
Arada Stoves LTD

Project # 035-S-075-1

Model: Farrington 16

Type: Free Standing Residential

Catalytic Wood Fired Heater

February 24, 2017

EPA Test Method 28R for Certification and Auditing of Wood Heaters

Contact:

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Affidavit:

Dirigo Laboratories, Inc. was contracted by Arada Stoves Ltd. to provide testing services for the Farringdon 16 catalytic wood fired heater per EPA Method 28R for Certification and Auditing of Wood Heaters. All testing and associated procedures were conducted at Dirigo Laboratories, Inc. beginning on 2/14/2017 and ending on 2/17/2017. Dirigo Laboratories is located at 11785 SE Highway 212 – Suite 305, Clackamas, Oregon 97015. Testing procedures followed EPA Method 28R and ASTM E2780-10. Particulate sampling was performed per ASTM E2515-11 *Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel*.

Dirigo Laboratories 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. Dirigo holds EPA Accreditation Certificate Numbers 4 and 4M (mobile). Dirigo Laboratories, Inc. is accredited by A2LA to ISO 17020:2012 “Criteria for Bodies Performing Inspections, ISO 17025:2005 “Requirements for Testing Laboratories”, and ISO 17065:2012 “Requirements for Bodies Operating Product Certification Systems”. Dirigo holds A2LA Certificate Numbers 3726.01, 3726.02, and 3726.03. See Appendix E for Accreditations.

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

John Steinert, President

Ben Nelke, Test Technician

Doug Towne, QA Manager

Introduction:

Arada Stoves Ltd. of Axminster, United Kingdom, contracted with Dirigo Laboratories, Inc. to perform EPA certification testing for their Model Farrington 16 catalytic wood heater. All testing was performed at Dirigo Laboratories, Inc. Testing was performed by Mr. Ben Nelke.

Notes:

- A 50 hour break-in was performed on the appliance at Dirigo Laboratories, Inc. from 12/02/16 through 12/14/16.
- Prior to testing, the dilution tunnel was cleaned with a steel brush.
- The heater has no blower so no fan confirmation test was performed.
- Front filters were changed on sample train A at one hour for all runs.

Wood Heater Identification and Testing:

- Appliance Tested: ***Farrington 16 Free Standing***
- Serial Number: ***DEV6764B***
- Manufacturer: ***Arada Stoves Ltd.***
- Catalyst: ***Yes***
- Heat exchange blower: ***None***
- Type: ***Wood Stove***
- Style: ***Free Standing***
- Date Received: ***Tuesday, November 29, 2016***
- Wood Heater Aging: ***December 2 - December 14, 2016***
- Testing Period – Start: ***Tuesday, February 14, 2017*** Finish: ***Friday, February 17, 2017***
- Test Location: ***Dirigo Laboratories, Inc. 11785 SE HWY 212 - Suite 305, Clackamas, OR 97015***
- Elevation: ***≈131 Feet above sea level***
- Test Technician(s): ***Ben Nelke***
- Observers: ***None***

Test Procedures and Equipment:

All Sampling and analytical procedures were performed by Ben Nelke. All procedures used are directly from EPA Method 28R, ASTM E2780-10 and ASTM E2515-11. See the list below for equipment used. See Appendix D for calibration data.

Equipment List:


1. Analyzer -California Analytical ZRE CO2/CO/O2 IR ANALYZER
2. Delmhorst J-2000 Wood Moisture Meter
3. Dayton 4c121 Blower for dilution tunnel -Emissions Booth #1
4. ScienTech Balance Scale
5. 10 lb Calibration Weight
6. DigiWeigh Bench Shipping Scale
7. APEX XC-60 Digital Emissions Sampling Box A
8. APEX XC-60 Digital Emissions Sampling Box B
9. APEX Ambient sampling box
10. Gast MOA-P122-AA Vacuum Pump
11. Rice Lake 3'x3' floor scale w/digital weight indicator

Results:

For the Farringdon 16 wood heater, the weighted average emission rate is **1.5 g/hr** with a weighted average efficiency of **77.2%** and a weighted average CO of **61.6 g/hr**. The Arada Stoves Ltd. Model Farringdon 16 catalytic free standing wood heater meets the 2020 PM emission standard of ≤ 2.0 g/hr per CFR 40 part 60, §60.532 (b).

Detailed individual run data can be found in separate digital folders supplied with this report.

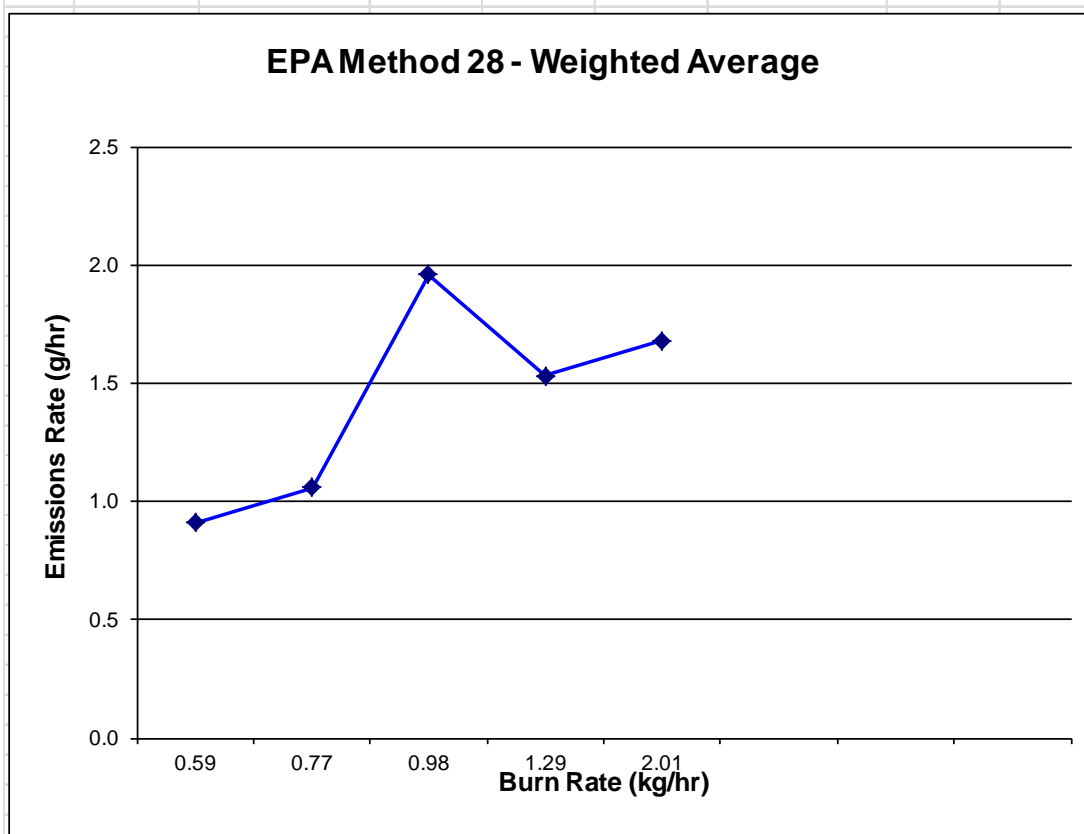
Emissions:

EPA Method 28 - Weighted Average			
			
Weighted Average: 1.5 (g/hr)			
Client:	Arada		
Model:	Farringdon 16		
Tracking No.:	75		
Project No.:	035-S-075-1		
Test Dates:	2/14/17 - 2/17/17		
Burn Rate Category	1	Burn Rate Category	1
Burn Rate (kg/hr-dry)	0.59	Burn Rate (kg/hr-dry)	0.77
Emissions Rate (g/hr)	0.9	Emissions Rate (g/hr)	1.1
Emissions Rate Cap (g/hr)	15	Emissions Rate Cap (g/hr)	15
Weighting Factor	10.96%	Weighting Factor	14.42%
Run Number	1	Run Number	2
Burn Rate Category	2	Burn Rate Category	3
Burn Rate (kg/hr-dry)	0.98	Burn Rate (kg/hr-dry)	1.29
Emissions Rate (g/hr)	2.0	Emissions Rate (g/hr)	1.5
Emissions Rate Cap (g/hr)	15	Emissions Rate Cap (g/hr)	15
Weighting Factor	22.65%	Weighting Factor	30.52%
Run Number	3	Run Number	4
Burn Rate Category	4		
Burn Rate (kg/hr-dry)	2.01		
Emissions Rate (g/hr)	1.7		
Emissions Rate Cap (g/hr)	18		
Weighting Factor	21.45%		
Run Number	5		




EPA Method 28 - Weighted Average

Client: Arada
Model: Farrington 16
Tracking No.: 75
Project No.: 035-S-075-1
Test Dates: 2/14/17 - 2/17/17



Efficiency:

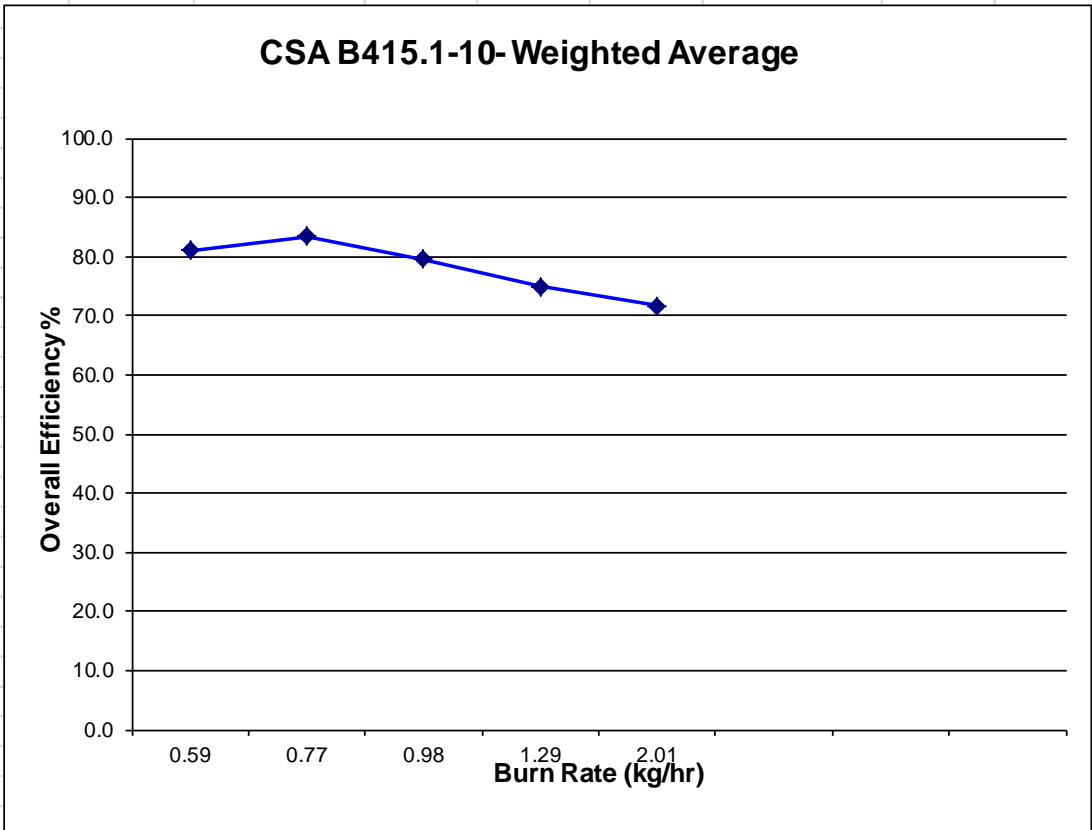
All efficiency values use the HHV.

		CSA B415.1-10 Weighted Average			
					



CSA B415.1-10 - Weighted Average

Client: Arada
Model: Farrington 16
Tracking No.: 75
Project No.: 035-S-075-1
Test Dates: 2/14/17 - 2/17/17



Summary Table:

Category 1 <0.80 kg/hr		Category 1 <0.80 kg/hr		Category 2 0.80 to 1.25 kg/hr		Category 3 1.25 to 1.90 kg/hr		Category 4 Maximum	
Run Number	1	Run Number	2	Run Number	3	Run Number	4	Run Number	5
Emissions Rate g/hr	0.91	Emissions Rate g/hr	1.06	Emissions Rate g/hr	1.99	Emissions Rate g/hr	1.53	Emissions Rate g/hr	1.68
Burn Rate kg/hr	0.59	Burn Rate kg/hr	0.77	Burn Rate kg/hr	0.98	Burn Rate kg/hr	1.29	Burn Rate kg/hr	2.01
BTU/hr (HHV)	8,928	BTU/hr (HHV)	12,124	BTU/hr (HHV)	14,589	BTU/hr (HHV)	18,210	BTU/hr (HHV)	27,025
CO g/hr	40.78	CO g/hr	9.49	CO g/hr	55.47	CO g/hr	77.29	CO g/hr	91.53
OA Efficiency (HHV)	81.1%	OA Efficiency (HHV)	83.4%	OA Efficiency (HHV)	79.5%	OA Efficiency (HHV)	75.0%	OA Efficiency (HHV)	71.7%

Run 1:

An attempt at a category I burn rate was performed on 2/14/17, resulting in a 0.59 kg/hr category I burn rate. The test duration was 7 hours. The fuel weight was 10.9 lbs. There was an average particulate emissions rate of 0.91 g/hr. The run had an overall efficiency of 81.1%. The A filter was changed at 1 hr. The 1-hour filter catch was 3.1 mg. All test results were appropriate and valid. The burn rate category was achieved. There were no anomalies and all criteria were met.

Run 2:

An attempt at a category II burn rate was performed on 2/15/17. However, 25 minutes into the test run, the 4 x 4 on the front stack of the fuel load fell forward against the glass slowing the burn which resulted in an additional category I burn rate of 0.77 kg/hr. The test duration was 5 hours 10 minutes. The fuel weight was 10.6 lbs. There was an average particulate emissions rate of 1.06 g/hr. The run had an overall efficiency of 83.4%. The A filter was changed at 1 hr. The 1-hour filter catch was 3.3 mg. All test results were appropriate and valid. The attempted burn rate category was missed. There were no anomalies and all criteria were met.

Run 3:

Run 3 was an attempt at a category II burn rate performed on 2/16/17, resulting in a 0.98 kg/hr burn rate. The test duration was 4 hours 10 minutes. The fuel weight was

10.7 lbs. There was an average particulate emissions rate of 1.99 g/hr. The run had an overall efficiency of 79.5%. The A filter was changed at 1 hr. The 1-hour filter catch was 5.3 mg. All test results were appropriate and valid. The burn rate category was achieved. There were no anomalies and all criteria were met.

Run 4:

Run 4 was an attempt at a category III burn rate performed on 2/17/17, resulting in a 1.29 kg/hr burn rate. The test duration was 3 hours 10 minutes. The fuel weight was 10.8 lbs. There was an average particulate emissions rate of 1.53 g/hr. The run had an overall efficiency of 75.0%. The A filter was changed at 1 hr. The 1-hour filter catch was 4.2 mg. All test results were appropriate and valid. The burn rate category was achieved. There were no anomalies and all criteria were met.

Run 5:

Run 5 was a high burn performed on 2/17/17 resulting in a 2.01 kg/hr burn rate. The test duration was 2 hours. The fuel weight was 10.6 lbs. There was an average particulate emissions rate of 1.68 g/hr. The run had an overall efficiency of 71.7%. The A filter was changed at 1 hr. The 1-hour filter catch was 3.0 mg. All test results were appropriate and valid. The burn rate category was achieved. There were no anomalies and all criteria were met.

One Hour Particulate Data:

Run Number	Total Estimated PM Emissions at 1 hour
1	3.1 mg
2	3.3 mg
3	5.3 mg
4	4.2 mg
5	3.0 mg

Filter Catch:

Run 1:

Project #	035-S-075-1					MFG	Arada				
Run #	1					Model	Farrington 16				
Date	2/21/17										

Train A	Front	Rear	Filter #	Tare	Final	Net	Train B	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>		3028	0.1175	0.1206	0.0031		<input checked="" type="checkbox"/>	<input type="checkbox"/>	3030			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3029					<input type="checkbox"/>	<input checked="" type="checkbox"/>	3031	0.2341	0.2392	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3033	0.2348	0.2372			<input checked="" type="checkbox"/>	<input type="checkbox"/>	O ring			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O Ring					<input type="checkbox"/>	<input checked="" type="checkbox"/>	O ring	3.5446	3.5452	0.0057
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5909	3.5917	0.0032							
	6.3 mg							5.7 mg					

Nozzle	#	TARE	FINAL	Net
1A	115.6254	115.6257	0.0003	0.3
1B	115.9004	115.9005	0.0001	0.1

Train A Total Catch	6.6 mg	Train B Total Catch	5.8 mg
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Ambient	<input checked="" type="checkbox"/>	Filter #	Tare	Final	Net	Vol (liter)
		3032	0.1169	0.1170	0.0001	2305.638
		O ring	1.6727	1.6730	0.0003	
		Total			0.4 mg	

Notes: Train A Total: 6.6mg Train B Total: 5.8mg Ambient Total: 0.4mg 1 Hour Catch: 3.1mg

Run 2:

Project #	035-S-075-1					MFG	Arada				
Run #	2					Model	Farrington 16				
Date	2/21/17										

Train A	Front	Rear	Filter #	Tare	Final	Net	Train B	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>		3034	0.1179	0.1212	0.0033		<input checked="" type="checkbox"/>	<input type="checkbox"/>	3036			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3035					<input type="checkbox"/>	<input checked="" type="checkbox"/>	3037	0.2354	0.2395	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3039	0.2360	0.2366			<input checked="" type="checkbox"/>	<input type="checkbox"/>	O ring			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O Ring					<input type="checkbox"/>	<input checked="" type="checkbox"/>	O ring	3.5554	3.5562	0.0049
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5158	3.5168	0.0016							
	4.9 mg							4.9 mg					

Nozzle	#	TARE	FINAL	Net
6A	116.5641	116.5645	0.0004	0.4
6B	116.1165	116.1167	0.0002	0.2

Train A Total Catch	5.3 mg	Train B Total Catch	5.1 mg
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Ambient	<input checked="" type="checkbox"/>	Filter #	Tare	Final	Net	Vol (liter)
		3038	0.1174	0.1174	0.0000	1736.481
		O ring	1.6482	1.6484	0.0002	
		Total			0.2 mg	

Notes: Train A Total: 5.3mg Train B Total: 5.1mg Ambient Total: 0.2mg 1 Hour Catch: 3.3mg

Run 3:

Project #	035-S-075-1		MFG	Arada	
Run #	3		Model	Farrington 16	
Date	2/21/17				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3040	0.1181	0.1234	0.0053
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3041			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3045	0.2358	0.2380	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O Ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5420	3.5420	0.0022
						7.5 mg

Train B	Front	Rear	Filter #	Tare	Final	Net
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3042			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3043	0.2361	0.2435	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O ring	3.5593	3.5593	0.0074
						7.4 mg

Nozzle	#	TARE	FINAL	Net
	10A	116.8265	116.8265	0.0000
				0.0

Nozzle	#	TARE	FINAL	Net
	10B	117.1676	117.1677	0.0001
				0.1

Train A Total Catch	7.5 mg
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Train B Total Catch	7.5 mg
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Ambient	Filter #	Tare	Final	Net	Vol (liter)
<input checked="" type="checkbox"/>	3044	0.1177	0.1179	0.0002	1403.742
	O ring	1.6416	1.6416	0.0000	
	Total			0.0002 mg	

Notes: Train A Total: 7.5mg Train B Total: 7.5mg Ambient Total: 0.2mg 1 Hour Catch: 5.3mg

Run 4:

Project #	035-S-075-1		MFG	Arada	
Run #	4		Model	Farrington 16	
Date	2-21-2-17				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3046	0.1174	0.1216	0.0042
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3047			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3051	0.2346	0.2347	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O Ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5734	3.5734	0.0001
						0.1 mg

Train B	Front	Rear	Filter #	Tare	Final	Net
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3048			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3049	0.2357	0.2402	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O ring	3.5379	3.5379	0.0045
						4.5 mg

Nozzle	#	TARE	FINAL	Net
	12A	116.8890	116.8890	0.0000
				0.0

Nozzle	#	TARE	FINAL	Net
	12B	117.0523	117.0523	0.0000
				0.0

Train A Total Catch	0.1 mg
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Train B Total Catch	4.5 mg
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Ambient	Filter #	Tare	Final	Net	Vol (liter)
<input checked="" type="checkbox"/>	3050	0.1175	0.1175	0.0000	1003.027
	O ring	1.6823	1.6823	0.0000	
	Total			0.0 mg	

Notes: Train A Total: 4.3mg Train B Total: 4.5mg Ambient Total: 0.0mg 1 Hour Catch: 4.2mg

Run 5:

Project #	035-S-075-1		MFG	Arada	
Run #	5		Model	Farrington 16	
Date	2/21/17				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3052	0.1172	0.1202	0.0030
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3053			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3057	0.2345	0.2346	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O Ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5771	3.5771	0.0001
						3.1 mg

Train B	Front	Rear	Filter #	Tare	Final	Net
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3054			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3055	0.2354	0.2385	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O ring	3.5135	3.5135	0.0031
						3.1 mg

Nozzle	#	TARE	FINAL	Net
	13A	117.4532	117.4532	0.0000
				0.0

Nozzle	#	TARE	FINAL	Net
	13B	117.0625	117.0626	0.0001
				0.1

Train A Total Catch	3.1 mg
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Train B Total Catch	3.2 mg
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Ambient	Filter #	Tare	Final	Net	Vol (liter)
<input checked="" type="checkbox"/>	3056	0.1180	0.1180	0.0000	633.178
	O ring	1.6545	1.6546	0.0001	
			Total	0.1 mg	

Notes:	Train A Total: 3.1mg Train B Total: 3.2mg Ambient Total: 0.1mg 1 Hour Catch: 3.0mg
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Test Condition Summary:

All testing conditions for all runs fell within allowable specifications of EPA Method 28R, ASTM E2780-10 and ASTM E2515-11. A summary of facility conditions, temperature averages, fuel burned and run times is listed below.

Runs	Ambient (Deg. F)		Barometric Pressure (In. Hg.)	Test Fuel Burned (Lbs.)	Test Fuel Moisture (Dry Basis)	Run Time (Min.)
	Pre	Post				
1	69	69	30.06	10.9	20.6	420
2	70	70	29.72	10.6	20.3	310
3	72	70	29.56	10.7	19.3	250
4	67	69	29.60	10.8	19.7	190
5	70	73	29.60	10.6	19.9	120

Heater Specifications:

Dimensions, firebox configuration, air supply locations, air introduction locations, and baffle locations of the wood heater are referenced below and on the following page.

Heater Dimensions

Heater Dimensions				
Height	Width	Depth	Firebox Volume	Weight
13.5"	21.250"	11.75"	1.57 ft ³	340.7 lbs

Air Flow Schematic

CBI

Front



Left



Right



Rear



Process Operations and Description:

The appliance was operated according to procedures as described in the Operations Manual. Detailed run information can be found in corresponding digital folders submitted with this report.

Settings & Run Notes

	Run Notes	
	Pre-Burn	Test Run
Run 1	Primary set to $7^{13}/_{32}$ ". Start at 1417	Category I: Test start: 1518 – Bypass closed, primary fully open, door open 1 minute. At 5 mins Primary air set to $7^{13}/_{32}$ ". Front filter A changed at 1618. At 1828 the door was opened and the coals were stirred due to no weight loss in 10 minutes after 60% of fuel load was burned. END test: 2218 – Run time 7 hours.
Run 2	Primary set to $7^1/_2$ ". Start at 1238	Category I: Test start: 1339 - Bypass closed, primary fully open, door open 1 minute. At 5 mins Primary air set to $7^1/_2$ ". 25 minutes into the test run (at 1404) the front 4x4 fell forward against the glass. Front filter A changed at 1439. At 1759 the door was opened and the coals were stirred due to no weight loss in 10 minutes after 60% of fuel load was burned. END test: 1849 – Run time 5 hours, 10 minutes.
Run 3	Primary set to $7^9/_{16}$ ". Start at 1152	Category II: Test start: 1253 – Bypass closed, primary fully open, door open 1 minute 30 seconds. At 5 mins Primary set to $7^9/_{16}$ ". Front filter A changed at 1353. END Test: 1703 - Run time 4 hours 10 mins.
Run 4	Primary set to $7^{31}/_{32}$ ". Start at 1153	Category III: Test start: 1254. Bypass closed, primary fully open, door open 1 minute. Front filter A changed at 1354. END test: 1604 - Run Time: 3 hours 10 minutes.
Run 5	Primary fully open. Start at 1624	Category IV: Test start: 1724 - Bypass closed, primary fully open and left open, door open 1 minute. Front filter A changed at 1824. END test: 1924 - Run time 2 hours.



Test Fuel Properties:



Fuel consisted of 2"x4"x17.5" and 4"x4"x17.5" Green, Douglas fir. Detailed fuel load specifications for each run can be found in the corresponding digital folders submitted with this report.

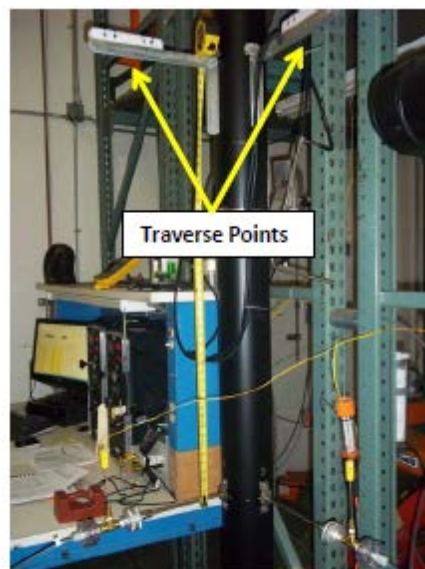
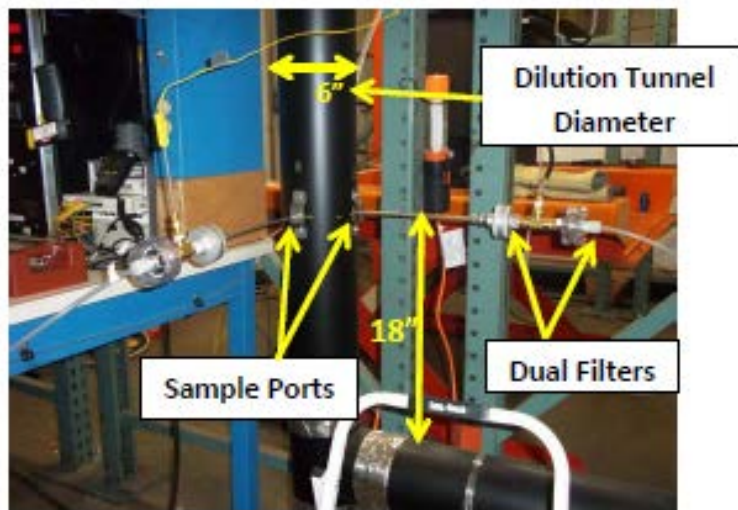
Pre-burn Configuration:



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:

EPA ASTM E2515-11 was used in collecting particulate samples. The dilution tunnel is 6 inches in diameter. All sampling conditions per ASTM E2515-11 were followed. No alternate procedures were used.

Analytical Methods Description:

All sample recovery and analysis procedures followed EPA ASTM E2515-11 procedures. At the end of each test run, filters and probes were removed from their housings, dessicated for 24 hours, and then weighed at 6 hour intervals to a constant weight per ASTM E2515-11 section 11.0.

Calibration, Quality Control and Assurances:

Calibration procedures and results were conducted per EPA Method 28R, ASTM E2515-11 and ASTM E2780-10. Test method quality control procedures (leak checks, volume meter checks, stratification checks, proportionality results) followed the procedures outlined.

Appliance Sealing and Storage:

Following securing with metal strapping and the seal below, the appliance was placed into storage at client facilities located at: The Fire Works, Weycroft Avenue, Axminster, Devon, United Kingdom EX13 5HU.

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 40 CFR PART 60 SUBPART AAA §60.535(g)	
REPORT # _____	DATE SEALED _____
MANUFACTURER _____	MODEL # _____

Sealed Unit





Appendices:

Appendix A:

Sampling and Analytical Procedures

All Sampling and analytical procedures were performed by Ben Nelke. All procedures used were directly from EPA Method 28R, ASTM 2515-11 and ASTM E2780-10. No alternative procedures were used for this test series.

Appendix B:

Participants

The following personnel performed all testing:

- Ben Nelke

Analysis and Report Writing

The following people were involved with analysis and report writing:

- Ben Nelke, Doug Towne

Observers:

The following people were observers during testing:

- None

Appendix C:

Appliance Updates

No updates to the appliance were made.

Appendix D:

Test Equipment Calibration Audit:

- Calibrations for the platform scale and bench scale were performed with Certified Class F weights
- Moisture meter calibration was performed with Delmhorst moisture meter calibrator
- Gas Analyzer calibration performed with certified EPA Protocol gases
- 47mm filters weighed to a constant weight with calibrated analytical balance

All equipment calibration data submitted in separate digital file along with this report.

Appendix E:


*Accreditations:***CERTIFICATE OF ACCREDITATION**

This certifies that:



Dirigo Laboratories, Inc.

Has satisfied the requirements for laboratory accreditation for the certification 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.

October 21, 2015 - October 21, 2020**EFFECTIVE DATE**
MEASUREMENT TECHNOLOGY GROUP
GROUP LEADER

Methods 28R, 28 WHH, 28 WHH-PTS,
All Methods listed in Sections 60.534 and 60.5476

METHODS4**CERTIFICATE NUMBER**



American Association for Laboratory Accreditation

Accredited Inspection Body

A2LA has accredited

DIRIGO LABORATORIES, INC.

Clackamas, OR

for technical competence as an

Inspection Body

This inspection body is accredited in accordance with the recognized International Standard ISO/IEC 17020:2012 *Conformity Assessment – Requirements for the operation of various types of bodies performing inspection*. This accreditation demonstrates technical competence for a defined scope and the operation of a quality management system.

Presented this 17th day of October 2014.



Peter Abney
President & CEO

President & CEO
For the Accreditation Council
Certificate Number 3726.03
Valid to December 31, 2016

For the inspections to which this accreditation applies, please refer to the organization's Inspection Body Scope of Accreditation.



American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

DIRIGO LABORATORIES, INC.

Clakamas, OR

for technical competence in the field of

Mechanical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 17th day of October 2014.

President & CEO
For the Accreditation Council
Certificate Number 3726.01
Valid to December 31, 2016



For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Mechanical Scope of Accreditation.



American Association for Laboratory Accreditation

Accredited Product Certification Body

A2LA has accredited

DIRIGO LABORATORIES, INC.

Clackamas, OR

for technical competence as a

Product Certification Body

This product certification body is accredited in accordance with the recognized International Standard
ISO/IEC 17065:2012 *Conformity Assessment – Requirements for Bodies Certifying Products, Processes and Services*.
This accreditation demonstrates technical competence for a defined scope and the operation of a quality management system.

Presented this 17th day of October 2014.



President & CEO
For the Accreditation Council
Certificate Number 3726.02
Valid to December 31, 2016

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation