindling and startup fuel

[2]Total test time was 99 min, high fire test load burn duration was 72 min.

Appliance Operation and Test Settings

No operating instructions were provided by the manufacturer for testing. The unit was operated per instructions in the Operations Manual, found in Appendix B submitted with this report. Detailed run information can be found in Appendix A submitted with this report.

Settings & Run Notes

Run	Pre-Burn Air Setting	Test Run Air Settings
1	N/A – Cold Start Ignition	Air control set to high fire test setting – control handle at fully open, slide out
2	Air control set to High Fire Setting in accordance with ASTM E3053	Air control set to high fire test setting for first 12 minutes, the set to low fire (fully closed, slide in) test setting.
3	Air control set to High Fire Setting in accordance with ASTM E3053	Air control set to high fire test setting for first 9 minutes, the set to medium fire test setting (fully closed, slide out).

Appliance Description

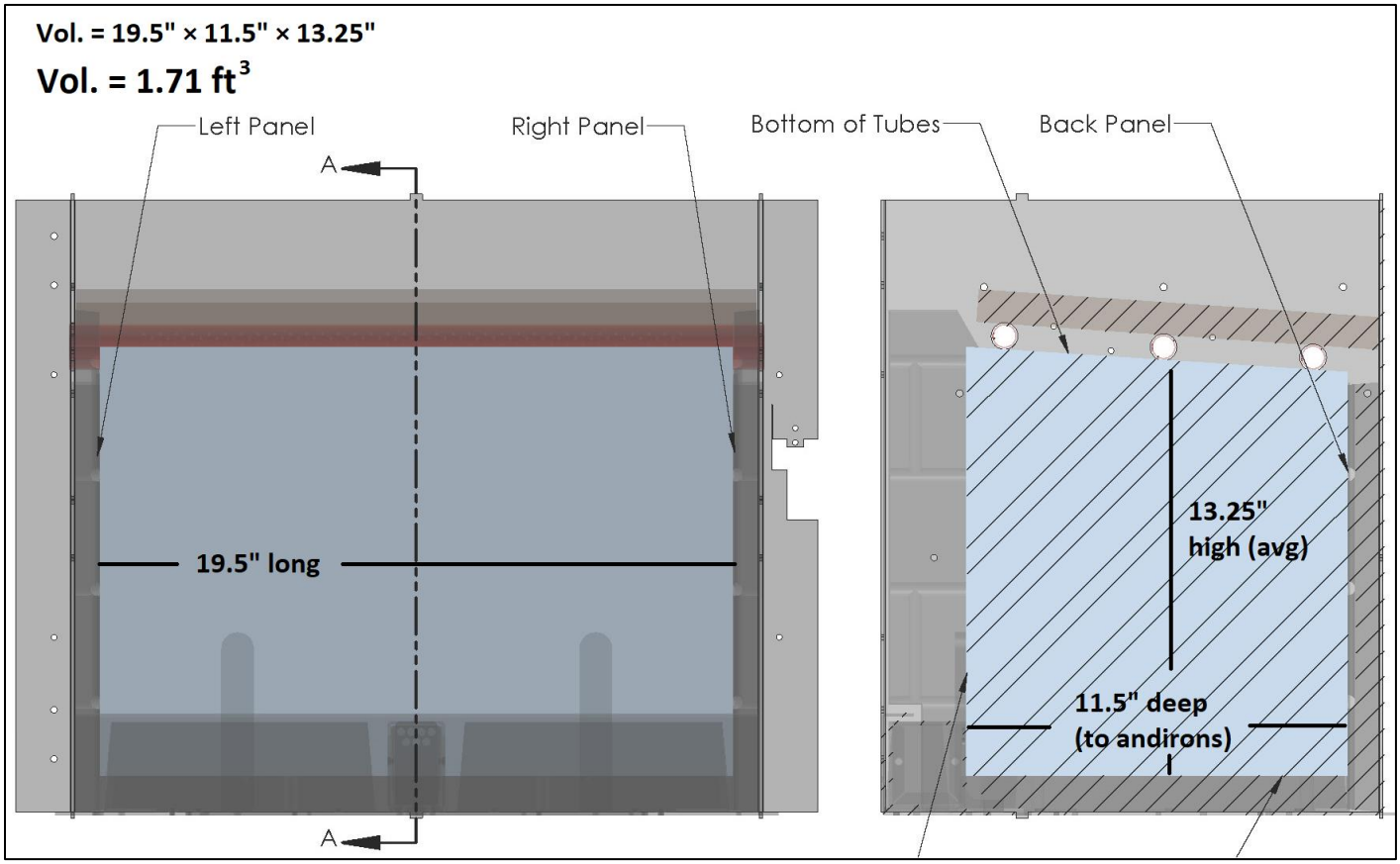
Model(s): Ladera-D

WRT3920-B

Additional Model Discussion: The second variant (WRT3920-B) is identical in construction to the Ladera-D. The distinction is for branding purposes only.

Appliance Type: Built-in Wood-Fired Room Heater

Firebox Volume: See calculation below:



Air Introduction System: Primary Air enters the firebox through the air control box at the lower of the appliance and ducted up to the top and then and down through the air wash, as well as through a pilot air opening in the front of the firebox. Primary air is controlled via a damper arm located on the lower side of the appliance which moves left (open) and right (closed). This same damper arm controls a pilot air opening by sliding in (closed) or out (open).

Secondary air is pulled through fixed openings on the rear of the appliance and channeled in through 3 secondary air tubes. Dimensions on all these features can be found in Appendix D.

Baffles: A steel baffle is located above the secondary air tubes The baffle is topped with a 1" think Kaowool blanket.

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

Gasketing: The door glass is lined with 1" x 3/16" fiberglass gasket, and the door frame seals against the body of the stove with a 3/4" diameter fiberglass rope gasket.

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

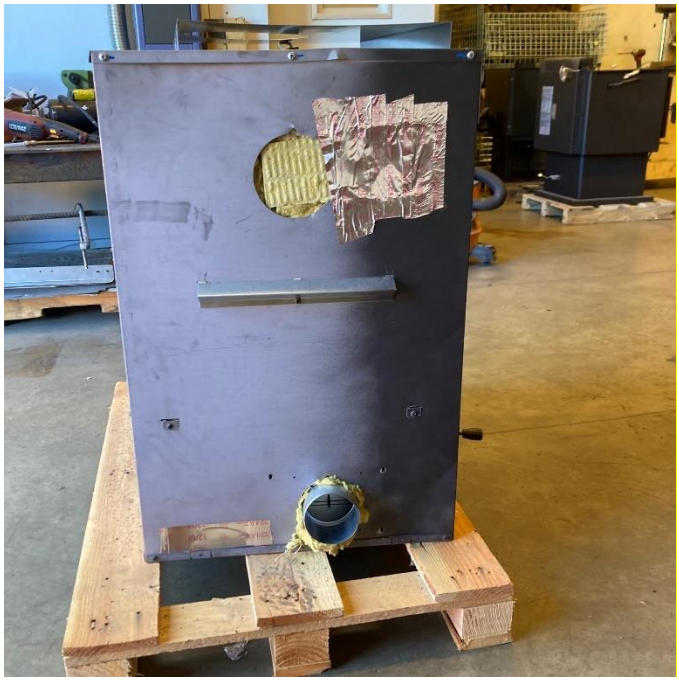
Catalytic Combustor: N/A

Fan: The Ladera-D comes as standard with a heat-circulating blower fan that is operated by a snap disc mounted to the underside of the firebox.

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

Appliance Front

Appliance Left



Appliance Right

Appliance Rear

Test Fuel Properties

Test fuel used was Maple cordwood, split and air-dried to the specified moisture content range. Typical fuel loads are pictured below:

Typical Kindling Load

Typical Startup Load

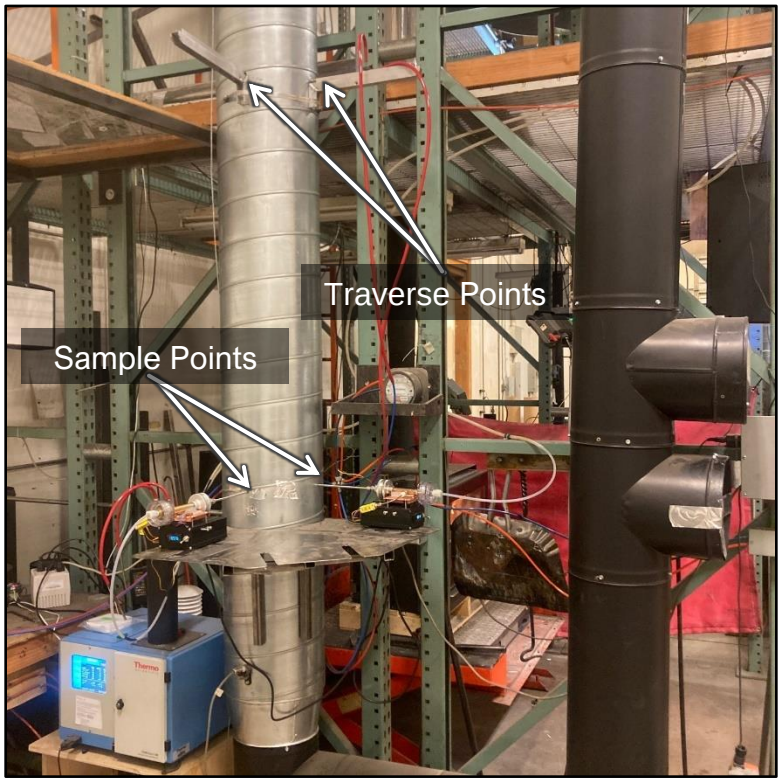
Typical High Fire Load

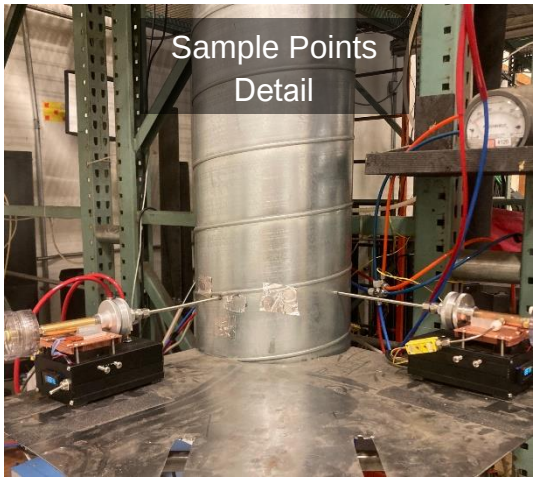
Typical Low Fire Load

Sampling Locations and Descriptions

Sample ports are located 16.5 feet downstream from any disturbances and 2 feet upstream from any disturbances. Flow rate traverse data was collected 8 feet downstream from any disturbances and 4 feet upstream from any disturbances. (See below).

Photos





Sampling Methods

ASTM E2515 was used in collecting particulate samples. The dilution tunnel is 12 inches in diameter. All sampling conditions per ASTM E2515 were followed. No alternate procedures were used with the exception of caveats described in ALT-125: Pall TX40 Emfab filters were used, filter temperatures were maintained between 80 and 90°F for all tests, filters were weighed in pairs where applicable, and no sampling intervals fell outside of proportional rates of +/- 10%.

Analytical Methods Description

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

Calibration, Quality Control and Assurances

Calibration procedures and results were conducted per EPA Method 28R, ASTM E2515-11 and ASTM E3053. Test method quality control procedures (leak checks, volume meter checks, stratification checks, proportionality results) followed the procedures outlined.

Appliance Sealing and Storage

Upon completion of testing, the appliance was secured with metal strapping and the seal below was applied, the appliance was then returned to the manufacturer's location at: 1502 14th St NW, Auburn, WA 98001, for archival.

Sealing Label

ATTENTION:

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

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

REPORT #_____ DATE SEALED_____

MANUFACTURER_____ MODEL #_____

Sealed Unit

List of Appendices

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

Appendix A – Test Run Data, Technician Notes, Sample Analysis, and Alternate Test Method Approval

Appendix B – Labels and Manuals

Appendix C –Equipment Calibration Records

Appendix D – Design Drawings (CBI Report Only)

Appendix E – Manufacturer QAP (CBI Report Only)