
**Hussong Manufacturing
Co., Inc.,
dba Kozy Heat
Fireplaces**

Project # 18-449

Model: Z42

Type: Wood-Fired Room Heater

July 22, 2019

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

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Contents

Affidavit	3
Introduction	4
Notes	4
Wood Heater Identification and Testing	5
Test Procedures and Equipment	6
Results	7
Summary Table	7
Test Run Narrative	8
Run 1	8
Run 2	8
Run 3	8
Test Conditions Summary	9
Appliance Operation and Test Settings	9
Settings & Run Notes	9
Appliance Description	10
Appliance Dimensions	10
Test Fuel Properties	13
Sampling Locations and Descriptions	14
Sample Points	14
Sampling Methods	15
Analytical Methods Description	15
Calibration, Quality Control and Assurances	15
Appliance Sealing and Storage	15
Sealing Label	15
Sealed Unit	16
List of Appendices	17

Affidavit

PFS-TECO was contracted by Hussong Manufacturing Co., Inc. (Kozy Heat Fireplaces) to provide testing services for the Model Z42 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 beginning on 6/11/2019 and ending on 6/13/2019. 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.



Sebastian Button, Laboratory Supervisor

Introduction

Kozy Heat Fireplaces of Lakefield, MN, contracted with PFS-TECO to perform EPA certification testing on Z42 Wood-Fired Room Heater. All testing was performed at PFS-TECO's Portland Laboratory. Testing was performed by Mr. Sebastian Button.

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 additional tests performed, see Run Narrative section for further detail on each run.

Wood Heater Identification and Testing

- Appliance Tested: **Z42**
- Serial Number: **15294 – PFS Tracking Number 0019**
- Manufacturer: **Kozy Heat Fireplaces**
- Catalyst: **No**
- Heat exchange blower: **Optional**
- Type: **Wood Stove**
- Style: **Zero-Clearance**
- Date Received: **Monday, January 07, 2019**
- Testing Period – Start: **Tuesday, June 11, 2019** Finish: **Thursday, June 13, 2019**
- Test Location: **PFS-TECO Portland Laboratory, 11785 SE HWY 212 - Suite 305, Clackamas, OR 97015**
- Elevation: **≈131 Feet above sea level**
- Test Technician(s): **Sebastian Button**
- Observers: **None**

Test Procedures and Equipment

All Sampling and analytical procedures were performed by Sebastian Button. 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
041	Rice Lake 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
055	APEX Ambient sampling box
057	California Analytical ZRE CO2/CO/O2 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
CC700832	Gas Analyzer Calibration Span Gas
CC170624	Gas Analyzer Calibration Mid Gas

Results

The weighted average emissions rate for the 3 run test series was measured to be **1.22 g/hr** with a Higher Heating Value efficiency of **66.0%**. The average CO emission rate for the 3 tests was **1.4 g/min.** The FPI F5200 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	6/11/2019	6/13/2019	6/11/2019
Run Number	1	3	2
PM Emission Rate (g/hr)	2.90	0.74	0.87
Burn Rate (kg/hr)	3.14	1.01	1.31
Heat Output (BTU/hr)	36,231	12,850	16,688
HHV Efficiency (%)	59.8%	67.3%	67.7%
LHV Efficiency (%)	64.0%	72.0%	72.4%
CO Emissions (g/MJ output)	3.28	4.40	4.00
CO Emissions (g/kg dry fuel)	39.11	59.10	54.07
CO Emissions (g/min)	2.09	0.99	1.17
First Hour Emission Rate (g/hr)	2.75	0.77	2.70
Weighting Factor (%)	20%	40%	40%
Weighted particulate emission average of 3 test runs: 1.22 grams per hour.			
Weighted average HHV efficiency of 3 test runs: 66.0%.			
Average CO emission rate for 3 test runs: 1.4 grams per minute			

Test Run Narrative

Run 1

Run 1 was performed on 6/11/2019 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 23 minutes into the test. Testing was completed when 90% of the test fuel load was consumed. Total test time was 145 minutes, main test fuel load burn time was 122 min. The particulate emissions rate from kindling ignition to test completion was 2.90 g/hr. The burn rate of the test fuel load was 3.14 kg/hr. The main test load portion of the run had an overall HHV efficiency of 59.8%. 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 6/11/2019 as an attempted low fire test run per ASTM E3053. The overall test duration was 398 minutes. The burn rate for the test run was 1.31 kg/hr, meeting medium fire category requirements, less than the mid-point of the high and low burn rates (2.08 kg/hr). The particulate emissions rate for the test run was 0.87 g/hr. The run had an overall HHV efficiency of 67.7%. The train A front filter was changed at 1 hr. There were no anomalies and all criteria were met.

Run 3

Run 3 was performed on 6/13/2019 as a low fire test run per ASTM E3053. The overall test duration was 539 minutes. The burn rate for the test run was 1.01 kg/hr. The particulate emissions rate for the test run was 0.74 g/hr. The run had an overall HHV efficiency of 67.3%. 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.

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	76	86	42.3	25	29.96	7.5 ¹	20.1	23.4%	145 ²
2	86	83	25	36.4	29.87	20.1	23.31	21.9%	398
3	78	81	32.6	13.4	29.79	19.97	23.98	19.7%	539

¹This is the weight of the kindling and startup fuel

²Total test time was 145 min, high fire test load burn duration was 122 min.

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
Run 1	N/A – Cold Start Ignition	Air control set to high fire test setting; blower set to high.
Run 2	Air control set to High Fire Setting in accordance with ASTM E3053	Air control set to fully closed; blower set to high.
Run 3	Air control set to High Fire Setting in accordance with ASTM E3053	Air control set to fully closed; blower set to high.

Appliance Description

Model(s): Z42

Appliance Type: Wood-Fired Room Heater

Firebox Volume: 1.92 ft³

Air Introduction System: Primary Air enters the firebox from the left side of the appliance and is channeled over the top 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 door which moves up (open) and down (closed). Secondary air is pulled through a fixed opening on the side of the appliance and channeled through a four secondary air tubes. Dimensions on all these features can be found in Appendix D.

Baffle:

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

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

Catalytic Combustor: N/A

Fan: The Z42 is optionally offered with a convection fan that attaches to the bottom rear of the appliance.

Appliance Dimensions

Z42 Unit Dimensions

Height	Width	Depth	Firebox Volume
38"	31.75"	26"	1.92 ft ³

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



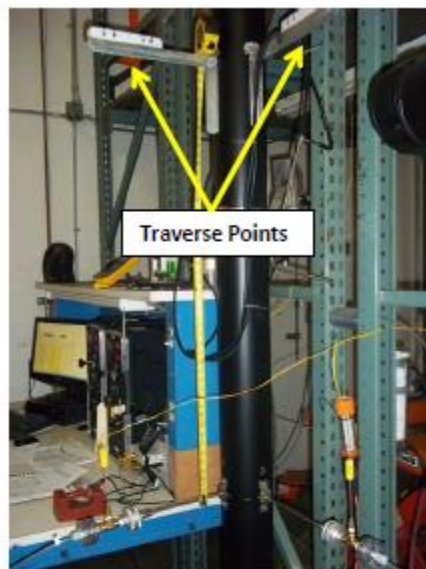
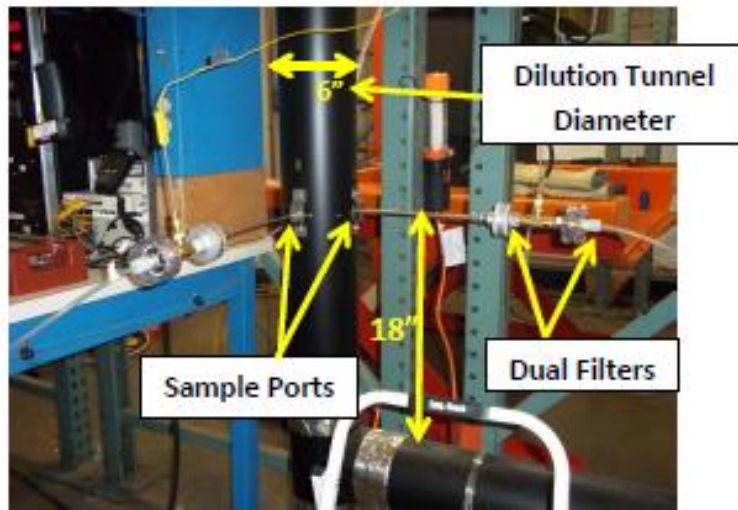
Typical Low Fire Load



Sampling Locations and Descriptions

Sample ports are located 16.5 feet downstream from any disturbances and 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: 204 Industrial Park Drive, Lakefield, MN 56150, for archival.

Sealing Label

ATTENTION:

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

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

REPORT # _____

DATE SEALED _____

MANUFACTURER _____

MODEL # _____

Sealed Unit



List of Appendices

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

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

Appendix B – Labels and Manuals

Appendix C – Equipment Calibration Records

Appendix D – Design Drawings (CBI Report Only)

Appendix E – Manufacturer QAP (CBI Report Only)