
Pacific Energy

Project # 034-S-074-1

Model: TN20 (series B), TN20 Insert
(series B), (AKA: True North 20)

Type: Free Standing / Insert

Residential Non-catalytic Wood Fired
Heater

January 27, 2017

Revised: 11/12/2021, 12/7/2021

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

Contact:

Mr. Jeff Bain

2975 Allenby Road

Duncan, BC

Canada V9L 6V8

Jeff.Bain@pefp.net

(250) 715-2398

Prepared by: Doug Towne, QA Manager



11785 SE Highway 212 – Suite 305

Clackamas, OR 97015-9050

(503) 650-0088

WWW.DIRIGOLAB.COM

Revision History:

11/11/2021: The following revisions were made to the report.

- CO added in g/m - page 12
- Negative filter weight statement- page 17
- Added additional fuel load pictures to body of report-page 28
- Confirmed conditioning data compliant.
- Added firebox volume- page 21
- Added precision statement- page 14
- 1-hour filter pull data added– page 14
- Confirmed minimum chimney height recommendation and warranty in manual.

12/7/2021

- Updated “Process Operation and Description” to include reference to operating procedures that were supplied by the manufacturer.

11/12/2021:

Request for renewal submitted. New Certificate of Conformity Issued by PFS.

Table of Contents

Affidavit:	4
Introduction:	5
Notes:	5
Wood Heater Identification and Testing:	6
<i>Test Procedures and Equipment:</i>	<i>7</i>
Results:	8
Efficiency:	10
Summary Table:	12
Run 2:	12
Run 3:	12
Run 4:	13
Run 5:	13
Run 6:	13
One Hour Particulate Data:	14
Precision Statement:	14
Filter Catch & Negative Weights Statement:	15
Run 1:	15
Run 2:	15
Run 3:	16
Run 4:	16
Run 5:	17
Run 6 – Fan Confirmation:	18
Test Condition Summary:	19
Heater Specifications:	19
Heater Dimensions	19
Air Flow Schematic	20
Firebox Volume:	21
Process Operations and Description:	26
Settings & Run Notes	26
Test Fuel Properties:	27
Fuel Load Run Pictures:	28
Sampling Locations and Descriptions:	30
Sample Points	30

Sampling Methods:	31
Analytical Methods Description:	31
Calibration, Quality Control and Assurances:	31
Appliance Sealing and Storage:	31
<i>Sealing Label</i>	31
<i>Sealed Unit</i>	32
Appendices:	34
Appendix A:	34
Sampling and Analytical Procedures	34
Appendix B:	34
Participants.....	34
Analysis and Report Writing.....	34
Observers:.....	34
Appendix C:	34
Appliance Updates	34
Appendix D:	35
Test Equipment Calibration Audit:.....	35
Appendix E:	36
Accreditations:.....	36

Affidavit:

Dirigo Laboratories, Inc. was contracted by Pacific Energy Fireplace Products Ltd. to provide testing services for the True North 20 (series B) non-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 12/13/2016 and ending on 12/20/2016. 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 E2515-10 *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.

Ben Nelke

Digitally signed by Ben Nelke
DN: cn=Ben Nelke, o, ou,
email=Bnelke@dirigolab.com,
c=US
Date: 2017.02.01 11:45:26 -08'00'

Ben Nelke, Test Technician

**Doug
Towne**

Digitally signed by Doug Towne
DN: cn=Doug Towne, o=Dirigo,
ou=QA/QC,
email=dtowne@dirigolab.com, c=US
Date: 2017.02.01 11:39:08 -08'00'

Doug Towne, QA Manager

Introduction:

Pacific Energy Fireplace Products Ltd. of Duncan, BC, contracted with Dirigo Laboratories, Inc. to perform EPA certification testing for their Model True North 20 (series B) non-catalytic wood heater. All testing was performed at Dirigo Laboratories, Inc. Testing was performed by Mr. Ben Nelke and Mr. Gary Nelke, CMfgE.

Notes:

- A 50 hour break-in was performed on the appliance: 37 hours by the manufacturer prior to the test series; and 13 hours during assessment runs at Dirigo Laboratories, Inc.
- Prior to testing, the dilution tunnel was cleaned with a steel brush.
- Run #'s 1, 2, 3, 4 & 5 were performed with the convection blower in operation. Run #6 was the blower confirmation run and was performed with the convection blower off.
- Front filters were changed on sample train A at one hour for all runs.

Wood Heater Identification and Testing:

- Appliance Tested: ***TN20 (series B) Free Standing***
- Serial Number: ***TN20 001***
- Manufacturer: ***Pacific Energy Fireplace Products Ltd.***
- Catalyst: ***No***
- Heat exchange blower: ***Optional***
- Type: ***Wood Stove***
- Style: ***Free Standing***
- Date Received: ***Friday, December 02, 2016***
- Wood Heater Aging: ***November 20 - December 8, 2016***
- Testing Period – Start: ***Tuesday, December 13, 2016*** Finish: ***Tuesday, December 20, 2016***
- 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, Gary Nelke***
- Observers: ***Ken Davis***

Test Procedures and Equipment:

All Sampling and analytical procedures were performed by Ben Nelke and Gary Nelke. All procedures used are directly from EPA Method 28R, ASTM E2780-10 and ASTM E2515-10. 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:

The weighted average emission rate is **1.6 g/hr** with a weighted average efficiency of **72.7%** and an average CO of **1.56 g/min**. The Pacific Energy Fireplace Products Ltd. Model True North 20 (series B) non-catalytic 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.

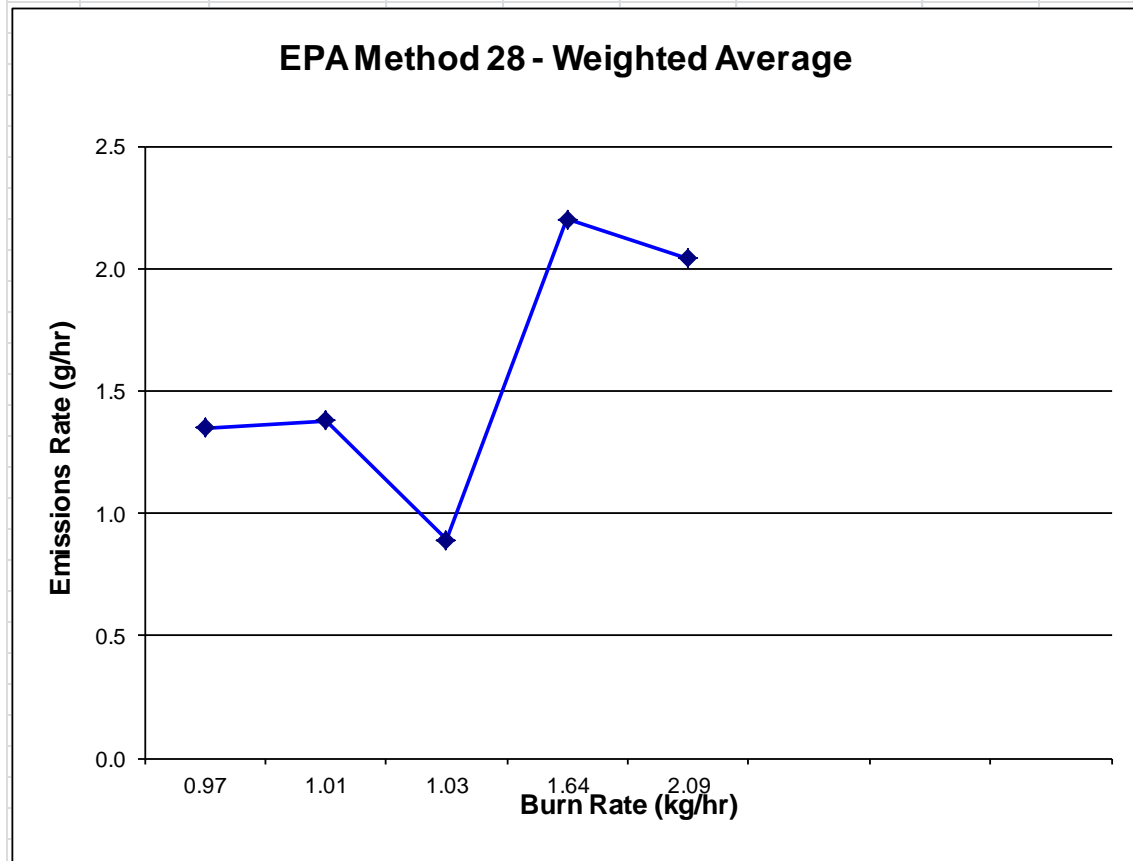
Emissions:

EPA Method 28 - Weighted Average			
			
Weighted Average: 1.6 (g/hr)			
Client:	Pacific Energy		
Model:	TN20 (series B)		
Tracking No.:	74		
Project No.:	034-S-74-1		
Test Dates:	12/13/16 - 12/20/16		
Burn Rate Category	2	Burn Rate Category	2
Burn Rate (kg/hr-dry)	0.97	Burn Rate (kg/hr-dry)	1.01
Emissions Rate (g/hr)	1.4	Emissions Rate (g/hr)	1.4
Emissions Rate Cap (g/hr)	15	Emissions Rate Cap (g/hr)	15
Weighting Factor	24.47%	Weighting Factor	3.01%
Run Number	5	Run Number	2
Burn Rate Category	2	Burn Rate Category	3
Burn Rate (kg/hr-dry)	1.03	Burn Rate (kg/hr-dry)	1.64
Emissions Rate (g/hr)	0.9	Emissions Rate (g/hr)	2.2
Emissions Rate Cap (g/hr)	15	Emissions Rate Cap (g/hr)	18
Weighting Factor	27.59%	Weighting Factor	33.51%
Run Number	1	Run Number	3
Burn Rate Category	4		
Burn Rate (kg/hr-dry)	2.09		
Emissions Rate (g/hr)	2.0		
Emissions Rate Cap (g/hr)	18		
Weighting Factor	11.43%		
Run Number	4		




EPA Method 28 - Weighted Average

Client: Pacific Energy
Model: TN20 (series B)
Tracking No.: 74
Project No.: 034-S-74-1
Test Dates: 12/13/16 - 12/20/16



Efficiency:

All efficiency values use the HHV.

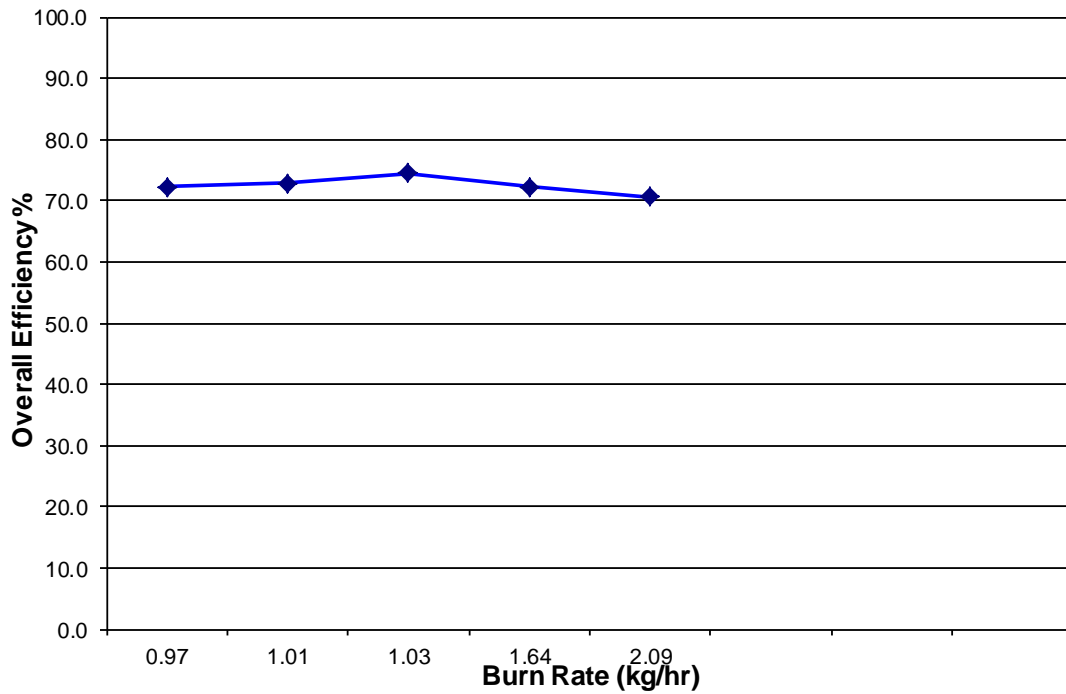
		CSA B415.1-10 Weighted Average			
Weighted Average:		72.7	%		
Client:	Pacific Energy				
Model:	TN20 (series B)				
Tracking No.:	74				
Project No.:	034-S-74-1				
Test Dates:	12/13/16 - 12/20/16				
Burn Rate Category	2	Burn Rate Category	2		
Burn Rate (kg/hr-dry)	0.97	Burn Rate (kg/hr-dry)	1.01		
OA Efficiency %	72.2	OA Efficiency %	72.9		
Emissions Rate Cap (g/hr)	15	Emissions Rate Cap (g/hr)	15		
Weighting Factor	24.47%	Weighting Factor	3.01%		
Run Number	5	Run Number	2		
Burn Rate Category	2	Burn Rate Category	3		
Burn Rate (kg/hr-dry)	1.03	Burn Rate (kg/hr-dry)	1.64		
OA Efficiency %	74.5	OA Efficiency %	72.2		
Emissions Rate Cap (g/hr)	15	Emissions Rate Cap (g/hr)	18		
Weighting Factor	27.59%	Weighting Factor	33.51%		
Run Number	1	Run Number	3		
Burn Rate Category	4				
Burn Rate (kg/hr-dry)	2.09				
Emissions Rate (g/hr)	70.6				
Emissions Rate Cap (g/hr)	18				
Weighting Factor	11.43%				
Run Number	4				



CSA B415.1-10 - Weighted Average

Client: Pacific Energy
Model: TN20 (series B)
Tracking No.: 74
Project No.: 034-S-74-1
Test Dates: 12/13/16 - 12/20/16

EPA Method 28 - Weighted Average



Summary Table:

Category 2 < 1.00 kg/hr		Category 2 0.80 to 1.25 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	5	Run Number	2	Run Number	1	Run Number	3	Run Number	4
Emissions Rate g/hr	1.35	Emissions Rate g/hr	1.38	Emissions Rate g/hr	0.89	Emissions Rate g/hr	2.20	Emissions Rate g/hr	2.04
Burn Rate kg/hr	0.97	Burn Rate kg/hr	1.01	Burn Rate kg/hr	1.03	Burn Rate kg/hr	1.64	Burn Rate kg/hr	2.09
BTU/hr (HHV)	13,931	BTU/hr (HHV)	24,633	BTU/hr (HHV)	15,161	BTU/hr (HHV)	23,451	BTU/hr (HHV)	29,208
CO g/min	1.75	CO g/min	1.65	CO g/min	1.32	CO g/min	1.51	CO g/min	1.55
OA Efficiency (HHV)	72.2%	OA Efficiency (HHV)	72.9%	OA Efficiency (HHV)	74.5%	OA Efficiency (HHV)	72.2%	OA Efficiency (HHV)	70.6%

Run 1:

An attempt at a category II burn rate <1.00 kg/hr was performed on 12/13/16, resulting in a 1.03 kg/hr category II burn rate. The test duration was 5 hours 10 minutes. The fuel weight was 14.0 lbs. There was an average particulate emissions rate of 0.89 g/hr. The run had an overall efficiency of 74.5%. The A filter was changed at 1 hr. The 1-hour filter catch was 3.57g/hr. 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 additional attempt at a category II burn rate <1.00 kg/hr was performed on 12/14/16, resulting in a 1.01 kg/hr category II burn rate. The test duration was 5 hours 10 minutes. The fuel weight was 13.8 lbs. There was an average particulate emissions rate of 1.38 g/hr. The run had an overall efficiency of 72.9%. The A filter was changed at 1 hr. The 1-hour filter catch was 6.5 g/hr. All test results were appropriate and valid. The burn rate category was achieved. There were no anomalies and all criteria were met.

Run 3:

Run 3 was a category III burn rate performed on 12/14/16. The test duration was 3 hours 10 minutes. The fuel weight was 13.7 lbs. There was an average particulate emissions rate of 2.20 g/hr. The run had an overall efficiency of 72.2%. The A filter

was changed at 1 hr. The 1-hour filter catch was 5.91 g/hr. 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 a category IV burn rate performed on 12/15/16. The test duration was 2 hours 30 minutes. The fuel weight was 13.6 lbs. There was an average particulate emissions rate of 2.04 g/hr. The run had an overall efficiency of 70.6%. The A filter was changed at 1 hr. The 1-hour filter catch was 4.52 g/hr. 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, performed on 12/16/16 and resulting in 0.97 kg/hr, was a successful category II burn rate <1.00 kg/hr. The test duration was 5 hours 20 minutes. The fuel weight was 13.7 lbs. There was an average particulate emissions rate of 1.35 g/hr. The run had an overall efficiency of 72.2%. The A filter was changed at 1 hr. The 1-hour filter catch was 5.65 g/hr. All test results were appropriate and valid. The burn rate category was achieved. There were no anomalies and all criteria were met.

Run 6:

Run 6 was the fan confirmation run performed on 12/20/16. The test duration was 5 hours. The fuel weight was 13.6 lbs. There was an average particulate emissions rate of 2.16 g/hr. The one-hour filter catch was 10.74 g/hr. Per Method 28 & ASTM E2515-10 a category II run was performed with the fan in the off position. The emission rate resulting from this test run without the blower operating is equal to or less than the emissions rate plus 1.0 g/h for the test run in the medium burn rate category with the blower operating. Because of this, the wood heater is considered to have the same average emissions rate with or without the blower operating. Additional test runs without the blower operating are unnecessary. Results from Run 6 are not included in the calculation of results.

One Hour Particulate Data:

Run Number	Total Estimated PM Emissions at 1 hour
1	3.57
2	6.5
3	5.91
4	4.52
5	5.65
6*	10.74

*-Fan confirmation

Precision Statement:

Dual Train Comparison (ASTM E2515 11.7 - If either criterion (7.5% of average or 0.5 g/kg difference) is met, the run is valid.									
Run #	Train A % of avg.	Train B % of avg.	Max difference	<7.5% of average?	Or	Train A g/kg	Train B g/kg	Difference	<0.5 g/kg from each other?
1	100.1	99.9	0.1	✓					
2	104.5	95.5	4.5	✓					
3	99.9	100.1	0.1	✓					
4	99.0	101.0	1.0	✓					
5	100.3	99.7	0.3	✓					
6	104.7	95.3	4.7	✓					

Filter Catch & Negative Weights Statement:

Run 1:

Project #	034-S-74-1		MFG	Pacific Energy	
Run #	1		Model	TN20 (series B)	
Date	12/20/16				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2992	0.1187	0.1219	0.0032
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2993			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2997	0.2380	0.2387	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O Ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5766	3.5770	0.0011
					4.3 mg	

Train B	Front	Rear	Filter #	Tare	Final	Net
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2994			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2995	0.2383	0.2419	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O ring	3.5411	3.5416	0.0041
					4.1 mg	

Nozzle	#	TARE	FINAL	Net
	9A	116.7186	116.7186	0.0000

Nozzle	#	TARE	FINAL	Net
	9B	117.1380	117.1381	0.0001

Train A Total Catch	4.3
---------------------	-----

Train B Total Catch	4.2
---------------------	-----

Ambient <input type="checkbox"/>	Filter #	Tare	Final	Net	Vol (liter)
	2996	0.1186	0.1186	0.0000	1715.259
	O ring	1.6849	1.6850	0.0002	
Total				0.2 mg	

Notes:	Train A Total: 4.3mg	Train B Total: 4.2mg	Ambient Total: 0.2mg	1 Hour Catch: 3.2mg
--------	----------------------	----------------------	----------------------	---------------------

Run 2:

Project #	034-S-74-1		MFG	Pacific Energy	
Run #	2		Model	TN20 (series B)	
Date	12/20/16				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2998	0.1181	0.1240	0.0059
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2999			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3003	0.2358	0.2364	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O Ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5799	3.5804	0.0011
					7.0 mg	

Train B	Front	Rear	Filter #	Tare	Final	Net
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3000			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3001	0.2365	0.2425	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O ring	3.5164	3.5166	0.0062
					6.2 mg	

Nozzle	#	TARE	FINAL	Net
	11A	117.0372	117.0372	0.0000

Nozzle	#	TARE	FINAL	Net
	11B	116.6756	116.6757	0.0001

Train A Total Catch	7.0 mg
---------------------	--------

Train B Total Catch	6.3 mg
---------------------	--------

Ambient <input checked="" type="checkbox"/>	Filter #	Tare	Final	Net	Vol (liter)
	3002	0.1184	0.1186	0.0002	1726.447
	O ring	1.6564	1.6565	0.0001	
Total				0.3 mg	

Notes:	Train A Total: 7.0mg	Train B Total: 6.3mg	Ambient Total: 0.3mg	1 Hour Catch: 5.9mg
--------	----------------------	----------------------	----------------------	---------------------

Run 3:

Project #	034-S-74-1		MFG	Pacific Energy	
Run #	3		Model	TN20 (series B)	
Date	12/20/16				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3004	0.1181	0.1234	0.0053
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3005			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3009	0.2366	0.2367	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O Ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5745	3.5749	0.0005
						5.8 mg

Train B	Front	Rear	Filter #	Tare	Final	Net
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3006			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3007	0.2367	0.2420	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O ring	3.5597	3.5603	0.0059
						5.9 mg

Nozzle	#	TARE	FINAL	Net
	7A	116.7505	116.7510	0.0005
				0.5

Nozzle	#	TARE	FINAL	Net
	7B	117.3054	117.3057	0.0003
				0.3

Train A Total Catch	6.3 mg	Train B Total Catch	6.2 mg
---------------------	--------	---------------------	--------

Ambient <input checked="" type="checkbox"/>	Filter #	Tare	Final	Net	Vol (liter)
	3008	0.1189	0.1189	0.0000	1054.703
	O ring	1.6639	1.6639	0.0000	
	Total			0.0 mg	

Notes:	Train A Total: 6.3mg Train B Total: 6.2mg Ambient Total: 0.0mg 1 Hour Catch: 5.3mg				
--------	---	--	--	--	--

Run 4:

Project #	034-S-74-1		MFG	Pacific Energy	
Run #	4		Model	TN20 (series B)	
Date	12/20/16				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3010	0.1187	0.1228	0.0041
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3011			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3015	0.2362	0.2363	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O Ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5379	3.5384	0.0006
						4.7 mg

Train B	Front	Rear	Filter #	Tare	Final	Net
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3012			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3013	0.2388	0.2429	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	O ring			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O ring	3.5897	3.5900	0.0044
						4.4 mg

Nozzle	#	TARE	FINAL	Net
	8A	116.8311	116.8311	0.0000
				0.0

Nozzle	#	TARE	FINAL	Net
	8B	116.8259	116.8262	0.0003
				0.3

Train A Total Catch	4.7 mg	Train B Total Catch	4.7 mg
---------------------	--------	---------------------	--------

Ambient <input checked="" type="checkbox"/>	Filter #	Tare	Final	Net	Vol (liter)
	3014	0.1188	0.1188	0.0000	833.188
	O ring	1.6864	1.6865	0.0001	
	Total			0.0 mg	

Notes:	Train A Total: 4.7mg Train B Total: 4.7mg Ambient Total: 0.1mg 1 Hour Catch: 4.1mg				
--------	---	--	--	--	--

Run 5:

Project #	034-S-74-1					MFG	Pacific Energy								
Run #	5					Model	TN20 (series B)								
Date	12/20/16														
Train A	Front	Rear	Filter #	Tare	Final	Net	Train B	Front	Rear	Filter #	Tare	Final	Net		
First Hour	<input checked="" type="checkbox"/>		3016	0.1173	0.1224	0.0051		<input checked="" type="checkbox"/>	<input type="checkbox"/>	3018					
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3017					<input type="checkbox"/>	<input checked="" type="checkbox"/>	3019	0.2337	0.2395			
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3021	0.2347	0.2357			<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	3.5450	3.5454	0.0062		
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5390	3.5393	0.0013									
						6.4	mg						6.2	mg	
Nozzle							Nozzle								
#	TARE		FINAL	Net			#	TARE		FINAL	Net				
2A	116.2355		116.2355	0.0000		0.0	2B	116.3287		116.3287	0.0000		0.0		
Train A Total Catch						6.4	mg	Train B Total Catch						6.2	mg
Ambient	<input checked="" type="checkbox"/>	Filter #	Tare	Final	Net	Vol (liter)									
		3020	0.1164	0.1164	0.0000	1721.635									
		O ring	1.6834	1.6834	0.0000										
		Total			0.0	mg									
Notes:	Train A Total: 6.4mg Train B Total: 6.2mg Ambient Total: 0.0mg 1 Hour Catch: 5.1mg														

Run 6 – Fan Confirmation:

Project #	034-S-74-1		MFG	Pacific Energy	
Run #	6		Model	TN20 (series B)	
Date	12/22/16				

Train A	Front	Rear	Filter #	Tare	Final	Net	Train B	Front	Rear	Filter #	Tare	Final	Net
First Hour	<input checked="" type="checkbox"/>		3022	0.1171	0.1264	0.0093		<input checked="" type="checkbox"/>	<input type="checkbox"/>	3024			
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3023					<input type="checkbox"/>	<input checked="" type="checkbox"/>	3025	0.2350	0.2437	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3027	0.2361	0.2365			<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	3.5701	3.5706	0.0092
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O Ring	3.5809	3.5814	0.0009							
						10.2 mg							9.2 mg

Nozzle	#	TARE	FINAL	Net
	3A	116.0714	116.0714	0.0000
	3B	116.3383	116.3383	0.0000

Train A Total Catch	10.2	Train B Total Catch	9.2
---------------------	------	---------------------	-----

Ambient	Filter #	Tare	Final	Net	Vol (liter)
<input checked="" type="checkbox"/>	3026	0.1170	0.1172	0.0002	1565.189
	O ring	1.6737	1.6740	0.0003	
	Total			0.5 mg	

Notes:	Train A Total: 10.2mg	Train B Total: 9.2mg	Ambient Total: 0.5mg	1 Hour Catch: 9.3mg
--------	-----------------------	----------------------	----------------------	---------------------

There were no negative filter weights recorded.

Test Condition Summary:

All testing conditions for all runs fell within allowable specifications of EPA Method 28R, ASTM E2780-10 and ASTM E2515-10. 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	70	69	30.20	14.0	19.7	310
2	70	71	29.96	13.8	19.6	310
3	74	72	29.96	13.7	19.8	190
4	75	74	29.91	13.6	19.9	150
5	71	72	30.12	13.7	19.7	320
6	77	73	30.30	13.6	19.7	300

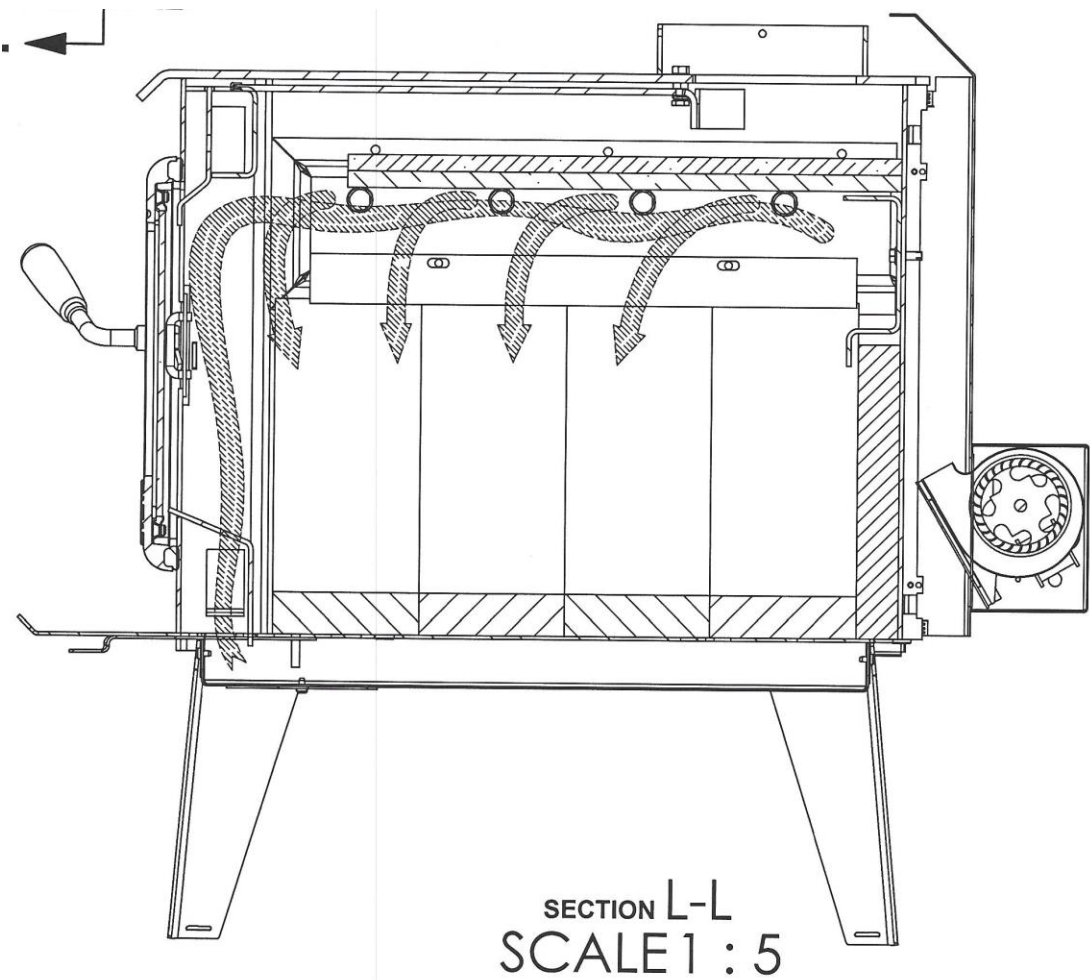
Heater Specifications:

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
11.469"	15.25"	18.094"	1.996 ft ³	255 lbs

Air Flow Schematic



Firebox Volume:

DESCRIPTION:	USEABLE FIREBOX VOLUME	MODEL:	TN20
		SERIES:	B
		DRAWING #	TN20 #9

VOLUME: DEPTH X WIDTH X HEIGHT

VOLUME 1: $17\frac{27}{32} \times 15\frac{1}{4} \times 11\frac{15}{32} = 3120.844\text{ IN}^3$

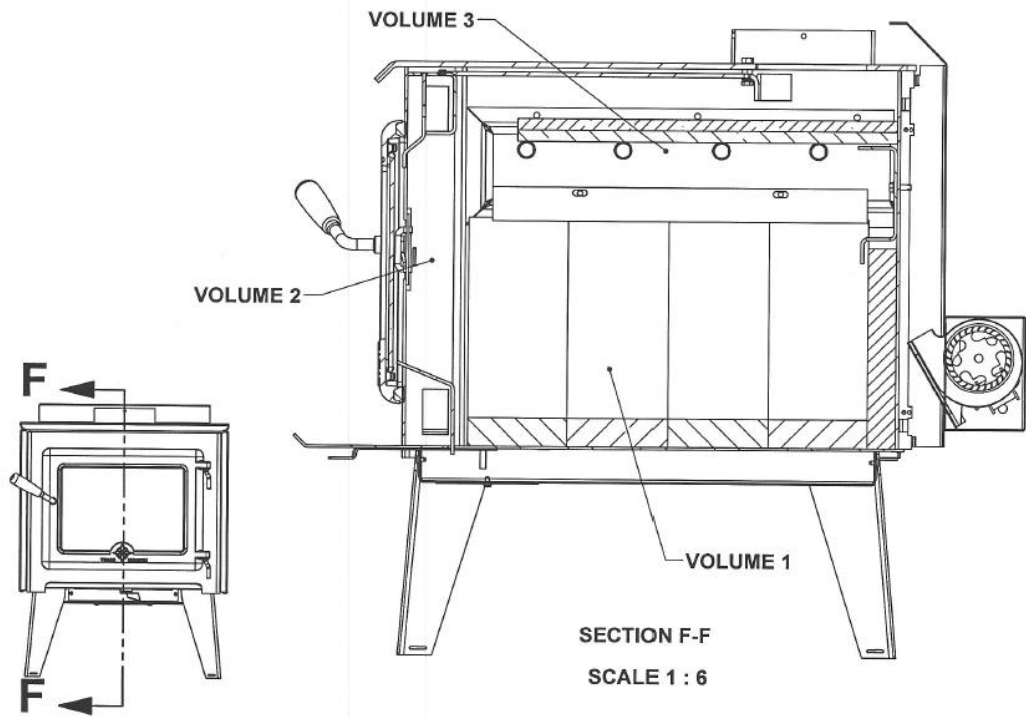
VOLUME 2: $2\frac{5}{16} \times 14\frac{3}{32} \times 8\frac{17}{32} = 278.049\text{ IN}^3$

VOLUME 3: $4\frac{1}{4} \times 15\frac{1}{4} \times \frac{25}{32} = 0.029\text{ IN}^3$

USEABLE FIREBOX VOLUME= VOLUME 1 + VOLUME 2 + VOLUME 3

USEABLE FIREBOX VOLUME = $3210.844 + 278.049 + 0.029 = 3449.528\text{ IN}^3$

USEABLE FIREBOX VOLUME = 1.996 FT^3



Front



Left



Right



Rear



Process Operations and Description:

The appliance was operated according to procedures as described in the Operations Manual. Detailed run instructions were provided to the lab and are consistent with the general instructions in the Operations Manual. 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 0.212". Start at 1054	Category II. Test start: 1155 – Door open 1 minute 30 seconds, Primary fully open. At 5 mins Primary air set to 0.212", fan off. Fan set to high at 1215. Front Filter change at 1255. END test: 1705 – Run time 5 hours, 10 minutes.
Run 2	Primary set to 0.165". Start at 1249	Category II. Test start: 1350 – Door open 2 minutes, Primary fully open. At 5 mins Primary air set to 0.165", fan off. Fan set to high at 1410. Front Filter change at 1450. END test: 1900 – Run time 5 hours, 10 minutes.
Run 3	Primary set to 0.720". Start at 2037	Category III: Test start: 2138 – Door open 1 minute 30 seconds, Primary fully open. At 5 mins Primary set to 0.0720", fan off. Fan set to high at 2158. Front filter change at 2238. END Test: 0048 – Run time 3 hours 10 mins.
Run 4	Primary fully open. Start at 0309	Category IV: Test start: 0415. Door Open 1 minute 30 seconds, Primary air fully open and left open. Fan on high. Front filter changed at 0515. END test: 0645 – Run Time: 2 hours 30 minutes.
Run 5	Primary set to 0.125". Start at 1348	Category II (average below 1.00 kg/hr): Test start: 1450 – Door open 1 minute 30 seconds, At 5 mins primary set to 0.125", fan off. Fan set to high at 1510. Front filter changed at 1550. END test: 2030 – Run time 5 hours 20 minutes.
Run 6	Primary set to 0.125". Start at 1230	Fan Confirmation – Fan OFF. Category II: Test start: 1341. Door open 1 minute 30 seconds, Primary open for 5 minutes, fan off. Fan remained off for entire test. Changed front filter at 1441. END test: 1841 – Run time: 5 hours.

Test Fuel Properties:



Fuel consisted of 2"x4"x18.25" and 4"x4"x18.25" Green, Douglas fir. Detailed fuel load specifications for each run can be found in the corresponding digital folders submitted with this report.

Fuel Load Run Pictures:



Run 1



Run 2



Run 3



Run 4



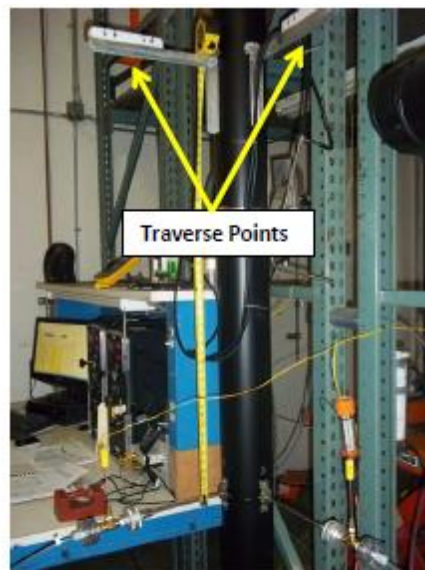
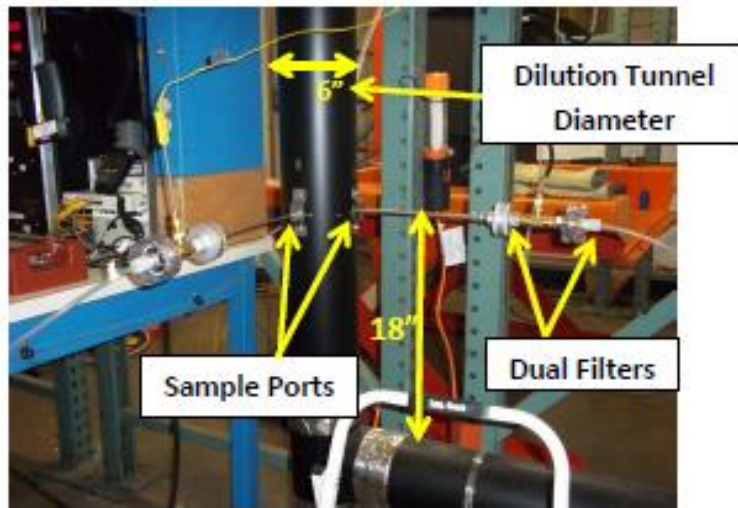
Run 5

Detailed fuel data for all runs in appendix.

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: 2975 Allenby Road, Duncan, BC, Canada, V9L 6V8.

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 # _____



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 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, Gary Nelke, CMfgE

Analysis and Report Writing

The following people were involved with analysis and report writing:

- Ben Nelke, Gary Nelke, CMfgE, Doug Towne

Observers:

The following people were observers during testing:

- Ken Davis

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**

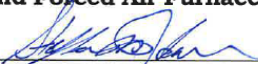
This certifies that:



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
METHODS

4
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.



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.

A handwritten signature in black ink, reading "Peter M. Meyer", is positioned above the title of the President & CEO.

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