# Foyers Supreme Inc. Fireplace Products

Project # 019-S-056-1

Model: Fusion

Type: Residential Wood Fired Heater

February 19, 2016

EPA Certification Testing to Method 28R –Certification and Auditing of Wood Heaters

#### Contact:

Mr. Emmanuel Marcakis 3594 Jarry East Montreal, QC H1Z 2G4 CANADA emmanuel@supremem.com http://www.supremem.com/

Prepared by: John Steinert, President



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#### **Affidavit:**

Dirigo Laboratories, Inc. was contracted by Foyers Supreme Incorporated to provide testing services for the Fusion non-catalytic fireplace wood heater per EPA Method 28R for Certification and Auditing of Wood Heaters, and particulate sampling performed per ASTM E2515-11 Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel. All EPA protocols from Methods 28R and ASTM E2780-10 were followed in the testing, sampling, analysis, and calibrations for the test series and all results are based on these methods. Efficiency, CO emissions and heat output were calculated per CSA B415.1-10. All testing and associated procedures were conducted at Dirigo Laboratories, Inc. beginning 2/9/2016 and ending on 2/12/2016. Dirigo Laboratories is located at 11785 SE Highway 212 -Suite 305, Clackamas, Oregon 97015.

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 60. Standards of Performance for New Hydronic Heaters and Forced Air Furnaces. Dirigo is certified for Methods 28R, 28 WHH, 28 WHH-PTS and all methods listed in 40 CFR 60 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 all certifications.

with this project.	
John Steinert, President	Gary Nelke, CMfgE
Ben Nelke, Technician	Doug Towne, QA/QC

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

#### **Introduction:**

Foyers Supreme Inc. contracted with Dirigo Laboratories, Inc. to perform EPA certification testing on their Fusion non-catalytic, residential wood heater. All testing was performed at Dirigo Laboratories, Inc. Testing was performed by Mr. Ben Nelke, and Mr. Gary Nelke, CMfgE. Third Party Certification services to be provided by Dirigo Laboratories, Inc.

#### **Technician Notes:**

- The stove was damaged during shipping which delayed the originally scheduled start date. EPA was notified and the repairs were made prior to the start of the test series.
- A 50-hour break-in was performed on the appliance prior to testing.
- Prior to testing, the dilution tunnel was cleaned with a steel brush.
- Front filters were changed on sample train A at one hour for all runs.
- A Category 1 burn rate could not be achieved using the lowest possible air setting on this appliance. Two Category 2 burn rates were performed with burn rates of 0.86 Kg/hr and 1.00 Kg/hr per Applicable Determination WDS-109.

#### **Wood Heater Identification and Testing:**

- Appliance Tested: Fusion
- Serial Number: 0001
- Manufacturer: Foyers Supreme Inc.
- Catalyst: No
- Heat exchange blower: Integral
- Type: Wood Stove
- Style: Insert
- Date Received: Wednesday, January 20, 2016
- Wood Heater Aging: January 22, 2016
- Testing Period Start: Tuesday, February 09, 2016 Finish: Friday, February 12, 2016
- Test Location: Dirigo Laboratories, Inc. -11785 SE HWY 212 Suite 305, Clackamas. OR 97008
- Elevation: 30 Feet above sea level
- Test Technician(s): Ben Nelke, Gary Nelke

### Test Procedures and Equipment:

All Sampling and analytical procedures were performed by Ben Nelke and Gary Nelke. All procedures used were directly from EPA Methods 28R, ASTM E2780-10, CSA B415.1-10, and ASTM E2515-11. See Figures 1 and 2 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 #2
- 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
- APEX XC 60 Ambient Sampling Box
- 10. Gast MOA-P122-AA Vacuum Pump Analyzer
- 11. Rice Lake 3'x3' floor scale w/digital weight indicator

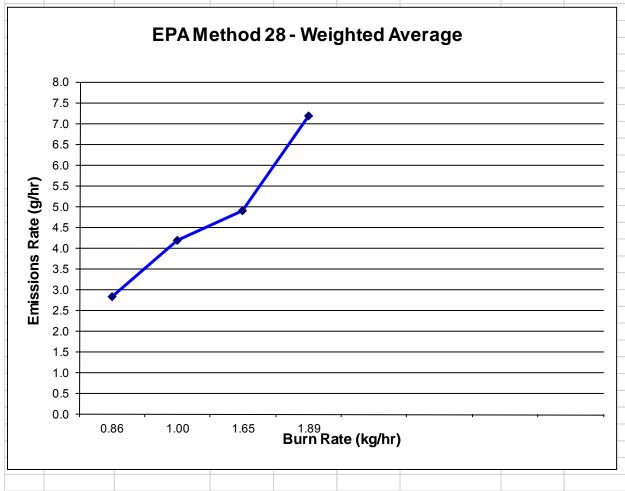
## Results: Weighted Average Emissions and Efficiency

The overall weighted average emission rate based on the 4 certification runs is 4.4 g/hr. The Fusion wood fired residential fireplace heater meets the 2015 standard PM limit of 4.5 g/hr per CFR 40 part 60, §60.532 (a).

The overall weighted average efficiency per CSA B415.1-10 is 64.1%

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		ICO =						
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,	$\Lambda D \cap D \Lambda T \cap D$	RIES INC.						
L	HDUNATUR	NES ING. =						
	,	Weighted A	verage:	4.4	(g/hr)			
	Client:	Supreme						
	Model:	Fusion						
Tra	cking No.:	56						
Pı	oject No.:	019-S-056-1						
	est Dates:	2/9/16 - 2/12/1	6					
	Burn Rate	Category	2		Burn Rate	Category	2	
	Burn Rate		0.86			(kg/hr-dry)	1.00	
	Emissions		2.8			Rate (g/hr)	4.2	
		Rate Cap (g/hr)	15			Rate Cap (g/hr)	15	
	Weighting I		23.32%		Weighting		34.48%	
	Run Numbe	er	1		Run Numb	er	2	
	Burn Rate	 Category	3		Burn Rate	Category	3	
	Burn Rate		1.65			(kg/hr-dry)	1.89	
	Emissions		4.9			Rate (g/hr)	7.2	
		Rate Cap (g/hr)	18			Rate Cap (g/hr)	18	
	Weighting I	Factor	31.45%		Weighting	Factor	10.74%	
	Run Numbe	ar .	3		Run Numb	er	4	

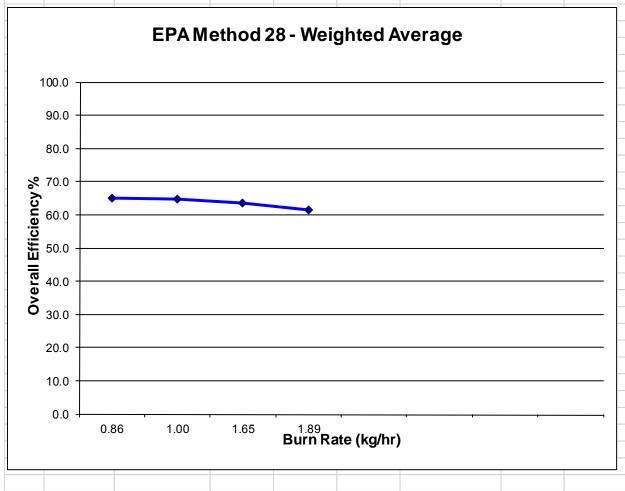
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	ICO =				
UIK	<b>IGO</b> RIES INC.				
I ARORATO	RIES INC				
LADOITATO	IILO II VO.				
Client:	Supreme				
Client: Model:					
Model:	Fusion 56				
Model: racking No.:	Fusion 56 019-S-056-1				
Model: racking No.: Project No.:	Fusion 56 019-S-056-1				
Model: racking No.: Project No.:	Fusion 56 019-S-056-1				



## Weighted Average Efficiency:

			CSA B	415.1-1	0 Weighted	Average
					_	
IIIK	<i>IGO</i>					
VIII	MU =					
LABORATO	RIES INC. 🧧					
	\ \^/aiabtad ^	Vorogo:	64.1	%		
	Weighted A	werage.	64.1	70		
Client:	Supreme					
Model:						
Tracking No.:	56					
Project No.:						
-		16				
Test Dates:	2/9/16 - 2/12/	10				
Burn Rate	Category	2		Burn Rate	Category	2
Burn Rate		0.86			(kg/hr-dry)	1.00
OA Efficien		65.0		OA Efficie		64.8
	Rate Cap (g/hr)	15			Rate Cap (g/hr)	15
Weighting		23.32%		Weighting		34.48%
Run Numbe	er	1		Run Numb	er	2
Burn Rate	Category	3		Burn Rate	Category	3
Burn Rate		1.65			(kg/hr-dry)	1.89
OA Efficier		63.5		OA Efficie		61.6
	Rate Cap (g/hr)	18			Rate Cap (g/hr)	18
		31.45%		Weighting		10.74%
Weighting						

			CSA B	415.1-10	) - Weight	ed Averag	е
LA	<b>DIR</b>	IGO RIES INC.					
	Client:	Supreme					
	Model:	Fusion					
Trac	cking No.:	56					
Pr	oject No.:	019-S-056-1					
Te	est Dates:	2/9/16 - 2/12/16					



#### **Table 1: Results**

Results in accordance with CSA B415.1-10

Run	1st Hour Particulate Emissions- grams	Overall Avg. Emission Rate g/hr	Overall Efficiency HHV CSA B415.1-10	Output BTU/hr. HHV CSA B415.1-10	Burn Rate kg/hr. CSA B415.1-10	CO g/hr
1	16.30	2.83	65.0%	11,051	0.86	111.03
2	21.29	4.19	64.8%	12,799	1.00	132.62
3	14.86	4.93	63.5%	20,703	1.65	182.74
4	20.21	7.19	61.6%	23,086	1.89	161.48

#### *Run 1:*

No anomalies. Front filters changed at 1 hr mark per method. Category 2 burn rate of 0.86 Kg/hr.

#### **Run 2:**

No anomalies. Front filters changed at 1 hr mark per method. Category 2 burn rate of 1.00 Kg/hr.

#### Run 3:

No anomalies. Front filters changed at 1 hr mark per method. Category 3 burn rate of 1.65 Kg/hr.

#### **Run 4:**

No anomalies. Front filters changed at 1 hr mark per method. Category 4 burn rate of 1.89 Kg/hr.

## **Test Condition Summary:**

All testing conditions for all runs fell within allowable specifications of EPA Method 28R. A summary of facility conditions, surface temperature averages, ambient temperature averages, fuel burned and run times is listed below. Before and after each test run, measured air velocities were less than 1ft/sec.

Runs	Ambient	(Deg. F)	Barometric Pressure (In. Hg.)	Test Fuel Burned (Lbs.)	Test Fuel Moisture (Dry Basis)	Run Time (Min.)
	Pre Post		(III. 11g.)	burneu (Lbs.)	Dasisj	
1	68	68	30.19	16.6	19.7	440
2	72	71	30.15	16.7	19.9	380
3	72 73		30.21	16.7	20.1	230
4	4 76 74		30.21	16.7	20.2	200

#### **Filter Catch:**

#### Run 1:

	Project #	019-S-056	5-1			MFG	Supreme									
	Run#	1				Model	Fusion			]						
	Date	2/16	/16													
	Train A	Front	Rear	Filter#	Tare	Final	Net		Train B	Front	Rear	Filter#	Tare	Final	Net	
	First Hour	<b>V</b>		2612	0.1207	0.1363	0.0156			~		2614				1
			<b>V</b>	2613							>	2615	0.2421	0.2599		
		<b>\</b>		2617	0.2434	0.2462				~		O ring				
		٧		O Ring			1				>	O ring	3.5602	3.5615	0.0191	
			~	O Ring	3.6103	3.6114	0.0039									
							19.5	mg							19.1	mg
	Nozzle								Nozzle							
	#	TAF		FIN		Net			#	TA		FIN		Net		
_	10A	116.8	3295	116.8	8306	0.0011	1.1		10B	117.1	1684	117.3	1693	0.0009	0.9	9
	Train A Total	Catch					20.6		Train B Tot	al Catch					20	
	Ambient 🗹	Filter#		Tare	Final	Net	Vol (liter)									
		2616		0.1212	0.1214	0.0002										
		O ring		1.6853	1.6859	0.0006										
					Total	0.0008	mg									
	Train A Total	: 20.6mg		Train B Tot	tal: 20mg	A	mbient Total: 0.8r	ng	One Hour C	atch: 15.6	mg					
_																
																-
																-

## Run 2:

Project #	019-S-056	6-1			MFG	Supreme									
Run#	2				Model	Fusion									
Date	2/16	/16													
Train A	Front	Rear	Filter#	Tare	Final	Net		Train B	Front	Rear	Filter#	Tare	Final	Net	
First Hour	<b>✓</b>	iteui	2618	0.1222	0.143	0.0208		Truit B	<b>✓</b>	П	2620	Turc	111101	Net	
		V	2619	OITEEE	0.1.5	0.0200				V	2621	0.2426	0.2662		
	<u> </u>		2623	0.2425	0.2466				V		O ring				
	V		O Ring			1				~	O ring	3.556	3.5573	0.0249	
		>	O Ring	3.5643	3.5652	0.005									
						25.8	mg							24.9	mg
Nozzle								Nozzle							
#	TAI	RE	FIN	IAL	Net	İ		#	TA	RE	FIN	IAL	Net		
5A	116.7	7742	116.	7746	0.0004	0.4		5B	116.8	3825	116	.883	0.0005	0.5	
Train A Tota	l Catch					26.2		Train B Tota	l Catch					25.4	
Ambient 🗹	Filter#		Tare	Final	Net	Vol (liter)									
	2622		0.1219	0.1223											
	O ring		1.6986			-									
				Total	0.0007	mg									
Train A Tota	l: 26.2mg		Train B Tota	al: 25.4mg		Ambient Total: 0.	7mg	One Hour C	atch: 20.8	mg					
I															

## Run 3:

	Project #	019-S-05	6-1			MFG	Supreme									
	Run#	3				Model	Fusion									
	Date	2/17	7/16													
	Train A	Front	Rear	Filter#	Tare	Final	Net		Train B	Front	Rear	Filter#	Tare	Final	Net	
	First Hour	>		2624	0.1212	0.1358	0.0146			V		2626				
			>	2625							٧	2627	0.2427	0.2589		
		K		2629	0.2428	0.2442						O ring				
		<b>V</b>		O Ring								O ring	3.5371	3.5383	0.0174	
		П	~	O Ring	3.5782	3.579	0.0022									
							16.8	mg							17.4	mg
	Nozzle								Nozzle							
	#	TA	RE	FIN	IAL	Net			#	TA	RE	FIN	IAL	Net		
	11A	117.0	0362	117.	0374	0.0012	1.2		11B	116.	676	116.0	6774	0.0014	1.4	
	Train A Tota	l Catch					18		Train B Total	Catch					18.8	
	Ambient 🗹	Filter#		Tare	Final	Net	Vol (liter)									
		2628		0.1218	0.1218	0	1285.88									
		O ring		1.7085	1.709											
					Total	0.0005	mg									
Notes:	Train A Tota	l: 18mg	Tra	ain B Total:	18.8mg	Amb	ient Total: 0.5mg	One	e Hour Catch:	14.6mg						

#### **Run 4:**

																-
	.,	019-S-056-1					Supreme									
	Run#	4				Model	Fusion									
	Date	2/17	/16													
	Train A	Front	Rear	Filter#	Tare	Final	Net		Train B	Front	Rear	Filter#	Tare	Final	Net	
	First Hour	<b>▼</b>	iteai	2630	0.122	0.1428	0.0208		II dili D	<u> </u>		2632	Tare	Tillal	ivet	1
	riist noui		•	2631	0.122	0.1428	0.0206				V	2633	0.2423	0.2637		
		V		2635	0.2439	0.2455				~		O ring				
		K		O Ring							>	O ring	3.5772	3.5784	0.022	6
			>	O Ring	3.5627	3.5638	0.0027									
							23.5	mg							22.6	mg
	Nozzle								Nozzle							
	#	TAI	RE	FIN	IAL	Net			#	TA	RE	FIN	IAL	Net		
	12A	116.8	3893	116.	8902	0.0009	0.9		12B	117.0	0522	117.	0545	0.0023	2.:	3
	Train A Total	Catch					24.4		Train B Total	Catch					24.	9
	Ambient 🗸	Filter#		Tare	Final	Net	Vol (liter)									
		2634		0.1215	0.1218	0.0003										
		O ring		1.6539	1.6545	0.0006										
					Total	0.0009	mg									
Notes:	Train A Total	: 24.4mg		Train B Tota	al: 24.9mg	ļ	L Ambient Total: 0.9	mg	One Hout 0	Catch: 20.	.8mg					

## **Heater Specifications:**

Dimensions, firebox configuration, air supply locations, air introduction locations, and baffle locations of the wood heater are referenced in the table below and in the following schematics.

#### **Heater Dimensions**

Height	Width	Depth	Firebox Volume	Weight	
20"	28.5"	20"	2.36	165 lbs	

## Air Flow Schematic

**CBI** 

**CBI** 

Non 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.

Non CBI

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### **Minimum Setting**

#### FUSION 2.4 | LOAD WEIGHT 15.5 - 16.5 LBS | % HUMIDITY 19 - 21 %

#### **CATEGORY 1 AND 2**

#### Pretest

Adjust the burn rate lever to the minimum to minimum rate (as illustrated).
Crush coals into small pieces.
Level the coals and create a groove in the middle.
Maintain coals between 3.1 to 3.5 lbs
Temperature between 300 to 325 oF.

#### Test

Activate the control by pushing it inwards. Put load as illustrated in Figure 1. Keep the door open for 5 min. After 4 min, start closing the door slowly.

#### **CATEGORY 3**

#### Pretest

Adjust the burn rate lever as illustrated. Crush coals to small pieces. Level the coals and create a groove in the middle. Maintain coals between 3 to 3.5 lbs Temperature between 400 to 450 F.

#### Test

Activate the control by pushing it inwards. Put load as illustrated in Figure 1. Keep the door open for 5 min. After 4 min, start closing the door slowly.

#### MAXIMUM BURN RATE

#### Pretest

Adjust the burn rate lever to the maximum burn rate (as illustrated).

Crush coals into small pieces.

Level the coals and create a groove in the middle. Maintain coals between 3 to 3.5 lbs

Temperature between 550 to 600 F.

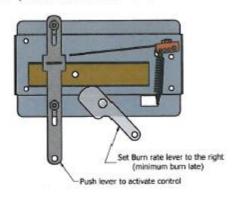
#### Test

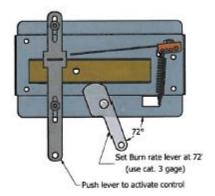
Activate the control by pushing it inwards.

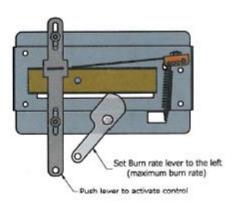
Put load as illustrated in Figure 1.

Your the door open for 5 min. After 4 min. et

Keep the door open for 5 min. After 4 min, start closing the door slowly.







## Test Fuel Properties:

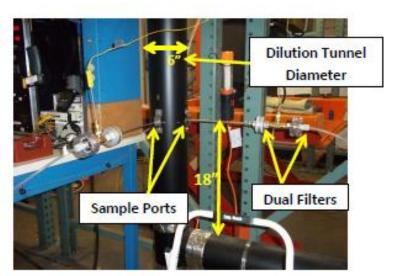


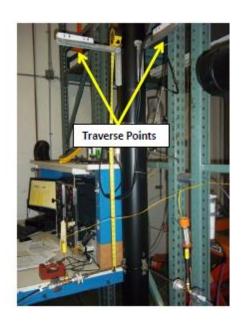


### Sampling Locations and Descriptions:

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.







#### **Sampling Methods:**

ASTM E2515-11 was used in collecting particulate samples. The dilution tunnel is 6 inches in diameter. All fueling and operating protocols per ASTM E2780-10 were followed. No alternate procedures were used.

#### **Analytical Methods Description:**

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

#### **Calibration, Quality Control and Assurances:**

Calibration procedures and results were conducted per ASTM E2515-11 Section 8 and ASTM E2779-10 Section 8. Test method quality control procedures (leak checks, volume meter checks, stratification checks, proportionality results) followed procedures outlined in ASTM E2515-11.

### **Appliance Sealing and Storage:**

Following testing the appliance was secured with metal strapping and the seal below and the appliance was placed into storage at client facilities located at: 3594 Jarry East Montreal, QC H1Z 2G4 CANADA

#### Sealing Label

ATTENTION:									
THIS SEAL IS NOT TO BE BROKEN WITHOUT PRIOR AUTHORIZATION									
MENTAL PROTECTION AGENCY.									
THIS APPLIANCE HAS BEEN SEALED IN ACCORDANCE WITH REQUIREMENTS OF 40 CFR PART 60 SUBPART AAA §60.535(g)									
DATE SEALED									
MODEL#									

## Sealed Unit



## **Appendices:**

#### Appendix A:

#### Sampling and Analytical Procedures

All Sampling and analytical procedures were performed by Ben Nelke and Gary Nelke. All procedures used were directly from EPA Method 28R, ASTM E2515-11, ASTM E2780-10, and CSA B415.1-10. No alternative procedures were used for this test series.

#### Appendix B:

#### *Participants*

The following personnel performed all testing: Ben Nelke, Gary Nelke, CMfgE

#### Analysis and Report Writing

The following people were involved with analysis and report writing:

- Ben Nelke, Gary Nelke, CMfgE
- John Steinert, Doug Towne

#### 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 has been submitted in a separate digital file along with this report.

#### Model: Fusion

## 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 Foxced 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 METHODS

4 CERTIFICATE NUMBER

#### CERTIFICATE OF ACCREDITATION

This certifies that:



Dirigo I	aboratories.	Inc. (	Mobile l	aboratory)	

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

October 21, 2015 - October 21, 2020 EFFECTIVE DATE

Methods 28R, 28 WHH, 28 WHH-PTS, All Methods listed in Sections 60:534 and 60:547 METHODS 4M

MEASUREMENT TECHNOLOGY GROUP GROUP LEADER

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.

CHOLD SELL SHEET

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.

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.

Non CBI



#### 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.

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