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# New Buck Corporation

Project # 20-592

Model: 81

Type: Wood-Fired Room Heater

June 3, 2020

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

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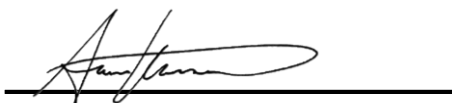
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## Affidavit

PFS-TECO was contracted by New Buck Corporation to provide testing services for the 81 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 Nelke Consulting LLC beginning on 4/7/2020 and ending on 4/9/2020. Nelke Consulting's laboratory is located at 30522 SE Leavenworth Ct, Eagle Creek, OR 97022. Testing procedures followed ASTM E3053, with variances as 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

New Buck Corporation of Spruce Pine, NC contracted with PFS-TECO to perform EPA certification testing on the model 81 Wood-Fired Room Heater. All testing was performed at Nelke Consulting LLC in Eagle Creek, OR. All testing was performed by 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 completed. Test runs were performed in accordance with ASTM E3053. For the three test runs used in the weighted average, no anomalies occurred. See the Run Narrative section for further detail on each run.

## Wood Heater Identification and Testing

- Appliance Tested: *81*
- Serial Number: *Un-serialized Prototype – PFS Tracking Number 0064*
- Manufacturer: *New Buck Corporation*
- Catalyst: *No*
- Heat exchange blower: *Optional*
- Type: *Wood Stove*
- Style: *Free Standing*
- Date Received: *Monday, April 06, 2020*
- Testing Period – Start: *Tuesday, April 07, 2020*  
Finish: *Thursday, April 09, 2020 9*
- Test Location: *Nelke Consulting LLC*  
*30522 SE Leavenworth Ct, Eagle Creek, OR*
- Elevation: *~500 Feet above sea level*
- Test Technician(s): *Aaron Kravitz*
- Observers: *Gary Nelke of Nelke Consulting.*

## 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
N/A	United 3'x3' floor scale w/digital weight indicator
050	Digiweigh DWP12i Platform Scale
053	APEX XC-60 Digital Emissions Sampling Box A
054	APEX XC-60 Digital Emissions Sampling Box B
057	California Analytical ZRE CO <sub>2</sub> /CO/O <sub>2</sub> IR ANALYZER
064	Digital Barometer
109A/B	Troemner 100mg/200mg Audit Weights
107	Sartorius Analytical Balance
051	10 lb audit weight
090	Dewalt Tape Measure
092	Digital Calipers
095	Anemometer
111	Microtector
115	Delmhorst Wood Moisture Meter
CC50101	Gas Analyzer Calibration Span Gas
BSG-00543	Gas Analyzer Calibration Zero Gas

## Results

The weighted average emissions rate for the 3 run test series was measured to be **1.1 g/hr** with a Higher Heating Value efficiency of **70%**. The average CO emission rate for the 3 tests was **1.1 g/min**. The New Buck Corporation model 81 Wood-Fired Room Heater meets the 2020 cordwood PM emission standard of  $\leq 2.5$  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	4/7/2020	4/7/2020	4/9/2020
Run Number	1	2	3
PM Emission Rate (g/hr)	2.66	0.60	0.87
Burn Rate (kg/hr)	4.92	1.18	1.16
Heat Output (BTU/hr)	59,490	13,795	14,193
HHV Efficiency (%)	68.9%	68.6%	71.6%
LHV Efficiency (%)	74.2%	73.9%	77.1%
CO Emissions (g/MJ output)	0.99	3.37	5.61
CO Emissions (g/kg dry fuel)	12.34	41.64	72.43
CO Emissions (g/min)	1.04	0.82	1.40
1 <sup>st</sup> Hour Emission Rate (g/hr)	5.71	2.82	0.90
Weighting Factor (%)	20%	40%	40%
<b>Weighted particulate emission average of 3 test runs: 1.12 grams per hour.</b>			
<b>Weighted average HHV efficiency of 3 test runs: 69.8%.</b>			
<b>Average CO emission rate for 3 test runs: 1.1 grams per minute</b>			



## Test Run Narrative

### *Run 1*

Run 1 was performed on 4/7/2020 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 52 minutes into the test. Testing was completed when 90% of the test fuel load was consumed. Total test time was 148 minutes, main test fuel load burn time was 96 min. The particulate emissions rate from kindling ignition to test completion was 2.66 g/hr. The burn rate of the test fuel load was 4.92 kg/hr. The main test load portion of the run had an overall HHV efficiency of 68.9%. The train A front filter 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 4/7/2020 as a low fire test run per ASTM E3053. The overall test duration was 559 minutes. The burn rate for the test run was 1.18 kg/hr. The particulate emissions rate for the test run was 0.60 g/hr. The run had an overall HHV efficiency of 68.6%. The train A front filter 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 4/9/2020 as a medium fire test run per ASTM E3053. The overall test duration was 569 minutes. The burn rate for the test run was 1.16 kg/hr, therefore the medium fire category requirements were met, less than the mid-point of the high and low burn rates (3.05 kg/hr). The particulate emissions rate for the test run was 0.87 g/hr. The run had an overall HHV efficiency of 71.6%. The train A front filter 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.

Runs	Ambient (°F)		Relative Humidity (%)		Average Barometric Pressure (In. Hg.)	Preburn Fuel Weight (lbs)	Test Fuel Weight (lbs)	Test Fuel Moisture (%DB)	Test Run Time (Min)
	Pre	Post	Pre	Post					
1	64	84	60	51	29.35	12.4	24.8	24.3%	148
2	80	67	55	61	29.36	24.8	29.54	22.2%	559
3	79	69	29	54	29.05	24.8	29.47	21.6%	569

## Appliance Operation and Test Settings

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

## Settings & Run Notes

	Pre-Burn Air Setting	Test Run Air and Fan Settings
<b>Run 1</b>	N/A – Cold Start Ignition	Air control set to high fire test setting, blower set to high (auto)
<b>Run 2</b>	Air control set to High Fire Setting in accordance with ASTM E3053	Air control set to low fire test setting at 13 minutes. Blower off for first 3 min, then set to low.
<b>Run 4</b>	Air control set to High Fire Setting in accordance with ASTM E3053	Air control set to medium fire test setting at 14.5 minutes. Blower off for first 2 minutes, then set to medium.

## Appliance Description

**Model(s):** 81

**Appliance Type:** Wood-Fired Room Heater

**Firebox Volume:** 2.48 ft<sup>3</sup>

**Air Introduction System:** Primary Air enters the firebox from the front bottom of the appliance and is channeled up the sides on the appliance and down through the air wash, as well as through a pilot air opening in the front of the firebox. Primary air is controlled via a damper arm located below the ashlip which moves in (open) and out (closed). Secondary air is pulled through a fixed opening adjacent to the primary intake and channeled under the stove and up through 4 secondary air tubes. Dimensions on all these features can be found in Appendix D.

**Baffles:** A 24" x 15" x 0.50" vermiculite panel rests on top of the secondary air tubes.

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

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

**Catalytic Combustor:** N/A

**Fan:** The 81 is available with a convection fan that attached to the lower front of the appliance.

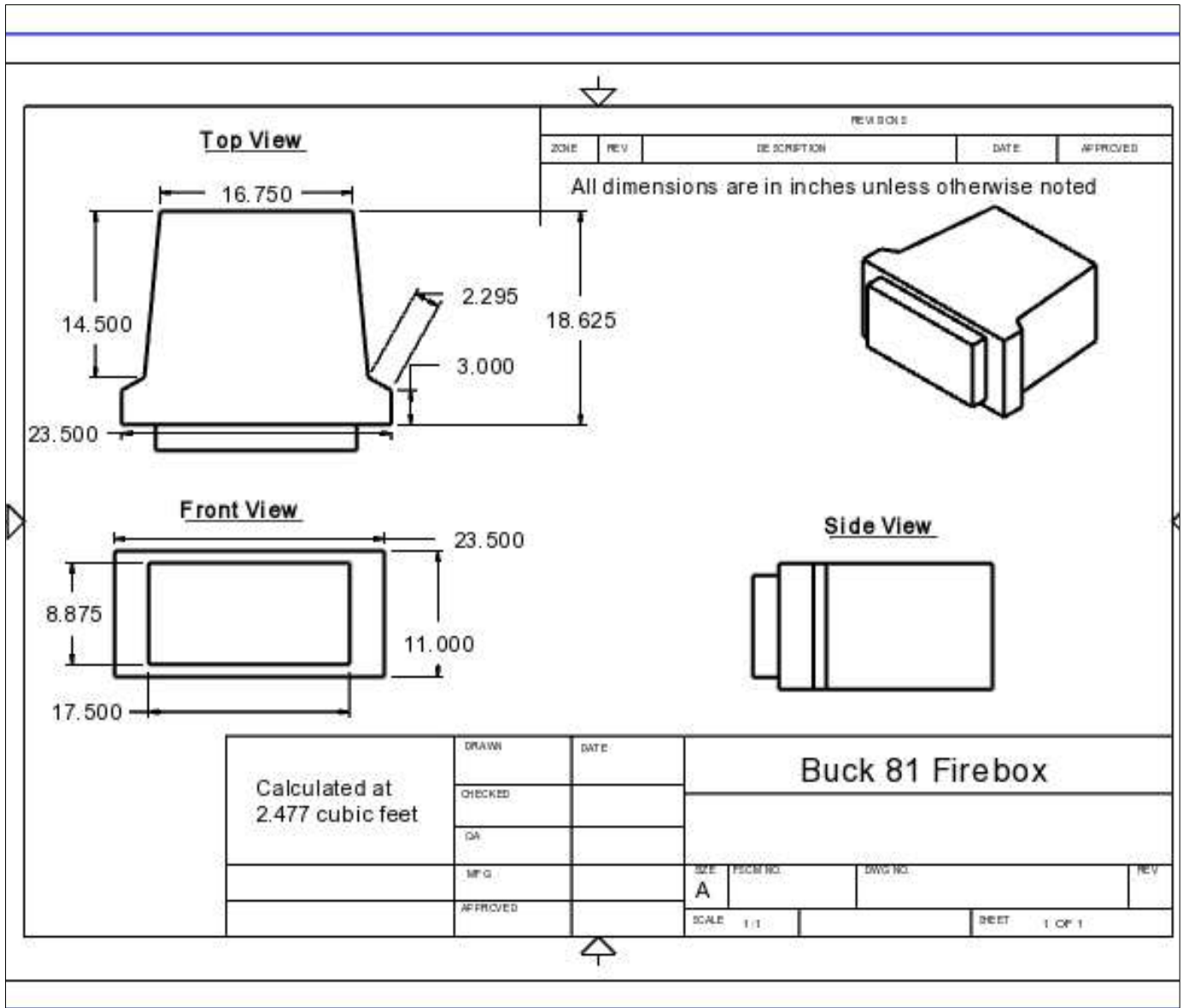
### Appliance Dimensions

81 Unit Dimensions

Height	Width	Depth	Firebox Volume
24"	30"	25"	2.48 ft <sup>3</sup>

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

# Firebox Drawing



Appliance Front



Appliance Left



Appliance Right



Appliance Rear





## Test Fuel Properties

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

Typical Kindling /Startup Load



Typical High Fire Load



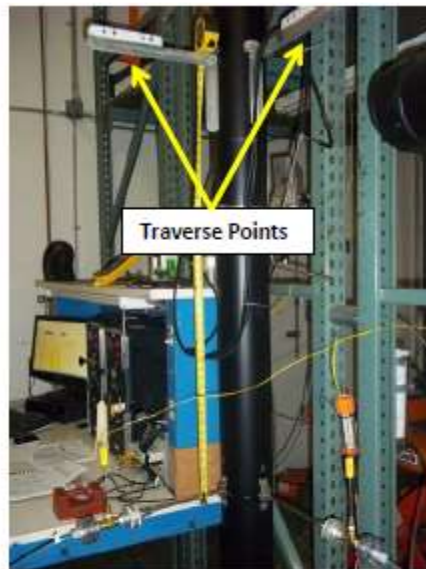
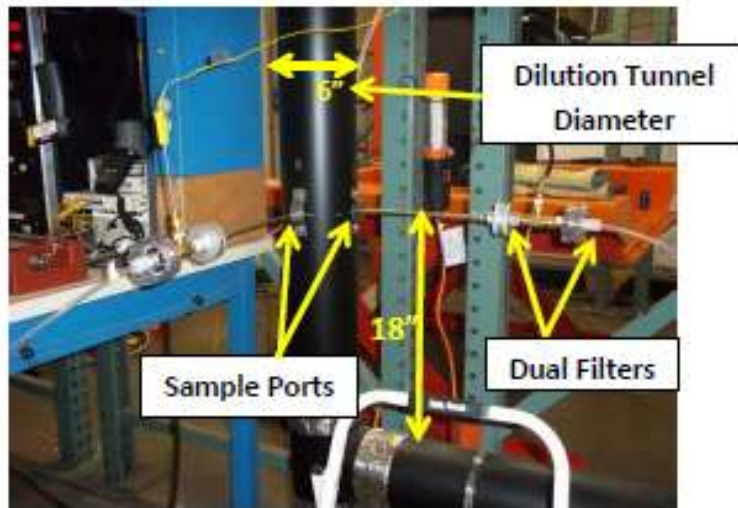
Typical Low Fire Load



## Sampling Locations and Descriptions

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

### Sample Points





## Sampling Methods

ASTM E2515 was used in collecting particulate samples. The dilution tunnel is 6 inches in diameter. All sampling conditions per ASTM E2515 were followed. No alternate procedures were used 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: 200 Ethan Allen Drive, Spruce Pine, NC 28777 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)