
Pacific Energy

Project # 034-S-071-1 (PFS 22-802)

Model: True North 10

Type: Free Standing Residential
Non-catalytic Wood Fired Heater

October 28, 2016

Revised: June 24, 2022, November
15, 2022

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

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Revisions:

Original report date of October 28, 2016 by Dirigo Laboratories.

Revision1: June 24, 2022

- Average CO emissions in g/min were added to the summary section on page 8.
- Update Summary Table for clarity. Pg 8
- Added a note to the Settings and Run Notes table, clarifying the air setting used for the Low Burn Rate, see page 24.
- Added a drawing of the firebox volume to the report on page 19.
- Added train precision table to page 14.
- Added fuel loading density information to Test Conditions table on Page 18.
- Added revised Owner's Manual to include visible emissions statement
- Added revised label to include test method used.
- Added reference to Method 28 use of 2 category II runs in lieu of a Category 1 per Section 8.1.1.3.2 Note in Method 28. Pg. 13
- Added statement that no negative catch weights recorded. Pg. 17

Revision 2: November 15, 2022

- Added CO in g/hr to summary table on page 12
- Added burn rate clarification statement regarding fuel load & spacer weight. Page 17
- Noted that all conditioning data provided by manufacturer indicated that a medium burn setting was used. Page 5

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Affidavit:

Dirigo Laboratories, Inc. was contracted by Pacific Energy Fireplace Products Ltd. to provide testing services for the True North 10 free standing 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 10/13/2016 and ending on 10/16/2016. 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.

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Date: 2016.11.22 16:08:13 -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 on their Model True North 10 free standing 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 by the manufacturer prior to the test series. The manufacturer provided conditioning data indicates that all conditioning occurred at a medium setting.
- Prior to testing, the dilution tunnel was cleaned with a steel brush.
- At the completion of Run #1 it was determined that the minimum stop setting determining the minimum burn rate was incorrect. The minimum stop setting was set to the correct setting per the manufacturers' requirement and the test was performed again. No results from Run #1 were used in the calculation of results.
- Run #'s 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: ***True North 10***
- Serial Number: ***00001***
- Manufacturer: ***Pacific Energy Fireplace Products Ltd.***
- Catalyst: ***No***
- Heat exchange blower: ***Optional***
- Type: ***Wood Stove***
- Style: ***Free Standing***
- Date Received: ***Wednesday, October 12, 2016***
- Wood Heater Aging: ***August 24 - September 14, 2016***
- Testing Period – Start: ***Thursday, October 13, 2016*** Finish: ***Sunday, October 16, 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

The weighted average emission rate is **1.4 g/hr** with a weighted average efficiency of **72.6%**. CO emissions were calculated to be **0.76 g/min**. The Pacific Energy Fireplace Products Ltd. Model True North 10 non-catalytic wood heater meets the 2020 PM emission standard of ≤ 2.0 g/hr per CFR 40 part 60, §60.532 (b).

Emissions:

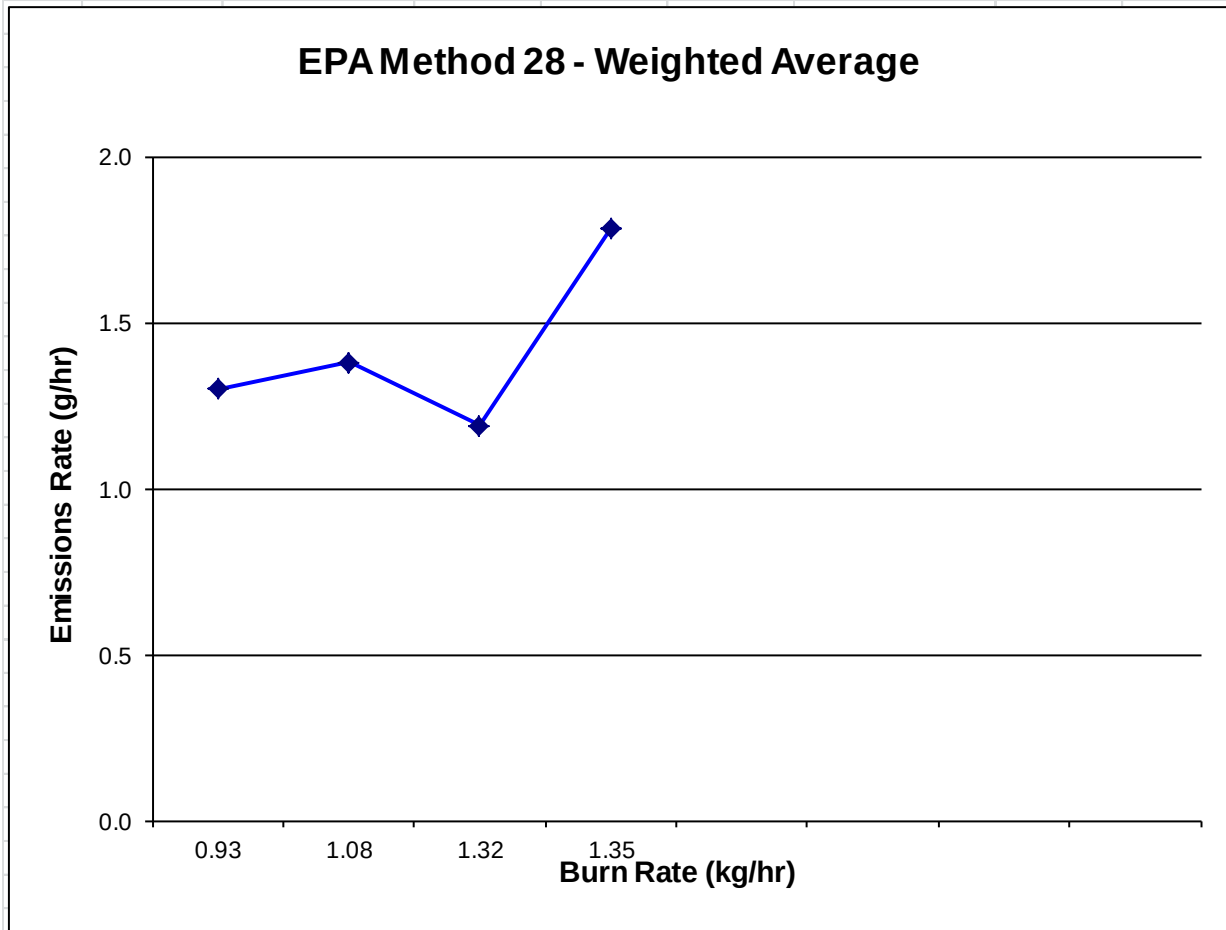


DIRIGO
LABORATORIES INC.



EPA Method 28 - Weighted Average

Client:	Pacific Energy
Model:	True North 10
Tracking No.:	71
Project No.:	034-S-071-1
Test Dates:	10/13/16 - 10/16/16



All efficiency values use the HHV.



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CSA B415.1-10 Weighted Average

Weighted Average: 72.6 %

Client:	Pacific Energy
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Model:	TN10
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Tracking No.:	71
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Project No.:	034-S-071-1
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Test Dates:	10/13/16 - 10/16/16
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Burn Rate Category	2
Burn Rate (kg/hr-dry)	0.93
OA Efficiency %	74.8
Emissions Rate Cap (g/hr)	15
Weighting Factor	32.81%
Run Number	2

Burn Rate Category	2
Burn Rate (kg/hr-dry)	1.08
OA Efficiency %	74.7
Emissions Rate Cap (g/hr)	15
Weighting Factor	23.69%
Run Number	3

Burn Rate Category	3
Burn Rate (kg/hr-dry)	1.32
OA Efficiency %	70.3
Emissions Rate Cap (g/hr)	15
Weighting Factor	16.09%
Run Number	5

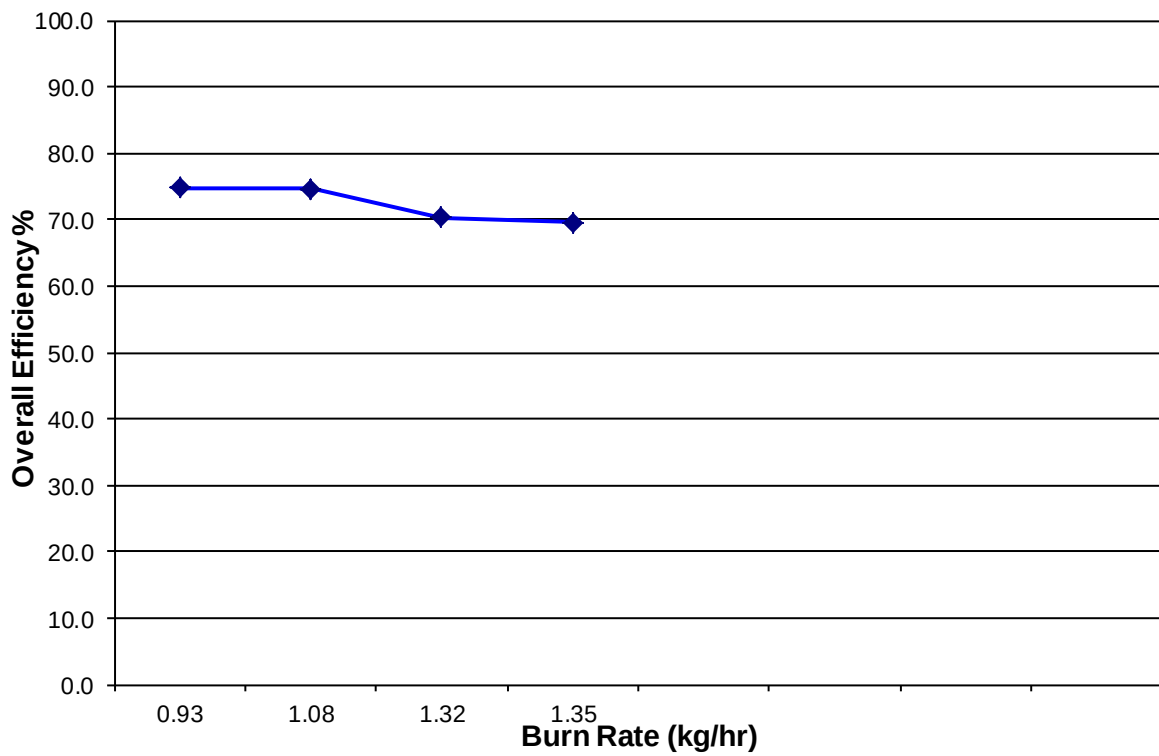
Burn Rate Category	3
Burn Rate (kg/hr-dry)	1.35
OA Efficiency %	69.5
Emissions Rate Cap (g/hr)	15
Weighting Factor	27.40%
Run Number	4



CSA B415.1-10 - Weighted Average

Client: Pacific Energy
Model: TN10
Tracking No.: 71
Project No.: 034-S-071-1
Test Dates: 10/13/16 - 10/16/16

EPA Method 28 - Weighted Average



Summary Table:

	<i>Run 2</i>	<i>Run 3</i>	<i>Run 4</i>	<i>Run 5</i>
Date	10/13/2016	10/14/2016	10/16/2016	10/16/2016
Run Number	2	3	4	5
Emission Rate (g/hr)	1.3	1.4	1.8	1.2
Burn Rate (kg/hr)	0.93	1.08	1.35	1.32
Heat Output (Btu/hr)	13,084	15,125	17,623	17,503
Overall Efficiency (% HHV)	74.8	74.7	69.5	70.3
CO Emissions (g/MJ Output)	2.82	2.64	2.51	3.0
CO Emissions (g/kg Dry Fuel)	41.83	39.06	34.55	41.84
CO Emissions (g/min)	0.65	0.70	0.77	0.92
Emissions Rate – First Hour (g/hr)	1.14	0.81	0.93	0.62
Particulate emission average of 4 test runs: 1.4 grams per hour.				
Weighted average HHV efficiency of 2 test runs: 72.6%.				
Average CO emissions of 4 test runs: 0.76 g/min (45.6 g/hr.)				

Run 1:

*- At the completion of Run #1 it was determined that the minimum stop setting determining the minimum burn rate was incorrect. The minimum stop setting was set to the correct setting per the manufacturers' requirement and the test was performed again. Run 1 was not used in the calculation of results. Detailed run data can be found in the electronic folder submitted with this report.

Run 2:

Run 2 was a category II burn rate performed on 10/13/16. The test duration was 2 hours 10 minutes. The fuel weight was 5.3 lbs. There was an average particulate emissions rate of 1.3 g/hr. The run had an overall efficiency of 74.8%. The A filter was changed at 1 hr. The 1-hour filter catch was 1.14 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 II burn rate performed on 10/14/16. The test duration was 1 hour 50 minutes. The fuel weight was 5.2 lbs. There was an average particulate emissions rate of 0.81 g/hr. The run had an overall efficiency of 74.7%. The A filter was changed

at 1 hr. The 1-hour filter catch was 1.8 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 a category IV burn rate performed on 10/14/16. The test duration was 1 hour 30 minutes. The fuel weight was 5.4 lbs. There was an average particulate emissions rate of 1.8 g/hr. The run had an overall efficiency of 69.5%. The A filter was changed at 1 hr. The 1-hour filter catch was 0.93 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 was a category III burn rate performed on 10/16/16. The test duration was 1 hour 30 minutes. The fuel weight was 5.3 lbs. There was an average particulate emissions rate of 1.2 g/hr. The run had an overall efficiency of 70.3%. The A filter was changed at 1 hr. The 1-hour filter catch was 0.62 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 10/16/16. The test duration was 2 hours. The fuel weight was 5.3 lbs. There was an average particulate emissions rate of 1.97 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.

Note:

Per Method 28 section 8.1.1.3.2 Note, in-lieu of a Category 1 run, a total of 2 category II runs were performed with Run 1 being between 0.80 kg/hr and 1.0kg/hr per the method.

Precision:

Dual Train Comparison (ASTM E2515 11.7 - If <u>either</u> 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?
2	102.7	97.3	2.7	✓		1.429	1.356	0.073	✓
3	105.0	95.0	5	✓		1.342	1.214	0.128	✓
4	98.8	101.2	1.2	✓		1.303	1.335	0.032	✓
5	98.8	101.2	1.2	✓		0.885	0.907	0.022	✓
6	100.4	99.6	0.4	✓		1.98	1.964	0.016	✓

Precision criteria was met for all runs.

Filter Catch:

Run 2:

Project #	034-S-071-1		MFG	Pacific Energy	
Run #	2		Model	True North 10	
Date	10/18/16				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	☒	☐	2920	0.1202	0.1226	0.0024
	☐	☒	2921			
	☒	☐	2925	0.2373	0.2374	
	☒	☐	O Ring			0.0007
	☐	☒	O Ring	3.5942	3.5948	
						3.1 mg

Train B	Front	Rear	Filter #	Tare	Final	Net
	☒	☐	2922			
	☐	☒	2923	0.2360	0.2383	
	☒	☐	O ring			0.0028
	☐	☒	O ring	3.5480	3.5485	
						2.8 mg

Nozzle	#	TARE	FINAL	Net
8A	116.8307	116.8308	0.0001	0.1

Nozzle	#	TARE	FINAL	Net
8B	116.8260	116.8262	0.0002	0.2

Train A Total Catch	3.2
---------------------	-----

Train B Total Catch	3.0
---------------------	-----

Ambient ☒	Filter #	Tare	Final	Net	Vol (liter)
	2924	0.1196	0.1198	0.0002	720.147
	O ring	1.6749	1.6753	0.0004	
	Total			0.0006	mg

Notes:	Train A Total: 3.2mg	Train B Total: 3.0mg	Ambient Total: 0.6mg	1 Hour Catch: 2.4mg
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Run 3:

Project #	034-S-071-1		MFG	Pacific Energy	
Run #	3		Model	True North 10	
Date	10/18/16				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	☒	☐	2926	0.1201	0.1219	0.0018
	☐	☒	2927			
	☒	☐	2931	0.2376	0.2376	
	☒	☐	O Ring			0.0010
	☐	☒	O Ring	3.5215	3.5225	
						2.8 mg

Train B	Front	Rear	Filter #	Tare	Final	Net
	☒	☐	2928			
	☐	☒	2929	0.2382	0.2402	
	☒	☐	O ring			0.0027
	☐	☒	O ring	3.5620	3.5627	
						2.7 mg

Nozzle	#	TARE	FINAL	Net
9A	116.7192	116.7194	0.0002	0.2

Nozzle	#	TARE	FINAL	Net
9B	117.1368	117.1368	0	0

Train A Total Catch	3.0
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Train B Total Catch	2.7
---------------------	-----

Ambient ☒	Filter #	Tare	Final	Net	Vol (liter)
	2930	0.1198	0.1200	0.0002	607.262
	O ring	1.6522	1.6527	0.0005	
	Total			0.0007	mg

Notes:	Train A Total: 3.0mg	Train B Total: 2.7mg	Ambient Total: 0.7mg	1 Hour Catch: 1.8mg
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Run 4:

Project #	034-S-071-1					MFG	Pacific Energy				
Run #	4					Model	True North 10				
Date	10/18/16										

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	☒		2932	0.1191	0.1212	0.0021
	☐	☒	2933			
	☒	☐	2937	0.2388	0.2389	
	☒	☐	O Ring			
	☐	☒	O Ring	3.5494	3.5500	0.0007
					2.8	mg

Train B	Front	Rear	Filter #	Tare	Final	Net
First Hour	☒	☐	2934			
	☐	☒	2935	0.2391	0.2413	
	☒	☐	O ring			
	☐	☒	O ring	3.5659	3.5666	0.0029
						2.9

Nozzle	#	TARE	FINAL	Net
10A	116.8284	116.8286	0.0002	0.2

Nozzle	#	TARE	FINAL	Net
10B	117.1705	117.1706	0.0001	0.1

Train A Total Catch	3.0
---------------------	-----

Train B Total Catch	3.0
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Ambient ☒	Filter #	Tare	Final	Net	Vol (liter)
	2936	0.1200	0.1202	0.0002	494.708
	O ring	1.6460	1.6465	0.0005	
	Total			0.0007	mg

Notes:	Train A Total: 3.0mg Train B Total: 3.0mg Ambient Total: 0.7mg 1 Hour Catch: 2.1mg				
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Run 5:

Project #	034-S-071-1					MFG	Pacific Energy				
Run #	5					Model	True North 10				
Date	10/19/16										

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	☒		2938	0.1194	0.1208	0.0014
	☐	☒	2939			
	☒	☐	2943	0.2364	0.2365	
	☒	☐	O Ring			
	☐	☒	O Ring	3.5835	3.5840	0.0006
					2.0	mg

Train B	Front	Rear	Filter #	Tare	Final	Net
First Hour	☒	☐	2940			
	☐	☒	2941	0.2388	0.2405	
	☒	☐	O ring			
	☐	☒	O ring	3.5484	3.5487	0.0020
						2.0

Nozzle	#	TARE	FINAL	Net
11A	117.0375	117.0375	0	0

Nozzle	#	TARE	FINAL	Net
11B	116.6761	116.6761	0	0

Train A Total Catch	2.0
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Train B Total Catch	2.0
---------------------	-----

Ambient ☒	Filter #	Tare	Final	Net	Vol (liter)
	2942	0.1188	0.1190	0.0002	493.225
	O ring	1.6894	1.6896	0.0002	
	Total			0.0004	mg

Notes:	Train A Total: 2.0mg Train B Total: 2.0mg Ambient Total: 0.4mg 1 Hour Catch: 1.4mg				
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Run 6 – Fan Confirmation:

Project #	034-S-071-1		MFG	Pacific Energy	
Run #	6		Model	True North 10	
Date	10/19/16				

Train A	Front	Rear	Filter #	Tare	Final	Net
First Hour	☒		2944	0.1166	0.1199	0.0033
	☐	☒	2945			
	☒	☐	2949	0.2373	0.2376	
	☒	☐	O Ring			
	☐	☒	O Ring	3.5873	3.5875	0.0005
						3.8 mg

Train B	Front	Rear	Filter #	Tare	Final	Net
	☒	☐	2946			
	☐	☒	2947	0.2380	0.2415	
	☒	☐	O ring			
	☐	☒	O ring	3.5231	3.5233	0.0037
						3.7 mg

Nozzle	#	TARE	FINAL	Net
12A	116.8917	116.8917	0	0

Nozzle	#	TARE	FINAL	Net
12B	117.0548	117.0547	0	0

Train A Total Catch	3.8
---------------------	-----

Train B Total Catch	3.7
---------------------	-----

Ambient	Filter #	Tare	Final	Net	Vol (liter)
☒	2948	0.1209	0.1209	0	657.398
	O ring	1.6607	1.6607	0	
	Total			0 mg	

Notes:	Train A Total: 3.8mg	Train B Total: 3.7mg	Ambient Total: 0.0mg	1 Hour Catch: 3.3mg
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Catch Weight Discussion:

There were no negative weights recorded. All samples were appropriately handled.

Burn Rate Calculation Clarification:

All fuel load weights used in calculation of burn rates included spacers. Total fuel load weights on the fuel load calculation sheets on pages 86-91 reflect fuel loads with spacers.

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.)	Fuel Loading Density (lbs/ft ³)	Test Fuel Moisture (Dry Basis)	Run Time (Min.)
	Pre	Post					
2	73	73	29.60	5.3	6.54	19.3	130
3	74	74	29.58	5.2	6.42	19.4	110
4	74	75	29.58	5.4	6.66	21.0	90
5	75	75	29.47	5.3	6.54	21.0	90

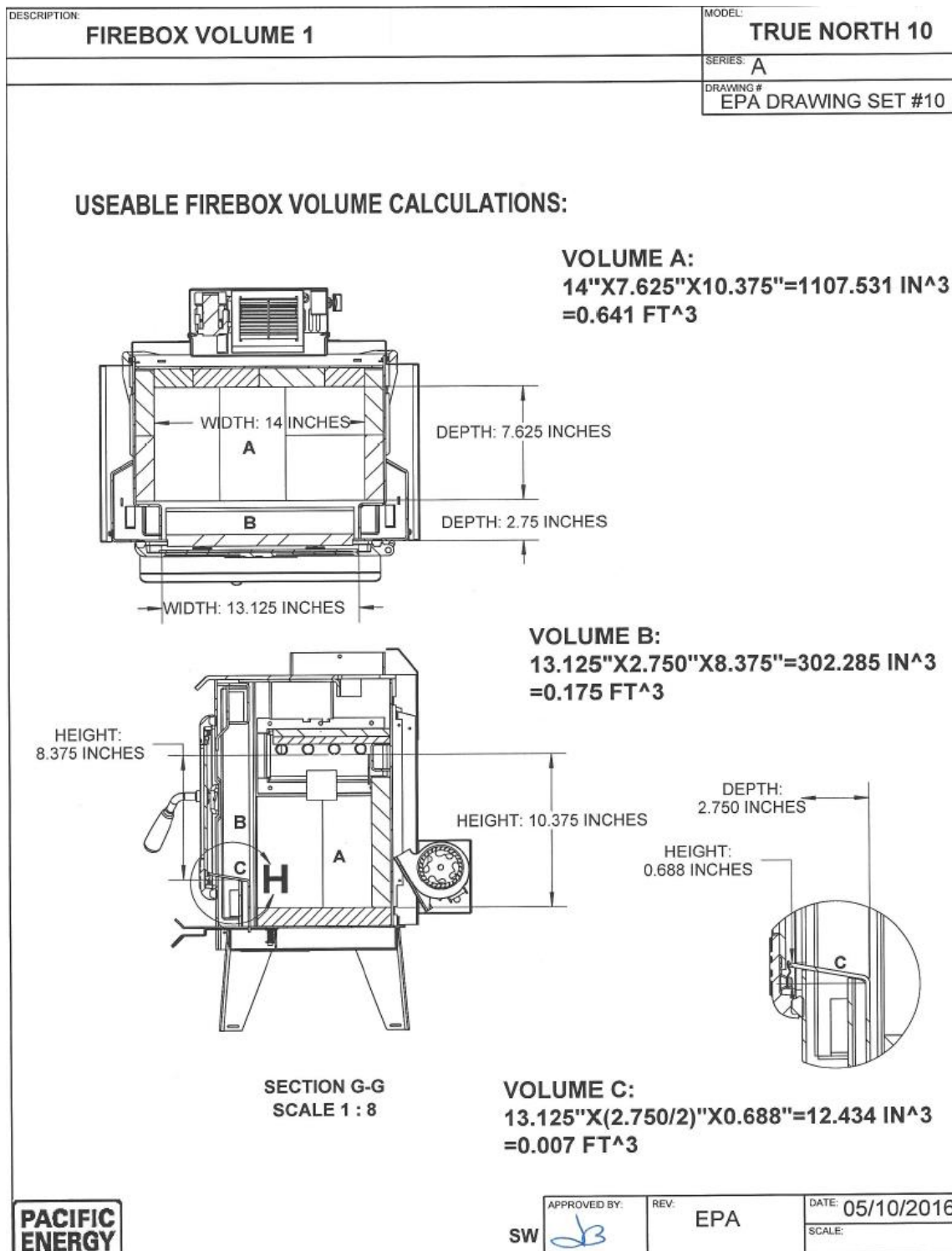
Heater Specifications:

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

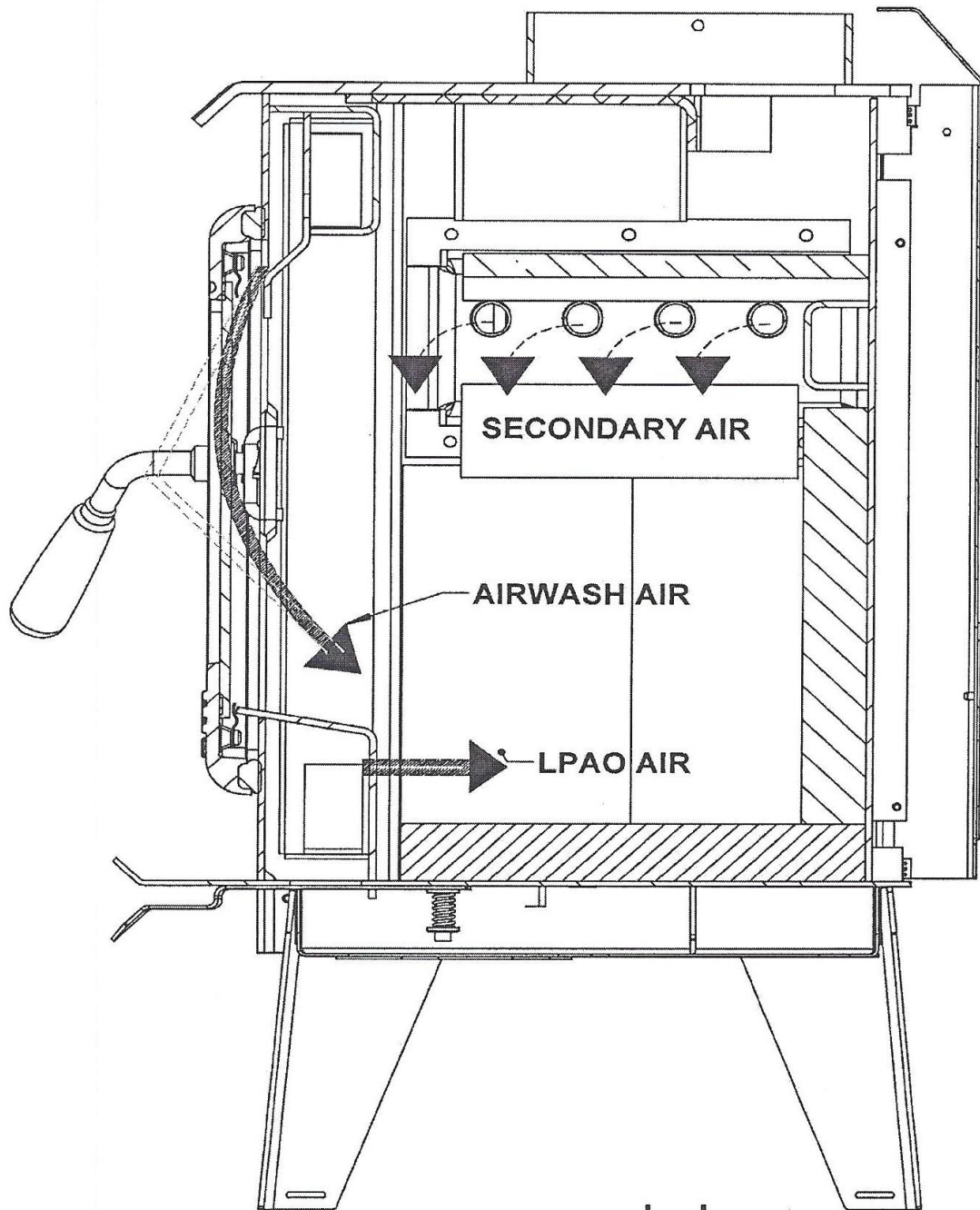
Heater Dimensions				
Height	Width	Depth	Firebox Volume	Weight
10.25" front 8.375" back	13.75"	10.25" upper 8.25" lower	0.81 ft ³	160.5 lbs

Firebox Volume:



0.81 Cu. Ft.

Air Flow Schematic



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. Detailed test operating instructions were provided to the laboratory and are included in the report.

Settings & Run Notes

	Run Notes	
	Pre-Burn	Test Run
Run 2	Primary fully closed. Start at 1651	Category II (average below 1.00 kg/hr). Test start: 1752 - Door open 1 minute 45 seconds, Primary fully open. At 5 mins Primary air set to fully closed, fan off. Fan set to low at 1802. Front Filter change at 1852. END test: 2002 – Run time 2 hours, 10 minutes.
Run 3	Primary set to $\frac{9}{16}$ ". Start at 1039	Category II: Test start: 1140 – Door open 1 minute 30 seconds, Primary fully open. At 5 mins Primary set to $\frac{9}{16}$ ", fan off. Fan set to low at 1150. Front filter change at 1240. END Test: 1330 - Run time 1 hour 50 mins.
Run 4	Primary fully open. Start at 1400	Category IV: Test start: 1651. Door Open 1 minute, Primary air fully open and left open. Fan on high. Front filter changed at 1751. Run Time: 1 hour 30 minutes.
Run 5	Primary fully open. Start at 1020	Category III: Test start: 1316 - Door open 1 minute, Primary fully open and left open. Fan on high. Front filter changed at 1416. END test: 1446 - Run time 1 hour 30 minutes.
Run 6	Primary fully closed. Start at 1654	Fan Confirmation - Fan OFF. Category II: Test start: 1755. Door open 1 minute 30 seconds, Primary fully open, fan off. At 5 mins Primary air set to fully closed. Fan remained off for entire test. Changed front filter at 1855. END test: 1955 - Run time: 2 hours.

*Testing was performed on a prototype model with a wider air setting range than is available on production models. Production models utilized fixed openings with the same overall air inlet area as that used in testing. This test data represents use of the lowest possible burn setting available to consumers, see drawings appendix for further detail.

Test Fuel Properties:

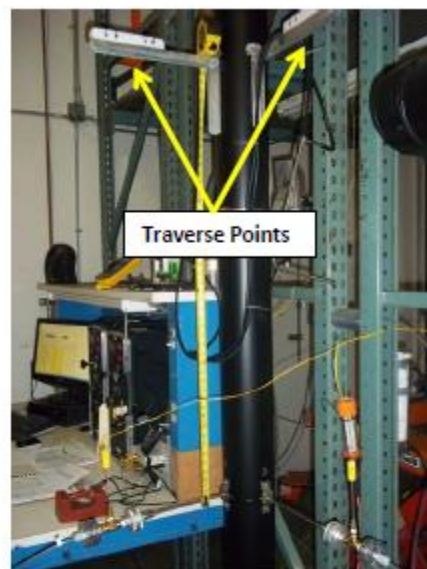
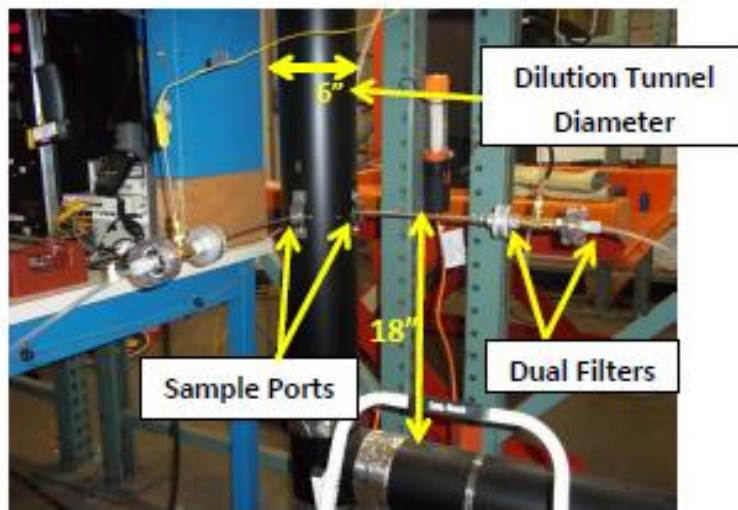


Fuel consisted of 2"x4"x11⁵/₈" Green, Douglas fir. Detailed fuel load specifications for each run can be found in the corresponding digital folders submitted with this report.

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 # _____

Sealed Unit





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.

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

Appliance Updates

No updates to the appliance were made.

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.

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.



Peter M. Hays

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

List of Appendices:

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

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

Appendix B – Labels and Manuals

Appendix C –Equipment Calibration Records

Appendix D – Design Drawings (CBI Report Only)

Appendix E – Manufacturer QAP (CBI Report Only)

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

VERSION: 2.4

4/15/2010

Manufacturer: Pacific Energy

Model: True North 10

Date: 10/18/2016

Run: 1

Control #: 034-S-071-1

Test Duration: 130

Burn Category 2

Wood Moisture (% DRY): 20.1

Wood Moisture (% wet): 16.74

Load Weight (lb wet): 5.30

Burn Rate (dry kg/h): 0.92

Total Particulate Emissions: 5.81 g

Appliance Type: Non-Cat (Cat, Non-Cat, Pellet)

Temp. Units: F (F or C)

Weight Units: lb (kg or lb)

Fuel Data

D. Fir

HHV 19,810 kJ/kg

%C 48.73

%H 6.87

%O 43.90

%Ash 0.50

☒ Douglas☐ Oak

Averages

266.4

73.0

14.44

5.91

0.66

Temp. (F)

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Temp. (F)	Room Temp	Flue Gas Composition (%)		
				O2	CO2	CO
0	5.3	207.0	73.0	18.51	1.86	0.61
10	4.7	298.0	72.0	13.09	7.67	0.30
20	3.8	332.0	73.0	12.63	8.31	0.43
30	2.8	403.0	73.0	9.50	11.60	0.22
40	1.8	415.0	73.0	9.35	11.74	0.25
50	1.0	375.0	73.0	12.00	8.60	0.04
60	0.8	266.0	73.0	16.00	3.94	0.82
70	0.7	232.0	74.0	15.69	4.32	0.84
80	0.6	217.0	73.0	15.64	4.41	0.90
90	0.5	208.0	73.0	15.55	4.50	0.85
100	0.4	201.0	73.0	15.72	4.29	1.00
110	0.2	197.0	73.0	15.94	4.06	0.96
120	0.1	192.0	73.0	16.17	3.76	1.07
130	0.0	187.0	73.0	16.38	3.64	0.89

Test Duration: 130 min

[illegible]

%HC
1.32

Moisture of Wood (wet basis):
Initial Dry Weight Wtdo (kg):
Moisture Content Dry

Btu/lb

[illegible]

Moisture Content MCwb: 16.74

16.74 Dry kg : 2.00
2.00 CA: 48.73
20.10 HY: 6.87
 OX: 43.90

HHV LHV
8522.48 7885.21

34.97	111.10	5.25	0.59	571.49	33.35	11.17	403.39	4292.59	3225.03	3134.77	3100.30	4144.21	3750.83	295.93	2189.70
Moles per kg of Dry Wood						Moisture Present	Stack Temp K	Heat Content Change - Ambient to Stack Temperature Flue Gas Constituent						Room Temp K	CO2
CO2	O2	CO	HC	N2	H2O			CO2	O2	CO	N2	CH4	H2O		
30.02	300.36	9.84	0.95	1273.57	32.62	11.17	370.37	2918.32	2216.98	2160.95	2135.93	2763.93	2587.54	295.93	87.60
39.16	64.30	1.53	0.12	405.58	34.28	11.17	420.93	5012.98	3767.34	3662.16	3621.84	4837.33	4381.95	295.37	196.31
38.61	55.00	2.00	0.20	369.03	34.12	11.17	439.82	5785.53	4330.03	4204.73	4159.37	5622.00	5029.76	295.93	223.39
39.99	29.13	0.76	0.06	274.87	34.40	11.17	479.26	7476.38	5549.56	5377.63	5322.00	7365.65	6429.19	295.93	298.98
39.88	28.14	0.85	0.08	270.86	34.37	11.17	485.93	7766.61	5757.07	5576.73	5519.45	7668.96	6666.58	295.93	309.77
40.69	55.58	0.19	-0.06	376.62	34.65	11.17	463.71	6804.17	5066.95	4914.04	4862.34	6667.61	5876.24	295.93	276.83
33.13	136.86	6.90	0.78	664.02	32.95	11.17	403.15	4254.22	3208.93	3122.25	3087.26	4079.29	3736.84	295.93	140.95
33.54	123.12	6.52	0.75	613.17	33.02	11.17	384.26	3459.39	2619.76	2551.53	2522.41	3294.46	3054.59	296.48	116.02
33.23	118.53	6.78	0.80	595.02	32.93	11.17	375.93	3142.55	2384.43	2323.46	2296.70	2982.64	2781.90	295.93	104.43
33.71	117.31	6.37	0.74	591.65	33.04	11.17	370.93	2940.71	2233.71	2177.19	2151.99	2785.72	2606.97	295.93	99.12
32.36	119.19	7.54	0.91	595.24	32.71	11.17	367.04	2784.21	2116.65	2063.52	2039.55	2633.53	2471.00	295.93	90.10
32.27	127.73	7.63	0.91	627.29	32.71	11.17	364.82	2694.99	2049.81	1998.61	1975.34	2546.95	2393.35	295.93	86.98
30.94	134.34	8.80	1.07	648.79	32.39	11.17	362.04	2583.66	1966.33	1917.51	1895.12	2439.11	2296.32	295.93	79.94
32.06	145.84	7.84	0.91	695.14	32.71	11.17	359.26	2472.55	1882.92	1836.45	1814.95	2331.70	2199.33	295.93	79.28

SUMS						AVERAGE	SUMS						
4110.90	20990.49	21694.02	7341.30	22295.33	7460.26	6148.72	10188	1714	8473.63	29851	1714	128.14	7.53
Energy Losses (kJ/kg of Dry Fuel)						Total Loss Rate							
Flue Gas Constituent							Total Loss	Chemical Loss 1	Sensible and Latent Loss	Total Output	Chem Loss 2	Grams Produced	
O2	CO	N2	CH4	H2O Comb	H2O Fuel MC							CO	HC
665.89	2806.85	2720.26	849.82	1518.63	519.89	9168.93	0	0	0.00	0	0	0.00	0.00
242.24	439.07	1468.94	107.24	1657.61	539.92	4651.35	1845	214	1630.82	6013	214	17.01	0.76
238.17	573.81	1534.92	181.62	1671.70	547.16	4970.76	1784	268	1516.29	5326	268	20.08	1.16
161.65	218.71	1462.84	57.16	1733.46	562.78	4495.59	1698	103	1595.87	5786	103	8.02	0.38
162.01	245.09	1494.98	70.51	1740.12	565.44	4587.91	1560	105	1454.43	5176	105	8.09	0.43
281.65	54.48	1831.27	-55.46	1726.95	556.61	4672.32	883	0	882.85	2859	0	1.00	-0.19
439.19	1972.90	2050.01	701.93	1572.04	532.72	7409.74	420	150	269.72	703	150	10.94	0.71
322.56	1862.14	1546.67	672.34	1552.60	525.10	6597.43	249	95	154.21	499	95	6.90	0.45
282.63	1935.05	1366.59	712.65	1539.36	522.06	6462.76	244	99	144.81	504	99	7.17	0.48
262.04	1815.61	1273.22	660.18	1539.05	520.10	6169.32	233	93	140.14	515	93	6.73	0.45
252.29	2150.29	1214.03	810.50	1518.91	518.58	6554.71	371	167	204.68	751	167	11.97	0.82
261.83	2174.86	1239.11	809.59	1516.46	517.72	6606.56	374	168	206.25	748	168	12.11	0.82
264.16	2508.58	1229.54	952.69	1498.44	516.63	7049.98	400	195	204.47	723	195	13.97	0.97
274.60	2233.03	1261.65	810.54	1509.99	515.55	6684.65	126	57	69.09	248	57	4.15	0.27

Dirigo Laboratories, Inc.

Manufacturer: Pacific Energy
Model: True North 10
Date: 10/18/2016
Run: 1
Control #: 034-S-071-1
Test Duration: 130
Output Category: 2

	HHV Basis	LHV Basis
Overall Efficiency	74.3%	80.3%
Combustion Efficiency	95.7%	95.7%
Heat Transfer Efficiency	77.7%	83.9%

HHV Output Rate (kJ/h)	13,605	12,906	(Btu/h)
Burn Rate (kg/h)	0.92	2.04	(lb/h)
Input (kJ/h)	18,307	17,366	(Btu/h)

Test Load Weight (dry kg)	2.0	4.4	dry lb
MC wet (%)	16.74		
MC dry (%)	20.10		
Particulate (g)	5.81		
CO (g)	128		
Test Duration (h)	2.166666667		

Emissions	Particulate	CO
g/MJ Output	0.20	4.35
g/kg Dry Fuel	2.90	64.00
g/h	2.68	59.14
lb/MM Btu Output	0.46	10.10

Air/Fuel Ratio (A/F)	15.40
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Test Results in Accordance with CSA B415.1-10

VERSION: 2.4

4/15/2010

Manufacturer: Pacific Energy

Model: True North 10

Date: 10/18/2016

Run: 2

Control #: 034-S-071-1

Test Duration: 130

Burn Category 2

Wood Moisture (% DRY): 19.3

Wood Moisture (% wet): 16.18

Load Weight (lb wet): 5.30

Burn Rate (dry kg/h): 0.93

Total Particulate Emissions: 2.81 g

Appliance Type: Non-Cat (Cat, Non-Cat, Pellet)

Temp. Units: F (F or C)

Weight Units: lb (kg or lb)

Fuel Data

D. Fir

HHV 19,810 kJ/kg

%C 48.73

%H 6.87

%O 43.90

%Ash 0.50

☒ Douglas☐ Oak

Averages

277.9

73.0

14.53

5.70

0.52

Temp. (F)

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Temp.	Room Temp	Flue Gas Composition (%)		
				O2	CO2	CO
0	5.3	219.0	73.0	18.25	1.90	0.56
10	4.6	319.0	73.0	13.17	7.61	0.12
20	3.7	361.0	73.0	12.36	8.52	0.08
30	2.7	409.0	73.0	10.28	10.61	0.13
40	1.8	419.0	73.0	10.04	10.77	0.07
50	1.0	382.0	73.0	11.17	9.36	0.06
60	0.7	296.0	73.0	15.26	4.77	0.46
70	0.6	254.0	73.0	15.53	4.48	0.57
80	0.5	233.0	73.0	15.48	4.49	0.73
90	0.4	215.0	73.0	16.23	3.58	0.91
100	0.3	204.0	73.0	16.39	3.35	1.06
110	0.2	196.0	73.0	16.27	3.58	0.88
120	0.1	192.0	73.0	16.51	3.30	0.98
130	0.0	191.0	73.0	16.47	3.42	0.72

Test Duration: 130 min

Heat Transfer Efficiency: 76.9%

Air

Averages	0.52	5.70	275.1%	20.53	14.57	136.6	22.8	91.0%	75.6%	68.9%	22.1
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[illegible]

Exhaust Gas (Nr):	563.71	%HC
Fuel Ratio (A/F)	16.12	1.32

Deg. C

Load Weight (kg):	2.40	
Fuel Heating:	HHV	LHV
Value in kJ/kg - CV:	19810.00	18328.69

[illegible]

Moisture Content MCwb: 16.18

Wood (wet basis): 16.18
Weight Wtdo (kg): 2.02
sture Content Dry 19.30

Dry kg : 2.02
CA: 48.73
HY: 6.87
OX: 43.90

HHV LHV
Btu/lb 8522.48 7885.21

0.15	35.57	120.03	4.74	0.50	606.77	33.53	10.72	409.74	4556.49	3418.77	3321.97	3285.68	4408.90
kg Wood per 100 mole dfp Nk	Moles per kg of Dry Wood						Moisture Present	Stack Temp K	Heat Content Change - Ambient to Stack Temperatu Flue Gas Constituent				
	CO2	O2	CO	HC	N2	H2O			CO2	O2	CO	N2	CH4
0.06	30.87	302.19	9.10	0.84	1282.72	32.84	10.72	377.04	3187.51	2417.95	2355.98	2328.88	3026.59
0.19	40.19	67.39	0.63	-0.02	419.96	34.55	10.72	432.59	5480.82	4108.25	3990.92	3947.54	5312.18
0.21	40.47	56.10	0.38	-0.03	378.02	34.59	10.72	455.93	6470.70	4826.46	4682.75	4633.08	6323.67
0.26	40.30	36.30	0.49	0.01	302.78	34.50	10.72	482.59	7621.33	5653.27	5477.15	5420.69	7517.00
0.27	40.57	35.48	0.26	-0.02	300.36	34.56	10.72	488.15	7863.64	5826.32	5643.15	5585.33	7770.62
0.23	40.59	47.39	0.26	-0.04	345.42	34.60	10.72	467.59	6971.57	5187.40	5029.81	4977.12	6840.85
0.13	36.93	120.72	3.56	0.32	612.93	33.87	10.72	419.82	4945.43	3717.02	3613.35	3573.55	4771.19
0.13	35.80	126.58	4.55	0.46	632.12	33.60	10.72	396.48	3979.98	3006.39	2926.24	2893.23	3806.88
0.13	34.57	121.18	5.62	0.62	608.52	33.27	10.72	384.82	3503.18	2652.92	2583.83	2554.34	3336.16
0.11	31.79	147.49	8.08	0.94	700.65	32.64	10.72	374.82	3097.63	2350.92	2290.94	2264.53	2938.76
0.11	30.13	150.83	9.53	1.15	708.95	32.23	10.72	368.71	2851.23	2166.80	2112.23	2087.73	2698.65
0.11	32.03	148.75	7.87	0.91	706.05	32.71	10.72	364.26	2672.70	2033.11	1982.39	1959.29	2525.35
0.11	30.64	156.61	9.10	1.07	732.11	32.37	10.72	362.04	2583.66	1966.33	1917.51	1895.12	2439.11
0.10	33.09	163.40	6.97	0.75	764.17	33.02	10.72	361.48	2561.42	1949.65	1901.29	1879.08	2417.59

		SUMS							AVERAGE			
3974.46	295.93	2369.83	4689.35	18953.32	24281.60	6231.88	22521.00	7196.90	6160.28	10047	1054	8993.32
re	Room Temp K	Energy Losses (kJ/kg of Dry Fuel) Flue Gas Constituent							Total Loss Rate			
		CO2	O2	CO	N2	CH4	H2O Comb	H2O Fuel MC		Total Loss	Chemical Loss 1	Sensible and Latent Loss
2820.80	295.93	98.41	730.68	2596.25	2987.31	750.47	1536.68	501.69	9201.48	0	0	0.00
4774.49	295.93	220.30	276.87	181.90	1657.80	-14.36	1684.32	522.64	4529.47	1981	72	1908.83
5600.29	295.93	261.85	270.78	109.31	1751.38	-31.27	1714.72	531.50	4608.28	1665	28	1637.35
6547.85	295.93	307.18	205.22	142.46	1641.27	12.19	1742.60	541.66	4592.57	1659	55	1604.45
6745.77	295.93	319.01	206.72	76.10	1677.61	-16.74	1752.70	543.78	4559.17	1474	19	1455.09
6014.35	295.93	282.98	245.83	74.94	1719.19	-34.37	1729.39	535.94	4553.90	953	8	944.30
4323.58	295.93	182.62	448.74	1020.62	2190.33	290.72	1635.81	517.81	6286.64	478	99	379.54
3502.59	295.93	142.47	380.56	1302.25	1828.86	411.46	1595.14	509.00	6169.75	235	65	170.05
3093.26	295.93	121.10	321.49	1604.99	1554.36	557.79	1565.95	504.62	6230.29	237	82	155.33
2743.02	295.93	98.48	346.73	2305.35	1586.65	840.10	1524.74	500.86	7202.91	274	119	155.12
2529.26	295.93	85.91	326.81	2718.21	1480.09	1024.20	1498.56	498.57	7632.36	290	141	148.83
2373.94	295.93	85.61	302.43	2243.74	1383.37	810.89	1515.69	496.90	6838.62	260	115	144.59
2296.32	295.93	79.16	307.94	2592.37	1387.44	958.98	1497.79	496.07	7319.75	418	201	216.12
2276.92	295.93	84.76	318.57	1984.83	1435.93	671.81	1526.91	495.86	6518.69	124	50	73.73

SUMS			
30260	1054	84.32	3.63
Total Output	Chem Loss 2	Grams Produced	
		CO	HC
0	0	0.00	0.00
6683	72	7.76	-0.11
5492	28	3.84	-0.20
5498	55	5.00	0.08
4930	19	2.39	-0.10
3191	8	1.52	-0.13
1029	99	7.58	0.40
519	65	4.85	0.28
516	82	5.98	0.38
479	119	8.61	0.57
463	141	10.15	0.70
493	115	8.38	0.55
713	201	14.53	0.98
253	50	3.71	0.23

Dirigo Laboratories, Inc.

Manufacturer: Pacific Energy
Model: True North 10
Date: 10/18/2016
Run: 2
Control #: 034-S-071-1
Test Duration: 130
Output Category: 2

	HHV Basis	LHV Basis
Overall Efficiency	74.8%	80.9%
Combustion Efficiency	97.4%	97.4%
Heat Transfer Efficiency	76.9%	83.1%

HHV Output Rate (kJ/h)	13,792	13,084	(Btu/h)
Burn Rate (kg/h)	0.93	2.05	(lb/h)
Input (kJ/h)	18,430	17,482	(Btu/h)

Test Load Weight (dry kg)	2.0	4.4	dry lb
MC wet (%)	16.18		
MC dry (%)	19.30		
Particulate (g)	2.81		
CO (g)	84		
Test Duration (h)	2.166666667		

Emissions	Particulate	CO
g/MJ Output	0.09	2.82
g/kg Dry Fuel	1.39	41.83
g/h	1.30	38.92
lb/MM Btu Output	0.22	6.56

Air/Fuel Ratio (A/F)	16.12
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Test Results in Accordance with CSA B415.1-10

VERSION: 2.4

4/15/2010

Manufacturer: Pacific Energy

Model: True North 10

Date: 10/18/2016

Run: 3

Control #: 034-S-071-1

Test Duration: 110

Burn Category 2

Wood Moisture (% DRY): 19.4

Wood Moisture (% wet): 16.25

Load Weight (lb wet): 5.20

Burn Rate (dry kg/h): 1.08

Total Particulate Emissions: 2.52 g

Appliance Type: Non-Cat (Cat, Non-Cat, Pellet)

Temp. Units: F (F or C)

Weight Units: lb (kg or lb)

Fuel Data

D. Fir

HHV 19,810 kJ/kg

%C 48.73

%H 6.87

%O 43.90

%Ash 0.50

☒ Douglas☐ Oak

Averages

294.9

74.0

14.55

5.92

0.55

Temp. (F)

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Temp. (F)	Room Temp	Flue Gas Composition (%)		
				O2	CO2	CO
0	5.2	222.0	74.0	18.52	1.89	0.58
10	4.3	370.0	74.0	11.17	10.07	0.10
20	3.3	380.0	74.0	12.32	8.81	0.08
30	2.2	417.0	74.0	10.66	10.53	0.03
40	1.2	415.0	74.0	11.20	9.72	0.06
50	0.8	335.0	74.0	14.51	5.83	0.27
60	0.6	275.0	74.0	15.63	4.61	0.63
70	0.5	244.0	74.0	16.21	3.74	1.04
80	0.3	230.0	74.0	15.97	4.05	0.96
90	0.1	218.0	74.0	16.33	3.59	1.07
100	0.1	221.0	74.0	15.62	4.59	0.81
110	0.0	212.0	74.0	16.40	3.61	0.91

Test Duration: 110 min

Heat Transfer Efficiency: 76.6%

Air

Stack Temp: 301.5 Deg. F 149.7

[illegible]

Exhaust Gas (Nr):	545.92	%HC	Combustion Efficiency:	97.5%			Moisture of
Fuel Ratio (A/F)	15.61	1.32	Total Input (kJ):	39,145	37,127	(Btu)	Initial Dry \
			Total Output (kJ):	29,231	27,724	(Btu)	Moi
			Efficiency:	74.7%			
			Total CO (g):	77.19			

kJ/h

kg/h

Deg. C

Combustion Efficiency:	97.5%				Moisture of
Total Input (kJ):	39,145	37,127	(Btu)		Initial Dry W
Total Output (kJ):	29,231	27,724	(Btu)		Moi
Efficiency:	74.7%				
Total CO (g):	77.19				

Load Weight (kg):	2.36	
Fuel Heating:	HHV	LHV
Value in kJ/kg - CV:	19810.00	18328.69

[illegible]

Moisture Content MCwb: 16.25

Wood (wet basis): 16.25
Weight Wtdo (kg): 1.98
sture Content Dry 19.40

Dry kg : 1.98
CA: 48.73
HY: 6.87
OX: 43.90

HHV LHV
Btu/lb 8522.48 7885.21

0.16	35.59	113.37	4.72	0.51	581.67	33.51	10.78	419.21	4926.96	3690.90	3584.95	3546.10	4780.17
kg Wood per 100 mole dfp Nk	Moles per kg of Dry Wood						Moisture Present	Stack Temp K	Heat Content Change - Ambient to Stack Temperatu Flue Gas Constituent				
	CO2	O2	CO	HC	N2	H2O			CO2	O2	CO	N2	CH4
0.06	30.55	300.63	9.38	0.88	1276.01	32.76	10.78	378.71	3233.82	2451.90	2388.76	2361.35	3073.16
0.25	40.42	40.73	0.40	-0.01	319.82	34.54	10.78	460.93	6663.69	4964.64	4815.39	4764.61	6524.91
0.22	40.48	52.85	0.37	-0.03	365.74	34.59	10.78	466.48	6902.51	5136.61	4980.71	4928.50	6771.79
0.26	40.74	37.52	0.12	-0.04	308.52	34.61	10.78	487.04	7793.93	5775.33	5593.92	5536.58	7700.28
0.24	40.60	44.04	0.25	-0.03	332.77	34.59	10.78	485.93	7745.43	5740.71	5560.72	5503.64	7649.48
0.15	38.90	97.24	1.80	0.11	529.37	34.31	10.78	441.48	5834.87	4364.91	4238.10	4192.49	5674.44
0.13	35.45	120.51	4.85	0.51	608.28	33.50	10.78	408.15	4439.55	3344.73	3253.41	3217.16	4265.75
0.12	31.12	136.15	8.65	1.04	656.09	32.44	10.78	390.93	3731.26	2821.56	2747.08	2715.94	3562.30
0.13	32.26	128.07	7.65	0.91	628.51	32.71	10.78	383.15	3414.21	2586.16	2518.96	2490.18	3250.06
0.12	30.59	140.66	9.12	1.10	671.76	32.32	10.78	376.48	3143.84	2384.83	2323.70	2296.98	2985.13
0.13	34.10	115.82	6.02	0.69	587.05	33.14	10.78	378.15	3211.31	2435.12	2372.50	2345.25	3051.13
0.11	31.85	146.25	8.03	0.94	696.12	32.65	10.78	373.15	3009.14	2284.31	2226.17	2200.48	2853.59

		SUMS							AVERAGE			
4288.64	296.48	2191.66	4174.77	16171.44	21853.93	5418.12	19422.42	6241.37	6289.48	9913	970	8943.72
re	Room Temp K	Energy Losses (kJ/kg of Dry Fuel) Flue Gas Constituent							Total Loss Rate			
		CO2	O2	CO	N2	CH4	H2O Comb	H2O Fuel MC		Total Loss	Chemical Loss 1	Sensible and Latent Loss
2859.96	296.48	98.80	737.12	2675.52	3013.10	788.78	1533.95	504.72	9351.99	0	0	0.00
5758.45	296.48	269.33	202.22	115.52	1523.81	-6.30	1717.42	535.96	4357.96	2318	57	2261.34
5955.69	296.48	279.39	271.46	105.84	1802.57	-28.21	1726.67	538.08	4695.81	1874	30	1843.30
6686.98	296.48	317.52	216.69	33.50	1708.13	-39.01	1753.18	545.96	4535.97	1810	-2	1812.18
6647.39	296.48	314.43	252.81	72.31	1831.45	-30.82	1750.88	545.54	4736.61	1260	11	1249.20
5069.52	296.48	227.00	424.46	517.52	2219.36	95.13	1682.52	528.53	5694.52	649	69	580.27
3893.50	296.48	157.40	403.07	1386.93	1956.92	458.30	1603.29	515.86	6481.77	369	104	265.31
3288.38	296.48	116.11	384.17	2472.48	1781.89	931.50	1532.94	509.33	7728.42	441	192	248.06
3015.65	296.48	110.13	331.21	2183.10	1565.11	811.69	1536.66	506.39	7044.29	535	226	309.45
2782.16	296.48	96.18	335.46	2601.48	1543.02	984.95	1510.86	503.88	7575.82	288	135	152.53
2840.51	296.48	109.52	282.04	1717.39	1376.78	617.14	1551.30	504.51	6158.67	234	88	145.94
2665.50	296.48	95.84	334.07	2289.86	1531.80	834.96	1522.74	502.62	7111.89	135	59	76.14

SUMS			
29608	970	77.19	3.41
Total Output	Chem Loss 2	Grams Produced	
		CO	HC
0	0	0.00	0.00
8220	57	5.98	-0.06
6031	30	4.11	-0.20
6094	-2	1.30	-0.28
4010	11	1.87	-0.15
1609	69	5.75	0.19
760	104	7.73	0.47
689	192	13.81	0.95
970	226	16.27	1.10
465	135	9.70	0.67
519	88	6.40	0.42
241	59	4.27	0.28

Dirigo Laboratories, Inc.

Manufacturer: Pacific Energy
Model: True North 10
Date: 10/18/2016
Run: 3
Control #: 034-S-071-1
Test Duration: 110
Output Category: 2

	HHV Basis	LHV Basis
Overall Efficiency	74.7%	80.7%
Combustion Efficiency	97.5%	97.5%
Heat Transfer Efficiency	76.6%	82.8%

HHV Output Rate (kJ/h)	15,944	15,125	(Btu/h)
Burn Rate (kg/h)	1.08	2.38	(lb/h)
Input (kJ/h)	21,352	20,254	(Btu/h)

Test Load Weight (dry kg)	2.0	4.4	dry lb
MC wet (%)	16.25		
MC dry (%)	19.40		
Particulate (g)	2.52		
CO (g)	77		
Test Duration (h)	1.833333333		

Emissions	Particulate	CO
g/MJ Output	0.09	2.64
g/kg Dry Fuel	1.28	39.06
g/h	1.37	42.10
lb/MM Btu Output	0.20	6.14

Air/Fuel Ratio (A/F)	15.61
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Test Results in Accordance with CSA B415.1-10

Manufacturer: Pacific Energy
Model: True North 10
Date: 10/18/2016
Run: 4
Control #: 034-S-071-1

Appliance Type: Non-Cat (Cat, Non-Cat, Pellet)

Temp. Units: F (F or C)
Weight Units: lb (kg or lb)

Test Duration: 90
Burn Category: 3

Wood Moisture (% DRY): 21
Wood Moisture (% wet): 17.36
Load Weight (lb wet): 5.40
Burn Rate (dry kg/h): 1.35
Total Particulate Emissions: 2.67 g

Fuel Data	
	D. Fir
HHV	19,810 kJ/kg
%C	48.73
%H	6.87
%O	43.90
%Ash	0.50

☒ Douglas
☐ Oak

Averages		357.3	74.6	14.89	5.73	0.32
		Temp. (F)				
Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas	Room Temp	Flue Gas Composition (%)		
				O2	CO2	CO
0	5.4	275.0	74.0	18.25	2.13	0.62
10	4.6	386.0	74.0	15.75	5.09	0.22
20	3.4	453.0	74.0	12.33	8.93	0.05
30	2.2	465.0	74.0	12.18	9.00	0.06
40	1.3	476.0	75.0	10.69	10.31	0.04
50	0.7	394.0	75.0	14.53	5.75	0.18
60	0.5	315.0	75.0	15.90	4.47	0.47
70	0.3	286.0	75.0	16.16	4.11	0.48
80	0.2	270.0	75.0	16.22	4.15	0.54
90	0.0	253.0	75.0	16.88	3.39	0.55

0

		Air Fuel Ratio (A/F)	
69.5%	Dry Molecular Weight (Md)	29.50	
98.0%	Dry Moles Exhaust Gas (Nr):	576.35	%HC
70.9%	Air Fuel Ratio (A/F)	16.49	1.32

Combustion Efficiency: 98.0%
Total Input (kJ): 40,113
Total Output (kJ): 27,866
Efficiency: 69.5%
Total CO (g): 69.96

Btu/h 18,577 kJ/h
Btu/h 26,742 kJ/h

h

lb/h 1.3 kg/h

Deg. F 185.8 Deg. C

66.4%	22.5	0.84	65.56	0.01	65.56	40855	4.06	6.87	2.74	19810.00	17.36
Net Eff %	Air Fuel Ratio	Wet Wt Now Wt	% Wet Consumed x	Dry Wt. Now Wtdn	% Dry Comsumed y	Fuel Properties			Oxygen /16= [c]	Calorific Value	Mw Moisture Fuel Burnt
						Total Input	Carbon /12= [a]	Hydrogen /1= [b]			
48.5%	41.8	2.45	0.00	2.02	0.00	0	4.06	6.87	2.74	19810.00	17.36
65.7%	22.2	2.09	14.81	1.72	14.81	10400	4.06	6.87	2.74	19810.00	17.36
73.2%	13.2	1.54	37.04	1.27	37.04	8914	4.06	6.87	2.74	19810.00	17.36
72.7%	13.1	1.00	59.26	0.82	59.26	7800	4.06	6.87	2.74	19810.00	17.36
74.3%	11.5	0.59	75.93	0.49	75.93	5571	4.06	6.87	2.74	19810.00	17.36
68.1%	19.9	0.32	87.04	0.26	87.04	2971	4.06	6.87	2.74	19810.00	17.36
65.4%	23.7	0.23	90.74	0.19	90.74	1486	4.06	6.87	2.74	19810.00	17.36
65.8%	25.4	0.14	94.44	0.11	94.44	1114	4.06	6.87	2.74	19810.00	17.36
66.5%	24.8	0.09	96.30	0.07	96.30	1857	4.06	6.87	2.74	19810.00	17.36
63.8%	29.5	0.00	100.00	0.00	100.00	743	4.06	6.87	2.74	19810.00	17.36
				0.00							

Moisture Content MCwb: 17.36

38,045	(Btu)	Moisture of Wood (wet basis):	17.36	Dry kg :	2.02
26,430	(Btu)	Initial Dry Weight Wtdo (kg):	2.02	CA:	48.73
		Moisture Content Dry	21.00	HY:	6.87
				OX:	43.90

Load Weight (kg):	2.45				
Fuel Heating:	HHV	LHV		HHV	LHV
Value in kJ/kg - CV:	19810.00	18328.69	Btu/lb	8522.48	7885.21

79.30	21.03	1.50	5.09	0.02	0.15	37.46	121.45	3.09	0.26	617.06	34.01
Mass Balance (moles/100 mole dry flue gas)					kg Wood per 100 mole dfp Nk	Moles per kg of Dry Wood					
[h]	[u]	[w]	[j]	[k]		CO2	O2	CO	HC	N2	H2O
78.93	20.94	0.69	2.26	0.06	0.07	30.93	265.97	9.00	0.88	1146.03	32.75
79.30	21.03	1.31	4.48	0.01	0.13	39.07	118.12	1.69	0.06	608.66	34.41
79.63	21.12	2.21	7.61	-0.01	0.22	40.64	51.84	0.23	-0.05	362.34	34.62
79.63	21.12	2.23	7.67	-0.01	0.22	40.58	51.01	0.27	-0.04	359.07	34.61
79.72	21.15	2.55	8.77	-0.01	0.25	40.69	39.18	0.16	-0.04	314.68	34.60
79.36	21.05	1.46	5.01	0.00	0.15	39.56	101.18	1.24	0.02	545.96	34.49
79.15	21.00	1.23	4.13	0.04	0.12	36.61	130.30	3.85	0.35	648.28	33.82
79.12	20.99	1.14	3.83	0.04	0.11	36.20	143.45	4.23	0.39	696.89	33.75
79.10	20.98	1.17	3.91	0.05	0.12	35.71	139.50	4.65	0.45	680.69	33.62
79.05	20.97	0.98	3.27	0.05	0.10	34.65	173.92	5.62	0.54	807.96	33.44

11.67	453.87	6379.92	4746.42	4602.04	4553.87	6261.94	5502.79	296.82	2443.81	4978.92	8861.61
Moisture Present	Stack Temp K	Heat Content Change - Ambient to Stack Temperature						Room Temp K	Energy		
		Flue Gas Constituent							CO2	O2	CO
		CO2	O2	CO	N2	CH4	H2O				
11.67	408.15	4439.55	3344.73	3253.41	3217.16	4265.75	3893.50	296.48	137.30	889.60	2576.46
11.67	469.82	7046.23	5239.93	5079.99	5026.93	6920.75	6074.11	296.48	275.28	618.94	486.44
11.67	507.04	8673.01	6400.44	6192.83	6130.73	8626.38	7400.83	296.48	352.43	331.79	65.80
11.67	513.71	8968.61	6609.61	6392.96	6329.33	8940.06	7639.28	296.48	363.99	337.15	78.30
11.67	519.82	9219.53	6785.33	6560.63	6495.81	9210.29	7838.89	297.04	375.18	265.86	45.72
11.67	474.26	7217.17	5361.48	5196.45	5142.46	7100.83	6212.92	297.04	285.49	542.50	356.86
11.67	430.37	5344.99	4007.38	3893.17	3850.80	5178.47	4657.62	297.04	195.69	522.16	1104.37
11.67	414.26	4671.76	3514.66	3417.45	3379.64	4499.86	4089.44	297.04	169.11	504.17	1210.84
11.67	405.37	4303.54	3243.81	3155.61	3120.38	4131.67	3776.59	297.04	153.69	452.50	1329.71
11.67	395.93	3914.81	2956.81	2877.89	2845.45	3745.32	3444.69	297.04	135.65	514.24	1607.12

SUMS				AVERAGE	SUMS					
25367.06	2284.73	16834.96	5771.75	6654.28	12247	789	11457.41	28609	789	69.96
y Losses (kJ/kg of Dry Fuel)				Total Loss Rate						
Flue Gas Constituent					Total Loss	Chemical Loss 1	Sensible and Latent Loss	Total Output	Chem Loss 2	Grams Pro CO
N2	CH4	H2O Comb	H2O Fuel MC							
3686.97	790.93	1567.69	558.40	10207.34	0	0	0.00	0	0	0.00
3059.71	50.33	1722.00	583.84	6796.53	3568	277	3290.87	6832	277	24.82
2221.40	-45.15	1778.58	599.32	5304.17	2387	9	2377.87	6527	9	2.87
2272.70	-38.33	1786.05	602.10	5401.96	2127	15	2111.68	5673	15	2.98
2044.07	-36.00	1792.69	604.43	5091.96	1432	3	1429.47	4139	3	1.24
2807.57	15.89	1730.63	585.46	6324.40	949	55	893.67	2023	55	5.20
2496.41	314.71	1644.53	567.32	6845.20	513	105	408.19	972	105	8.08
2355.22	344.86	1622.05	560.69	6766.95	381	87	294.02	734	87	6.66
2124.00	405.06	1605.05	557.04	6627.05	621	161	460.17	1236	161	12.20
2299.01	482.42	1585.67	553.16	7177.27	269	78	191.46	474	78	5.90

1.48
roduced HC

0.00

0.47

-0.36

-0.27

-0.18

0.04

0.42

0.35

0.68

0.32

Dirigo Laboratories, Inc.

Manufacturer: Pacific Energy
Model: True North 10
Date: 10/18/2016
Run: 4
Control #: 034-S-071-1
Test Duration: 90
Output Category: 3

	HHV Basis	LHV Basis
Overall Efficiency	69.5%	75.1%
Combustion Efficiency	98.0%	98.0%
Heat Transfer Efficiency	70.9%	76.6%

HHV Output Rate (kJ/h)	18,577	17,623	(Btu/h)
Burn Rate (kg/h)	1.35	2.98	(lb/h)
Input (kJ/h)	26,742	25,367	(Btu/h)

Test Load Weight (dry kg)	2.0	4.5	dry lb
MC wet (%)	17.36		
MC dry (%)	21.00		
Particulate (g)	2.67		
CO (g)	70		
Test Duration (h)	1.5		

Emissions	Particulate	CO
g/MJ Output	0.10	2.51
g/kg Dry Fuel	1.32	34.55
g/h	1.78	46.64
lb/MM Btu Output	0.22	5.83

Air/Fuel Ratio (A/F)	16.49
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Test Results in Accordance with CSA B415.1-10

Default Fuel Values

	D. Fir	Oak
HHV (kJ/kg)	19,810	19,887
%C	48.73	50
%H	6.87	6.6
%O	43.9	42.9
%Ash	0.5	0.5

VERSION: 2.4

4/15/2010

Manufacturer: Pacific Energy

Model: True North 10

Date: 10/19/2016

Run: 5

Control #: 034-S-071-1

Test Duration: 90

Burn Category 3

Wood Moisture (% DRY): 21

Wood Moisture (% wet): 17.36

Load Weight (lb wet): 5.30

Burn Rate (dry kg/h): 1.32

Total Particulate Emissions: 1.78 g

Appliance Type: Non-Cat (Cat, Non-Cat, Pellet)

Temp. Units: F (F or C)

Weight Units: lb (kg or lb)

Fuel Data

D. Fir

HHV 19,810 kJ/kg

%C 48.73

%H 6.87

%O 43.90

%Ash 0.50

☒ Douglas☐ Oak

Averages

352.9

75.0

14.80

5.72

0.43

Temp. (F)

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Temp. (F)	Room Temp	Flue Gas Composition (%)		
				O2	CO2	CO
0	5.3	276.0	75.0	18.40	2.09	0.47
10	4.3	432.0	75.0	12.08	8.82	0.29
20	3.0	462.0	75.0	12.43	8.70	0.05
30	2.0	468.0	75.0	11.91	9.11	0.05
40	1.1	458.0	75.0	12.24	8.51	0.04
50	0.6	360.0	75.0	15.81	4.42	0.47
60	0.5	297.0	75.0	16.23	3.98	0.65
70	0.4	268.0	75.0	16.58	3.49	0.87
80	0.2	254.0	75.0	16.24	4.01	0.60
90	0.0	254.0	75.0	16.12	4.03	0.81

Test Duration: 90 min

Heat Transfer Efficiency: 72.2%

Air

Stack Temp:	361.4	Deg. F	183.0
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[illegible]

kJ/h

kJ/h

Combustion Efficiency:	97.4%				Moisture of
Total Input (kJ):	39,370	37,340	(Btu)		Initial Dry \
Total Output (kJ):	27,677	26,251	(Btu)		Moi
Efficiency:	70.3%				
Total CO (g):	83.16				

kg/h	Load Weight (kg):	2.40	
	Fuel Heating:	HHV	LHV
Deg. C	Value in kJ/kg - CV:	19810.00	18328.69

[illegible]

Moisture Content MCwb: 17.36

Wood (wet basis): 17.36
 Weight Wtdo (kg): 1.99
 sture Content Dry 21.00

Dry kg : 1.99
 CA: 48.73
 HY: 6.87
 OX: 43.90

HHV LHV
 Btu/lb 8522.48 7885.21

0.15	36.56	120.50	3.88	0.37	611.13	33.78	11.67	451.43	6271.24	4665.72	4523.83	4476.47	6154.93
kg Wood per 100 mole dfp Nk	Moles per kg of Dry Wood						Moisture Present	Stack Temp K	Heat Content Change - Ambient to Stack Temperatu Flue Gas Constituent				
	CO2	O2	CO	HC	N2	H2O			CO2	O2	CO	N2	CH4
0.06	32.82	289.68	7.38	0.61	1240.53	33.30	11.67	408.71	4441.35	3345.29	3253.75	3217.54	4269.22
0.22	39.41	50.82	1.30	0.11	355.30	34.31	11.67	495.37	8137.61	6018.99	5827.18	5768.02	8063.94
0.21	40.63	54.35	0.23	-0.05	371.82	34.63	11.67	512.04	8873.40	6540.91	6326.89	6263.84	8841.91
0.22	40.64	49.96	0.22	-0.05	355.25	34.62	11.67	515.37	9021.52	6645.60	6427.02	6363.21	8999.37
0.21	40.68	56.63	0.19	-0.06	380.57	34.65	11.67	509.82	8774.83	6471.18	6260.18	6197.63	8737.28
0.12	36.57	132.06	3.89	0.35	654.84	33.81	11.67	455.37	6404.58	4776.58	4634.22	4585.09	6260.26
0.12	34.57	141.84	5.65	0.59	686.57	33.33	11.67	420.37	4926.24	3701.28	3597.73	3558.16	4755.55
0.11	31.94	153.07	7.96	0.91	722.13	32.69	11.67	404.26	4257.67	3210.00	3122.92	3088.00	4085.96
0.11	35.04	142.64	5.24	0.53	690.79	33.45	11.67	396.48	3937.61	2973.67	2894.22	2861.61	3767.91
0.12	33.35	133.93	6.70	0.76	653.51	33.00	11.67	396.48	3937.61	2973.67	2894.22	2861.61	3767.91

		SUMS							AVERAGE			
5409.28	297.04	2360.39	4798.52	11103.53	24511.25	3320.05	16691.62	5760.85	6854.62	11692	1029	10663.23
re	Room Temp K	Energy Losses (kJ/kg of Dry Fuel) Flue Gas Constituent							Total Loss Rate			
		CO2	O2	CO	N2	CH4	H2O Comb	H2O Fuel MC		Total Loss	Chemical Loss 1	Sensible and Latent Loss
3893.86	297.04	145.77	969.06	2112.50	3991.46	545.47	1593.97	558.40	9916.64	0	0	0.00
6964.95	297.04	320.70	305.88	374.25	2049.35	96.22	1747.46	594.23	5488.09	3396	286	3109.66
7560.45	297.04	360.55	355.50	67.56	2329.03	-48.01	1784.43	601.18	5450.25	2350	8	2342.27
7679.74	297.04	366.61	332.02	64.55	2260.54	-43.04	1787.99	602.57	5371.25	1913	7	1906.08
7480.96	297.04	357.00	366.47	55.31	2358.64	-56.84	1782.69	600.25	5463.53	1434	-1	1434.65
5542.20	297.04	234.21	630.82	1118.47	3002.50	317.66	1674.17	577.64	7555.46	850	159	690.66
4304.78	297.04	170.31	524.99	1618.12	2442.93	532.31	1609.11	563.20	7460.97	280	80	200.00
3737.52	297.04	135.98	491.35	2277.86	2229.93	817.56	1559.72	556.58	8068.98	454	172	281.35
3464.20	297.04	137.96	424.16	1498.68	1976.76	477.95	1586.80	553.39	6655.70	749	220	528.29
3464.20	297.04	131.31	398.28	1916.22	1870.09	680.78	1565.27	553.39	7115.35	267	97	170.26

SUMS			
28420	1029	83.16	3.39
Total Output	Chem Loss 2	Grams Produced	
		CO	HC
0	0	0.00	0.00
8861	286	22.45	1.06
6192	8	2.82	-0.37
5143	7	2.22	-0.27
3766	-1	1.41	-0.27
1379	159	12.25	0.64
463	80	5.93	0.36
660	172	12.54	0.82
1480	220	16.51	0.96
476	97	7.04	0.46

Dirigo Laboratories, Inc.

Manufacturer: Pacific Energy
Model: True North 10
Date: 10/19/2016
Run: 5
Control #: 034-S-071-1
Test Duration: 90
Output Category: 3

	HHV Basis	LHV Basis
Overall Efficiency	70.3%	76.0%
Combustion Efficiency	97.4%	97.4%
Heat Transfer Efficiency	72.2%	78.0%

HHV Output Rate (kJ/h)	18,452	17,503	(Btu/h)
Burn Rate (kg/h)	1.32	2.92	(lb/h)
Input (kJ/h)	26,247	24,898	(Btu/h)

Test Load Weight (dry kg)	2.0	4.4	dry lb
MC wet (%)	17.36		
MC dry (%)	21.00		
Particulate (g)	1.78		
CO (g)	83		
Test Duration (h)	1.5		

Emissions	Particulate	CO
g/MJ Output	0.06	3.00
g/kg Dry Fuel	0.90	41.84
g/h	1.19	55.44
lb/MM Btu Output	0.15	6.98

Air/Fuel Ratio (A/F)	16.28
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Test Results in Accordance with CSA B415.1-10

VERSION: 2.4

4/15/2010

Manufacturer: Pacific Energy

Model: True North 10

Date: 10/19/2016

Run: 6

Control #: 034-S-071-1

Test Duration: 120

Burn Category 2

Wood Moisture (% DRY): 20.3

Wood Moisture (% wet): 16.87

Load Weight (lb wet): 5.30

Burn Rate (dry kg/h): 1.00

Total Particulate Emissions: 3.94 g

Appliance Type: Non-Cat (Cat, Non-Cat, Pellet)

Temp. Units: F (F or C)

Weight Units: lb (kg or lb)

Fuel Data

D. Fir

HHV 19,810 kJ/kg

%C 48.73

%H 6.87

%O 43.90

%Ash 0.50

☒ Douglas☐ Oak

Averages

300.7

74.8

14.78

5.66

0.51

Temp. (F)

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Temp. (F)	Room Temp	Flue Gas Composition (%)		
				O2	CO2	CO
0	5.3	229.0	75.0	18.92	1.49	0.60
10	4.4	368.0	75.0	10.96	9.95	0.16
20	3.4	395.0	75.0	11.09	9.93	0.12
30	2.3	429.0	75.0	10.70	10.46	0.05
40	1.4	434.0	75.0	10.20	10.75	0.12
50	0.8	365.0	75.0	14.04	6.48	0.12
60	0.6	297.0	75.0	15.67	4.53	0.50
70	0.5	266.0	75.0	16.00	4.17	0.69
80	0.4	249.0	75.0	16.18	3.93	0.82
90	0.3	235.0	75.0	17.03	3.09	0.78
100	0.1	221.0	75.0	16.91	3.14	0.79
110	0.1	214.0	74.0	17.04	3.01	0.90
120	0.0	207.0	74.0	17.39	2.64	0.99

Test Duration: 120 min

Heat Transfer Efficiency: 76.2%

Air

Averages	0.51	5.66	304.2%	20.53	14.62	149.3	23.8	90.3%	72.9%	66.1%	23.8
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0

kJ/h

kJ/h

%HC
1.32

Combustion Efficiency: 97.5%

Total Input (kJ):	39,599	37,558	(Btu)
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Total Output (kJ):	29,390	27,875	(Btu)
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Efficiency: 74.2%

Total CO (g): 79.97

Moisture of

Initial Dry V

Moi

Load Weight (kg): 2.40

Fuel Heating: HHV LHV

Value in kJ/kg - CV: 19810.00 18328.69

Deg. C

[illegible]

Moisture Content MCwb: 16.87

Wood (wet basis): 16.87
Weight Wtdo (kg): 2.00
sture Content Dry 20.30

Dry kg : 2.00
CA: 48.73
HY: 6.87
OX: 43.90

HHV LHV
Btu/lb 8522.48 7885.21

0.15	35.16	132.31	5.12	0.53	652.08	33.46	11.28	422.42	5045.38	3775.89	3666.58	3627.03	4903.20
kg Wood per 100 mole dfp Nk	Moles per kg of Dry Wood						Moisture Present	Stack Temp K	Heat Content Change - Ambient to Stack Temperatu Flue Gas Constituent				
	CO2	O2	CO	HC	N2	H2O			CO2	O2	CO	N2	CH4
0.05	28.33	361.42	11.41	1.08	1499.86	32.36	11.28	382.59	3370.43	2553.01	2486.67	2458.26	3208.40
0.25	40.14	41.32	0.65	0.03	321.31	34.47	11.28	459.82	6594.84	4913.91	4766.33	4716.04	6456.25
0.25	40.32	41.77	0.49	0.00	323.48	34.51	11.28	474.82	7241.23	5378.73	5213.01	5158.89	7125.86
0.26	40.65	37.93	0.19	-0.03	309.85	34.59	11.28	493.71	8064.47	5966.94	5777.30	5718.54	7987.00
0.27	40.35	35.33	0.45	0.01	299.24	34.50	11.28	496.48	8186.41	6053.71	5860.45	5801.02	8115.32
0.16	40.10	86.42	0.74	-0.03	491.58	34.58	11.28	458.15	6523.43	4862.39	4716.77	4666.92	6382.62
0.12	36.41	127.22	4.02	0.38	636.15	33.76	11.28	420.37	4926.24	3701.28	3597.73	3558.16	4755.55
0.12	34.49	133.19	5.71	0.62	653.67	33.29	11.28	403.15	4211.84	3176.21	3090.22	3055.64	4040.32
0.12	33.12	137.24	6.91	0.79	665.39	32.95	11.28	393.71	3823.73	2889.40	2812.62	2780.84	3655.14
0.10	31.88	177.49	8.05	0.89	814.24	32.75	11.28	385.93	3506.05	2653.81	2584.38	2554.95	3341.69
0.10	31.90	174.17	8.03	0.89	801.75	32.74	11.28	378.15	3190.12	2418.76	2356.48	2329.44	3031.63
0.10	30.61	175.13	9.15	1.05	802.00	32.42	11.28	374.26	3054.01	2317.81	2258.67	2232.64	2897.37
0.09	28.76	191.37	10.79	1.26	858.56	31.99	11.28	370.37	2897.14	2200.62	2144.94	2120.11	2744.45

		SUMS							AVERAGE			
4386.00	296.95	2413.51	5220.65	19015.22	26343.10	6197.47	21049.46	7089.44	6717.60	10209	1007	9201.78
re	Room Temp K	Energy Losses (kJ/kg of Dry Fuel) Flue Gas Constituent							Total Loss Rate			
		CO2	O2	CO	N2	CH4	H2O Comb	H2O Fuel MC		Total Loss	Chemical Loss 1	Sensible and Latent Loss
2976.99	297.04	95.47	922.71	3255.88	3687.05	965.88	1519.18	529.45	10975.63	0	0	0.00
5699.83	297.04	264.71	203.04	185.74	1515.29	24.76	1711.96	560.16	4465.65	2358	109	2248.53
6232.67	297.04	291.98	224.66	140.43	1668.79	3.43	1732.71	566.17	4628.17	1833	56	1776.87
6905.48	297.04	327.83	226.35	56.11	1771.90	-29.37	1759.65	573.76	4686.22	1767	10	1757.68
7004.60	297.04	330.35	213.89	130.12	1735.91	7.92	1758.84	574.87	4751.90	1344	38	1305.88
5640.71	297.04	261.59	420.19	213.65	2294.15	-27.60	1715.71	559.49	5437.19	820	28	792.70
4304.78	297.04	179.38	470.89	1151.81	2263.51	341.10	1629.74	544.43	6580.86	372	84	288.76
3698.45	297.04	145.26	423.04	1632.58	1997.38	552.23	1586.73	537.59	6874.80	259	82	177.65
3366.67	297.04	126.63	396.53	1974.84	1850.34	702.92	1559.70	533.85	7144.81	269	100	169.32
3093.82	297.04	111.77	471.03	2298.01	2080.34	792.91	1541.20	530.77	7826.02	443	174	269.23
2821.31	297.04	101.76	421.28	2289.98	1867.63	794.58	1532.07	527.69	7535.00	284	116	168.67
2704.38	296.48	93.48	405.91	2610.61	1790.56	939.77	1513.06	526.38	7879.76	297	133	164.18
2568.34	296.48	83.33	421.13	3075.45	1820.24	1128.94	1488.91	524.84	8542.84	161	79	82.32

SUMS			
29764	1007	79.97	3.57
Total Output	Chem Loss 2	Grams Produced	
		CO	HC
0	0	0.00	0.00
8102	109	9.54	0.23
6012	56	5.40	0.02
5704	10	2.05	-0.20
4259	38	3.57	0.04
2168	28	3.14	-0.07
748	84	6.37	0.35
488	82	6.03	0.37
478	100	7.30	0.47
678	174	12.75	0.80
463	116	8.47	0.54
450	133	9.66	0.64
212	79	5.70	0.38

Dirigo Laboratories, Inc.

Manufacturer: Pacific Energy
Model: True North 10
Date: 10/19/2016
Run: 6
Control #: 034-S-071-1
Test Duration: 120
Output Category: 2

	HHV Basis	LHV Basis
Overall Efficiency	74.2%	80.2%
Combustion Efficiency	97.5%	97.5%
Heat Transfer Efficiency	76.2%	82.3%

HHV Output Rate (kJ/h)	14,695	13,940	(Btu/h)
Burn Rate (kg/h)	1.00	2.20	(lb/h)
Input (kJ/h)	19,799	18,782	(Btu/h)

Test Load Weight (dry kg)	2.0	4.4	dry lb
MC wet (%)	16.87		
MC dry (%)	20.30		
Particulate (g)	3.94		
CO (g)	80		
Test Duration (h)	2		

Emissions	Particulate	CO
g/MJ Output	0.13	2.72
g/kg Dry Fuel	1.97	40.01
g/h	1.97	39.99
lb/MM Btu Output	0.31	6.32

Air/Fuel Ratio (A/F)	16.22
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Test Results in Accordance with CSA B415.1-10

CSA B415.1-10 Weighted Average



Weighted Average: **72.6** %

Client: Pacific Energy
Model: TN10
Tracking No.: 71
Project No.: 034-S-071-1
Test Dates: 10/13/16 - 10/16/16

Burn Rate Category	2
Burn Rate (kg/hr-dry)	0.93
OA Efficiency %	74.8
Emissions Rate Cap (g/hr)	15
Weighting Factor	32.81%
Run Number	2

Burn Rate Category	2
Burn Rate (kg/hr-dry)	1.08
OA Efficiency %	74.7
Emissions Rate Cap (g/hr)	15
Weighting Factor	23.69%
Run Number	3

Burn Rate Category	3
Burn Rate (kg/hr-dry)	1.32
OA Efficiency %	70.3
Emissions Rate Cap (g/hr)	15
Weighting Factor	16.09%
Run Number	5

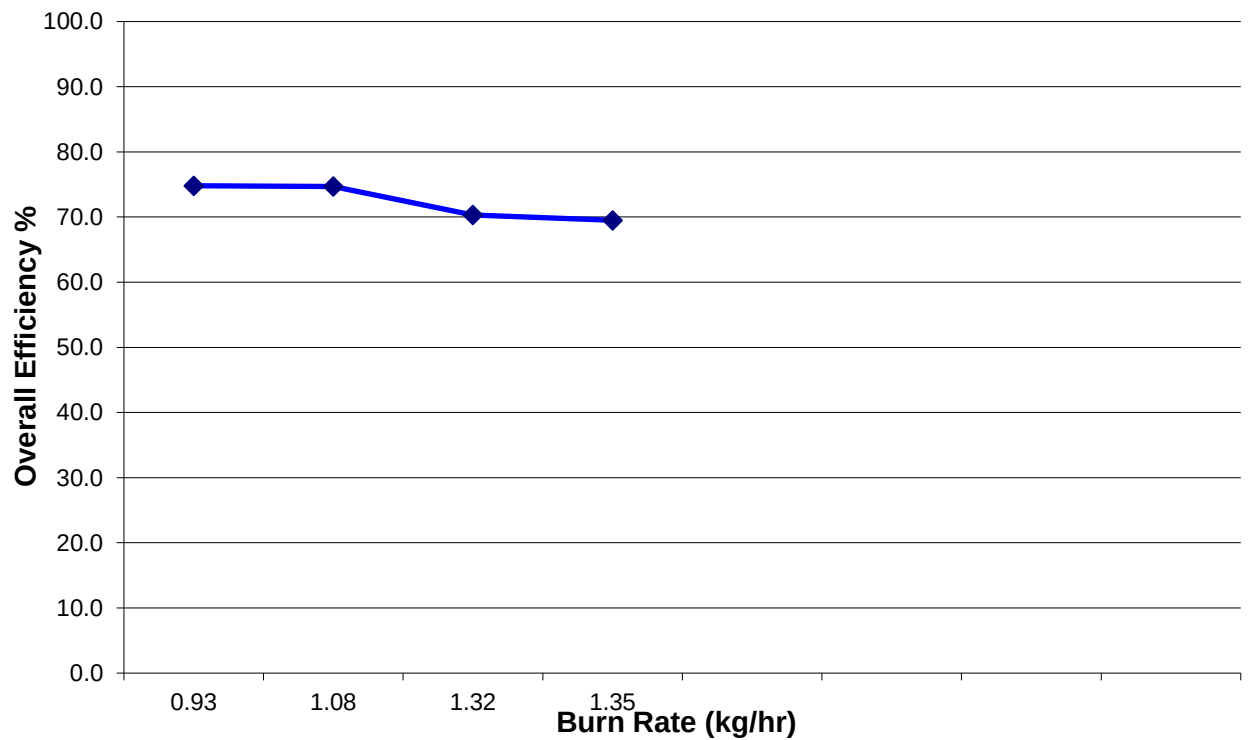
Burn Rate Category	3
Burn Rate (kg/hr-dry)	1.35
OA Efficiency %	69.5
Emissions Rate Cap (g/hr)	15
Weighting Factor	27.40%
Run Number	4

CSA B415.1-10 - Weighted Average



Client: Pacific Energy
Model: TN10
Tracking No.: 71
Project No.: 034-S-071-1
Test Dates: 10/13/16 - 10/16/16

EPA Method 28 - Weighted Average





Test No.	Burn Rate	Pi	Ei	Ki	KiEi	Burn Rate (kg/hr-dry)	Cum. Probability (P)
2	0.93	0.317	74.8	0.439	32.82	0.00	0.0000
3	1.08	0.439	74.7	0.317	23.66	0.01	0.0004
5	1.32	0.634	70.3	0.215	15.13	0.02	0.0008
4	1.35	0.654	69.5	0.366	25.46	0.03	0.0012
0	5.00	1.000	0.0	0.000	0.00	0.04	0.0016
0	5.00	1.000	0.0	0.000	0.00	0.05	0.0020
0	5.00	1.000	0.0	0.000	0.00	0.06	0.0030
0	5.00	1.000	0.0	0.000	0.00	0.07	0.0040
		1.000		1.337	97.08	0.08	0.0050
						0.09	0.0060
						0.10	0.0070
						0.11	0.0080
						0.12	0.0090
						0.13	0.0100
						0.14	0.0110
						0.15	0.0120
						0.16	0.0128
						0.17	0.0136
						0.18	0.0144

Nomenclature:

Pi = Probability for burn rate during test run

Ei = Emissions Rate for test run

Ki = Test run weighting factor

Fuel Load Information

Project Number
034-S-071-1

Client
Pacific Energy

Date
10/13/2016

Firebox Volume (ft³) 0.81

Assessment No

Longest useable measurement parallel or perpendicular to front of unit. 13.75"

Test Fuel Charge Range 5.1lbs - 6.2lbs
Coal bed range (lbs) 1.10 - 1.60

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length 11.63 Inches

Run # 1

Test Run Fuel Moisture (db)					Hydronic Heater		Weight With Out Cleats (Lbs)			
Piece	S1	S2	S3	S4	S5	S6	AVG (%)		Fuel	
1	20.5	19.5	20.5					20.2	1.3	
2	19.7	20.8	20.4					20.3	1.48	
3	20.1	20.8	21.4					20.8	1.19	
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
Spacer Average	19	Fuel Average						20.1	5.3 Total	

Signature

Date

Fuel Load Information

Project Number
034-S-071-1

Client
Pacific Energy

Date
10/13/2016

Firebox Volume (ft³) 0.81

Assessment No

Longest useable measurement parallel or perpendicular to front of unit. 13.75"

Test Fuel Charge Range 5.1lbs - 6.2lbs
Coal bed range (lbs) 1.10 - 1.60

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length 11.63 Inches

Run # 2

Test Run Fuel Moisture (db)

Hydronic Heater

Weight With Out
Cleats (Lbs)

Piece	S1	S2	S3	S4	S5	S6	AVG (%)	Fuel
1	20.1	19.0	20.2				19.8	1.46
2	19.0	19.0	19.0				19.0	1.1
3	19.4	19.0	19.3				19.2	1.39
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
Spacer Average	19						19.3	5.3 Total

Fuel Average

Signature

Date

Fuel Load Information

Project Number
034-S-071-1

Client
Pacific Energy

Date
10/14/2016

Firebox Volume (ft³) 0.81

Assessment No

Longest useable measurement parallel or perpendicular to front of unit. 13.75"

Test Fuel Charge Range 5.1lbs - 6.2lbs
Coal bed range (lbs) 1.10 - 1.60

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length 11.63 Inches

Run # 3

Test Run Fuel Moisture (db)

Hydronic Heater

Weight With Out
Cleats (Lbs)

Piece	S1	S2	S3	S4	S5	S6	AVG (%)	Fuel
1	19.5	19.3	22.0				20.3	1.19
2	19.0	19.5	19.0				19.2	1.21
3	19.0	19.0	19.0				19.0	1.46
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
Spacer Average	19.3						19.4	5.2 Total

Signature

Date

Fuel Load Information

Project Number
034-S-071-1

Client
Pacific Energy

Date
10/14/2016

Firebox Volume (ft³) 0.81

Assessment No

Longest useable measurement parallel or perpendicular to front of unit. 13.75"

Test Fuel Charge Range 5.1lbs - 6.2lbs
Coal bed range (lbs) 1.10 - 1.60

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length 11.63 Inches

Run # 4

Test Run Fuel Moisture (db)

Hydronic Heater

Weight With Out
Cleats (Lbs)

Piece	S1	S2	S3	S4	S5	S6	AVG (%)	Fuel
1	22.4	22.2	22.3				22.3	1.3
2	21.3	19.0	20.9				20.4	1.52
3	22.6	21.9	22.5				22.3	1.28
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
Spacer Average	19						21.0	5.4 Total

Fuel Average

Signature

Date

Fuel Load Information

Project Number
034-S-071-1

Client
Pacific Energy

Date
10/16/2016

Firebox Volume (ft³) 0.81

Assessment No

Longest useable measurement parallel or perpendicular to front of unit. 13.75"

Test Fuel Charge Range 5.1lbs - 6.2lbs
Coal bed range (lbs) 1.10 - 1.60

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length 11.63 Inches

Run # 5

Test Run Fuel Moisture (db)					Hydronic Heater		Weight With Out Cleats (Lbs)			
Piece	S1	S2	S3	S4	S5	S6	AVG (%)		Fuel	
1	19.0	20.2	20.3				19.8		1.46	
2	22.8	21.9	22.3				22.3		1.32	
3	21.6	21.7	22.1				21.8		1.17	
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
Spacer Average	20					Fuel Average	21.0		5.3 Total	

Signature

Date

Fuel Load Information

Project Number
034-S-071-1

Client
Pacific Energy

Date
10/16/2016

Firebox Volume (ft³) 0.81

Assessment No

Longest useable measurement parallel or perpendicular to front of unit. 13.75"

Test Fuel Charge Range 5.1lbs - 6.2lbs
Coal bed range (lbs) 1.10 - 1.60

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length 11.63 Inches

Run # 6

Test Run Fuel Moisture (db)

Hydronic Heater

Weight With Out
Cleats (Lbs)

Piece	S1	S2	S3	S4	S5	S6	AVG (%)	Fuel
1	20.2	20.3	19.0				19.8	1.5
2	20.0	19.0	20.0				19.7	1.1
3	22.7	22.4	22.7				22.6	1.3
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
Spacer Average	19						20.3	5.3 Total

Fuel Average

Signature

Date

1.48
TOP

1.36
Bot.

1.48
1.36







139
709

146
82

29







121

807

7/11

1.19





152

TM

1-3c

Box



1.46
TUE

1.32
BUT

1.46
TUE



20.2

22.4

21.7
081115 0774233372



13.0
TOP

1.25
1.51

1.10
1.14













NEO

2.5

ATTENTION
DO NOT BE BROKEN WITHOUT PROPER
INSTRUCTIONS. THIS WARNING
LABEL HAS BEEN PLACED ON THE
UNIT BY THE MANUFACTURER. IF
THE UNIT IS BROKEN, CONTACT
THE MANUFACTURER FOR
REPAIRS.



ATTENTION:

DO NOT BE BROKEN WITHOUT PRIOR AUTHORIZATION
ENVIRONMENTAL PROTECTION

HAS BEEN SEALED IN ACCORDANCE
OF 40 CFR PART 60 SUBPART

07/1

DATE

DL Energy

MO

PREBURN

JOB # 034_S_071_1

Model Designation TN10

TECHNICIAN BTNGEN

DATE: 10_13_16

RUN #: 2

READING INTERVAL: 10

.

Run Time: 60

Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.035	0.038	0.040	0.034	0.030	0.035	0.040	0.040
Temperature	100	100	100	100	100	100	100	100

0.037

100.000

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	4.3	-0.062	429	416	390	671	370	455.2
10	3.4	-0.053	446	418	281	645	385	435
20	2.7	-0.045	455	417	266	622	388	429.6
30	1.9	-0.048	453	427	253	616	385	426.8
40	1.6	-0.037	437	437	250	536	395	411
50	1.4	-0.026	422	416	253	427	409	385.4
60	1.3	-0.025	394	388	241	364	419	361.2

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 %
Dilution Tunnel Static: -0.400 In H2O
Tunnel Area: 0.196 ft²
Pitot Tube Cp: 0.99

Tunnel Velocity: 13.2295 ft/sec.
Intial Tunnel Flow: 140.705 scfm
Average Tunnel Flow: 141.571 scfm

Run # 2
 Date: 10/13/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.035	0.038	0.040	0.034	0.030	0.035	0.040	0.040
Temperature	100	100	100	100	100	100	100	100

0.037
100.000

Tunnel Velocity:	13.23	ft/sec.
Intial Tunnel Flow:	140.71	scfm
Average Tunnel Flow:	141.57	scfm

JOB #

034_S_071_1

TECHNICIAN

BTNGEN

DATE:

10_13_16

RUN #:

2

READING INTERVAL:

10

SAMPLE BOX :

A

METER Y FACTOR:

1.007

PROBE MATERIAL:

SS

ROOM TEMP (F)

73.0

BAROMETRIC

BEG

MID

END

AVG

29.6

29.6

29.6

29.6

FRONT FILTER #:

2920&2925

REAR FILTER #

REAR FILTER #:

2921

FINAL LEAK RATE (CFM)

<0.01

@

5

IN-HG

FINAL LEAK RATE (CFM)

<0.01

@

5

IN-HG

Run Time:

60

AMBIENT FILTER #:

2924

VOLUME

720.147

LITERS

FUEL MOISTURE DB

19.3

%

FINAL LEAK RATE (CFM):

<0.01

@

5

IN-HG

TEST START TIME:

17:52

1

2

3

4

5

6

TEMPERATURES

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional	Scale	Weight	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
							Rate (%)	Weight	Chg							
0	0.000	0.000	0.037	0.01	-0.07		NA	5.3	0	95	219	75	269	483.84	82	73
10	1.396	0.140	0.037	2	-1.16	13.144	100	4.6	0.7	99	319	79	330	872.24	82	73
20	2.802	0.141	0.037	1.99	-1.29	13.179	101	3.7	0.9	102	361	80	219	1043.23	84	73
30	4.209	0.141	0.037	2.01	-1.24	13.226	100	2.7	1	106	409	81	206	1236.64	87	73
40	5.629	0.142	0.037	2.03	-1.32	13.249	101	1.8	0.9	108	419	81	207	1217.65	90	73
50	7.046	0.142	0.037	2	-0.99	13.214	100	1	0.8	105	382	81	213	1016.95	92	73
60	8.475	0.143	0.037	2.01	-0.72	13.144	100	0.7	0.3	99	296	81	217	738.85	94	73

JOB #	034_S_071_1									
TECHNICIAN	BTNGEN									
DATE:	10_13_16									
RUN #:	2									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:		1.002	PROBE MATERIAL:		SS			
FRONT FILTER #:	2922				REAR FILTER #:	2923				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: 130 Firebox Delta 1 54.3

							1	2	3	4	5	6	Run No
							TEMPERATURES						
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB TOP	FB BOT	METER	
0	0	0	NA	0	0	1	392	385	75	363	420	81	366
10	1.378	0.138	100	-0.04	1.97	1.73	359	345	78	421	401	81	371
20	2.766	0.139	101	-0.05	1.98	1.21	351	331	79	488	382	84	354
30	4.158	0.139	101	-0.05	2	1.95	367	344	80	590	365	87	374
40	5.559	0.140	101	-0.06	1.99	2.01	398	372	81	684	358	89	404
50	6.965	0.141	101	-0.05	1.98	1.47	436	404	81	689	362	92	421
60	8.371	0.141	100	-0.04	1.99	1.38	441	422	80	563	370	94	403
70	9.780	0.141	#DIV/0!	-0.03	1.97	1.35	419	409	79	454	376	95	415
80	11.194	0.141	#DIV/0!	-0.03	1.96	1.94	399	393	79	393	372	97	389
90	12.606	0.141	#DIV/0!	-0.02	1.98	1.46	380	377	78	352	367	98	369
100	14.024	0.142	#DIV/0!	-0.02	1.98	1.35	360	356	77	322	360	99	350
110	15.439	0.142	#DIV/0!	-0.02	1.99	1.85	343	337	77	301	351	99	333
120	16.858	0.142	#DIV/0!	-0.02	1.98	2	329	321	77	288	337	100	319
130	18.275	0.142	#DIV/0!	-0.02	1.98	1.82	320	310	76	282	334	100	312

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
TECHNICIAN: BTNGEN
DATE: 10_13_16
RUN NUMBER: 2

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	83.6	0	0
End	720.147	100.7	0	0

Total Sample Volume - Vm
Total Sample Volume - Vm
Average Sample Rate
Sample Time
Average Meter Temperature
Total Sample Volume (Standard Conditions) - Vmstd

Total Particulates

Particulate Concentration (dry-standard)

Particulate Emission Rate

SAMPLE INFORMATION	
720.147	Liters
25.432	ft ³
0.42	ft ³ /min
60.00	Minutes
92.15	°F
24.131	dscf
0.6	mg
0.000024864	grams/dscf
0.000600000	grams/hour

JOB NUMBER 034_S_071_1

RUN # 2
DATE: 10_13_16

BURN RATE 2.02 KG/HR DRY

FILTER A PARTICULATE 2.4 mg

FILTER B PARTICULATE mg

Total Sample Volume - Vm
Average Gas Velocity in Dilution Tunnel - vs
Average Gas Flow Rate in Dilution Tunnel - Qsd
Total Sample Volume (Standard Conditions) - Vmstd

Average Tunnel Temperature
Average Delta p

Average Gas Meter Temperature
Average Delta H
Total Time of Test

Total Particulates

Particulate Concentration (dry-standard)
Ambient Train (dry-standard)
Net (dry-standard)
Particulate Emission Rate
Total PM Emissions

Average Total PM Emissions
AVERAGE PARTICULATE EMISSIONS RATE
% OF AVERAGE
Emissions Factor

SAMPLE A INFORMATION
8.48
13.23
8494.25
8.19

feet/second
dscf/hour
dscf

SAMPLE B INFORMATION

feet/second
dscf/hour
dscf

102.0	F
0.037	

	F

87	F
2.01	in-h20
60	min

	F
	in-h20
	min

2.4	mg
-----	----

	mg
--	----

0.00029	grams/dscf
0.000024864	grams/dscf
0.000268315	grams/dscf
2.28	grams/hour
2.28	grams

	grams/dscf
	grams/dscf
	grams/dscf
	grams/hour
	grams

	2.28
	1.14
200.0	
1.131	g/Kg -Dry

grams
grams/hour
0.0
0.000

PREBURN

JOB # 034_S_071_1 Model Designation TN10

TECHNICI/ BTNGEN

DATE: 10_14_16

RUN #: 3

READING INTERVAL: 10

.

Run Time: 60

Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.037	0.043	0.044	0.036	0.035	0.043	0.044	0.032
Temperature	110	110	110	110	110	110	110	110

0.039

110.000

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	4.3	-0.067	466	444	441	746	437	506.8
10	3.2	-0.055	482	455	307	725	434	480.6
20	2.2	-0.055	496	465	289	715	431	479.2
30	1.8	-0.041	496	484	283	619	428	462
40	1.6	-0.032	471	474	286	492	432	431
50	1.4	-0.029	435	435	281	408	432	398.2
60	1.2	-0.021	398	399	268	355	430	370

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 %
Dilution Tunnel Static: -0.400 In H2O
Tunnel Area: 0.196 ft²
Pitot Tube Cp: 0.99

Tunnel Velocity: 13.5904 ft/sec.
Intial Tunnel Flow: 144.497 scfm
Average Tunnel Flow: 145.261 scfm

Run # 3
 Date: 10/14/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.037	0.043	0.044	0.036	0.035	0.043	0.044	0.032
Temperature	110	110	110	110	110	110	110	110

0.039
110.000

Tunnel Velocity: 13.59 ft/sec.
 Intial Tunnel Flow: 144.5 scfm
 Average Tunnel Flow 145.26 scfm

JOB #

034_S_071_1

TECHNICIAN

BTNGEN

DATE:

10_14_16

RUN #:

3

READING INTERVAL:

10

SAMPLE BOX :

A

METER Y FACTOR:

1.007

PROBE MATERIAL:

SS

FRONT FILTER #:

2926&2931

REAR FILTER #:

2927

FINAL LEAK RATE (CFM):

<0.01

FINAL LEAK RATE (CFM):

<0.01

ROOM TEMP (F)

74.0

BAROMETRIC

BEG

MID

END

AVG

29.58

29.58

29.58

29.58

Run Time:

60

AMBIENT FILTER #:

2930

VOLUME

607.262

LITERS

FUEL MOISTURE DB

19.4

%

TEST START TIME:

11:40

FINAL LEAK RATE (CFM):

<0.01

@

5

IN-HG

1

2

3

4

5

6

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional	Scale	Weight	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
							Rate (%)	Weight	Chg							
0	0.000	0.000	0.039	0	-0.14		NA	5.2	0	95	222	75	283	469.15	80	74
10	1.394	0.139	0.039	2.01	-1.22	13.535	100	4.3	0.9	102	370	79	357	1046.13	81	74
20	2.802	0.141	0.039	2.02	-1.16	13.559	101	3.3	1	104	380	80	241	1037.72	83	74
30	4.214	0.141	0.039	2.01	-1.49	13.607	101	2.2	1.1	108	417	81	228	1164.75	87	74
40	5.631	0.142	0.039	2.01	-1.16	13.607	101	1.2	1	108	415	82	234	1131.24	90	74
50	7.053	0.142	0.039	2.01	-0.86	13.535	100	0.8	0.4	102	335	82	243	824.94	92	74
60	8.479	0.143	0.039	2.02	-0.95	13.475	99	0.6	0.2	97	275	81	248	682.29	95	74

JOB #	034_S_071_1									
TECHNICIAN	BTNGEN									
DATE:	10_14_16									
RUN #:	3									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:		1.002	PROBE MATERIAL:		SS			
FRONT FILTER #:	2928				REAR FILTER #:	2929				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: 110 Firebox Delta 1 20.35

							1	2	3	4	5	6	Run No
							TEMPERATURES						
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB TOP	FB BOT	METER	
0	0	0	NA	0	0	1	396	397	75	357	430	79	373
10	1.372	0.137	101	-0.05	1.97	1.53	363	357	78	452	412	80	388
20	2.751	0.138	101	-0.05	1.97	1.44	366	358	80	556	393	83	383
30	4.134	0.138	101	-0.06	2	1.49	387	375	81	649	379	86	404
40	5.528	0.139	101	-0.05	1.99	1.79	418	401	81	707	375	89	427
50	6.928	0.140	101	-0.04	1.97	1.95	437	425	81	627	378	91	422
60	8.328	0.140	100	-0.03	1.98	1.33	429	429	80	494	383	93	397
70	9.731	0.140	#DIV/0!	-0.03	1.98	1.4	414	411	80	416	385	95	407
80	11.139	0.141	#DIV/0!	-0.02	1.98	1.24	397	389	79	370	378	97	384
90	12.544	0.141	#DIV/0!	-0.02	1.97	1.86	381	369	78	341	374	98	366
100	13.955	0.141	#DIV/0!	-0.03	1.98	1.26	369	353	78	326	372	99	355
110	15.366	0.141	#DIV/0!	-0.02	1.97	1.22	363	345	78	320	381	99	352

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
TECHNICIAN: BTNGEN
DATE: 10_14_16
RUN NUMBER: 3

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	90.3	0	0
End	607.262	101.5	0	0

Total Sample Volume - Vm
Total Sample Volume - Vm
Average Sample Rate
Sample Time
Average Meter Temperature
Total Sample Volume (Standard Conditions) - Vmstd

Total Particulates

Particulate Concentration (dry-standard)

Particulate Emission Rate

SAMPLE INFORMATION	
607.262	Liters
21.445	ft ³
0.36	ft ³ /min
60.00	Minutes
95.9	°F
20.198	dscf
0.7	mg
0.000034657	grams/dscf
0.000700000	grams/hour

JOB NUMBER 034_S_071_1

RUN # 3
DATE: 10_14_16

BURN RATE 1.98 KG/HR DRY

FILTER A
PARTICULATE 1.8 mg

FILTER B
PARTICULATE mg

Total Sample Volume - Vm
Average Gas Velocity in Dilution Tunnel - vs
Average Gas Flow Rate in Dilution Tunnel - Qsd
Total Sample Volume (Standard Conditions) - Vmstd

Average Tunnel Temperature
Average Delta p

Average Gas Meter Temperature
Average Delta H
Total Time of Test

Total Particulates

Particulate Concentration (dry-standard)
Ambient Train (dry-standard)
Net (dry-standard)

Particulate Emission Rate
Total PM Emissions

Average Total PM Emissions
AVERAGE PARTICULATE
EMISSIONS RATE

% OF AVERAGE

Emissions Factor

SAMPLE A INFORMATION		SAMPLE B INFORMATION	
8.48			
13.59	feet/second		feet/second
8715.63	dscf/hour		dscf/hour
8.19	dscf		dscf
102.3	F		F
0.039			
87	F		F
2.01	in-h20		in-h20
60	min		min
1.8	mg		mg
0.00022	grams/dscf		grams/dscf
0.000034657	grams/dscf		grams/dscf
0.000185095	grams/dscf		grams/dscf
1.61	grams/hour		grams/hour
1.61	grams		grams
	1.61	grams	
	0.81	grams/hour	
200.0		0.0	
0.817	g/Kg -Dry	0.000	g/Kg -Dry

PREBURN

JOB # 034_S_071_1
TECHNICI/BTNGEN
DATE: 10_14_16
RUN #: 4
READING INTERVAL: 10

Model Designation TN10

Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.037	0.043	0.044	0.036	0.035	0.043	0.044	0.032
Temperature	120	120	120	120	120	120	120	120

0.039

120.000

Run Time: 60

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	6.9	-0.032	448	446	385	455	380	422.8
10	6	-0.061	381	371	193	444	347	347.2
20	4.6	-0.06	372	354	182	563	349	364
30	3.2	-0.063	402	395	185	666	373	404.2
40	2.2	-0.06	453	442	195	674	398	432.4
50	1.6	-0.046	469	452	204	543	416	416.8
60	1.4	-0.033	428	413	197	400	428	373.2

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 %
Dilution Tunnel Static: -0.400 In H2O
Tunnel Area: 0.196 ft²
Pitot Tube Cp: 0.99

Tunnel Velocity: 13.709 ft/sec.
Intial Tunnel Flow: 143.246 scfm
Average Tunnel Flow: 144.004 scfm

Run # 4
 Date: 10/14/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.037	0.043	0.044	0.036	0.035	0.043	0.044	0.032
Temperature	120	120	120	120	120	120	120	120

0.039
120.000

Tunnel Velocity:	13.709	ft/sec.
Intial Tunnel Flow:	143.25	scfm
Average Tunnel Flow	144	scfm

JOB #

034_S_071_1

TECHNICIAN

BTNGEN

DATE:

10_14_16

RUN #:

4

READING INTERVAL:

10

SAMPLE BOX :

A

METER Y FACTOR:

1.007

PROBE MATERIAL:

SS

ROOM TEMP (F)

74.6

BAROMETRIC

BEG

MID

END

AVG

29.58

29.58

29.58

29.58

FRONT FILTER #:

2932&2937

REAR FILTER #

REAR FILTER #:

2933

FINAL LEAK RATE (CFM)

<0.01

@

5

IN-HG

FINAL LEAK RATE (CFM)

<0.01

@

5

IN-HG

Run Time:

60

AMBIENT FILTER #:

2936

VOLUME

494.708

LITERS

FUEL MOISTURE DB

21

%

TEST START TIME:

16:51

FINAL LEAK RATE (CFM):

<0.01

@

5

IN-HG

1

2

3

4

5

6

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional	Scale	Weight	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
							Rate (%)	Weight	Chg							
0	0.000	0.000	0.039	0.01	-0.07		NA	5.4	0	104	275	77	196	565.35	83	74
10	1.399	0.140	0.039	2.01	-1.2	13.619	100	4.6	0.8	109	386	81	178	972.79	84	74
20	2.805	0.141	0.039	2.04	-0.96	13.703	101	3.4	1.2	116	453	82	162	1103.93	86	74
30	4.217	0.141	0.039	2.03	-1.35	13.739	101	2.2	1.2	119	465	83	159	1172.22	88	74
40	5.636	0.142	0.039	2.02	-1.51	13.739	101	1.3	0.9	119	476	84	162	1180.95	91	75
50	7.052	0.142	0.039	2.02	-1.47	13.667	100	0.7	0.6	113	394	84	172	860.49	93	75
60	8.477	0.143	0.039	2.02	-1.51	13.571	99	0.5	0.2	105	315	83	180	692.53	96	75

JOB #	034_S_071_1									
TECHNICIAN	BTNGEN									
DATE:	10_14_16									
RUN #:	4									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:		1.002	PROBE MATERIAL:		SS			
FRONT FILTER #:	2934				REAR FILTER #:	2935				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: 90 Firebox Delta 1 13.7

							1	2	3	4	5	6	Run No
							TEMPERATURES						
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB TOP	FB BOT	METER	
0	0	0	NA	0	0	1	425	410	77	392	428	83	370
10	1.376	0.138	100	-0.06	1.96	1.94	364	351	80	406	404	83	341
20	2.759	0.138	101	-0.06	1.98	1.77	352	332	82	514	377	85	347
30	4.147	0.139	101	-0.06	1.98	1.49	371	347	82	573	360	88	362
40	5.538	0.139	101	-0.06	1.98	1.63	397	379	84	601	355	90	379
50	6.932	0.139	100	-0.05	1.97	1.42	449	430	83	572	357	92	396
60	8.333	0.140	99	-0.04	1.97	2.01	447	432	83	444	360	95	373
70	9.738	0.141	#DIV/0!	-0.04	2.01	1.61	422	414	82	372	361	96	392
80	11.155	0.142	#DIV/0!	-0.04	1.99	1.73	397	389	81	336	366	98	372
90	12.572	0.142	#DIV/0!	-0.03	2.01	1.6	379	367	80	311	369	99	357

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
TECHNICIAN: BTNGEN
DATE: 10_14_16
RUN NUMBER: 4

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	85	0	0
End	494.708	101.5	0	0

Total Sample Volume - Vm
Total Sample Volume - Vm
Average Sample Rate
Sample Time
Average Meter Temperature
Total Sample Volume (Standard Conditions) - Vmstd

Total Particulates

Particulate Concentration (dry-standard)

Particulate Emission Rate

SAMPLE INFORMATION	
494.708	Liters
17.470	ft ³
0.29	ft ³ /min
60.00	Minutes
93.25	°F
16.533	dscf
0.7	mg
0.000042339	grams/dscf
0.000700000	grams/hour

JOB NUMBER 034_S_071_1

RUN # 4
DATE: 10_14_16

BURN RATE 2.02 KG/HR DRY

FILTER A PARTICULATE 2.1 mg

FILTER B PARTICULATE mg

Total Sample Volume - Vm
Average Gas Velocity in Dilution Tunnel - vs
Average Gas Flow Rate in Dilution Tunnel - Qsd
Total Sample Volume (Standard Conditions) - Vmstd

Average Tunnel Temperature
Average Delta p

Average Gas Meter Temperature
Average Delta H
Total Time of Test

Total Particulates

Particulate Concentration (dry-standard)
Ambient Train (dry-standard)
Net (dry-standard)
Particulate Emission Rate
Total PM Emissions

Average Total PM Emissions
AVERAGE PARTICULATE EMISSIONS RATE
% OF AVERAGE
Emissions Factor

SAMPLE A INFORMATION
8.48
13.71
8640.23
8.16

feet/second
dscf/hour
dscf

SAMPLE B INFORMATION

feet/second
dscf/hour
dscf

112.1	F
0.039	

	F

89	F
2.02	in-h20
60	min

	F
	in-h20
	min

2.1	mg
-----	----

	mg
--	----

0.00026	grams/dscf
0.000042339	grams/dscf
0.000214964	grams/dscf
1.86	grams/hour
1.86	grams

	grams/dscf
	grams/dscf
	grams/dscf
	grams/hour
	grams

	1.86
	0.93
200.0	
0.918	g/Kg -Dry

grams
grams/hour
0.0
0.000

PREBURN

JOB # 034_S_071_1

Model Designation TN10

TECHNICIAN/ BTN

DATE: 10_16_16

RUN #: 5

READING INTERVAL: 10

.

Run Time: 60

Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.032	0.044	0.044	0.035	0.033	0.036	0.042	0.030
Temperature	120	120	120	120	120	120	120	120

0.037

120.000

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	7	-0.036	510	497	376	543	422	469.6
10	5.8	-0.062	426	416	214	510	381	389.4
20	4.4	-0.069	422	396	197	603	364	396.4
30	3	-0.066	461	411	199	674	361	421.2
40	1.9	-0.056	496	445	206	689	371	441.4
50	1.5	-0.041	482	456	209	529	385	412.2
60	1.4	-0.036	447	414	204	395	402	372.4

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 %
Dilution Tunnel Static: -0.400 In H2O
Tunnel Area: 0.196 ft²
Pitot Tube Cp: 0.99

Tunnel Velocity: 13.3343 ft/sec.
Intial Tunnel Flow: 138.707 scfm
Average Tunnel Flow: 140.458 scfm

Run # 5
 Date: 10/16/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.032	0.044	0.044	0.035	0.033	0.036	0.042	0.030
Temperature	120	120	120	120	120	120	120	120

0.037
120.000

Tunnel Velocity:	13.334	ft/sec.
Intial Tunnel Flow:	138.71	scfm
Average Tunnel Flow	140.46	scfm

JOB #

034_S_071_1

TECHNICIAN

BTN

DATE:

10_16_16

RUN #:

5

READING INTERVAL:

10

SAMPLE BOX :

A

METER Y FACTOR:

1.007

ROOM TEMP (F)

75.0

BAROMETRIC

BEG

MID

END

AVG

29.47

29.47

29.47

29.47

FRONT FILTER #:

2938&2943

REAR FILTER #

REAR FILTER #:

2939

PROBE MATERIAL:

SS

FINAL LEAK RATE (CFM)

<0.01

@

5

IN-HG

FINAL LEAK RATE (CFM)

<0.01

@

5

IN-HG

Run Time:

60

AMBIENT FILTER #:

2942

VOLUME

493.225

LITERS

FUEL MOISTURE DB

21

%

TEST START TIME:

13:16

FINAL LEAK RATE (CFM):

<0.01

@

5

IN-HG

1

2

3

4

5

6

TEMPERATURES

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional	Scale	Weight	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
							Rate (%)	Weight	Chg							
0	0.000	0.000	0.037	0.01	-0.04		NA	5.3	0	100	276	76	204	559.49	77	75
10	1.396	0.140	0.037	2	-0.92	13.302	100	4.3	1	110	432	81	187	1073.58	79	75
20	2.799	0.140	0.037	2.01	-1.35	13.360	101	3	1.3	115	462	83	171	1116.07	81	75
30	4.215	0.142	0.037	2.03	-1.09	13.360	101	2	1	115	468	84	167	1158.72	85	75
40	5.630	0.142	0.037	2	-1.18	13.349	100	1.1	0.9	114	458	84	170	1062.65	88	75
50	7.053	0.142	0.037	2.01	-1.29	13.255	100	0.6	0.5	106	360	84	171	772.31	91	75
60	8.478	0.143	0.037	2.02	-0.85	13.173	99	0.5	0.1	99	297	83	173	657.53	94	75

JOB #	034_S_071_1									
TECHNICIAN	BTN									
DATE:	10_16_16									
RUN #:	5									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:	1.002	PROBE MATERIAL:			SS			
FRONT FILTER #:	2940				REAR FILTER #:	2941				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: **90** Firebox Delta 1 **21.85**

							1	2	3	4	5	6	Run No
							TEMPERATURES						
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB TOP	FB BOT	METER	
0	0	0	NA	0	0	1	446	411	76	390	402	77	371
10	1.373	0.137	101	-0.06	1.95	1.67	396	360	80	448	387	78	356
20	2.754	0.138	101	-0.06	1.98	1.91	388	351	82	561	376	81	369
30	4.140	0.139	101	-0.06	1.99	1.39	403	370	83	598	367	84	381
40	5.530	0.139	101	-0.06	1.97	1.96	431	398	83	621	366	87	397
50	6.930	0.140	100	-0.05	1.99	1.68	461	428	83	535	367	90	392
60	8.338	0.141	99	-0.04	1.99	1.73	437	419	82	418	366	93	363
70	9.746	0.141	#DIV/0!	-0.03	1.99	1.28	409	398	81	352	360	95	380
80	11.159	0.141	#DIV/0!	-0.03	1.99	1.75	383	374	80	314	352	96	356
90	12.573	0.141	#DIV/0!	-0.03	2.01	1.38	371	358	79	302	364	97	349

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
TECHNICIAN: BTN
DATE: 10_16_16
RUN NUMBER: 5

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	89	0	0
End	493.225	99.7	0	0

Total Sample Volume - Vm
Total Sample Volume - Vm
Average Sample Rate
Sample Time
Average Meter Temperature
Total Sample Volume (Standard Conditions) - Vmstd

Total Particulates

Particulate Concentration (dry-standard)
Particulate Emission Rate

SAMPLE INFORMATION	
493.225	Liters
17.418	ft³
0.29	ft³/min
60.00	Minutes
94.35	°F
16.390	dscf
0.4	mg
0.000024406	grams/dscf
0.000400000	grams/hour

JOB NUMBER

034_S_071_1

RUN #

5

DATE:

10_16_16

BURN RATE

1.99

KG/HR DRY

FILTER A
PARTICULATE

1.4

mg

FILTER B
PARTICULATE

mg

Total Sample Volume - Vm
 Average Gas Velocity in Dilution Tunnel - vs
 Average Gas Flow Rate in Dilution Tunnel - Qsd
 Total Sample Volume (Standard Conditions) - Vmstd

Average Tunnel Temperature
 Average Delta p

Average Gas Meter Temperature

Average Delta H

Total Time of Test

Total Particulates

Particulate Concentration (dry-standard)

Ambient Train (dry-standard)**Net (dry-standard)**

Particulate Emission Rate

Total PM Emissions

Average Total PM Emissions

AVERAGE PARTICULATE

EMISSIONS RATE

% OF AVERAGE

Emissions Factor

SAMPLE A
INFORMATION

8.48

13.33

8427.49

8.19

feet/second

dscf/hour

dscf

108.4

F

0.037

85

F

2.01

in-h20

60

min

1.4

mg

0.00017

grams/dscf

0.000024406

grams/dscf

0.000146586

grams/dscf

1.24

grams/hour

1.24

grams

1.24

grams

0.62

grams/hour

200.0

0.0

0.622

g/Kg -Dry

0.000

g/Kg -Dry

SAMPLE B
INFORMATION

feet/second

dscf/hour

dscf

F

F

in-h20

min

mg

grams/dscf

grams/dscf

grams/dscf

grams/hour

grams

PREBURN

JOB # 034_S_071_1

Model Designation TN10

TECHNICIAN BTNGEN

DATE: 10_13_16

RUN #: 1

READING INTERVAL: 10

.

Run Time: 60

Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.030	0.041	0.043	0.031	0.029	0.032	0.040	0.040
Temperature	100	100	100	100	100	100	100	100

0.036

100.000

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	4.2	-0.061	438	392	401	685	424	468
10	3.3	-0.054	453	408	277	662	415	443
20	2.4	-0.051	464	425	261	677	404	446.2
30	1.8	-0.04	462	443	253	612	398	433.6
40	1.7	-0.032	444	443	255	492	397	406.2
50	1.4	-0.025	414	412	245	402	403	375.2
60	1.3	-0.021	388	381	233	351	411	352.8

Dilution Tunnel MW(dry):	29.00	lb/lb-mole
Dilution Tunnel MW(wet):	28.78	lb/lb-mole
Dilution Tunnel H2O:	2.00	%
Dilution Tunnel Static:	-0.400	In H2O
Tunnel Area:	0.196	ft ²
Pitot Tube Cp:	0.99	

Tunnel Velocity:	12.958 ft/sec.
Initial Tunnel Flow:	139.01 scfm
Average Tunnel Flow:	140.631 scfm

Run # 1
 Date: 10/13/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.030	0.041	0.043	0.031	0.029	0.032	0.040	0.040
Temperature	100	100	100	100	100	100	100	100

0.036
100.000

Tunnel Velocity: 12.958 ft/sec.
 Intial Tunnel Flow: 139.01 scfm
 Average Tunnel Flow: 140.63 scfm

JOB #

034_S_071_1

TECHNICIAN

BTNGEN

DATE:

10_13_16

RUN #:

1

READING INTERVAL:

10

SAMPLE BOX :

A

METER Y FACTOR:

1.007

PROBE MATERIAL:

SS

ROOM TEMP (F)

73.0

BAROMETRIC

BEG

MID

END

AVG

29.6

29.6

29.6

29.6

FRONT FILTER #:

2914&2919

REAR FILTER #:

2915

FINAL LEAK RATE (CFM):

<0.01

FINAL LEAK RATE (CFM):

<0.01

@

5

IN-HG

@

5

IN-HG

Run Time:

130

TEST START TIME:

12:17

AMBIENT FILTER #:

2918

FINAL LEAK RATE (CFM):

<0.01

VOLUME

720.414

LITERS

IN-HG

FUEL MOISTURE DB

20.1

%

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional	Scale	Weight	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
							Rate (%)	Weight	Chg							
0	0.000	0.000	0.036	0.01	-0.05		NA	5.3	0	92	207	74	266	481.13	79	73
10	1.388	0.139	0.036	2.01	-1	12.930	101	4.7	0.6	96	298	77	323	820.55	80	72
20	2.784	0.140	0.036	2.01	-1.5	12.965	101	3.8	0.9	99	332	78	216	960.71	83	73
30	4.191	0.141	0.036	2.01	-1.45	13.023	102	2.8	1	104	403	80	207	1211.63	86	73
40	5.598	0.141	0.036	2	-0.89	13.046	101	1.8	1	106	415	80	212	1240.08	89	73
50	7.011	0.141	0.036	2	-1.1	13.023	101	1	0.8	104	375	81	219	1074.33	92	73
60	8.431	0.142	0.036	2.01	-1.48	12.930	100	0.8	0.2	96	266	80	221	662.13	94	73
70	9.862	0.143	0.036	2.03	-1.43	12.895	101	0.7	0.1	93	232	80	216	591.67	96	74
80	11.288	0.143	0.036	2.02	-0.66	12.872	100	0.6	0.1	91	217	79	213	555.48	98	73
90	12.723	0.144	0.036	2.02	-0.65	12.849	100	0.5	0.1	89	208	78	212	540.85	99	73
100	14.154	0.143	0.036	2.02	-1.16	12.837	99	0.4	0.1	88	201	78	211	520.29	100	73
110	15.585	0.143	0.036	2.02	-1.43	12.825	99	0.2	0.2	87	197	77	207	518.93	100	73
120	17.019	0.143	0.036	2.02	-1.36	12.825	99	0.1	0.1	87	192	77	197	494.28	101	73
130	18.448	0.143	0.036	2.02	-1.22	12.814	99	0	0.1	86	187	77	190	473.84	101	73

JOB #	034_S_071_1									
TECHNICIAN	BTNGEN									
DATE:	10_13_16									
RUN #:	1									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:	1.002	PROBE MATERIAL:			SS			
FRONT FILTER #:	2916				REAR FILTER #:	2917				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: 130 Firebox Delta T 58

							1	2	3	4	5	6		
							TEMPERATURES							
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB	FB	METER	STOVE AVG T	
										TOP	BOT			
0	0	0	NA	0	0	1	385	377	74	351	412	78	358	
10	1.365	0.137	100	-0.04	1.98	1.65	352	340	77	394	392	79	360	
20	2.737	0.137	101	-0.05	1.96	1.99	334	328	78	470	366	82	343	
30	4.117	0.138	101	-0.05	1.98	1.52	346	341	79	580	351	85	365	
40	5.503	0.139	101	-0.06	1.98	1.7	378	380	80	679	348	88	399	
50	6.891	0.139	101	-0.05	1.98	1.3	412	416	80	705	350	91	420	
60	8.296	0.141	101	-0.03	1.98	1.4	421	416	80	538	355	93	390	
70	9.702	0.141	100	-0.03	1.99	1.25	398	391	79	425	359	95	358	
80	11.110	0.141	100	-0.02	1.98	1.97	379	371	78	371	363	97	339	
90	12.524	0.141	100	-0.02	2	1.78	366	358	78	343	364	98	329	
100	13.937	0.141	100	-0.01	2	1.28	356	349	77	325	361	99	320	
110	15.355	0.142	100	-0.02	2	1.69	349	339	77	314	363	100	314	
120	16.770	0.142	99	-0.02	2	1.77	342	325	77	304	369	100	307	
130	18.190	0.142	99	-0.02	2	1.46	334	314	77	293	370	101	300	

Run No:

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
TECHNICIAN: BTNGEN
DATE: 10_13_16
RUN NUMBER: 1

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	87	0	0
End	720.414	101.2	0	0

Total Sample Volume - Vm
Total Sample Volume - Vm
Average Sample Rate
Sample Time
Average Meter Temperature
Total Sample Volume (Standard Conditions) - Vmstd

Total Particulates

Particulate Concentration (dry-standard)

Particulate Emission Rate

SAMPLE INFORMATION	
720.414	Liters
25.441	ft ³
0.20	ft ³ /min
130.00	Minutes
94.1	°F
24.055	dscf
0.2	mg
0.000008314	grams/dscf
0.000092308	grams/hour

JOB NUMBER

034_S_071_1

RUN #

1

DATE:

10_13_16

BURN RATE

0.92

KG/HR DRY

FILTER A
PARTICULATE

5.7

mg

FILTER B
PARTICULATE

5.7

mg

Total Sample Volume - Vm

Average Gas Velocity in Dilution Tunnel - vs

Average Gas Flow Rate in Dilution Tunnel - Qsd

Total Sample Volume (Standard Conditions) - Vmstd

SAMPLE A
INFORMATION

18.45

feet/second

12.96

dscf/hour

8437.86

dscf

17.64

SAMPLE B
INFORMATION

18.19

feet/second

12.96

dscf/hour

8437.86

dscf

17.34

Average Tunnel Temperature

94.1

F

Average Delta p

0.036

94.1

F

0.036

Average Gas Meter Temperature

93

F

Average Delta H

2.01

in-h20

Total Time of Test

130

min

92

F

1.99

in-h20

130

min

Total Particulates

5.7

mg

5.7

mg

Particulate Concentration (dry-standard)

0.00032

grams/dscf

Ambient Train (dry-standard)

0.000008314

grams/dscf

Net (dry-standard)

0.000314732

grams/dscf

Particulate Emission Rate

2.66

grams/hour

Total PM Emissions

5.75

grams

0.00033

grams/dscf

0.000008314

grams/dscf

0.00032046

grams/dscf

2.70

grams/hour

5.86

grams

Average Total PM Emissions

5.81

grams

AVERAGE PARTICULATE

2.68

grams/hour

EMISSIONS RATE

% OF AVERAGE

99.1

100.9

Emissions Factor

2.875

g/Kg -Dry

2.927

g/Kg -Dry

PREBURN

JOB # 034_S_071_1

Model Designation TN10

TECHNICIAN/ BTNGEN

DATE: 10_13_16

RUN #: 2

READING INTERVAL: 10

Run Time: 60

Tunnel Traverse Information

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	
dP	0.035	0.038	0.040	0.034	0.030	0.035	0.040	0.040	0.037
Temperature	100	100	100	100	100	100	100	100	100.000

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	4.3	-0.062	429	416	390	671	370	455.2
10	3.4	-0.053	446	418	281	645	385	435
20	2.7	-0.045	455	417	266	622	388	429.6
30	1.9	-0.048	453	427	253	616	385	426.8
40	1.6	-0.037	437	437	250	536	395	411
50	1.4	-0.026	422	416	253	427	409	385.4
60	1.3	-0.025	394	388	241	364	419	361.2

Dilution Tunnel MW(dry):	29.00	lb/lb-mole
Dilution Tunnel MW(wet):	28.78	lb/lb-mole
Dilution Tunnel H2O:	2.00	%
Dilution Tunnel Static:	-0.400	In H2O
Tunnel Area:	0.196	ft ²
Pitot Tube Cp:	0.99	

Tunnel Velocity:	13.1562 ft/sec.
Initial Tunnel Flow:	140.705 scfm
Average Tunnel Flow:	142.36 scfm

Run # 2
 Date: 10/13/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.035	0.038	0.040	0.034	0.030	0.035	0.040	0.040
Temperature	100	100	100	100	100	100	100	100

0.037
100.000

Tunnel Velocity: 13.156 ft/sec.
 Intial Tunnel Flow: 140.71 scfm
 Average Tunnel Flow: 142.36 scfm

JOB #034_S_071_1

TECHNICIANBTNGEN

DATE10_13_16

RUN #2

READING INTERVAL10

SAMPLE BOX :A

FRONT FILTER #:2920&2925

FINAL LEAK RATE (CFM)<0.01

METER Y FACTOR1.007

REAR FILTER #

REAR FILTER #2921

FINAL LEAK RATE (CFM)<0.01

ROOM TEMP (F)73.0

BAROMETRIC

BEG29.6

MID29.6

END29.6

AVG29.6

PROBE MATERIAL:SS

IN-HG

Run Time:130

TEST START TIME:17:52

AMBIENT FILTER #:2924

VOLUME720.147

FUEL MOISTURE DB19.3%

FINAL LEAK RATE (CFM)<0.01

IN-HG

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional Rate (%)	Scale Weight	Weight Chg	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
0	0.000	0.000	0.037	0.01	-0.07		NA	5.3	0	95	219	75	269	483.84	82	73
10	1.396	0.140	0.037	2	-1.16	13.144	101	4.6	0.7	99	319	79	330	872.24	82	73
20	2.802	0.141	0.037	1.99	-1.29	13.179	101	3.7	0.9	102	361	80	219	1043.23	84	73
30	4.209	0.141	0.037	2.01	-1.24	13.226	101	2.7	1	106	409	81	206	1236.64	87	73
40	5.629	0.142	0.037	2.03	-1.32	13.249	102	1.8	0.9	108	419	81	207	1217.65	90	73
50	7.046	0.142	0.037	2	-0.99	13.214	101	1	0.8	105	382	81	213	1016.95	92	73
60	8.475	0.143	0.037	2.01	-0.72	13.144	101	0.7	0.3	99	296	81	217	738.85	94	73
70	9.906	0.143	0.037	2	-1.21	13.097	100	0.6	0.1	95	254	80	219	637.38	96	73
80	11.340	0.143	0.037	2.03	-1.17	13.061	100	0.5	0.1	92	233	79	221	586.96	97	73
90	12.777	0.144	0.037	2.01	-0.72	13.038	100	0.4	0.1	90	215	78	220	532.72	98	73
100	14.213	0.144	0.037	2.02	-1.27	13.026	99	0.3	0.1	89	204	78	215	500.96	99	73
110	15.652	0.144	0.037	2.03	-0.82	13.014	99	0.2	0.1	88	196	77	210	480.49	100	73
120	17.095	0.144	0.037	2.04	-1.51	13.002	99	0.1	0.1	87	192	77	211	468.83	100	73
130	18.542	0.145	0.037	2.03	-0.67	12.990	100	0	0.1	86	191	77	207	472.95	100	73

JOB #	034_S_071_1									
TECHNICIAN	BTNGEN									
DATE:	10_13_16									
RUN #:	2									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:	1.002	PROBE MATERIAL:			SS			
FRONT FILTER #:	2922				REAR FILTER #:	2923				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: 130 Firebox Delta T 75.2

							1	2	3	4	5	6		
							TEMPERATURES							
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB	FB	METER	STOVE AVG T	
										TOP	BOT			
0	0	0	NA	0	0	1	392	385	75	363	420	81	366	
10	1.378	0.138	101	-0.04	1.97	1.73	359	345	78	421	401	81	371	
20	2.766	0.139	101	-0.05	1.98	1.21	351	331	79	488	382	84	354	
30	4.158	0.139	101	-0.05	2	1.95	367	344	80	590	365	87	374	
40	5.559	0.140	102	-0.06	1.99	2.01	398	372	81	684	358	89	404	
50	6.965	0.141	101	-0.05	1.98	1.47	436	404	81	689	362	92	421	
60	8.371	0.141	100	-0.04	1.99	1.38	441	422	80	563	370	94	403	
70	9.780	0.141	100	-0.03	1.97	1.35	419	409	79	454	376	95	375	
80	11.194	0.141	100	-0.03	1.96	1.94	399	393	79	393	372	97	356	
90	12.606	0.141	99	-0.02	1.98	1.46	380	377	78	352	367	98	339	
100	14.024	0.142	99	-0.02	1.98	1.35	360	356	77	322	360	99	323	
110	15.439	0.142	99	-0.02	1.99	1.85	343	337	77	301	351	99	308	
120	16.858	0.142	99	-0.02	1.98	2	329	321	77	288	337	100	297	
130	18.275	0.142	99	-0.02	1.98	1.82	320	310	76	282	334	100	291	

Run No:

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
TECHNICIAN: BTNGEN
DATE: 10_13_16
RUN NUMBER: 2

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	83.6	0	0
End	720.147	100.7	0	0

Total Sample Volume - Vm
Total Sample Volume - Vm
Average Sample Rate
Sample Time
Average Meter Temperature
Total Sample Volume (Standard Conditions) - Vmstd

Total Particulates

Particulate Concentration (dry-standard)
Particulate Emission Rate

SAMPLE INFORMATION	
720.147	Liters
25.432	ft³
0.20	ft³/min
130.00	Minutes
92.15	°F
24.131	dscf
0.6	mg
0.000024864	grams/dscf
0.000276923	grams/hour

JOB NUMBER

034_S_071_1

RUN #

2

DATE:

10_13_16

BURN RATE

0.93

KG/HR DRY

FILTER A
PARTICULATE

3.2

mg

FILTER B
PARTICULATE

3

mg

Total Sample Volume - Vm

Average Gas Velocity in Dilution Tunnel - vs

Average Gas Flow Rate in Dilution Tunnel - Qsd

Total Sample Volume (Standard Conditions) - Vmstd

SAMPLE A
INFORMATION

18.54

feet/second

13.16

dscf/hour

8541.60

dscf

17.73

SAMPLE B
INFORMATION

18.28

feet/second

13.16

dscf/hour

8541.60

dscf

17.40

Average Tunnel Temperature

95.8

F

Average Delta p

0.037

Average Gas Meter Temperature

93

F

Average Delta H

2.02

in-h20

Total Time of Test

130

min

Total Particulates

3.2

mg

Particulate Concentration (dry-standard)

0.00018

grams/dscf

Ambient Train (dry-standard)

0.000024864

grams/dscf

Net (dry-standard)

0.000155646

grams/dscf

Particulate Emission Rate

1.33

grams/hour

Total PM Emissions

2.88

grams

Average Total PM Emissions

2.81

AVERAGE PARTICULATE

1.30

EMISSIONS RATE

% OF AVERAGE

102.7

Emissions Factor

1.429

g/Kg -Dry

grams

grams/hour

97.3

1.356

g/Kg -Dry

PREBURN

JOB # 034_S_071_1

Model Designation TN10

TECHNICIAN BTNGEN

DATE: 10_14_16

RUN #: 3

READING INTERVAL: 10

.

Run Time: 60

Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.037	0.043	0.044	0.036	0.035	0.043	0.044	0.032
Temperature	110	110	110	110	110	110	110	110

0.039

110.000

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	4.3	-0.067	466	444	441	746	437	506.8
10	3.2	-0.055	482	455	307	725	434	480.6
20	2.2	-0.055	496	465	289	715	431	479.2
30	1.8	-0.041	496	484	283	619	428	462
40	1.6	-0.032	471	474	286	492	432	431
50	1.4	-0.029	435	435	281	408	432	398.2
60	1.2	-0.021	398	399	268	355	430	370

Dilution Tunnel MW(dry):	29.00	lb/lb-mole
Dilution Tunnel MW(wet):	28.78	lb/lb-mole
Dilution Tunnel H2O:	2.00	%
Dilution Tunnel Static:	-0.400	In H2O
Tunnel Area:	0.196	ft ²
Pitot Tube Cp:	0.99	

Tunnel Velocity:	13.5355 ft/sec.
Initial Tunnel Flow:	144.497 scfm
Average Tunnel Flow:	145.85 scfm

Run # 3
 Date: 10/14/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.037	0.043	0.044	0.036	0.035	0.043	0.044	0.032
Temperature	110	110	110	110	110	110	110	110

0.039
110.000

Tunnel Velocity: 13.535 ft/sec.
 Intial Tunnel Flow: 144.5 scfm
 Average Tunnel Flow 145.85 scfm

JOB #034_S_071_1

TECHNICIANBTNGEN

DATE10_14_16

RUN #3

READING INTERVAL10

SAMPLE BOX :A

FRONT FILTER #:2926&2931

FINAL LEAK RATE (CFM)<0.01

METER Y FACTOR:1.007

REAR FILTER #

REAR FILTER #:2927

FINAL LEAK RATE (CFM)<0.01

ROOM TEMP (F)74.0

BAROMETRIC

PROBE MATERIAL:SS

IN-HG

BEG29.58

MID29.58

END29.58

AVG29.58

Run Time:110

TEST START TIME:11:40

AMBIENT FILTER #:2930

FINAL LEAK RATE (CFM):<0.01

VOLUME607.262

LITERS

IN-HG

FUEL MOISTURE DB19.4%

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional Rate (%)	Scale Weight	Weight Chg	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
0	0.000	0.000	0.039	0	-0.14		NA	5.2	0	95	222	75	283	469.15	80	74
10	1.394	0.139	0.039	2.01	-1.22	13.535	101	4.3	0.9	102	370	79	357	1046.13	81	74
20	2.802	0.141	0.039	2.02	-1.16	13.559	101	3.3	1	104	380	80	241	1037.72	83	74
30	4.214	0.141	0.039	2.01	-1.49	13.607	101	2.2	1.1	108	417	81	228	1164.75	87	74
40	5.631	0.142	0.039	2.01	-1.16	13.607	101	1.2	1	108	415	82	234	1131.24	90	74
50	7.053	0.142	0.039	2.01	-0.86	13.535	101	0.8	0.4	102	335	82	243	824.94	92	74
60	8.479	0.143	0.039	2.02	-0.95	13.475	100	0.6	0.2	97	275	81	248	682.29	95	74
70	9.914	0.144	0.039	2.03	-1.45	13.439	100	0.5	0.1	94	244	81	245	594.78	96	74
80	11.348	0.143	0.039	2.03	-0.7	13.414	99	0.3	0.2	92	230	80	239	574.67	98	74
90	12.785	0.144	0.039	2.04	-0.63	13.402	99	0.1	0.2	91	218	79	231	530.63	99	74
100	14.228	0.144	0.039	2.04	-0.8	13.390	99	0.1	0	90	221	79	224	561.35	100	74
110	15.672	0.144	0.039	2.03	-1.27	13.390	99	0	0.1	90	212	79	220	522.46	101	74

JOB #	034_S_071_1									
TECHNICIAN	BTNGEN									
DATE:	10_14_16									
RUN #:	3									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:	1.002	PROBE MATERIAL:			SS			
FRONT FILTER #:	2928				REAR FILTER #:	2929				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: **110** Firebox Delta T **46.8**

							1	2	3	4	5	6		
							TEMPERATURES							
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB TOP	FB BOT	METER	STOVE AVG T	
0	0	0	NA	0	0	1	396	397	75	357	430	79	373	
10	1.372	0.137	101	-0.05	1.97	1.53	363	357	78	452	412	80	388	
20	2.751	0.138	101	-0.05	1.97	1.44	366	358	80	556	393	83	383	
30	4.134	0.138	101	-0.06	2	1.49	387	375	81	649	379	86	404	
40	5.528	0.139	101	-0.05	1.99	1.79	418	401	81	707	375	89	427	
50	6.928	0.140	101	-0.04	1.97	1.95	437	425	81	627	378	91	422	
60	8.328	0.140	100	-0.03	1.98	1.33	429	429	80	494	383	93	397	
70	9.731	0.140	100	-0.03	1.98	1.4	414	411	80	416	385	95	374	
80	11.139	0.141	100	-0.02	1.98	1.24	397	389	79	370	378	97	355	
90	12.544	0.141	99	-0.02	1.97	1.86	381	369	78	341	374	98	339	
100	13.955	0.141	99	-0.03	1.98	1.26	369	353	78	326	372	99	329	
110	15.366	0.141	99	-0.02	1.97	1.22	363	345	78	320	381	99	326	

Run No:

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
TECHNICIAN: BTNGEN
DATE: 10_14_16
RUN NUMBER: 3

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	90.3	0	0
End	607.262	101.5	0	0

Total Sample Volume - Vm
Total Sample Volume - Vm
Average Sample Rate
Sample Time
Average Meter Temperature
Total Sample Volume (Standard Conditions) - Vmstd

Total Particulates

Particulate Concentration (dry-standard)
Particulate Emission Rate

SAMPLE INFORMATION	
607.262	Liters
21.445	ft ³
0.19	ft ³ /min
110.00	Minutes
95.9	°F
20.198	dscf
0.7	mg
0.000034657	grams/dscf
0.000381818	grams/hour

JOB NUMBER

034_S_071_1

RUN #

3

DATE:

10_14_16

BURN RATE

1.08

KG/HR DRY

FILTER A
PARTICULATE

3

mg

FILTER B
PARTICULATE

2.7

mg

Total Sample Volume - Vm

Average Gas Velocity in Dilution Tunnel - vs

Average Gas Flow Rate in Dilution Tunnel - Qsd

Total Sample Volume (Standard Conditions) - Vmstd

SAMPLE A
INFORMATION

15.67

feet/second

13.54

dscf/hour

8751.00

dscf

15.00

SAMPLE B
INFORMATION

15.37

feet/second

13.54

dscf/hour

8751.00

dscf

14.66

Average Tunnel Temperature

97.8

F

Average Delta p

0.039

Average Gas Meter Temperature

92

F

Average Delta H

2.02

in-h20

Total Time of Test

110

min

Total Particulates

3

mg

Particulate Concentration (dry-standard)

0.00020

grams/dscf

Ambient Train (dry-standard)

0.000034657

grams/dscf

Net (dry-standard)

0.000165295

grams/dscf

Particulate Emission Rate

1.45

grams/hour

Total PM Emissions

2.65

grams

Average Total PM Emissions

2.52

AVERAGE PARTICULATE

1.38

EMISSIONS RATE

% OF AVERAGE

105.0

Emissions Factor

1.342

g/Kg -Dry

grams

grams/hour

95.0

1.214

g/Kg -Dry

PREBURN

JOB # 034_S_071_1

Model Designation TN10

TECHNICIAN BTNGEN

DATE: 10_14_16

RUN #: 4

READING INTERVAL: 10

.

Run Time: 60

Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.037	0.043	0.044	0.036	0.035	0.043	0.044	0.032
Temperature	120	120	120	120	120	120	120	120

0.039

120.000

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	6.9	-0.032	448	446	385	455	380	422.8
10	6	-0.061	381	371	193	444	347	347.2
20	4.6	-0.06	372	354	182	563	349	364
30	3.2	-0.063	402	395	185	666	373	404.2
40	2.2	-0.06	453	442	195	674	398	432.4
50	1.6	-0.046	469	452	204	543	416	416.8
60	1.4	-0.033	428	413	197	400	428	373.2

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 %
Dilution Tunnel Static: -0.400 In H2O
Tunnel Area: 0.196 ft²
Pitot Tube Cp: 0.99

Tunnel Velocity: 13.6605 ft/sec.
Intial Tunnel Flow: 143.246 scfm
Average Tunnel Flow: 144.515 scfm

Run # 4
 Date: 10/14/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.037	0.043	0.044	0.036	0.035	0.043	0.044	0.032
Temperature	120	120	120	120	120	120	120	120

0.039
120.000

Tunnel Velocity:	13.661	ft/sec.
Intial Tunnel Flow:	143.25	scfm
Average Tunnel Flow	144.52	scfm

JOB #

034_S_071_1

TECHNICIAN

BTNGEN

DATE:

10_14_16

RUN #:

4

READING INTERVAL:

10

SAMPLE BOX :

A

METER Y FACTOR:

1.007

PROBE MATERIAL:

SS

FRONT FILTER #:

2932&2937

REAR FILTER #:

2933

FINAL LEAK RATE (CFM):

<0.01

FINAL LEAK RATE (CFM):

<0.01

ROOM TEMP (F)

74.6

BAROMETRIC

BEG

MID

END

AVG

29.58

29.58

29.58

29.58

Run Time:

90

TEST START TIME:

16:51

AMBIENT FILTER #:

2936

VOLUME

494.708

LITERS

FUEL MOISTURE DB

21

%

FINAL LEAK RATE (CFM):

<0.01

IN-HG

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional	Scale	Weight	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
							Rate (%)	Weight	Chg							
0	0.000	0.000	0.039	0.01	-0.07		NA	5.4	0	104	275	77	196	565.35	83	74
10	1.399	0.140	0.039	2.01	-1.2	13.619	100	4.6	0.8	109	386	81	178	972.79	84	74
20	2.805	0.141	0.039	2.04	-0.96	13.703	101	3.4	1.2	116	453	82	162	1103.93	86	74
30	4.217	0.141	0.039	2.03	-1.35	13.739	101	2.2	1.2	119	465	83	159	1172.22	88	74
40	5.636	0.142	0.039	2.02	-1.51	13.739	101	1.3	0.9	119	476	84	162	1180.95	91	75
50	7.052	0.142	0.039	2.02	-1.47	13.667	100	0.7	0.6	113	394	84	172	860.49	93	75
60	8.477	0.143	0.039	2.02	-1.51	13.571	100	0.5	0.2	105	315	83	180	692.53	96	75
70	9.912	0.144	0.039	2.04	-0.68	13.523	100	0.3	0.2	101	286	83	179	637.39	97	75
80	11.342	0.143	0.039	2.01	-1.29	13.499	99	0.2	0.1	99	270	82	171	609.02	99	75
90	12.780	0.144	0.039	2.02	-1.49	13.463	99	0	0.2	96	253	81	164	554.42	100	75

JOB #	034_S_071_1									
TECHNICIAN	BTNGEN									
DATE:	10_14_16									
RUN #:	4									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:		1.002	PROBE MATERIAL:		SS			
FRONT FILTER #:	2934				REAR FILTER #:	2935				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: 90

Firebox Delta 1 52.2

							1	2	3	4	5	6		
							TEMPERATURES							
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB	FB	METER	STOVE AVG T	
										TOP	BOT			
0	0	0	NA	0	0	1	425	410	77	392	428	83	370	
10	1.376	0.138	100	-0.06	1.96	1.94	364	351	80	406	404	83	341	
20	2.759	0.138	101	-0.06	1.98	1.77	352	332	82	514	377	85	347	
30	4.147	0.139	101	-0.06	1.98	1.49	371	347	82	573	360	88	362	
40	5.538	0.139	101	-0.06	1.98	1.63	397	379	84	601	355	90	379	
50	6.932	0.139	100	-0.05	1.97	1.42	449	430	83	572	357	92	396	
60	8.333	0.140	100	-0.04	1.97	2.01	447	432	83	444	360	95	373	
70	9.738	0.141	99	-0.04	2.01	1.61	422	414	82	372	361	96	350	
80	11.155	0.142	100	-0.04	1.99	1.73	397	389	81	336	366	98	332	
90	12.572	0.142	99	-0.03	2.01	1.6	379	367	80	311	369	99	318	

Run No

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
 TECHNICIAN: BTNGEN
 DATE: 10_14_16
 RUN NUMBER: 4

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	85	0	0
End	494.708	101.5	0	0

Total Sample Volume - Vm
 Total Sample Volume - Vm
 Average Sample Rate
 Sample Time
 Average Meter Temperature
 Total Sample Volume (Standard Conditions) - Vmstd

SAMPLE INFORMATION	
494.708	Liters
17.470	ft ³
0.19	ft ³ /min
90.00	Minutes
93.25	°F
16.533	dscf
0.7	mg
0.000042339	grams/dscf
0.000466667	grams/hour

Total Particulates

Particulate Concentration (dry-standard)
 Particulate Emission Rate

JOB NUMBER

034_S_071_1

RUN #

4

DATE:

10_14_16

BURN RATE

1.35

KG/HR DRY

FILTER A
PARTICULATE

3

mg

FILTER B
PARTICULATE

3

mg

Total Sample Volume - Vm

Average Gas Velocity in Dilution Tunnel - vs

Average Gas Flow Rate in Dilution Tunnel - Qsd

Total Sample Volume (Standard Conditions) - Vmstd

Average Tunnel Temperature

Average Delta p

Average Gas Meter Temperature

Average Delta H

Total Time of Test

Total Particulates

Particulate Concentration (dry-standard)

Ambient Train (dry-standard)**Net (dry-standard)**

Particulate Emission Rate

Total PM Emissions

Average Total PM Emissions

AVERAGE PARTICULATE

EMISSIONS RATE

% OF AVERAGE

Emissions Factor

SAMPLE A
INFORMATION

12.78

13.66

8670.92

12.24

feet/second

dscf/hour

dscf

108.1

F

0.039

92

F

2.02

in-h20

90

min

3

mg

0.00025

grams/dscf

0.000042339

grams/dscf

0.000202801

grams/dscf

1.76

grams/hour

2.64

grams

2.67

grams

1.78

grams/hour

98.8

1.303

g/Kg -Dry

SAMPLE B
INFORMATION

12.57

13.66

8670.92

12.00

feet/second

dscf/hour

dscf

108.1

F

0.039

91

F

1.98

in-h20

90

min

3

mg

0.00025

grams/dscf

0.000042339

grams/dscf

0.00020776

grams/dscf

1.80

grams/hour

2.70

grams

PREBURN

JOB # 034_S_071_1

Model Designation TN10

TECHNICIAN/ BTN

DATE: 10_16_16

RUN #: 5

READING INTERVAL: 10

.

Run Time: 60

Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.032	0.044	0.044	0.035	0.033	0.036	0.042	0.030
Temperature	120	120	120	120	120	120	120	120

0.037

120.000

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	7	-0.036	510	497	376	543	422	469.6
10	5.8	-0.062	426	416	214	510	381	389.4
20	4.4	-0.069	422	396	197	603	364	396.4
30	3	-0.066	461	411	199	674	361	421.2
40	1.9	-0.056	496	445	206	689	371	441.4
50	1.5	-0.041	482	456	209	529	385	412.2
60	1.4	-0.036	447	414	204	395	402	372.4

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 %
Dilution Tunnel Static: -0.400 In H2O
Tunnel Area: 0.196 ft²
Pitot Tube Cp: 0.99

Tunnel Velocity: 13.2811 ft/sec.
Intial Tunnel Flow: 138.707 scfm
Average Tunnel Flow: 141.021 scfm

Run # 5
 Date: 10/16/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.032	0.044	0.044	0.035	0.033	0.036	0.042	0.030
Temperature	120	120	120	120	120	120	120	120

0.037
120.000

Tunnel Velocity:	13.281	ft/sec.
Intial Tunnel Flow:	138.71	scfm
Average Tunnel Flow	141.02	scfm

JOB #034_S_071_1

TECHNICIANBTN

DATE10_16_16

RUN #5

READING INTERVAL10

SAMPLE BOX :A

METER Y FACTOR:1.007

PROBE MATERIAL:SS

ROOM TEMP (F)75.0

BAROMETRIC

BEG29.47

MID29.47

END29.47

AVG29.47

FRONT FILTER #:2938&2943

REAR FILTER #

REAR FILTER #:2939

FINAL LEAK RATE (CFM)<0.01

@

5

IN-HG

FINAL LEAK RATE (CFM)<0.01

@

5

IN-HG

Run Time:90

AMBIENT FILTER #:2942

VOLUME493.225

LITERS

FUEL MOISTURE DB21

%

FINAL LEAK RATE (CFM):<0.01

@

5

IN-HG

TEST START TIME:13:16

1

2

3

4

5

6

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional	Scale	Weight	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
							Rate (%)	Weight	Chg							
0	0.000	0.000	0.037	0.01	-0.04		NA	5.3	0	100	276	76	204	559.49	77	75
10	1.396	0.140	0.037	2	-0.92	13.302	101	4.3	1	110	432	81	187	1073.58	79	75
20	2.799	0.140	0.037	2.01	-1.35	13.360	101	3	1.3	115	462	83	171	1116.07	81	75
30	4.215	0.142	0.037	2.03	-1.09	13.360	102	2	1	115	468	84	167	1158.72	85	75
40	5.630	0.142	0.037	2	-1.18	13.349	101	1.1	0.9	114	458	84	170	1062.65	88	75
50	7.053	0.142	0.037	2.01	-1.29	13.255	100	0.6	0.5	106	360	84	171	772.31	91	75
60	8.478	0.143	0.037	2.02	-0.85	13.173	99	0.5	0.1	99	297	83	173	657.53	94	75
70	9.914	0.144	0.037	2.04	-1.29	13.126	99	0.4	0.1	95	268	82	174	588.16	96	75
80	11.353	0.144	0.037	2.02	-1.5	13.102	99	0.2	0.2	93	254	81	171	568.52	97	75
90	12.790	0.144	0.037	2.02	-0.99	13.090	99	0	0.2	92	254	80	164	571.77	98	75

JOB #	034_S_071_1									
TECHNICIAN	BTN									
DATE:	10_16_16									
RUN #:	5									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:		1.002	PROBE MATERIAL:		SS			
FRONT FILTER #:	2940				REAR FILTER #:	2941				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: 90

Firebox Delta 1 58.8

							1	2	3	4	5	6		
							TEMPERATURES							
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB	FB	METER	STOVE AVG T	
										TOP	BOT			
0	0	0	NA	0	0	1	446	411	76	390	402	77	371	
10	1.373	0.137	101	-0.06	1.95	1.67	396	360	80	448	387	78	356	
20	2.754	0.138	101	-0.06	1.98	1.91	388	351	82	561	376	81	369	
30	4.140	0.139	101	-0.06	1.99	1.39	403	370	83	598	367	84	381	
40	5.530	0.139	101	-0.06	1.97	1.96	431	398	83	621	366	87	397	
50	6.930	0.140	100	-0.05	1.99	1.68	461	428	83	535	367	90	392	
60	8.338	0.141	100	-0.04	1.99	1.73	437	419	82	418	366	93	363	
70	9.746	0.141	99	-0.03	1.99	1.28	409	398	81	352	360	95	339	
80	11.159	0.141	99	-0.03	1.99	1.75	383	374	80	314	352	96	319	
90	12.573	0.141	99	-0.03	2.01	1.38	371	358	79	302	364	97	312	

Run No

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
TECHNICIAN: BTN
DATE: 10_16_16
RUN NUMBER: 5

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	89	0	0
End	493.225	99.7	0	0

Total Sample Volume - Vm
Total Sample Volume - Vm
Average Sample Rate
Sample Time
Average Meter Temperature
Total Sample Volume (Standard Conditions) - Vmstd

Total Particulates

Particulate Concentration (dry-standard)
Particulate Emission Rate

SAMPLE INFORMATION	
493.225	Liters
17.418	ft ³
0.19	ft ³ /min
90.00	Minutes
94.35	°F
16.390	dscf
0.4	mg
0.000024406	grams/dscf
0.000266667	grams/hour

JOB NUMBER

034_S_071_1

RUN #

5

DATE:

10_16_16

BURN RATE

1.32

KG/HR DRY

FILTER A
PARTICULATE

2

mg

FILTER B
PARTICULATE

2

mg

Total Sample Volume - Vm

Average Gas Velocity in Dilution Tunnel - vs

Average Gas Flow Rate in Dilution Tunnel - Qsd

Total Sample Volume (Standard Conditions) - Vmstd

Average Tunnel Temperature

Average Delta p

Average Gas Meter Temperature

Average Delta H

Total Time of Test

Total Particulates

Particulate Concentration (dry-standard)

Ambient Train (dry-standard)

Net (dry-standard)

Particulate Emission Rate

Total PM Emissions

Average Total PM Emissions

AVERAGE PARTICULATE

EMISSIONS RATE

% OF AVERAGE

Emissions Factor

SAMPLE A
INFORMATION

12.79

13.28

8461.26

12.27

feet/second

dscf/hour

dscf

103.9

F

0.037

89

F

2.02

in-h20

90

min

2

mg

0.00016

grams/dscf

0.000024406

grams/dscf

0.000138582

grams/dscf

1.17

grams/hour

1.76

grams

1.78

grams

1.19

grams/hour

98.8

0.885

g/Kg -Dry

SAMPLE B
INFORMATION

12.57

13.28

8461.26

12.02

feet/second

dscf/hour

dscf

103.9

F

0.037

88

F

1.98

in-h20

90

min

2

mg

0.00017

grams/dscf

0.000024406

grams/dscf

0.00014199

grams/dscf

1.20

grams/hour

1.80

grams

PREBURN

JOB # 034_S_071_1

Model Designation TN10

TECHNICIAN/ BTN

DATE: 10_16_16

RUN #: 6

READING INTERVAL: 10

.

Run Time: 60

Tunnel Traverse Information								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.038	0.042	0.040	0.038	0.030	0.036	0.040	0.030
Temperature	100	100	100	100	100	100	100	100

0.037

100.000

			1	2	3	4	5	
			TEMPERATURES					
ET	SCALE READING	FLUE DRAFT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM	STOVE AVG T
0	4.3	-0.067	466	400	412	744	383	481
10	3.2	-0.059	491	424	426	752	383	495.2
20	2.3	-0.054	507	447	435	756	382	505.4
30	1.9	-0.047	500	462	433	675	381	490.2
40	1.8	-0.038	478	449	423	548	383	456.2
50	1.5	-0.031	458	428	415	468	393	432.4
60	1.3	-0.028	431	394	396	404	392	403.4

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.78 lb/lb-mole
Dilution Tunnel H2O: 2.00 %
Dilution Tunnel Static: -0.400 In H2O
Tunnel Area: 0.196 ft²
Pitot Tube Cp: 0.99

Tunnel Velocity: 13.2041 ft/sec.
Intial Tunnel Flow: 140.787 scfm
Average Tunnel Flow: 141.843 scfm

Run # 6
 Date: 10/16/16

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Dilution Tunnel H2O: 2.00 %
 Dilution Tunnel Static: -0.400 In H2O
 Tunnel Area: 0.196 ft²
 Pitot Tube Cp: 0.99

Dilution Tunnel Traverse Data								
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8
dP	0.038	0.042	0.040	0.038	0.030	0.036	0.040	0.030
Temperature	100	100	100	100	100	100	100	100

0.037
100.000

Tunnel Velocity:	13.204	ft/sec.
Intial Tunnel Flow:	140.79	scfm
Average Tunnel Flow	141.84	scfm

JOB #

034_S_071_1

TECHNICIAN

BTN

DATE:

10_16_16

RUN #:

6

READING INTERVAL:

10

SAMPLE BOX :

A

METER Y FACTOR:

1.007

PROBE MATERIAL:

SS

ROOM TEMP (F)

74.8

BAROMETRIC

BEG

MID

END

AVG

29.47

29.47

29.47

29.47

FRONT FILTER #:

2944&2949

REAR FILTER #:

2945

FINAL LEAK RATE (CFM)

<0.01

@

5

IN-HG

FINAL LEAK RATE (CFM)

<0.01

@

5

IN-HG

Run Time:

120

AMBIENT FILTER #:

2948

VOLUME

657.398

LITERS

FUEL MOISTURE DB

20.3

%

TEST START TIME:

17:55

FINAL LEAK RATE (CFM):

<0.01

@

5

IN-HG

1

2

3

4

5

6

ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	TUNNEL DELTA P	ORIFICE DELTA H	FILTER VAC	TUNNEL VEL FT/SEC	Proportional	Scale	Weight	TUNNEL TEMP	FLUE TEMP	FILTER TEMP	FB REAR TEMP	FB INT	METER TEMP	AMBIENT TEMP
							Rate (%)	Weight	Chg							
0	0.000	0.000	0.037	0.01	-0.06		NA	5.3	0	95	229	77	395	491.36	81	75
10	1.400	0.140	0.037	2.01	-1.51	13.208	101	4.4	0.9	102	368	80	365	1067.6	82	75
20	2.819	0.142	0.037	2.02	-1.45	13.232	102	3.4	1	104	395	81	348	1178.08	84	75
30	4.234	0.142	0.037	2.01	-0.92	13.279	101	2.3	1.1	108	429	82	350	1254.26	87	75
40	5.659	0.143	0.037	1.99	-1.38	13.290	102	1.4	0.9	109	434	83	365	1190.59	90	75
50	7.082	0.142	0.037	2.03	-0.66	13.232	101	0.8	0.6	104	365	83	377	940.01	92	75
60	8.514	0.143	0.037	2.02	-1.56	13.161	100	0.6	0.2	98	297	82	383	740.74	94	75
70	9.952	0.144	0.037	2.04	-0.87	13.126	100	0.5	0.1	95	266	82	386	667.78	96	75
80	11.389	0.144	0.037	2.03	-1.62	13.102	100	0.4	0.1	93	249	81	381	629.34	97	75
90	12.830	0.144	0.037	2.03	-1.5	13.078	100	0.3	0.1	91	235	80	374	571.43	98	75
100	14.274	0.144	0.037	2.03	-1.1	13.067	100	0.1	0.2	90	221	79	360	540.01	99	75
110	15.715	0.144	0.037	2.03	-1.42	13.055	99	0.1	0	89	214	79	343	521.11	100	74
120	17.154	0.144	0.037	2.04	-1.17	13.043	99	0	0.1	88	207	78	330	499.93	100	74

JOB #	034_S_071_1									
TECHNICIAN	BTN									
DATE:	10_16_16									
RUN #:	6									
READING INTERVAL:	10									
SAMPLE BOX :	B	METER Y FACTOR:		1.002	PROBE MATERIAL:		SS			
FRONT FILTER #:	2946				REAR FILTER #:	2947				
FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	FINAL LEAK RATE (CFM)	<0.01	@	5	IN-HG	

Run Time: 120 Firebox Delta 1 60.8

							1	2	3	4	5	6	
							TEMPERATURES						
ET	GAS METER VOLUME	SAMPLE RATE(FT3/MIN)	PROPORTIONAL RATE	FLUE DRAFT	ORIFICE DELTA H	FILTER VAC	LEFT SIDE	RIGHT SIDE	FILTER	FB	FB	METER	STOVE AVG T
										TOP	BOT		
0	0	0	NA	0	0	1	428	391	77	402	391	81	401
10	1.382	0.138	101	-0.05	1.98	1.66	382	345	80	465	370	81	385
20	2.770	0.139	101	-0.06	1.97	1.77	376	339	81	556	357	84	395
30	4.166	0.140	101	-0.06	2.02	1.64	398	368	82	686	351	86	431
40	5.570	0.140	102	-0.06	1.98	1.63	429	404	82	751	353	89	460
50	6.979	0.141	101	-0.05	2	1.9	456	437	82	695	359	92	465
60	8.389	0.141	100	-0.03	2	2.04	454	445	81	565	365	94	442
70	9.806	0.142	100	-0.03	1.99	1.55	434	430	81	479	368	95	419
80	11.220	0.141	99	-0.03	2	1.69	414	411	80	431	363	97	400
90	12.641	0.142	100	-0.02	1.99	1.71	398	391	79	400	356	98	384
100	14.060	0.142	99	-0.03	1.99	1.28	383	368	79	373	357	98	368
110	15.484	0.142	99	-0.03	1.99	1.65	368	347	78	351	356	99	353
120	16.905	0.142	99	-0.02	1.99	1.33	355	330	78	338	350	99	341

Run No

Ambient Sample Results:

JOB NUMBER: 034_S_071_1
TECHNICIAN: BTN
DATE: 10_16_16
RUN NUMBER: 6

METER Y FACTOR: **1.003**

	<u>Sample Volume (L)</u>	<u>Meter Temp °F</u>	<u>ΔH</u>	<u>ΔP</u>
Start	0	83	0	0
End	657.398	100.5	0	0

Total Sample Volume - Vm
Total Sample Volume - Vm
Average Sample Rate
Sample Time
Average Meter Temperature
Total Sample Volume (Standard Conditions) - Vmstd

Total Particulates

Particulate Concentration (dry-standard)

Particulate Emission Rate

SAMPLE INFORMATION	
657.398	Liters
23.216	ft ³
0.19	ft ³ /min
120.00	Minutes
91.75	°F
21.948	dscf
0.0	mg
0.000000000	grams/dscf
0.000000000	grams/hour

JOB NUMBER

034_S_071_1

RUN #

6

DATE:

10_16_16

BURN RATE

1.00

KG/HR DRY

FILTER A
PARTICULATE

3.8

mg

FILTER B
PARTICULATE

3.7

mg

Total Sample Volume - Vm

Average Gas Velocity in Dilution Tunnel - vs

Average Gas Flow Rate in Dilution Tunnel - Qsd

Total Sample Volume (Standard Conditions) - Vmstd

Average Tunnel Temperature

Average Delta p

Average Gas Meter Temperature

Average Delta H

Total Time of Test

Total Particulates

Particulate Concentration (dry-standard)

Ambient Train (dry-standard)

Net (dry-standard)

Particulate Emission Rate

Total PM Emissions

Average Total PM Emissions

AVERAGE PARTICULATE

EMISSIONS RATE

% OF AVERAGE

Emissions Factor

SAMPLE A
INFORMATION

17.15

13.20

8510.57

16.35

feet/second

dscf/hour

dscf

97.4

F

0.037

92

F

2.02

in-h20

120

min

3.8

mg

0.00023

grams/dscf

0.000000000

grams/dscf

0.000232450

grams/dscf

1.98

grams/hour

3.96

grams

3.94

grams

1.97

grams/hour

100.4

1.980

g/Kg -Dry

SAMPLE B
INFORMATION

16.91

13.20

8510.57

16.04

feet/second

dscf/hour

dscf

97.4

F

0.037

92

F

1.99

in-h20

120

min

3.7

mg

0.00023

grams/dscf

0.000000000

grams/dscf

0.00023061

grams/dscf

1.96

grams/hour

3.93

grams

grams

grams/hour

99.6

1.964

g/Kg -Dry

Troutdale, OR

History

Weather History for KTTD - October, 2016

October132016Thursday, October 13, 2016

View

DailyWeeklyMonthlyCustom		
Actual	Average	Record
56 °F	55 °F	
60 °F	65 °F	79 °F (1991)
51 °F	44 °F	34 °F (1966)
9	10	
104	111	
0	0	
0	0	
6 (Base 50)		
50 °F		
87		
96		
77		
1.83 in	0.11 in	1.83 in (2016)
5.44	1.19	
27.95	29.76	
29.60 in		

16 mph (East)

29 mph

38 mph

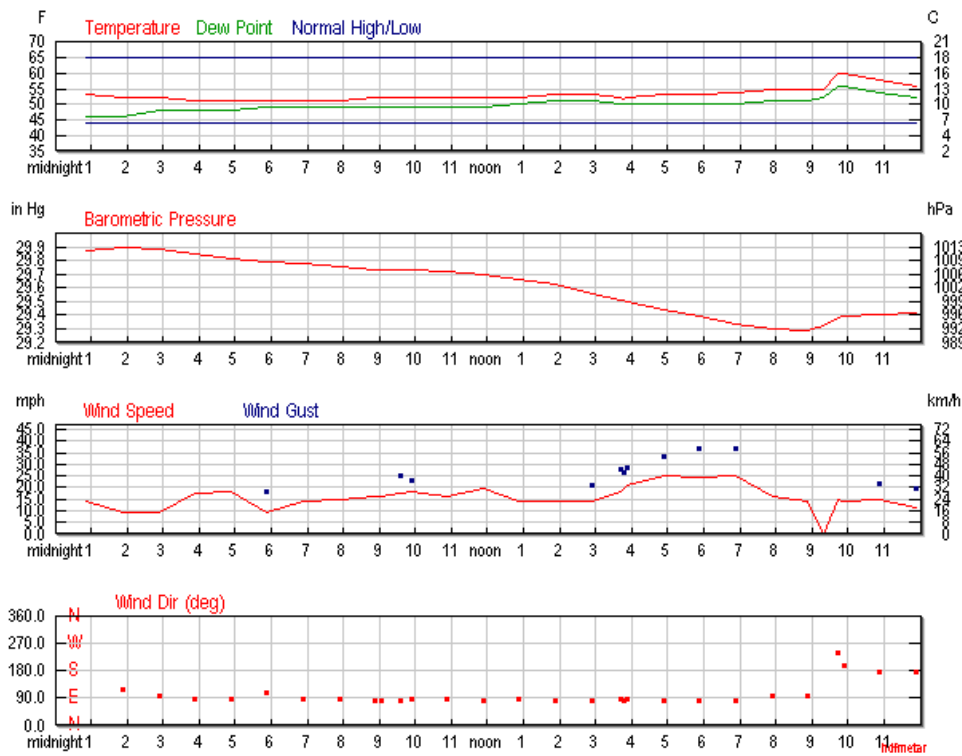
7 miles

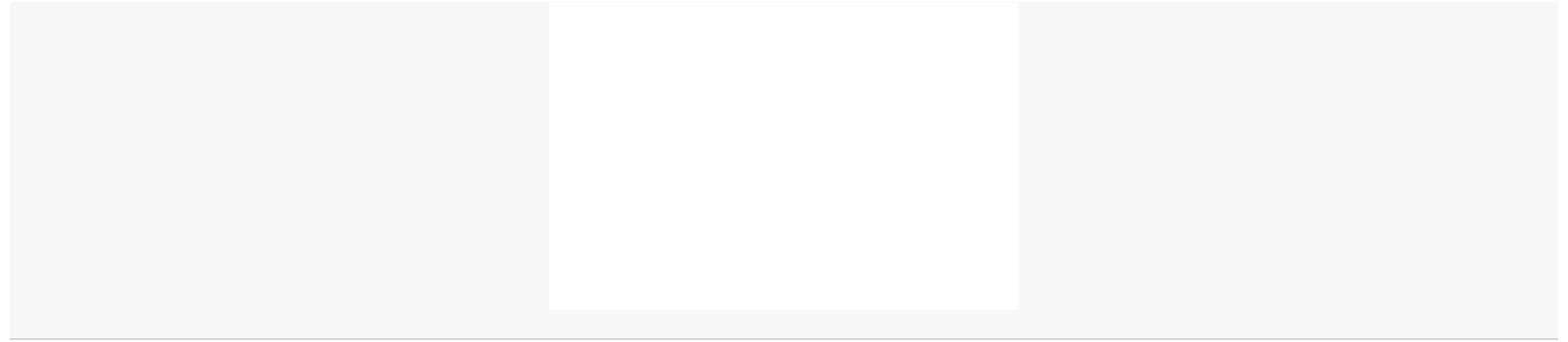
Rain

T = Trace of Precipitation, MM = Missing Value

Source: NWS Daily Summary

Daily Weather History Graph





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Search for Another Location

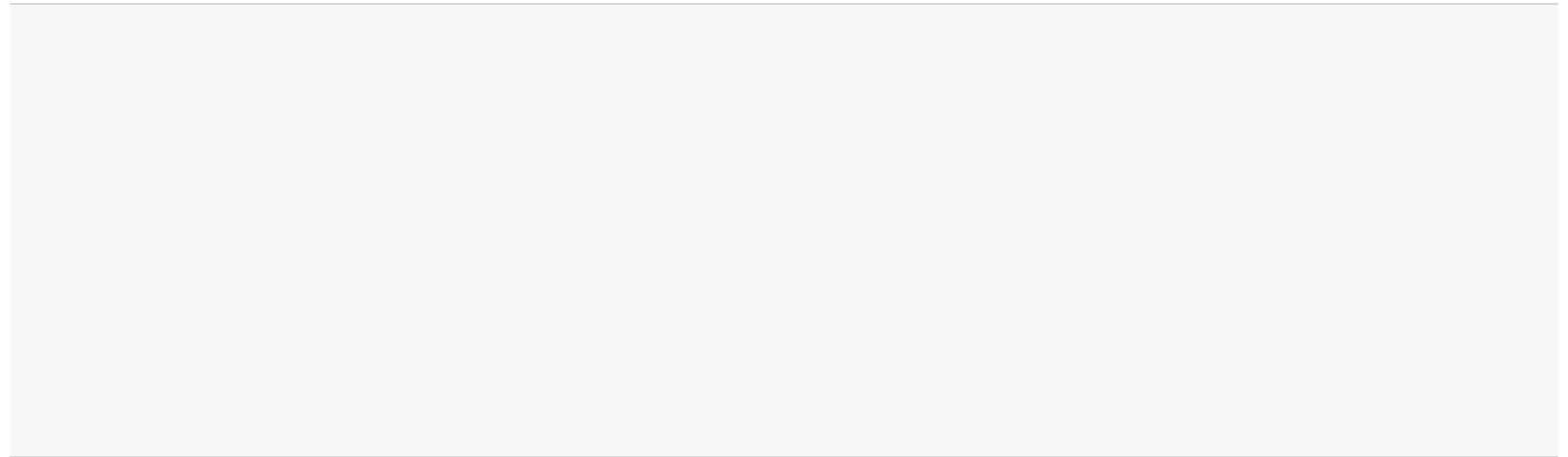
Airport or City:

Trip Planner

Search our weather history database for the weather conditions in past years. The results will help you decide how hot, cold, wet, or windy it might be!

Date:

October13



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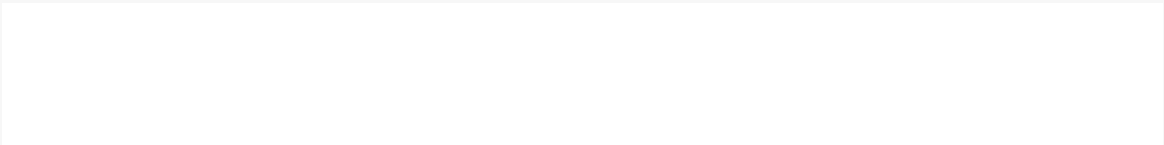
Astronomy

Oct. 13, 2016	Rise	Set
Actual Time	7:24 AM PDT	6:26 PM PDT
Civil Twilight	6:54 AM PDT	6:56 PM PDT
Nautical Twilight	6:19 AM PDT	7:30 PM PDT
Astronomical Twilight	5:45 AM PDT	8:04 PM PDT
Moon	5:25 PM PDT (10/13)	4:09 AM PDT (10/13)
Length of Visible Light	12h 02m	

Length of Day	11h 02m
---------------	---------

Waxing Gibbous, 92% of the Moon is Illuminated

Oct 13  Waxing Gibbous	Oct 15  Full	Oct 22  Last Quarter	Oct 30  New	Nov 7  First Quarter
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Hourly Weather History & Observations

Temp.	Dew Point	Humidity	Pressure	Visibility	Wind Dir	Wind Speed	Gust Speed	Precip	Events	Conditions
53.1 °F	46.0 °F	77%	29.88 in	10.0 mi	East	13.8 mph	-	0.02 in	Rain	Light Rain
52.0 °F	46.0 °F	80%	29.90 in	10.0 mi	ESE	9.2 mph	-	0.03 in	Rain	Light Rain
52.0 °F	48.0 °F	86%	29.89 in	7.0 mi	East	9.2 mph	-	0.08 in	Rain	Light Rain
51.1 °F	48.0 °F	89%	29.85 in	10.0 mi	East	17.3 mph	-	0.08 in	Rain	Light Rain
51.1 °F	48.0 °F	89%	29.82 in	6.0 mi	East	18.4 mph	24.2 mph	0.06 in	Rain	Light Rain
51.1 °F	48.9 °F	92%	29.80 in	8.0 mi	ESE	9.2 mph	18.4 mph	0.07 in	Rain	Light Rain
51.1 °F	48.9 °F	92%	29.78 in	6.0 mi	East	13.8 mph	-	0.12 in	Rain	Light Rain
51.1 °F	48.9 °F	92%	29.76 in	9.0 mi	East	15.0 mph	23.0 mph	0.07 in	Rain	Light Rain
52.0 °F	48.9 °F	89%	29.74 in	6.0 mi	East	16.1 mph	-	0.04 in	Rain	Light Rain
52.0 °F	48.9 °F	89%	29.73 in	9.0 mi	East	16.1 mph	21.9 mph	0.00 in	Rain	Light Rain
52.0 °F	48.9 °F	89%	29.73 in	5.0 mi	East	17.3 mph	25.3 mph	0.04 in	Rain	Light Rain
52.0 °F	48.9 °F	89%	29.73 in	4.0 mi	East	18.4 mph	23.0 mph	0.07 in	Rain	Light Rain
52.0 °F	48.9 °F	89%	29.72 in	3.0 mi	East	16.1 mph	-	0.20 in	Rain	Light Rain
52.0 °F	48.9 °F	89%	29.70 in	4.0 mi	East	19.6 mph	27.6 mph	0.12 in	Rain	Light Rain
52.0 °F	50.0 °F	93%	29.67 in	4.0 mi	East	13.8 mph	-	0.09 in	Rain	Light Rain
53.1 °F	51.1 °F	93%	29.63 in	6.0 mi	East	13.8 mph	19.6 mph	0.05 in	Rain	Light Rain
53.1 °F	51.1 °F	93%	29.56 in	4.0 mi	East	13.8 mph	20.7 mph	0.07 in	Rain	Light Rain
52.0 °F	50.0 °F	93%	29.51 in	4.0 mi	East	18.4 mph	27.6 mph	0.05 in	Rain	Light Rain

51.8 °F	50.0 °F	94%	29.51 in	2.5 mi	East	19.6 mph	26.5 mph	0.06 in	Rain	Rain
52.0 °F	50.0 °F	93%	29.50 in	3.0 mi	East	20.7 mph	28.8 mph	0.07 in	Rain	Rain
53.1 °F	50.0 °F	89%	29.44 in	10.0 mi	East	25.3 mph	33.4 mph	0.08 in	Rain	Light Rain
53.1 °F	50.0 °F	89%	29.39 in	10.0 mi	East	24.2 mph	36.8 mph	0.06 in	Rain	Light Rain
54.0 °F	50.0 °F	86%	29.34 in	10.0 mi	East	25.3 mph	36.8 mph	0.01 in	Rain	Light Rain
55.0 °F	51.1 °F	86%	29.30 in	10.0 mi	East	16.1 mph	-	0.01 in	Rain	Light Rain
55.0 °F	51.1 °F	86%	29.29 in	10.0 mi	East	13.8 mph	-	0.02 in	Rain	Light Rain
55.0 °F	52.0 °F	89%	29.32 in	4.0 mi	Calm	Calm	-	0.07 in	Rain	Rain
60.1 °F	55.9 °F	86%	29.38 in	9.0 mi	WSW	15.0 mph	-	0.13 in	Rain	Light Rain
60.1 °F	55.9 °F	86%	29.40 in	7.0 mi	SSW	13.8 mph	21.9 mph	0.15 in	Rain	Rain
57.9 °F	54.0 °F	87%	29.41 in	8.0 mi	South	15.0 mph	21.9 mph	0.18 in	Rain	Light Rain
55.9 °F	52.0 °F	87%	29.42 in	10.0 mi	South	11.5 mph	19.6 mph	0.08 in	Rain	Light Rain

||

Troutdale, OR

History

Weather History for KTTD - October, 2016

October132016

Friday, October 14, 2016

View

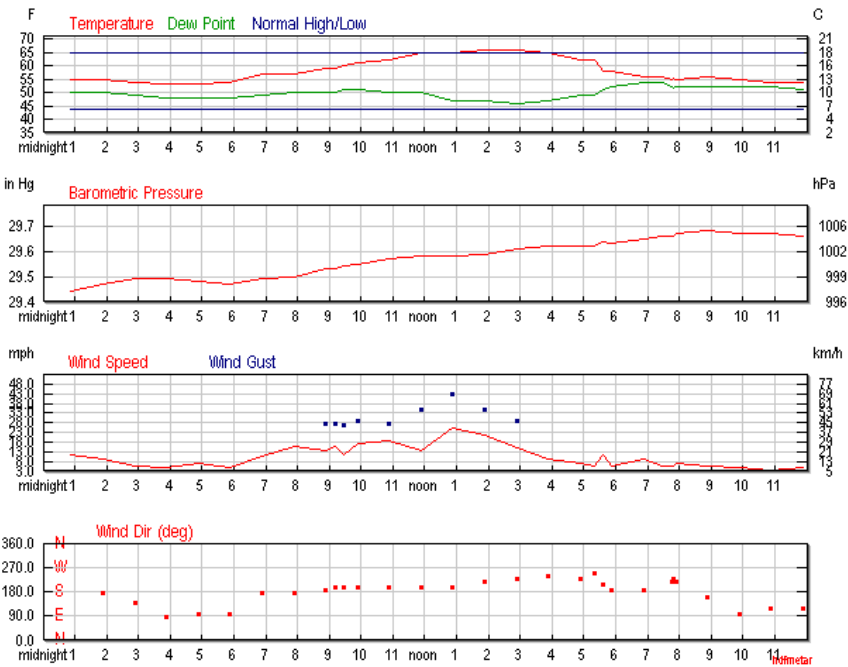
Daily	Weekly	Monthly	Custom
Actual	Average	Record	
59 °F	54 °F		
66 °F	65 °F	81 °F (1991)	
52 °F	44 °F	34 °F (1966)	
6	11		
110	122		
0	0		
0	0		
10 (Base 50)			
50 °F			
67			
86			
48			
0.77 in	0.12 in	0.77 in (2016)	
6.21	1.31		
28.72	29.88		
29.58 in			
10 mph (South)			
30 mph			
42 mph			
9 miles			

Rain , Thunderstorm

T = Trace of Precipitation, MM = Missing Value

Source: NWS Daily Summary

Daily Weather History Graph



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Search for Another Location

Airport or City:

KTTD

Submit

Trip Planner

Search our weather history database for the weather conditions in past years. The results will help you decide how hot, cold, wet, or windy it might be!

Date:

October

13

Submit



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Astronomy

Oct. 14, 2016	Rise	Set
Actual Time	7:25 AM PDT	6:24 PM PDT
Civil Twilight	6:55 AM PDT	6:54 PM PDT
Nautical Twilight	6:21 AM PDT	7:28 PM PDT
Astronomical Twilight	5:46 AM PDT	8:03 PM PDT
Moon	5:58 PM PDT (10/14)	5:22 AM PDT (10/14)
Length of Visible Light	11h 58m	
Length of Day	10h 59m	

Waxing Gibbous, 97% of the Moon is Illuminated

Oct 14 Waxing Gibbous	Oct 15 Full	Oct 22 Last Quarter	Oct 30 New	Nov 7 First Quarter
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Hourly Weather History & Observations

Temp.	Dew Point	Humidity	Pressure	Visibility	Wind Dir	Wind Speed	Gust Speed	Precip	Events	Conditions
55.0 °F	50.0 °F	83%	29.44 in	10.0 mi	South	11.5 mph	23.0 mph	0.02 in	Rain	Light Rain
55.0 °F	50.0 °F	83%	29.47 in	10.0 mi	South	9.2 mph	-	0.00 in		Overcast
54.0 °F	48.9 °F	83%	29.49 in	10.0 mi	SE	5.8 mph	17.3 mph	N/A		Scattered Clouds
53.1 °F	48.0 °F	83%	29.49 in	10.0 mi	East	4.6 mph	-	N/A		Mostly Cloudy
53.1 °F	48.0 °F	83%	29.48 in	10.0 mi	East	6.9 mph	-	N/A		Clear
54.0 °F	48.0 °F	80%	29.47 in	10.0 mi	East	4.6 mph	-	0.00 in		Mostly Cloudy
57.0 °F	48.9 °F	74%	29.49 in	10.0 mi	South	10.4 mph	-	0.03 in	Rain	Light Rain
57.0 °F	50.0 °F	77%	29.50 in	10.0 mi	South	16.1 mph	31.1 mph	0.01 in		Mostly Cloudy
59.0 °F	50.0 °F	72%	29.53 in	10.0 mi	South	13.8 mph	27.6 mph	N/A		Scattered Clouds
59.0 °F	50.0 °F	72%	29.53 in	10.0 mi	SSW	16.1 mph	27.6 mph	N/A	Thunderstorm	Mostly Cloudy
60.1 °F	51.1 °F	72%	29.54 in	10.0 mi	SSW	11.5 mph	26.5 mph	N/A		Mostly Cloudy
61.0 °F	51.1 °F	70%	29.55 in	10.0 mi	SSW	17.3 mph	28.8 mph	N/A		Mostly Cloudy
62.1 °F	50.0 °F	65%	29.57 in	10.0 mi	SSW	18.4 mph	27.6 mph	N/A		Mostly Cloudy
64.9 °F	50.0 °F	58%	29.58 in	10.0 mi	SSW	13.8 mph	34.5 mph	N/A		Mostly Cloudy
64.9 °F	46.9 °F	52%	29.58 in	10.0 mi	SSW	25.3 mph	42.6 mph	N/A		Overcast
66.0 °F	46.9 °F	50%	29.59 in	10.0 mi	SW	21.9 mph	34.5 mph	N/A		Mostly Cloudy
66.0 °F	46.0 °F	48%	29.61 in	10.0 mi	SW	15.0 mph	28.8 mph	0.00 in		Mostly Cloudy
64.9 °F	46.9 °F	52%	29.62 in	10.0 mi	WSW	9.2 mph	-	N/A		Overcast
62.1 °F	48.9 °F	62%	29.62 in	10.0 mi	SW	6.9 mph	18.4 mph	0.00 in		Overcast
62.1 °F	48.9 °F	62%	29.62 in	10.0 mi	WSW	5.8 mph	-	0.00 in	Rain , Thunderstorm	Light Rain
57.9 °F	51.1 °F	78%	29.64 in	5.0 mi	SSW	11.5 mph	-	0.08 in	Rain	Light Rain
57.9 °F	52.0 °F	81%	29.63 in	10.0 mi	South	5.8 mph	-	0.08 in		Overcast
55.9 °F	54.0 °F	93%	29.65 in	4.0 mi	South	9.2 mph	-	0.07 in	Rain	Rain
55.9 °F	54.0 °F	93%	29.66 in	1.8 mi	Variable	5.8 mph	-	0.20 in	Rain	Heavy Rain
55.0 °F	52.0 °F	89%	29.66 in	2.0 mi	SW	5.8 mph	-	0.42 in	Rain	Rain
55.4 °F	51.8 °F	88%	29.66 in	3.0 mi	SW	5.8 mph	-	0.42 in	Rain	Rain
55.0 °F	52.0 °F	89%	29.67 in	5.0 mi	SW	6.9 mph	-	0.43 in	Rain	Light Rain
55.9 °F	52.0 °F	87%	29.68 in	10.0 mi	SSE	5.8 mph	-	0.06 in		Overcast
55.0 °F	52.0 °F	89%	29.67 in	10.0 mi	East	4.6 mph	-	N/A		Overcast
54.0 °F	52.0 °F	93%	29.67 in	5.0 mi	ESE	3.5 mph	-	0.05 in	Rain	Light Rain
54.0 °F	51.1 °F	90%	29.66 in	10.0 mi	ESE	4.6 mph	-	0.01 in	Rain	Light Rain

Troutdale, OR

History

Weather History for KTTD - October, 2016

October162016Sunday, October 16, 2016View

Actual	Average	Record
55 °F	54 °F	
58 °F	64 °F	76 °F (2015)
52 °F	44 °F	30 °F (1949)
10	11	
125	144	
0	0	
0	0	
4 (Base 50)		
50 °F		
84		
96		
72		
0.60 in	0.12 in	0.60 in (2016)
7.39	1.54	
29.90	30.11	
29.47 in		
6 mph (SE)		

16 mph

23 mph

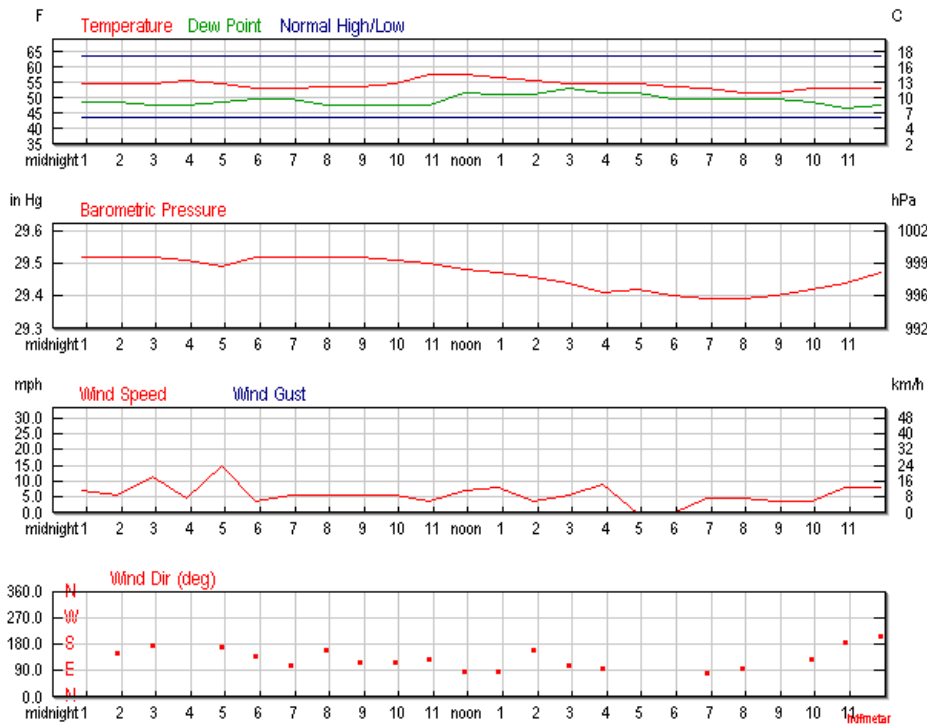
9 miles

Rain

T = Trace of Precipitation, MM = Missing Value

Source: NWS Daily Summary

Daily Weather History Graph



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Search for Another Location

Airport or City:

KTTD

Submit

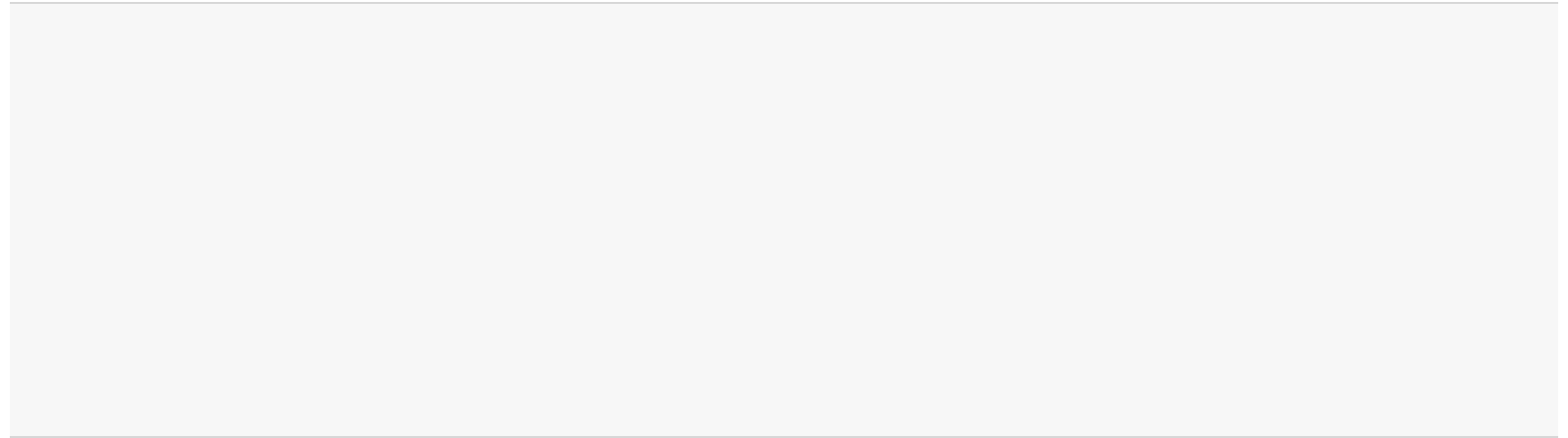
Trip Planner

Search our weather history database for the weather conditions in past years. The results will help you decide how hot, cold, wet, or windy it might be!

Date:

October16

Submit



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Astronomy

Oct. 16, 2016	Rise	Set
Actual Time	7:28 AM PDT	6:21 PM PDT
Civil Twilight	6:58 AM PDT	6:51 PM PDT
Nautical Twilight	6:23 AM PDT	7:25 PM PDT
Astronomical Twilight	5:49 AM PDT	7:59 PM PDT
Moon	7:09 PM PDT (10/16)	7:54 AM PDT (10/16)
Length of Visible Light	11h 52m	
Length of Day	10h 53m	

Waxing Gibbous, 99% of the Moon is Illuminated

Oct 16

Waxing Gibbous

Oct 22

Last Quarter

Oct 30

New

Nov 7

First Quarter

Nov 14

Full

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Hourly Weather History & Observations

https://www.wunderground.com/...KTTD/2016/10/16/DailyHistory.html?req_city=Clackamas&req_state=OR&req_statename=Oregon&reqdb.zip=97015&reqdb.magic=1&reqdb.wmo=99999[11/29/2016 2:38:02 PM]

Temp.	Dew Point	Humidity	Pressure	Visibility	Wind Dir	Wind Speed	Gust Speed	Precip	Events	Conditions
55.0 °F	48.9 °F	80%	29.52 in	10.0 mi	South	6.9 mph	-	0.03 in		Scattered Clouds
55.0 °F	48.9 °F	80%	29.52 in	10.0 mi	SSE	5.8 mph	-	0.00 in		Overcast
55.0 °F	48.0 °F	77%	29.52 in	10.0 mi	South	11.5 mph	18.4 mph	N/A		Partly Cloudy
55.9 °F	48.0 °F	75%	29.51 in	10.0 mi	Variable	4.6 mph	-	0.00 in	Rain	Light Rain
55.0 °F	48.9 °F	80%	29.49 in	9.0 mi	South	15.0 mph	23.0 mph	0.06 in	Rain	Light Rain
53.1 °F	50.0 °F	89%	29.52 in	8.0 mi	SE	3.5 mph	-	0.03 in	Rain	Light Rain
53.1 °F	50.0 °F	89%	29.52 in	10.0 mi	ESE	5.8 mph	-	0.05 in		Overcast
54.0 °F	48.0 °F	80%	29.52 in	9.0 mi	SSE	5.8 mph	-	0.01 in	Rain	Light Rain
54.0 °F	48.0 °F	80%	29.52 in	10.0 mi	ESE	5.8 mph	-	0.02 in		Overcast
55.0 °F	48.0 °F	77%	29.51 in	10.0 mi	ESE	5.8 mph	-	N/A		Overcast
57.9 °F	48.0 °F	70%	29.50 in	10.0 mi	SE	3.5 mph	-	N/A		Mostly Cloudy
57.9 °F	52.0 °F	81%	29.48 in	10.0 mi	East	6.9 mph	-	0.00 in		Overcast
57.0 °F	51.1 °F	81%	29.47 in	10.0 mi	East	8.1 mph	-	N/A		Overcast
55.9 °F	51.1 °F	84%	29.46 in	5.0 mi	SSE	3.5 mph	-	0.04 in	Rain	Light Rain
55.0 °F	53.1 °F	93%	29.44 in	9.0 mi	ESE	5.8 mph	-	0.06 in	Rain	Light Rain
55.0 °F	52.0 °F	89%	29.41 in	10.0 mi	East	9.2 mph	-	0.04 in	Rain	Light Rain
55.0 °F	52.0 °F	89%	29.42 in	7.0 mi	Calm	Calm	-	0.03 in	Rain	Light Rain
54.0 °F	50.0 °F	86%	29.40 in	10.0 mi	Calm	Calm	-	0.02 in	Rain	Light Rain
53.1 °F	50.0 °F	89%	29.39 in	10.0 mi	East	4.6 mph	-	0.05 in	Rain	Light Rain
52.0 °F	50.0 °F	93%	29.39 in	10.0 mi	East	4.6 mph	-	0.00 in	Rain	Light Rain
52.0 °F	50.0 °F	93%	29.40 in	10.0 mi	Variable	3.5 mph	-	0.00 in		Overcast
53.1 °F	48.9 °F	86%	29.42 in	10.0 mi	SE	3.5 mph	-	N/A		Overcast
53.1 °F	46.9 °F	80%	29.44 in	10.0 mi	South	8.1 mph	-	0.01 in		Mostly Cloudy
53.1 °F	48.0 °F	83%	29.47 in	8.0 mi	SSW	8.1 mph	-	0.01 in	Rain	Light Rain

TRUE NORTH 10 AGING DATA - 48 HOURS

Date						
August 24 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	'F
Top	19.4	18.5	18.9	1.3	0	252
Bottom	19	18.8	18.5	1.2	1	339
Side	19.2	18.7	19.5	1.4	2	274
Spacers (12)				1.4	3	172
					4	120
Average Dry basis			18.94444444	%MC _{DRY}		
Average Wet basis			15.92713685	%Mcwet		
Fuel Load Mass lbs			5.3	lbs	Total Hours	4

Date						
August 25 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	'F
Top	21.3	21.5	20.3	1.4	0	384
Bottom	21.6	18.7	21.9	1.3	1	336
Side	19.7	19.2	19.4	1.3	2	336
Spacers (12)				1.4	3	501
					4	268
Average Dry basis			20.4	%MC _{DRY}		
Average Wet basis			16.94352159	%M _c wet		
Fuel Load Mass lbs			5.4	lbs	Total Hours	4

Date						
August 26 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	21.9	21.4	20.9	1.4	0	460
Bottom	20.6	22	21.3	1.4	1	521
Side	20.9	19.4	20.3	1.4	2	395
Spacers (12)				1.6	3	333
					4	519
Average Dry basis			20.96666667	%MC _{DRY}		
Average Wet basis			17.33259851	%M _c wet		
Fuel Load Mass lbs			5.8	lbs	Total Hours	4

Date						
August 29 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	21.3	20.6	20.6	1.4	0	538
Bottom	18.9	18.7	18.8	1.4	1	562
Side	19.3	19	18.9	1.3	2	572
Spacers (12)				1.4	3	284
					4	385
Average Dry basis			19.56666667	%MC _{DRY}		
Average Wet basis			16.36465013	%M _c wet		
Fuel Load Mass lbs			5.5	lbs	Total Hours	4

Date						
August 30 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	23.8	23.8	22.8	1.3	0	494
Bottom	22.1	22.2	22.3	1.3	1	566
Side	22.1	21.4	21.1	1.2	2	563
Spacers (12)				1.5	3	496
					4	282
Average Dry basis			22.4	%MC _{DRY}		
Average Wet basis			18.30065359	%Mcwet		
Fuel Load Mass lbs			5.3	lbs	Total Hours	4

Date						
August 31 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	22.7	22.3	23	1.3	0	487
Bottom	22	21.9	22.1	1.3	1	559
Side	21.4	20.1	20.3	1.3	2	531
Spacers (12)				1.5	3	512
					4	287
Average Dry basis			21.75555556	%MC _{DRY}		
Average Wet basis			17.86822413	%Mc _{wet}		
Fuel Load Mass lbs			5.4	lbs	Total Hours	4

Date						
Sept 1 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	22.5	22.6	22.6	1.3	0	480
Bottom	27.7	22.4	20.6	1.4	1	505
Side	22.1	19.7	17.7	1.2	2	455
Spacers (12)				1.4	3	326
					4	289
Average Dry basis			21.98888889	%MC _{DRY}		
Average Wet basis			18.02532107	%M _c wet		
Fuel Load Mass lbs			5.3	lbs	Total Hours	4

Date						
Sept 6 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	20.5	19	20.6	1.3	0	413
Bottom	22.5	21.6	19.4	1.3	1	536
Side	19.7	19.4	18.3	1.2	2	410
Spacers (12)				1.5	3	424
					4	250
Average Dry basis			20.11111111	%MC _{DRY}		
Average Wet basis			16.74375578	%M _c wet		
Fuel Load Mass lbs			5.3	lbs	Total Hours	4

Date						
Sept 8 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	22.3	19.7	22.2	1.4	0	548
Bottom	22.8	22.2	18.9	1.4	1	643
Side	21.1	22.3	22.2	1.2	2	541
Spacers (12)				1.5	3	531
					4	286
Average Dry basis			21.52222222	%MC _{DRY}		
Average Wet basis			17.71052391	%M _c wet		
Fuel Load Mass lbs			5.5	lbs	Total Hours	4

Date						
Sept 9 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	21.9	22.1	21.3	1.4	0	474
Bottom	20.8	21	20	1.2	1	457
Side	20.4	19.5	19	1.2	2	367
Spacers (12)				1.6	3	515
					4	239
Average Dry basis			20.66666667	%MC _{DRY}		
Average Wet basis			17.12707182	%M _c wet		
Fuel Load Mass lbs			5.4	lbs	Total Hours	4

Date						
Sept 12 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	21.7	21.3	20.3	1.4	0	513
Bottom	20.6	20.5	21.7	1.4	1	669
Side	22.8	22.2	21.9	1.3	2	411
Spacers (12)				1.4	3	510
					4	250
Average Dry basis			21.44444444	%MC _{DRY}		
Average Wet basis			17.65782251	%M _c wet		
Fuel Load Mass lbs			5.5	lbs	Total Hours	4

Date						
Sept 14 2016						
	Moisture Content dry basis			Mass	Time	Stack Temp
	Piece 1	Piece 2	Piece 3	lbs	Hours	°F
Top	19.8	20	19.2	1.4	0	507
Bottom	19.8	17	20.3	1.2	1	614
Side	18.9	22.6	17	1.2	2	476
Spacers (12)				1.5	3	498
					4	259
Average Dry basis			19.4	%MC _{DRY}		
Average Wet basis			16.2479062	%Mc _{wet}		
Fuel Load Mass lbs			5.3	lbs	Total Hours	4

All aging was done with the burn rate set at medium.

Fuel Load Information

Project Number
034-S-071-1

Client
Pacific Energy

Date
10/13/16

Firebox Volume (ft³)
0.81

Assessment ☒ Y ☐ N

Longest useable measurement parallel or perpendicular to front of unit.
13³/₄"

Test Fuel Charge Range
5.1 - 6.2 lbs

Coal bed range (lbs)
1.1 - 1.6

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

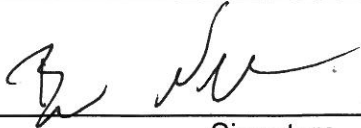
Fuel Piece Length
11 5/8 Inches

Run # 1

Test Run Fuel Moisture (db)					Hydronic Heater		Weight (Lbs)		
Piece	S1	S2	S3	S4	S5	S6	AVG (%)	W/pt Fuel	
1	20.5	19.5	20.5				20.2	1.30	
2	19.7	20.8	20.4				20.3	1.48	
3	20.1	20.8	21.4				20.8	1.19	
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
Spacer Average	19								
					Fuel Average	20.1	#DIV/0!	5.8 total	

-3.97

1.33 lb cleats wt.


Signature

10/13/16
Date

Fuel Load Information

Project Number
034-5071-1

Client
Pacific Energy

Date
10/13/16

Firebox Volume (ft³)
0.81

Assessment
Y/N

Longest useable measurement parallel or perpendicular to front of unit.
13 3/4"

Test Fuel Charge Range
5.1 - 6.2

Coal bed range (lbs)
1.5 - 1.6

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length
11 5/8 Inches

Run # 2

Test Run Fuel Moisture (db)					Hydronic Heater		Weight (Lbs)		
Piece	S1	S2	S3	S4	S5	S6	AVG (%)	w/out Fuel	
1	20.1	19	20.2				19.8	1.46	
2	19	19	19				19	1.10	
3	19.4	19	19.3				19.2	1.39	
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
Spacer Average	19								
					Fuel Average		19.3	#DIV/0!	5.3 1/2

Signature

Date
10/13/16

-3.95
1.35

Fuel Load Information

Project Number
034-S-071-1

Client
Pacific Energy

Date
10/14/16

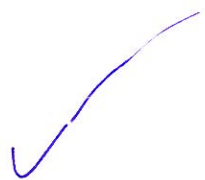
Firebox Volume (ft³)
0.81

Assessment
Y (N)

Longest useable measurement parallel or perpendicular to front of unit.
13 3/4"

Test Fuel Charge Range
5.1 - 6.2 lbs

Coal bed range (lbs)
1.1 - 1.6

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length
11 5/8 Inches

Run # 3

Test Run Fuel Moisture (db)					Hydronic Heater		Weight (Lbs)		
Piece	S1	S2	S3	S4	S5	S6	AVG (%)	w/ wet Fuel	
1	19.5	19.3	22				20.3	1.19	
2	19	19.5	19				19.2	1.21	
3	19	19	19				19	1.46	
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
Spacer Average	19.3								
					Fuel Average		19.4	#DIV/0!	5.2 total



Signature

10/14/16

Date

-3.86
1.34

Fuel Load Information

Project Number
039-5-071-1

Client
Pacific Energy

Date
10/14/16

Firebox Volume (ft³)
0.81

Assessment
Y/N

Longest useable measurement parallel or perpendicular to front of unit.
13 3/4"

Test Fuel Charge Range
5.1 - 6.2 lbs

Coal bed range (lbs)
1.1 - 1.6

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length
11 5/8 Inches

Run # 4

Test Run Fuel Moisture (db)					Hydronic Heater		Weight (Lbs)		
Piece	S1	S2	S3	S4	S5	S6	AVG (%)	w/out Fuel	
1	22.4	22.2	22.3				22.3	1.30	
2	21.3	19	20.9				20.4	1.52	
3	22.6	21.9	22.5				22.3	1.28	
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
Spacer Average	19								
					Fuel Average		21	#DIV/0!	5.4 total
								-4.1	
								1.3	

Signature
Ben Nall

Date
10/14/16

Fuel Load Information

Project Number
034-5-071-1

Client
Pacific Energy

Date
10/16/16

Firebox Volume (ft³)
0.81

Assessment
Y/N

Longest useable measurement parallel or perpendicular to front of unit.
13 3/4"

Test Fuel Charge Range
5.1 - 6.2

Coal bed range (lbs)
1.1 - 1.6

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
✓		

Fuel Piece Length
11 5/8 Inches

Run # 5

Test Run Fuel Moisture (db)					Hydronic Heater		Weight (Lbs)		
Piece	S1	S2	S3	S4	S5	S6	AVG (%)	w/mt	Fuel
1	19	20.2	20.3				19.8		1.46
2	22.8	21.9	22.3				22.3		1.32
3	21.6	21.7	22.1				21.8		1.17
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
Spacer Average	20								
					Fuel Average	21	#DIV/0!	5.3 total	

Signature

Date
10/16/16

-3.95
1.35

Fuel Load Information

Project Number
034-5-071-1

Client
Pacific Energy

Date
10/16/16

Firebox Volume (ft³)
0.81

Assessment
Y/N

Longest useable measurement parallel or perpendicular to front of unit.
13 3/4"

Test Fuel Charge Range
5.1 - 6.1
Coal bed range (lbs)
1.1 - 1.6

Vol ≤ 1.5 ft ³	Vol > 1.5 ≤ 3.0 ft ³	Vol > 3.0 ft ³
		
		

Fuel Piece Length
11 5/8 Inches

Run # 6

Test Run Fuel Moisture (db)					Hydronic Heater		Weight (Lbs)		
Piece	S1	S2	S3	S4	S5	S6	AVG (%)	W/out Fuel	
1	20.2	20.3	19				19.8	1.50	
2	20	19	20				19.7	1.10	
3	22.7	22.4	22.7				22.6	1.30	
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
Spacer Average	19						20.3	#DIV/0!	5.3 to 6.1

Fuel Average

20.3

#DIV/0!

5.3 to 6.1

-3.9

1.4

Signature

Date



Client:	Pacific Energy
Model:	True North 10
Tracking No.:	71
Project No.:	034-S-071-1
Test Dates:	10/13/16 - 10/16/16

Run Number	(kg/hr) Burn Rate	(g/hr) Emmissions Rate
2	0.93	1.3
3	1.08	1.4
5	1.32	1.2
4	1.35	1.8

Total Runs: 4

EPA Method 28 - Weighted Average



Weighted Average: **1.4** (g/hr)

Client: Pacific Energy
Model: True North 10
Tracking No.: 71
Project No.: 034-S-071-1
Test Dates: 10/13/16 - 10/16/16

Burn Rate Category	2
Burn Rate (kg/hr-dry)	0.93
Emissions Rate (g/hr)	1.3
Emissions Rate Cap (g/hr)	15
Weighting Factor	32.81%
Run Number	2

Burn Rate Category	2
Burn Rate (kg/hr-dry)	1.08
Emissions Rate (g/hr)	1.4
Emissions Rate Cap (g/hr)	15
Weighting Factor	23.69%
Run Number	3

Burn Rate Category	3
Burn Rate (kg/hr-dry)	1.32
Emissions Rate (g/hr)	1.2
Emissions Rate Cap (g/hr)	15
Weighting Factor	16.09%
Run Number	5

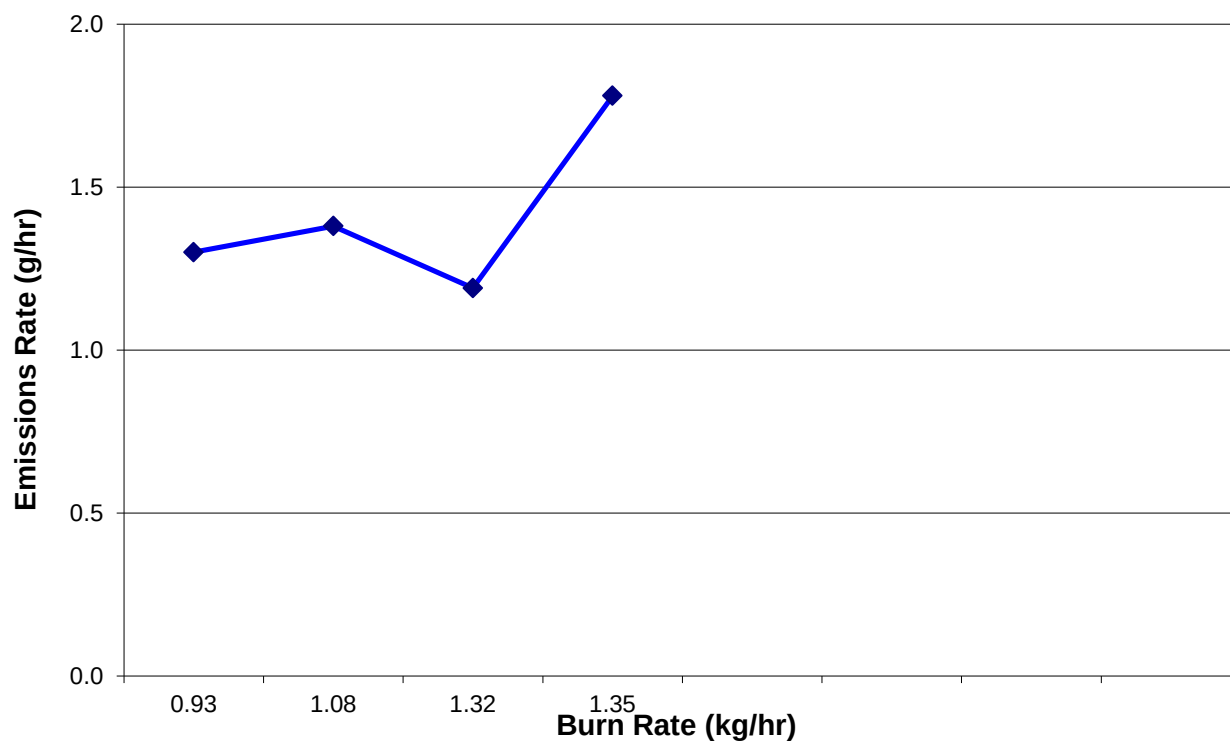
Burn Rate Category	3
Burn Rate (kg/hr-dry)	1.35
Emissions Rate (g/hr)	1.8
Emissions Rate Cap (g/hr)	15
Weighting Factor	27.40%
Run Number	4

EPA Method 28 - Weighted Average



Client: Pacific Energy
Model: True North 10
Tracking No.: 71
Project No.: 034-S-071-1
Test Dates: 10/13/16 - 10/16/16

EPA Method 28 - Weighted Average





Test No.	Burn Rate	Pi	Ei	Ki	KiEi	Burn Rate (kg/hr-dry)	Cum. Probability (P)
2	0.93	0.317	1.3	0.439	0.57	0.00	0.0000
3	1.08	0.439	1.4	0.317	0.44	0.01	0.0004
5	1.32	0.634	1.2	0.215	0.26	0.02	0.0008
4	1.35	0.654	1.8	0.366	0.65	0.03	0.0012
0	5.00	1.000	0.0	0.000	0.00	0.04	0.0016
0	5.00	1.000	0.0	0.000	0.00	0.05	0.0020
0	5.00	1.000	0.0	0.000	0.00	0.06	0.0030
0	5.00	1.000	0.0	0.000	0.00	0.07	0.0040
		1.000		1.337	1.92	0.08	0.0050
						0.09	0.0060
						0.10	0.0070
						0.11	0.0080
						0.12	0.0090
						0.13	0.0100
						0.14	0.0110
						0.15	0.0120
						0.16	0.0128
						0.17	0.0136
						0.18	0.0144

Nomenclature:

Pi = Probability for burn rate during test run

Ei = Emissions Rate for test run

Ki = Test run weighting factor

Appendix B – Labels and Manuals



**PACIFIC ENERGY
FIREPLACE PRODUCTS LTD.**

2975 Allenby Road
Duncan, BC, Canada, V9L 6V8
Telephone: (250) 748-1184
Toll Free: 1-888-223-0088
Fax: (250) 748-0844

10 October 2016
Mr. John Steinert
Dirigo Laboratories, Inc.
11785 SE Highway 212 - Suite 305
Clackamas, OR 97015

RE: OPERATING INSTRUCTIONS FOR THE TRUE NORTH 10 WOODSTOVE

John: The operating instructions for the True North 10 are as follows:

PRIMARY AIR CONTROL (PAC):

To open the primary air inlet orifice and increase the amount of air entering the stove, push the end of the handle underneath the ash lip to the left. To close the primary air inlet orifice and decrease the amount of air entering the stove, pull the end of the handle underneath the ash lip to the right.

BURN CATEGORY

Primary Air Control (PAC)

Low:

Set control at the stop. At the stop the primary air inlet orifice should be open 0.500" (1/2").

Medium Low:

Set primary air inlet orifice from the Low stop to 0.625" (5/8") opening of the primary air inlet orifice.

Medium High:

Set primary air inlet orifice from .625" (5/8") opening of the primary air inlet orifice to 0.953" (61/64") opening of the primary air inlet orifice.

High:

Set primary air control to Wide Open.

DOOR:

As soon as the fuel is loaded, close the door. If the fuel load is slow to ignite, crack the door open about 1/16" to 1/8". Monitor and adjust the door so that the impact of the air flow into the stove is maximized, i.e., watch the hot coals in the coal bed and adjust the door so that they become as bright as possible. Close the door as soon as the fuel load ignites. If the flames falter or go out, crack the door open again until the fuel reignites, then close the door.

FAN(S):

Operate the convection fan as follows:

Low, Medium Low: Turn fan on Low at 10 minutes.

High, Medium High: Turn fan on High at start of test.

LOWER PRIMARY AIR ORIFICE (LPAO):

Clear the coals away from in front of the LPAO on all runs.

If you require any additional information, please feel free to contact me at your convenience.

Yours truly,

Jeff Bain

New Product Development Manager – Solid Fuels

IMPORTANT:
THESE INSTRUCTIONS ARE TO
REMAIN WITH THE HOMEOWNER
SAVE THESE INSTRUCTIONS



SERIAL #

SAFETY NOTICE: If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area.

INSTALLATION AND OPERATING INSTRUCTIONS

TESTED and LISTED to CAN/ULC S627
AND UL 1482
Meets the Environmental Protection Agency's
2020 Crib wood Particulate Emission
Standards



MODEL: TN10



Visit www.truenorthstoves.com for the most up-to-date version of this manual

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PLEASE SAVE THESE INSTRUCTIONS

NOTE: WE STRONGLY RECOMMEND THAT SMOKE AND CARBON MONOXIDE DETECTORS BE INSTALLED IN THE AREA WHERE THE HEATER IS TO BE INSTALLED.

If smoke detectors have been previously installed, you may notice that they are operating more frequently. This may be due to curing of stove paint or fumes caused by accidentally leaving the fire door open. Do not disconnect the detectors.

SAFETY NOTICE: If this stove is not properly installed, a house fire may result. For your safety, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in you area.

Please read this entire manual before you install and use your new room heater. Failure to follow instructions may result in property damage, bodily injury, or even death.

Experience will give you the right settings for proper combustion and efficient burning. Remember the correct air inlet setting is affected by variables such as type of wood, outside temperature, chimney size and weather conditions. With practice, you will become proficient in operating your heater and will obtain the performance for which it was designed.

Safety and Maintenance

WARNING: Never use chemicals or any other volatile liquid to start a fire. Do not burn garbage, or flammable fluids such as gasoline, naptha, or engine oil.

WARNING: ONLY USE MATERIALS SUPPLIED BY MANUFACTURER WHEN DOING MAINTENANCE OR REPLACEMENTS.

1. Burn only dry and well seasoned cord wood. The denser or heavier the wood when dry, the greater its heat value. This is why hardwoods are generally preferred. Green or wet wood will cause a rapid buildup of creosote. If you feel it is necessary to burn wet or unseasoned wood, do so only with the air inlet set open enough to maintain a good strong fire and fairly high chimney temperatures. Do not attempt to burn overnight using green wood or wet wood. Wet wood can cause up to 25% drop in heater output, as well as contributing significantly to creosote buildup.
2. Remove ashes frequently. Embers can roll out the door and create a fire hazard. Maintain a 1"(25mm) minimum ash base.
3. If glass becomes darkened through slow burning or poor wood, it can readily be cleaned with fireplace glass cleaner when stove is cold. Never scrape with an object that might scratch the glass. The type and amount of deposit on the glass is a good indication of the flue pipe and chimney buildup. A light brown dusty deposit that is easily wiped off usually indicates good combustion and dry, well-seasoned wood and therefore relatively clean pipes and chimney. On the other hand, a black greasy deposit that is difficult to remove is a result of wet and green wood and too slow a burning rate. This heavy deposit is building up at least as quickly in the chimney.
4. DOOR GASKETS - The gasket used for the True North (5/8"(16mm) medium density fiberglass rope) requires only light pressure to seal. This will prolong seal life. It is important that the door seal be maintained in good condition. Periodically inspect seals and replace if necessary. Follow instructions included in the TN19.DGKIT kit obtainable from your nearest True North dealer.
5. DOOR GLASS - Do not slam loading door or otherwise impact glass. When closing door, make sure that no logs protrude to impact the glass. If the glass gets cracked or broken, it must be replaced before using the stove. Replacement glass can be obtained from your dealer. Use 9-1/4"(235mm) x 13-1/4"(337mm) x 5 mm. Ceramic glass only. Do not substitute with any other type.
 - -To remove broken glass, undo the four retaining screws and remove clamps, noting position for re-assembly. Remove all particles of glass. Be careful as they are very sharp. Install new glass complete with gasket. Replace clamps and screws.

CAUTION:

- do not overtighten, tighten screws very carefully
- do not clean glass when hot
- do not use abrasive cleaners on glass

6. The area where boost combustion air enters the firebox must be kept clear of excessive ash buildup which will block air flow. This area is at the front of the firebox.
7. Do not store wood within heater installation clearances, or within the space required for fuel loading and ash removal. Keep the area around the heater clean and free of loose combustibles, furniture, newspapers, etc.

8. Establish a routine for the fuel, wood burning and Lighting techniques. Check daily for creosote buildup in the firebox, until you are experienced and are operating the stove cleanly and safely.
9. Be aware that the hotter the fire, the less creosote is deposited. More frequent chimney cleaning may be necessary in mild weather or when burning "wet" or unseasoned wood.
10. Instruct all members of your family on the safe operation of the heater. Ensure they have enough knowledge of the entire system if they are expected to operate it. Stress the section on chimney fires and the importance of following the steps outlined "In Case of Chimney Fire".

Maintenance Checks

Check the following parts for damage such as cracks, excessive corrosion, burned out sections and excessive warping:

Weekly:

- Firebrick - Visual, for cracking.
- Door Gasket - sagging, placement, damage.

Monthly

- Brick rail tabs and brick rails.
- Back side of air wash chamber.
- Boost tube cover.
- Top baffle board.
- Baffle Tubes.

As Needed

- It is recommended that the chimney be inspected a minimum of every 2 months and cleaned as needed a minimum of 2 times a year.

When Cleaning the Chimney System:

- Top heat shield and mounting bolt.
- Brick Rails.
- Manifold.

- Replace the baffle tubes if they show signs of cracking or breakage.

- Please contact your Dealer for replacement parts, if you experience any of the damage listed above.

Continuing to operate your stove with broken parts may accelerate damage to other parts and will void your warranty

Blower:

- The blower should be cleaned out a minimum every six months by using a vacuum on the grill openings in the back and bottom of the blower casing to remove any dust and debris.

Reducing Visible Emissions and Creosote

When wood is burned too slowly, it produces tar and other organic vapours, which combine with expelled moisture to form creosote. The creosote vapours condense in the relatively cool chimney flue of a slow burning fire. As a result, creosote residue accumulates on the flue lining. When ignited, this creosote makes an extremely hot fire. The chimney connector and chimney should be inspected periodically (at least once every two months) during the heating season to determine if a creosote buildup has occurred. If creosote has accumulated (3 mm. or more), it should be removed to reduce the risk of a chimney fire.

1. Highest smoke densities and visible emissions occur when a large amount of wood is added to a bed of hot coals and the air inlet is closed. The heated wood generates smoke, but without ample air, the smoke cannot burn. Smoke-free, clean burning requires small fuel loads, two or three logs at a time or 1/4 to 1/2 of fuel load and leaving the air inlet relatively wide open, especially during the first 10 to 30 minutes after each loading, when most of the smoke generating reactions are occurring. After 30 minutes or so, the air inlet can be turned down substantially without excessive smoke generation. Wood coals create very little creosote-producing smoke.
2. The cooler the surface over which the wood smoke is passing, the more creosote will be condensed. Wet or green wood contributes significantly to creosote formation as the excess moisture that is boiled off cools the fire, making it difficult for the tars and gases to ignite, thus creating dense smoke and poor combustion. This moisture-laden smoke cools the chimney, compounding the problem by offering the smoke the ideal place to condense.

In summary, a certain amount of creosote is inevitable. Regular inspection and cleaning is the solution. The use of dry, seasoned wood and ample combustion air will help to minimize annoying smoke emissions and creosote buildup.

Chimney Fires

The dangerous side effect of excessive creosote buildup is a chimney fire. This causes much higher than normal temperatures in the chimney and on its exterior surfaces. Temperatures inside the chimney can exceed 2000°F (1100°C). Ignition of nearby or touching combustible material is more likely during a chimney fire. Proper clearances are critical to prevent damage during such a fire.

Chimney fires are easy to detect; they usually involve one or more of the following:

- Flames and sparks shooting out of the top of the chimney
- A roaring sound
- Vibration of the chimney

To Avoid a Chimney Fire

1. Burn wood cleanly. Do not burn wet wood or turn down the unit too quickly after loading.
2. Do not let creosote build up to a point where a chimney fire is possible.
3. Do not have fires in the heater that may ignite chimney fires. These are excessively hot fires, such as when burning household trash, cardboard, Christmas tree limbs, or even ordinary fuel wood; (eg. with a full load on a hot bed of coals and with the air inlet wide open for more time than is needed to completely char a fresh fuel load.)
4. The Chimney and connector pipe should be inspected /cleaned periodically.

In the event of a Chimney Fire

Have a fire extinguisher handy. Contact your local municipal or state/provincial fire authority for further information on how to handle a chimney fire. It is most important that you have a clearly understood plan on how to handle a chimney fire.

1. Close down the air inlet on the stove.
2. Call the local fire department.
3. Prepare to evacuate to ensure everyone's safety. Have a well understood plan of action for evacuation. Have a place outside where everyone is to meet.
4. After the chimney fire is out, the chimney must be cleaned and checked for stress and cracks before starting another fire. Also check combustibles around the chimney and the roof. The services of a competent or certified installer, (certified by the Wood Energy Technical Training program (WETT) - in Canada, National Fireplace Institute (NFI) - in U.S.A., are strongly recommended.

Operation

CAUTION: Hot while in operation. Keep children, clothing and furniture away. Contact may cause skin burns.

WARNING: Always keep loading door closed when burning. This heater is not designed for open door burning.

WARNING: No alteration or modification of the combustion air control assembly is permitted. Any tampering will void warranty and could be very hazardous.

WARNING: Do not use grates or andirons to elevate the fuel. Burn directly on the fire bricks. Replace broken or missing bricks. Failure to do so may create a hazardous condition.

WARNING: Never use gasoline, gasoline-type lantern fuel, kerosene, charcoal lighter fluid, or similar liquids to start or 'freshen up' a fire in this heater. Keep all such liquids well away from the heater while in use.

Your True North heater is designed for maximum overall efficiency at a moderate firing rate. Overfiring is hazardous, a waste of fuel and will damage your stove. Too slow a burn may contribute to creosote buildup and lowers combustion efficiency.

Wood Selection

This heater is designed to burn natural wood only. Higher efficiency and lower emissions generally result when burning air-dried seasoned hardwoods, as compared to softwoods or to green or freshly cut hardwoods.

Wood should be properly air dried (seasoned) for six months or more. Wet or undried wood will cause the fire to smoulder and produce large amounts of creosote. Wet wood also produces very little heat and tends to go out often.

DO NOT BURN:

• Salt water wood *	• Treated wood
• Wet or green wood	• Coal/charcoal
• Garbage*	• Solvents
• Lawn clippings/yard waste	• Unseasoned wood
• Railroad ties	• Manure or animal remains
• Materials containing rubber, including tires	• Materials containing plastic
• Waste petroleum products, paints or paint thinners, or asphalt products	• Materials containing asbestos
• Construction or demolition debris	• Paper products, cardboard, plywood, or particleboard.

*** These materials contain chlorides which will rapidly destroy metal surfaces and void warranty.**

Burning these materials may result in the release of toxic fumes or render the heater ineffective and cause smoke.

The prohibition against burning these materials does not prohibit the use of fire starters made from paper, cardboard, saw dust, wax and similar substances for the purpose of starting a fire in an affected wood heater.

Do not burn anything but cord wood. Other fuels, eg. charcoal, can produce large amounts of carbon monoxide, a tasteless, odorless gas that can kill. Under no circumstances should you attempt to barbecue in this heater.

How to Test Your Wood

Add a large piece of wood to the stove when it has a good large bed of coals. It is dry if it is burning on more than one side within one minute. It is damp if it turns black and lights within three minutes. If it sizzles, hisses and blackens without igniting in five minutes it is soaked and should not be burned.

Lighting a Fire

Remove the retaining clip on the front of the baffle before lighting for the first time.

1. Move air control lever to the left-most position (maximum firing rate) and open door.
2. Place crumpled newspaper in the centre of the heater and crisscross with several pieces of dry kindling. Add a few small pieces of dry wood on top.
3. Ignite the paper and leave the door ajar approximately 1/2"(13mm) - 1"(25mm) until the wood kindling is fully engulfed in flame.
4. After the kindling is fully engulfed add a few small logs. Close door.
5. Begin normal operation after a good coal base exists and wood has charred.

Normal Operation

WARNING: This wood heater has a manufacturer-set minimum low burn rate that must not be altered. It is against federal regulations to alter this setting or otherwise operate this wood heater in a manner inconsistent with the operating instructions in this manual.

1. Set air control to a desired setting. If smoke pours down across the glass (waterfall effect) this indicates you have shut the control down too soon or you are using too low a setting. The wide range control panel makes finding the desired setting for your application easy. As every home's heating needs vary (ie. insulation, windows, climate, etc.) the proper setting can only be found by trial and error and should be noted for future burns.
2. To refuel, adjust air control to high, and give the fire time to brighten. Open the door slowly, this will prevent back puffing.
3. Use wood of different shape, diameter and length (up to 14" (355mm)). Load your wood and try to place the logs so that the air can flow between them. Always use dry wood.
4. Do not load fuel to a height or in such a manner that would be hazardous when opening the door.
5. For extended or overnight burns, unsplit logs are preferred. Remember to char the wood completely on maximum setting before adjusting air control for overnight burn.

Restarting After Extended or Overnight Burns

1. Open door and rake hot embers towards the front of the heater. Add a couple of dry, split logs on top of embers, close door.
2. Adjust air control to high (control lever to the left) and in just a few minutes, logs should begin burning.
3. After wood has charred, reset air control to desired setting.
4. To achieve maximum firing rate, set air control lever to the left-most position. Do not use this setting other than for starting or preheating fresh fuel loads.

DO NOT OVERFIRE THIS HEATER: Attempts to achieve heat output rates that exceed heater design specifications can result in permanent damage to the heater and chimney.

Proper Draft

1. Draft is the force which moves air from the appliance up through the chimney. The amount of draft in your chimney depends on the length of the chimney, local geography, nearby obstructions and other factors.
2. Too much draft may cause excessive temperatures in the appliance. An uncontrollable burn or a glowing red stove part or chimney indicates excessive draft.
3. Inadequate draft may cause back puffing into the room and plugging of the chimney. Smoke leaking into the room through appliance and chimney connector joints indicates inadequate draft.

Curing of the Paint Finish

To achieve the best finish, the paint on your stove must be baked on with small fires. When burning your stove for the first 2-3 times it is very important that the room be well ventilated. Open all windows and doors. Smoke and fumes caused by the curing process may cause discomfort to some individuals.

Ash Removal

Caution: Ashes are to be removed only when the heater is cold. Whenever ashes get 3"(76mm) to 4"(102mm) deep in your firebox, and when fire has burned down and cooled, remove excess ashes. Leave an ash bed approximately 1" (25 mm) deep on the firebox bottom to help maintain a hot charcoal bed.

Disposal of Ashes

Ashes should be placed in a metal container with a tight fitting lid. The closed container of ashes should be placed outside on a non-combustible floor or on the ground, well away from all combustible materials, pending final disposal. If the ashes are disposed of by burial in soil or otherwise locally dispersed, they should be retained in closed container until all cinders have thoroughly cooled. Other waste should not be placed in this container.

Heat Output

Experience will give you the right settings for proper combustion and efficient burning. Remember that the correct air inlet setting is affected by variables such as type of wood, outside temperature, chimney size and weather conditions. With practice, you will become proficient in operating your heater and will obtain the performance for which it was designed.

Stove Dimensions

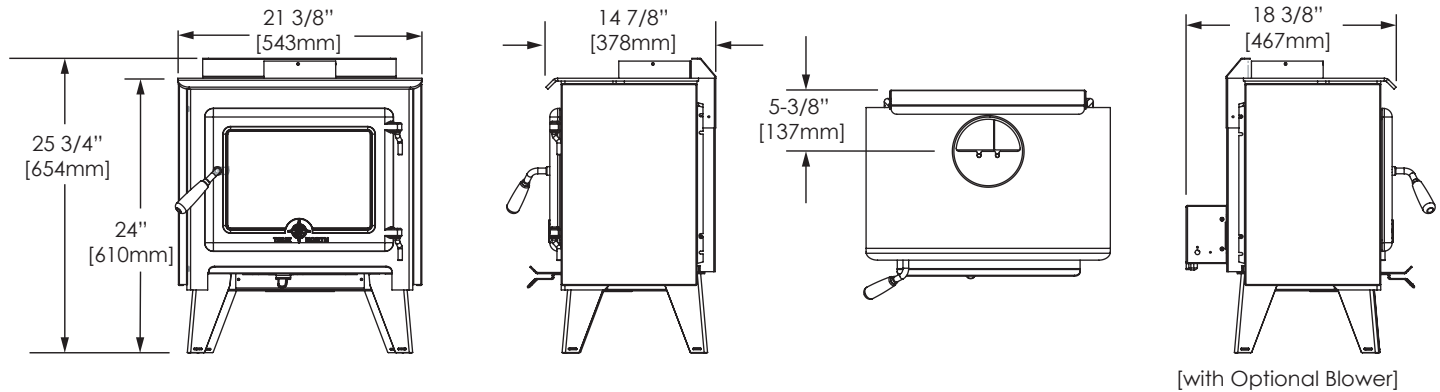


Figure 1: TN10 Dimensions.

Residential Installation

Warning: Under no circumstances is this heater to be installed in a makeshift or "temporary" manner. It may be fired only after the following conditions have been met.

- **DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.**
- **DO NOT INSTALL IN A SLEEPING ROOM.**
- **THIS ROOM HEATER MUST BE CONNECTED TO:**
 1. **A CHIMNEY SYSTEM LISTED TO: UL 103HT (USA) or ULC-S629 (CANADA) or**
 2. **A CODE APPROVED MASONRY CHIMNEY WITH A FLUE LINER.**
- DO NOT ATTEMPT TO CONNECT THIS HEATER TO ANY AIR DISTRIBUTION DUCT.
- The services of competent installer are strongly recommended.
- Outside combustion air or fresh air into the room may be required in your area, consult local building codes (See "Combustion Air" on page 20).



Crate Removal

1. Carefully remove wood top and supports.
 2. Remove plastic cover.
- Remove the retaining clip on the front of the baffle before lighting for the first time

Residential Clearances

- **BOTH CHIMNEY SYSTEM AND CONNECTOR MUST BE 6" (150mm) DIAMETER AND LISTED TO:**
CANADA - CONNECTOR - LISTED to ULC S-641 and CHIMNEY LISTED to ULC-S-629
USA - CONNECTOR AND CHIMNEY LISTED to UL-103 HT

1. Residential Clearances to Combustible surfaces and materials;

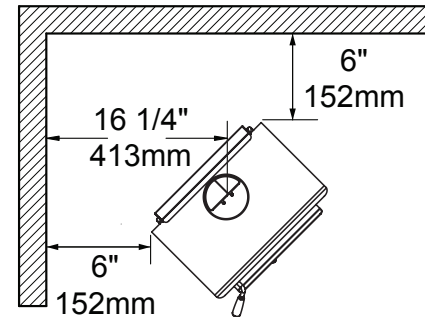
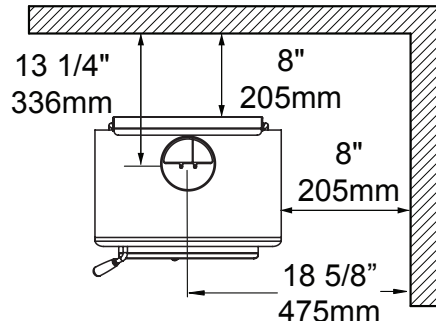
This heater may be installed using a single-wall connector (smoke pipe) as per local and National fire and Installation codes. See **Single wall Connector** in Figure 3. Clearances may be reduced with various heat shielding or insulating materials. Consult national fire codes and authorities for approval (U.S. -NFPA 211 or CAN. - CSA B365)

For for close clearances, use a listed double-wall connector, See Figure 2. "Double Wall Connector".

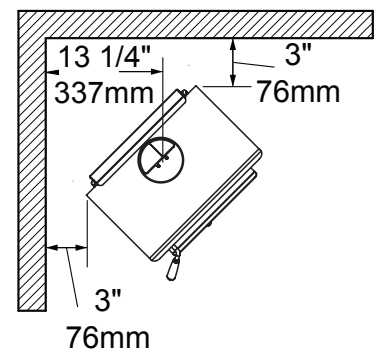
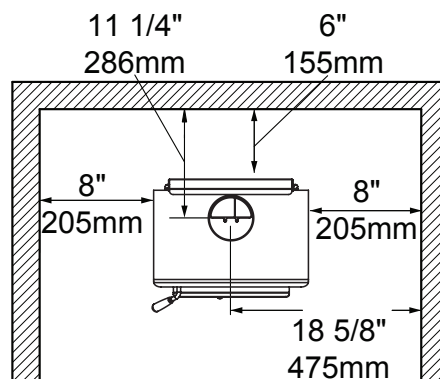
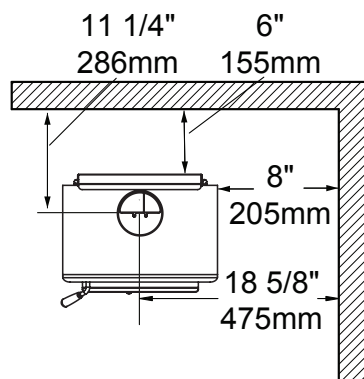
2. Mobile Home installation must use listed double-wall connector, For installation in a mobile home, see clearances in Figure 8 on page 19.

Minimum Clearance to Combustibles

Single Wall Connector - Residential



Double Wall Connector - Residential



Alcove: Min. Height 5' / 1.525m
Max. Depth 3' / 915mm

Figure 2: TN10 clearances.

Ember Protection

The stove may be installed on a combustible floor, provided ember protection made from a non-combustible material (a minimum K value of 23.7 btu/ft h °F /the equivalent of 20 Gauge steel) is used.
UL 1618 type 1 protection

This protection must extend as follows:

In Canada: 18" (457 mm) from the loading door on the firing side and 8" (203 mm) from the sides. See Figure 3, below.

In USA: 16" (406 mm) to the front of the firebox and 8" (203 mm) from the sides of the fuel loading door opening. See Figure 4, below. This protection is also required under the chimney connector and 2" (51 mm) beyond each side.

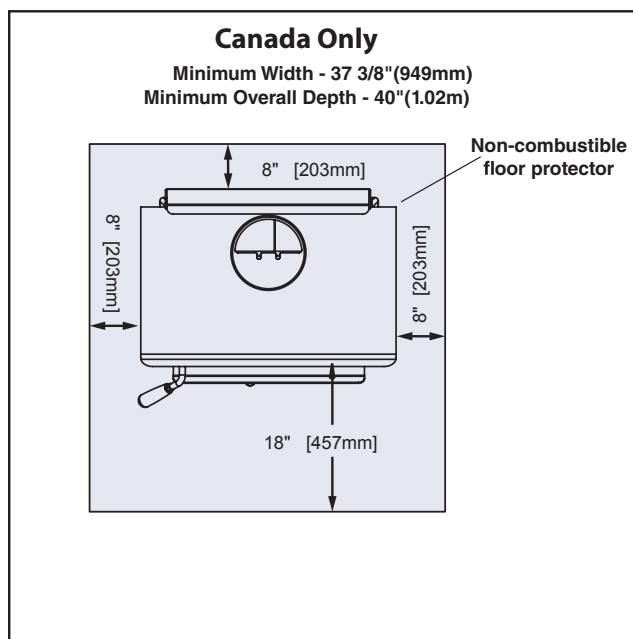


Figure 3: TN10 - CAN Floor protector.

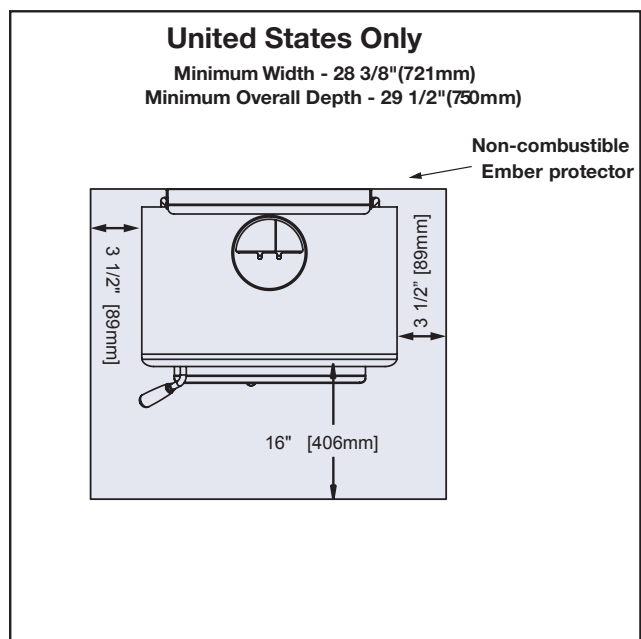


Figure 4: TN10 - US Floor protector.

Securing Bracket Installation:

These will be needed to anchor the stove in a mobile home installation and are recommended when installing combustion air to prevent movement of the unit and separation of the combustion air intake.

1. The hold down brackets are provided in a bag with the unit. Insert the brackets by sliding them through the slots in the rear legs. Then lag the bracket to the floor or hearth pad.



Figure 5: Securing bracket.

Double-Wall Connector

- Use a listed double-wall connector.
- Install all components to the chimney connector manufacturer's installation requirements.

Single-Wall Connector

Smoke pipe (chimney connector) must be:

- As short and straight as possible, use 6"(150mm) diameter, minimum 24 gauge black pipe, that is clean and in new condition.
- Secured at every joint and collar with 3 sheet metal screws.
- Installed with the crimped or male ends pointing down. This will carry any liquid creosote or condensation back into the stove.
- The Smoke pipe/chimney connector shall not pass through an attic, roof space, closet or similar concealed space, or a floor, or ceiling. Where passage through a wall, or partition of combustible material is desired, the installation shall conform to CAN/CSA-B365, INSTALLATION CODE FOR SOLID-FUEL-BURNING APPLIANCES AND EQUIPMENT or NFPA 211 STANDARD FOR CHIMNEYS, FIREPLACES AND SOLID FUEL BURNING APPLIANCES

Procedure

1. Position stove and floor protection (with hole for combustion air if required) in accordance with the clearances as stated on the label and in Figure 2., and Figure 3 or Figure 4.
2. Mark the position for the hole in the ceiling and roof by using a string and plumb-bob.
3. Check that the intended location will not interfere with floor joists, ceiling joists or rafters before proceeding further.
4. As per the chimney manufacturer's instructions;
 - Cut a hole in the ceiling and roof to suit the chimney system and frame in the sides. The chimney support is mounted to the framing. If a roof or ceiling support is used in the installation, you will find the chimney manufacturer's complete instructions packed with the roof support.
 - Assemble the chimney sections so the finished length is resting on the support and protruding through the roof. Install the radiation shield. Avoid having chimney joints between ceiling and roof.
 - Assemble flashing and storm collar and be sure to secure the flashing and seal with the appropriate sealant. Attach rain cap and check flashing for leaks.
5. If double-wall connector pipe is to be connected between the stove and the listed insulated chimney, install all components to the pipe manufacturer's installation requirements.
6. If smoke pipe is being used to connect between the stove and the listed insulated chimney,
 - Install the smoke pipe (chimney connector), crimped edge of the pipe down and inside the stove collar. Use holes provided in collar to secure pipe with three screws.
 - Install the remaining lengths of pipe, one on top of the other to the finished height of the listed insulated chimney adapter and secure to each other. A slip-section will make attaching the smoke pipe to the chimney system adapter easier.

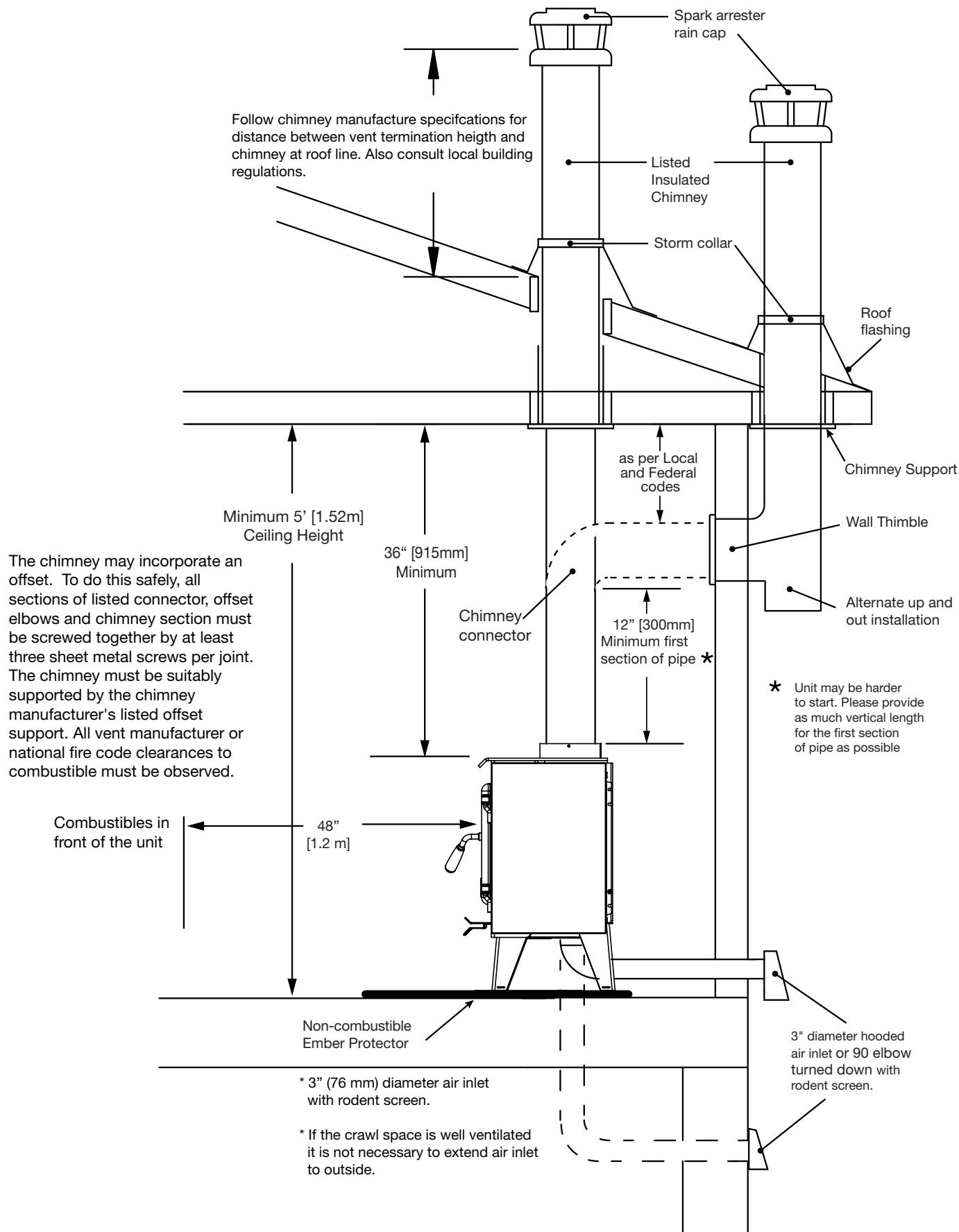


Figure 6: TN10 residential venting configuration.

Connecting to a masonry chimney

Ensure that the chimney is in good condition and meets local building codes. Your stove may work better if the chimney is fully lined with a stainless steel liner, this is because the liner will retain heat and promote draft. The chimney flue or liner should be the same size as the stove outlet for optimal performance. Reducing or increasing the flue size may adversely affect stove performance. Chimney flue exit is to be 3 feet (1 m.) above the roof and two feet (0.6 m.) above highest projection within 10 feet (3 m.). The installation must meet all local codes. Do not connect this unit to a chimney flue serving another appliance. Minimum system height is 12 feet (3.0 m.) (measured from top of appliance).

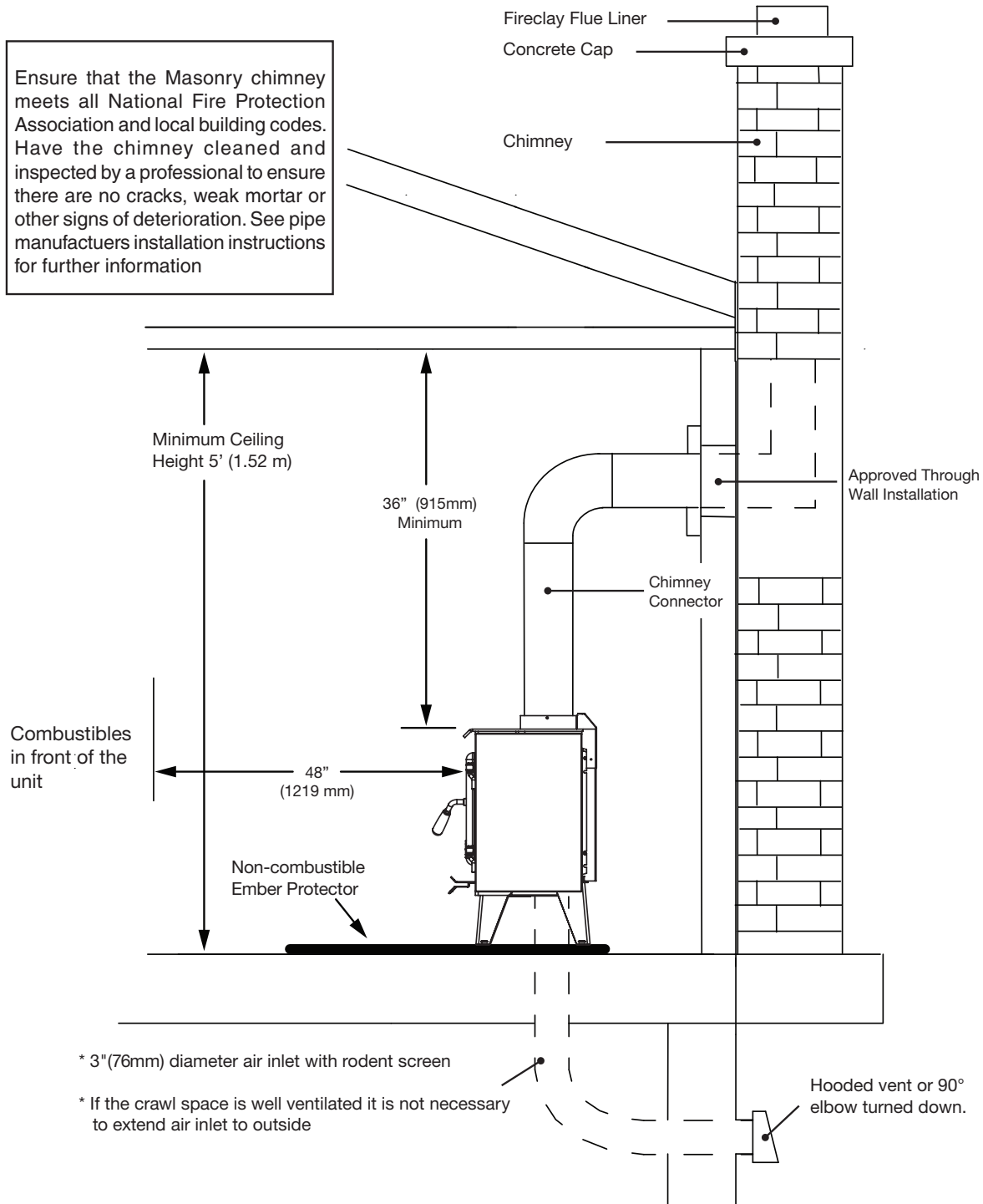
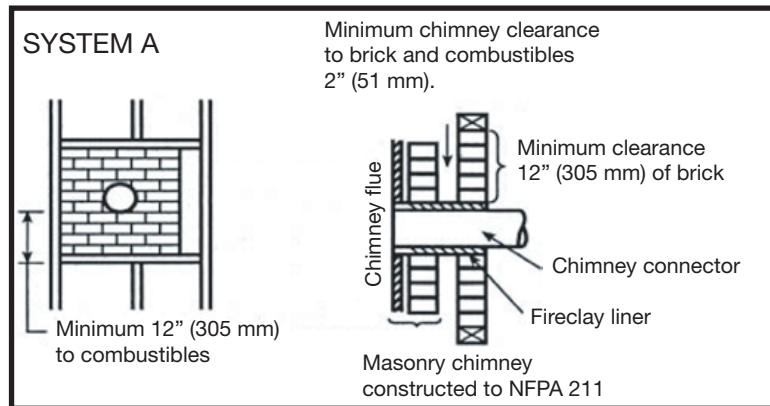


Figure 7: TN10 Venting to a masonry chimney.

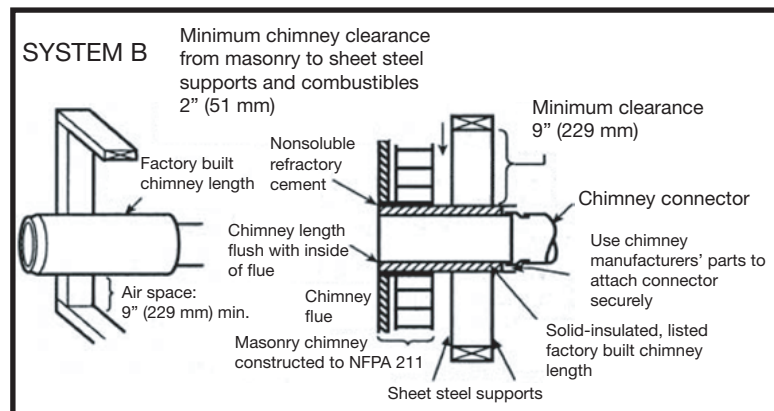
Through Wall Installations (as per NFPA 211-2013)

ATTENTION: VAPOUR BARRIER MUST BE MAINTAINED WHEREVER CHIMNEY OR OTHER COMPONENTS PENETRATE TO THE EXTERIOR OF THE STRUCTURE. SEE LOCAL BUILDING CODES FOR PROPER AND APPROVED METHODS OF MAINTAINING VAPOUR BARRIER.



System A. Minimum 3.5 in. (90 mm) thick brick masonry wall framed into combustible wall with a minimum of 12 in. (305 mm) brick separation from clay liner to combustibles. Fireclay liner (ASTM C 315, Standard Specifications for Clay Fire Linings, or equivalent), minimum 5/8 in. (16 mm) wall thickness, shall run from outer surface of brick wall to, but not beyond, the inner surface of chimney flue liner and shall be firmly cemented in place.

Minimum Clearance 12 in. (305mm)

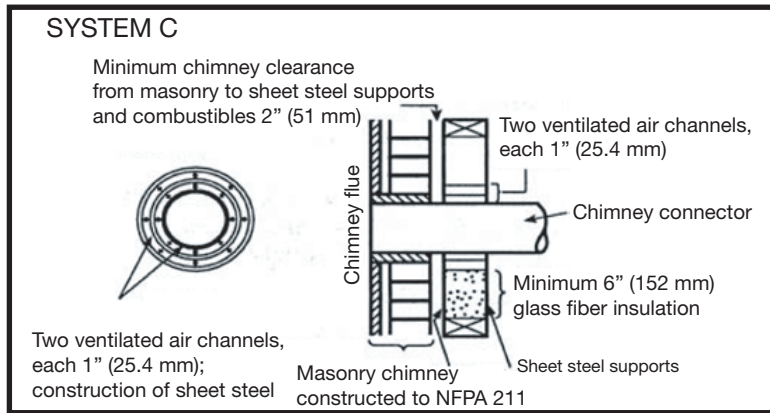


System B. Solid-Insulated, listed factory-built chimney length of the same inside diameter as the chimney connector and having 1 in. (25.4 mm) or more of insulation with a minimum 9 in. (229 mm) air space between the outer wall of the chimney length and combustibles.

The inner end of the chimney length shall be flush with the inside of the masonry chimney flue and shall be sealed to the flue and to the brick masonry penetration with non-water-soluble refractory cement. Supports shall be securely fastened to wall surfaces on all sides.

Fasteners between supports and the chimney length shall not penetrate the chimney liner.

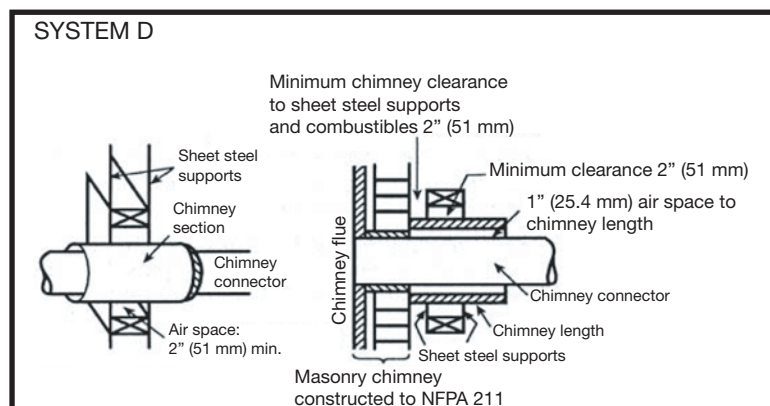
Minimum Clearance 9 in. (229mm)



System C. Sheet steel chimney connector, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, with a ventilated thimble, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness, having two 1 in. (25.4 mm) air channels, separated from combustibles by a minimum of 6 in. (152 mm) of glass fiber insulation. Opening shall be covered, and thimble supported with a sheet steel support, minimum 24 gauge [0.024 in. (0.61 mm)] in thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

Minimum Clearance: 6 in. (152mm)



System D. Solid-Insulated, listed factory-built chimney length with an inside diameter 2 in. (51 mm) larger than the chimney connector and having 1 in. (25.4mm) or more of insulation, serving as a pass-through for a single-wall sheet steel chimney connector of minimum 24 gauge [0.024 in. (0.61 mm)] thickness, with a minimum 2 in. (51 mm) air space between the outer wall of chimney section and combustibles.

Minimum length of chimney section shall be 12 in. (305 mm). Chimney section concentric with and spaced 1 in. (25.4 mm) away from connector by means of sheet steel support plates on both ends of chimney section. Opening shall be covered, and chimney section supported on both sides with sheet steel supports of minimum 24 gauge [0.024 in. (0.61 mm)] thickness.

Supports shall be securely fastened to wall surfaces on all sides and shall be sized to fit and hold chimney section. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

Minimum Clearance: 2 in. (51mm)

Mobile Home Installation

Warning: Under no circumstances is this heater to be installed in a makeshift or "temporary" manner. It may be fired only after the following conditions have been met.

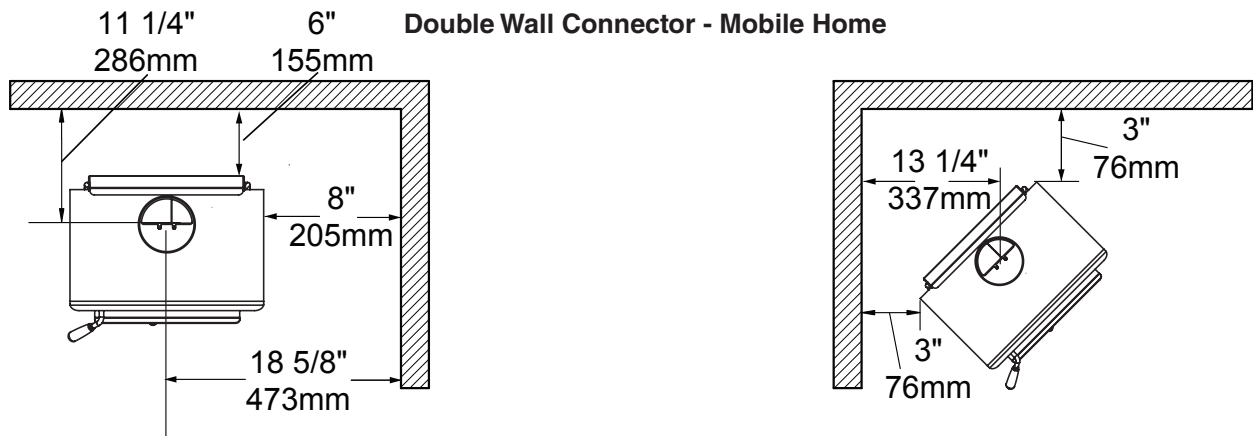
- **DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.**
- **DO NOT INSTALL IN A SLEEPING ROOM.**

THIS HEATER MUST BE INSTALLED WITH LISTED DOUBLE-WALL CONNECTOR. BOTH CHIMNEY SYSTEM AND CONNECTOR MUST BE 6"(150mm) DIAMETER AND LISTED TO:

**IN CANADA - ULC S-641 LISTED CONNECTOR AND ULC-S-629 LISTED CHIMNEY,
IN USA - UL-103 HT LISTED CONNECTOR AND CHIMNEY**

- Outside combustion air supply must be used for Mobile Home installations see "Combustion Air" on page 20

Mobile Home Clearances



Installation

Minimum chimney height from top of unit is 12' (3.66 m) or as per chimney manufacturers roof clearances whichever is greater.

NOTE: Longer chimney lengths and different pitch flashings may be used. Install all components to the connector or chimney manufacturer's installation requirements. Consult your chimney supplier for installation advice.

Procedure:

Follow Installation procedures "Securing Bracket Installation:" on page 13 plus the following extra steps.

WARNING: THE STRUCTURAL INTEGRITY OF THE MOBILE HOME FLOOR, WALL AND CEILING/ROOF MUST BE MAINTAINED.

Note: See "Combustion Air" on page 20.

- Attach stove to floor using two 1/4" x 1" or longer lag screws.
If installing a leg model, insert anchor tabs into slot on bottom of two rear legs and secure to floor with 1/4" x 1" or longer lag screws.
- If installing the Optional Blower Kit the unit must be grounded to the mobile home.

Combustion Air

Combustion air can be supplied to the stove in one of two ways. Consult your local building code or CAN/CSA-B365, or NFPA 211

1. Direct outside air supply - (Necessary for mobile home installation, optional for residential installation.)

- To draw outside air through the floor; Attach the outside air adapter to the underside of the stove. Mark then cut or drill a 3"(76mm) diameter or larger hole in the floor under the adapter. This hole must get its air from a ventilated crawl space or be extended with duct to the outdoors (Figure 6 on page 15. or Figure 7 on page 16

**If you are getting the intake air from a well ventilated crawl space, Connect the adapter to 3"(76mm) flexible or rigid metal venting passing thru the hole using into the ventilated space. Cover the inlet of the pipe with a 20GA wire mesh minimum rodent screen, and clamp in place.

**If you are extending the pipe thru to the outside, Install an approved 3"(76mm) inlet vent cap into the closest outside wall. Connect the stove's adapter to the Inlet vent through the hole using 3"(76mm) flexible and/or rigid metal venting.

- To draw air from behind the stove. Cut or drill a corresponding hole in the closest exterior wall. Install an approved 3"(76mm) inlet vent cap. Attach the outside air adapter to the underside of the stove. Connect the adapter to the inlet vent cap using 3"(76mm) flexible and/or rigid metal venting. Provide water protection as required.

2. Room air supply - Remove the knockout or cover plate from the bottom of the Air box enclosure. The stove will now draw its air from the room through this opening and into the firebox intake

Note:

The use of outside combustion air for installation requires the unit to be secured to the structure to prevent dislodging of the air duct ("Securing Bracket Installation:" on page 13).

The living space around the heater must be well ventilated with good air circulation. Anything that may cause a negative pressure can cause gases or fumes to be pulled into the living area. During extremely cold weather, and especially when burning at very slow rates, the upper parts of the exposed chimney may ice up, partially blocking the flue gases. If blockage occurs, flue gases may enter living space.

This unit is **not** designed to be operated with the firing door open. In addition to the obvious hazard of sparks landing on combustibles, an open fire door will cause the heater to draw air from the living space and possibly cause suffocation in an air tight home.

Baffle Board / Tube Installation

The Chimney connector pipe should be disconnected from the wood stove to clean and inspect the chimney. Only if this is not possible should you remove Baffle Board.

DO NOT OPERATE WITH BAFFLE BOARD INSULATION OR TUBES REMOVED.

Removal

1. With a set of vise-grips, grasp the front baffle tube on the right, slightly away from the baffle air assembly. While squeezing tightly, use a hammer to hit the pliers and pull the tube to the right to disengage the tube from the hole on the left. Allow the tube to hang freely from the hole on the right.
2. Repeat step #1 for second baffle tube.
3. Grasp the front edge of the left half of the baffle board and tilt up at the back. Guide the board down and through the door opening. **Caution - Baffle Board material is very fragile.**
4. Grasp the right half of the baffle board and slide it over to the left.
5. Tilt the back of the board up and guide it down and through the door opening.
6. Reverse the process to replace the baffle assembly.

Installation

1. Insert one half of baffle board above the two back baffle tubes inside the firebox, slide over to the right and allow to rest on the baffle air assembly.
2. Ensure that the second half is inserted to allow the two cuts in the baffle boards to overlap. Insert the other half of the baffle board and allow to rest on the left side baffle air assembly.
3. With the holes facing forward and the notch to the left side, insert a baffle tube into the hole in the baffle air channel on the right at an angle and then raise and insert into the opposite hole on the left side baffle air assembly.
4. With a set of vise-grips, grasp the baffle tube on the left, slightly away from the baffle air assembly. While squeezing tightly, use a hammer to hit the pliers and push the tube to the left to engage the tube in the hole on the left.
5. Repeat steps #3 & #4 with the remaining baffle tube.
6. Slide the baffle board halves in with the notches overlapping (one notch facing up and one notch facing down). Then separate, to ensure there are no gaps on either side, between the baffle board and the Secondary Air Chambers.
7. Push baffle board tight against the rear of the firebox.

Optional Blower

The optional blower kit, (part #31140001) is equipped with a three prong power cord and may be installed at any time. Route power supply cord away from heater.

Electrical rating: 115V, 60Hz, 0.5 amps.

Blower Installation

1. Remove the 4 screws and cover plate from the rear shield on the stove (Figure 10).
2. Using the same 4 screws, place the blower into the opening in the rear shield with the blower outlet pointing up (Figure 11).
3. Tighten the screws.

Blower Operation

Proper blower speed matched with air control setting will ensure peak performance from your stove.

- Except on "High" setting, wait 30 minutes before turning on blower to desired setting.

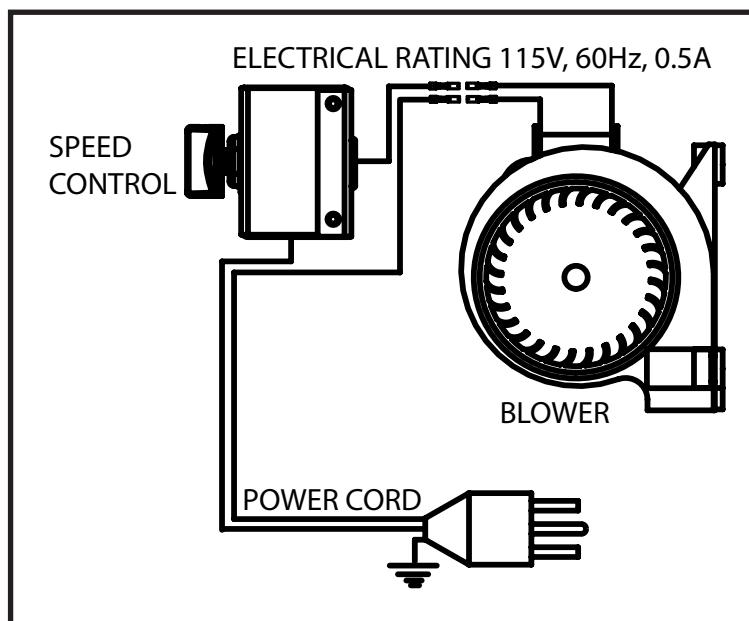


Figure 9: Blower Wiring Diagram.

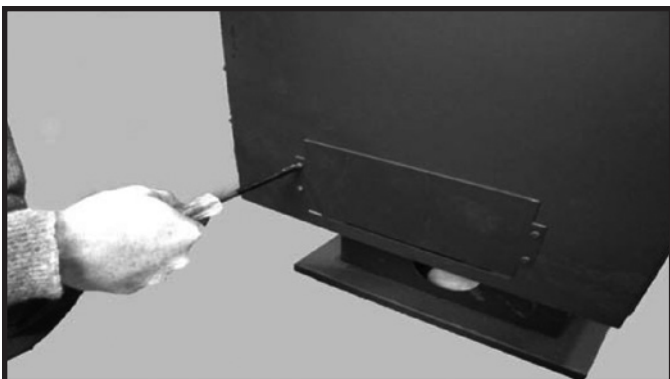


Figure 10: Remove the cover plate.

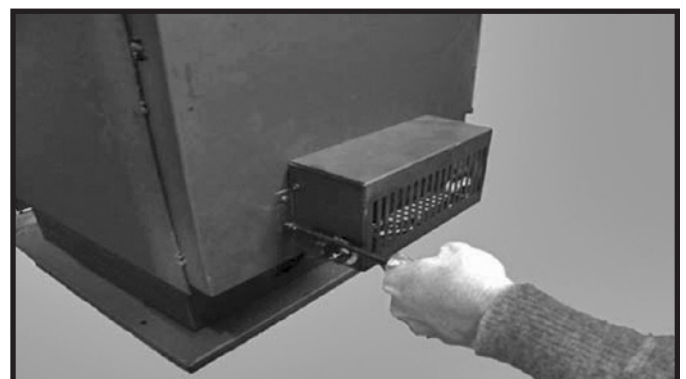


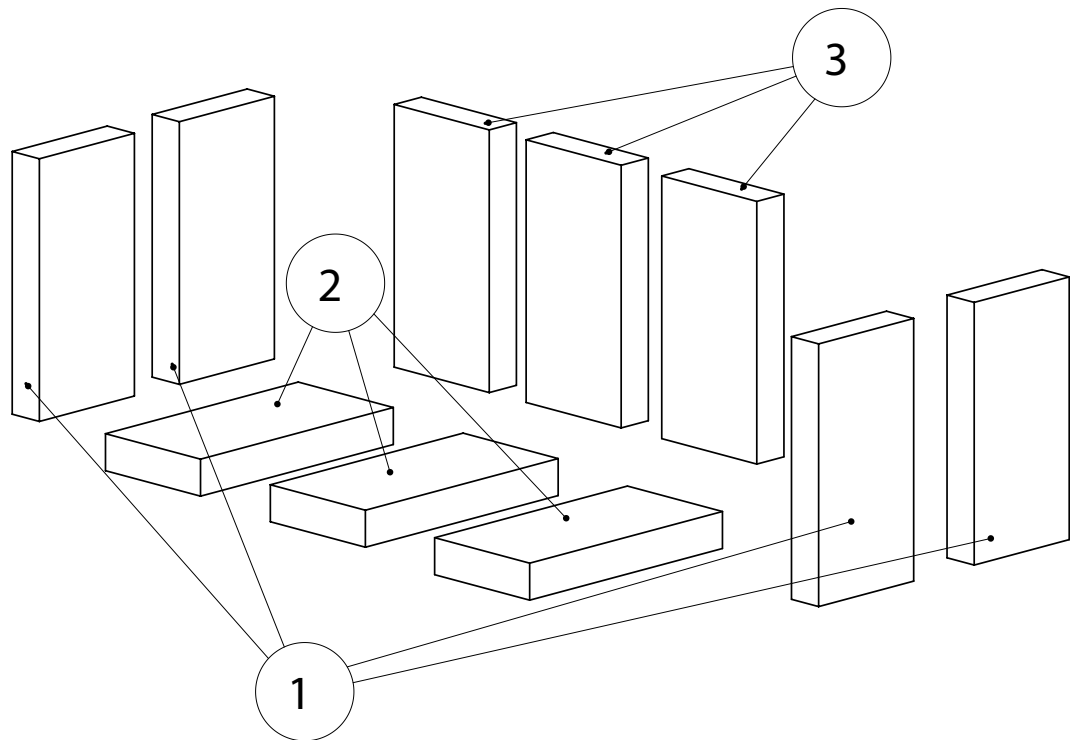
Figure 11: Installing the blower.

Firebrick Installation

This package contains 10 full-size firebricks.

With the heater in the upright position, install firebricks as follows:

- Install each side brick, insert the brick under the retaining flange near the front of the baffle air box on each side of the firebox and then slide the brick to the back of the unit.
- Next install 3 firebricks on the bottom of the unit. Place them to the rear of the firebox.
- Finally place 3 firebricks at the back of the heater, by inserting the bricks under the rear retainer



Troubleshooting

Problem	Cause	Cure
Glass is Dirty	1. Wood is wet	- Use dry wood
	2. Turning down air control or damper too soon	- Do not turn down until a) there is a good bed of coals b) the wood is charred
	3. Draft too low	- Improper chimney height and / or diameter - Chimney plugged or restricted, check flue - Provide outside air for combustion
	4. Door gasket leakage	- Replace gasket - Check latch
Excessive Creosote Buildup - See 1, 2, 3, above.		
Low Heat Output	1. Wood is wet	- Use dry wood
	2. Fire too small	- Build a larger fire
	3. Draft too low	- Chimney plugged or restricted, inspect and clean
Won't Burn Overnight	1. Air control is set too high	- Set control lower
	2. Not enough wood	- Unsplit wood is preferred for overnight burns
	3. Draft too high	- Excessive chimney height and/or diameter, See "Proper Draft" on page 10.
Stove Won't Burn	1. Combustion air supply blocked	- Check outside air supply for obstruction - Check that room air cover is removed
	2. Draft too low	- Chimney plugged or restricted, inspect and clean - Chimney oversized or otherwise unsuitable, consult Dealer

Replacement Parts

(WHEN ORDERING, INCLUDE PART NUMBER WITH DESCRIPTION)

ITEM	DESCRIPTION	PART NO.
1	Baffle Board (2pcs.), TN10	80002159
2	Baffle Tube Set (4pcs.), TN10.....	80002160
3a	Secondary Air Chamber Left, TN10 (c/w gasket/screws)	80002162
3b	Secondary Air Chamber Right, TN10 (c/w gasket/screws).....	80002163
4	Door Assembly - No Glass, TN19/20/10, Met Black.....	80000621
5	Door and Glass Gasket, TN10/19/20/40.....	80000600
6	Glass, TN10/19/20/40 (c/w clamps / gasket).....	80000616
7	4 pc Glass Clamp set (c/w screws.).....	80000617
8	Firebrick Set, TN10.....	80002161
9	Flame Shield, TN10.....	80002164
Not Shown		
	Rear Brick Rail, TN10.....	80002165
	Blower, Wood/Gas, Insert, Hinge Side	80000905
	Switch, Rheostat	80000908
	Blower, Knob, Speed Control.....	80000909
Optional Blower Kit		31140001

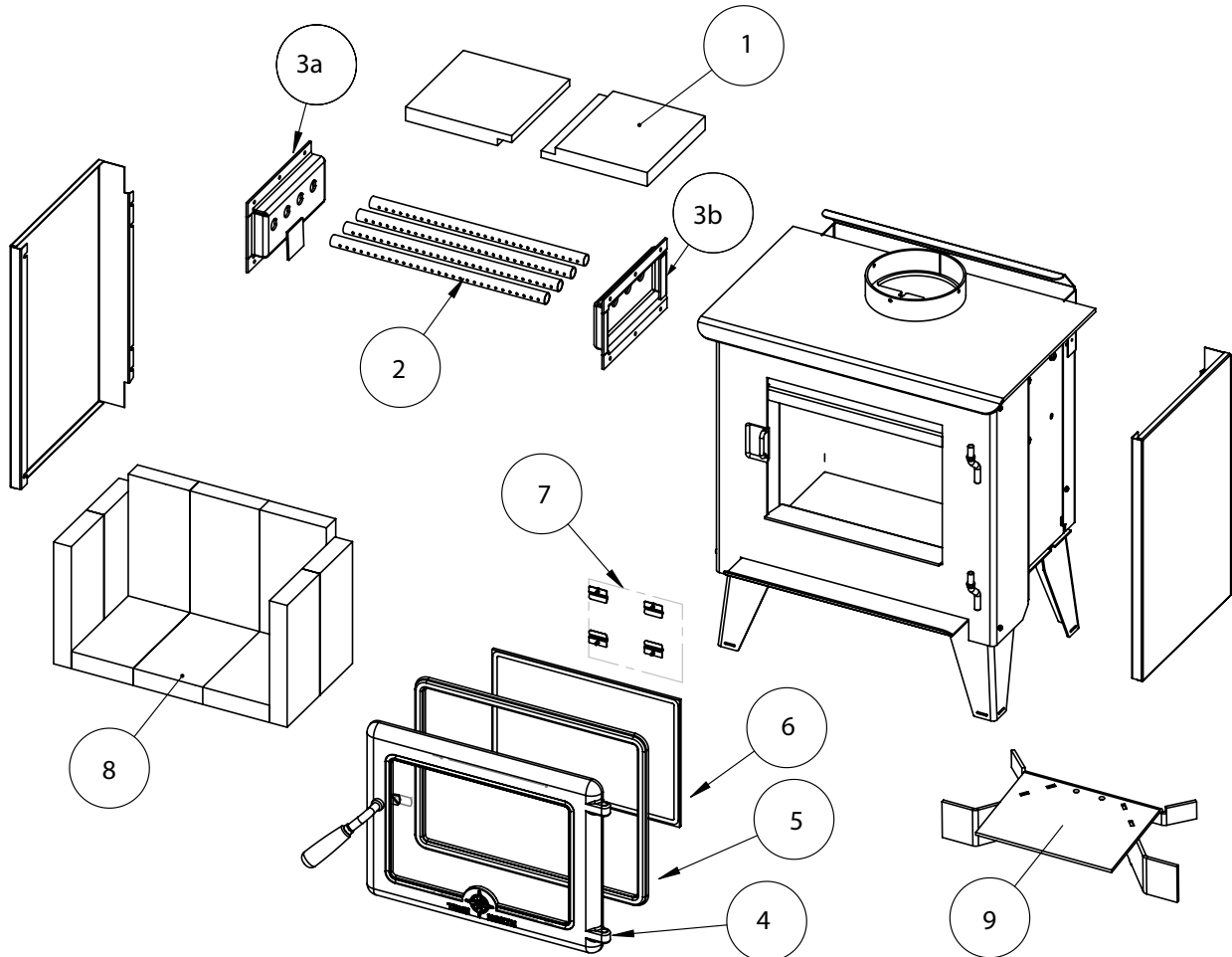


Figure 12: TN10 Exploded BOM .



Wood Products Warranty

True North warrants to the original consumer of the product the following:

3 years parts (1 year labour)

Firebox, Castings, Glass (glass for thermal breakage only, not impact)

1 year parts and labour

Electrical components and switches

1 year (parts only)

Gaskets, Paint (peeling), Bricks, Baffle tubes, Baffle manifold, Ceramic fibre board

Conditions

The warranty of the manufacturer extends only to the original consumer purchaser and is not transferable. Proof of purchase (dated, bill of sale), model name and serial number must be supplied when making any warranty claim to your TRUE NORTH Dealer. This warranty covers brand new products only, which have not been altered, modified nor repaired since shipment from factory. This warranty applies to normal residential use only.

The manufacturer may require that defective products be returned or that digital pictures be provided to support the claim. Returned products are to be shipped prepaid to the manufacturer or agent for investigation.

If a product is found to be defective, the manufacturer will repair or replace (at the manufacturer's discretion) such defect. The manufacturer may, at its discretion, fully discharge all obligations with respect to this warranty by refunding the wholesale price of any warranted but defective part(s).

Exclusions

- Damages caused by misuse, abuse, improper installation, lack of maintenance, over firing, negligence, accident during transportation, power failures, downdrafts, or venting problems are not covered by this warranty.
- This warranty does not cover any scratch, corrosion, warping, or discoloration caused by over firing, abrasives or chemical cleaners.
- Any defect or damage caused by the use of unauthorized parts void this warranty.
- An authorized qualified technician must perform the installation in accordance with the instructions supplied with this product and all local and national building codes.
- Any service call related to an improper installation is not covered by this warranty.

The manufacturer shall in no event be responsible for any special, indirect, consequential damages of any nature, which are in excess of the original purchase price of the product. A one-time replacement limit applies to all parts benefiting from warranty coverage.

REGISTER YOUR PRODUCT ONLINE

HAVE YOUR SERIAL NUMBER* AVAILABLE AND VISIT
truenorthstoves.com/register

*Your serial number can be found on the product certification label or on the cover of your installation manual.

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For technical support, please contact your retailer

**Web site: www.truenorthstoves.com
2975 Allenby Rd., Duncan, BC V9L 6V8**



Intertek
ETL#4001507

CERTIFIED FOR CANADA AND U.S.A. - SERIES / SÉRIE: A MODEL / MODÈLE: TN10
LISTED ROOM HEATER, SOLID FUEL TYPE.
ALSO FOR USE IN MOBILE HOMES
TESTED TO/ ÉPROUVÉ SELON: CAN/ULC S627-00 AND IN THE USA CONFORMS TO UL 1482-2011

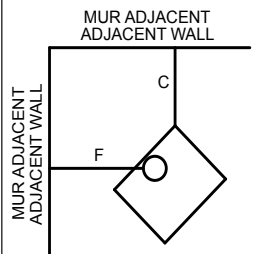
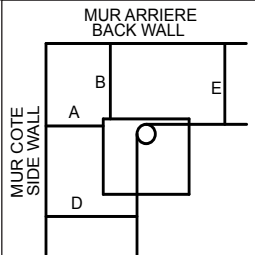
DO NOT REMOVE THIS LABEL



- INSTALL AND USE IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION AND OPERATING INSTRUCTIONS.
- CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS, INSTALLATION PERMIT AND INSPECTION IN YOUR AREA.
- DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.
- USE 6 INCH / 150MM DIAMETER MINIMUM 24 MSG BLACK OR LISTED CONNECTOR.
- CAN BE CONNECTED TO A LINED MASONRY CHIMNEY SUITABLE FOR USE WITH SOLID FUELS.
- DO NOT OBSTRUCT THE SPACE BENEATH THE HEATER.
- SEE LOCAL BUILDING CODE AND MANUFACTURER'S INSTRUCTIONS FOR PRECAUTIONS REQUIRED WHEN PASSING A CHIMNEY THROUGH A COMBUSTIBLE WALL OR CEILING.
- DO NOT PASS A CHIMNEY CONNECTOR THROUGH A COMBUSTIBLE WALL OR CEILING.
- MINIMUM CLEARANCE BETWEEN SINGLE WALL CHIMNEY CONNECTOR AND COMBUSTIBLE MATERIALS-18INCHES/455MM. CLEARANCE MAY BE REDUCED BY THE USE OF LISTED PIPE SHIELDS, WALL PROTECTORS OR OTHER MEANS APPROVED BY LOCAL BUILDING OR FIRE OFFICIALS.
- COMPONENTS REQUIRED FOR MOBILE HOME AND ALCOVE INSTALLATION: OUTSIDE AIR KIT. BOTH CHIMNEY SYSTEM AND CONNECTOR MUST BE LISTED TO:
IN CANADA - ULC S-641 LISTED CONNECTOR AND ULC-S-629 LISTED CHIMNEY
IN USA - UL-103 HT LISTED CONNECTOR AND CHIMNEY
- USE COMPONENTS SPECIFIED IN PACIFIC ENERGY INSTALLATION INSTRUCTIONS.
- OPTIONAL COMPONENT - BLOWER(TRNO.19BLOWA), FAN ELECTRICAL RATING: 115V, 60HZ, .5 AMP.
- CAUTION: RISK OF EXCESSIVE TEMPERATURES - KEEP ASH DUMP CLOSED DURING FIRING OF THE HEATER. • DO NOT ROUTE POWER CORD BENEATH HEATER.
- OPERATE ONLY WITH FEED DOOR CLOSED. OPEN TO FEED FIRE ONLY.
- KEEP FURNISHINGS AND OTHER COMBUSTIBLE MATERIALS WELL AWAY FROM HEATER.
- REPLACE GLASS ONLY WITH CERAMIC GLASS.
- HORIZONTAL CONNECTOR NOT PERMITTED IN MOBILE HOMES
- ♦ AS TESTED - PIPE SHIELD MAY BE REQUIRED BY LOCAL AUTHORITIES.
- * ALCOVE SIZE : DEPTH - 3 FT. / .91 M MAX., HEIGHT 5 FT. / 1.53 M MIN., WIDTH 38 IN. / .97 M MIN. COMBUSTIBLE FLOOR MUST BE PROTECTED BY A CONTINUOUS NON-COMBUSTIBLE MATERIAL EXTENDED TO THE FRONT, SIDES AND BACK AS INDICATED.
- FOR USE WITH SOLID WOOD FUEL ONLY. STOVE DESIGNED TO BURN CORDWOOD ONLY. BURNING OTHER MATERIALS MAY CAUSE DAMAGE TO STOVE OR HOME.
- THIS WOOD HEATER NEEDS PERIODIC INSPECTION AND REPAIR FOR PROPER OPERATION. - CONSULT THE OWNER'S MANUAL FOR FURTHER INFORMATION.
- IT IS AGAINST FEDERAL REGULATIONS TO OPERATE THIS WOOD HEATER IN A MANNER INCONSISTANT WITH THE OPERATING INSTRUCTIONS IN THE OWNER'S MANUAL

MINIMUM CLEARANCES TO COMBUSTIBLE MATERIALS/ DÉGAGEMENTS MINIMAUX AUX MATÉRIEAUX COMBUSTIBLES

- A. SIDEWALL TO UNIT/ MUR DE CÔTE / APPAREIL
- B. BACKWALL TO UNIT/ MUR DE FOND / APPAREIL
- C. CORNER TO UNIT/ COIN / APPAREIL
- D. SIDEWALL TO CONNECTOR/ MUR DE CÔTE / RACCORD
- E. BACKWALL TO CONNECTOR/ MUR DE FOND / RACCORD
- F. CORNER TO CONNECTOR/ COIN / RACCORD



RESIDENTIAL INSTALLATION USING SINGLE WALL CONNECTOR/ INSTALLATION RESIDENTIELLE UTILISANT UN RACCORD DE MUR SIMPLE

RACCORD VERTICAL CONNECTOR	RACCORD HORIZONTAL CONNECTOR
A. 8 IN. / 205 MM	8 IN. / 205 MM
B. 8 IN. / 205 MM	8 IN. / 205 MM
C. 6 IN. / 152 MM	6 IN. / 152 MM
D. 15-5/8 IN. / 397 MM	15-5/8 IN. / 397 MM
E. 10-1/4 IN. / 260 MM	10-1/4 IN. / 260 MM
F. 13-1/4 IN. / 337 MM	13-1/4 IN. / 337 MM

RESIDENTIAL CLOSE CLEARANCE INSTALLATION USING DOUBLE WALL CONNECTOR/ INSTALLATION RESIDENTIELLE AVEC DÉGAGEMENT MINIMAL, UTILISANT UN RACCORD DE MUR DOUBLE

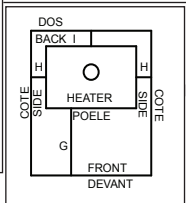
RACCORD VERTICAL CONNECTOR	RACCORD HORIZONTAL CONNECTOR
A. 8 IN. / 205 MM	8 IN. / 205 MM
B. 6 IN. / 155 MM	6 IN. / 155 MM
C. 3IN. / 76 MM	3 IN. / 76 MM
D. 15-5/8 IN. / 394 MM	15-5/8 IN. / 394 MM
E. 8-1/4 IN. / 210 MM	8-1/4 IN. / 210 MM
F. 10-1/4 IN. / 279 MM	10-1/4 IN. / 279 MM

MOBILE HOME INSTALLATION USING DOUBLE WALL CONNECTOR/ INSTALLATION EN MAISON MOBILE UTILISANT UN RACCORD DE MUR DOUBLE

A. 8 IN. / 205 MM	8 IN. / 205 MM
B. 6 IN. / 155 MM	6 IN. / 155 MM
C. 3 IN. / 76 MM	3 IN. / 76 MM
D. 15-5/8 IN. / 394 MM	15-5/8 IN. / 394 MM
E. 8-1/4 IN. / 210 MM	8-1/4 IN. / 210 MM
F. 10-1/4 IN. / 279 MM	10-1/4 IN. / 279 MM

IN CANADA	G. 18 INCHES / 457 MM
AU CANADA	H. 8 INCHES / 200 MM
	I. 8 INCHES / 200 MM

IN U.S.A.	G. 16 INCHES / 405 MM
	H. 3.5 INCHES / 89 MM
	I. 0 INCHES / 0 MM



(Type 1 floor protector - approved to UL1618)
Minimum 20GA steel

- INSTALLEZ ET UTILISEZ SELON LES INSTRUCTIONS D'INSTALLATION ET D'OPÉRATION FOURNI AVEC L'APPAREIL..
- CONTACTEZ LES OFFICIELS DE LA CONSTRUCTION OU DE SERVICE D'INCENDIE POUR DES INFORMATIONS QUANT AUX RESTRICTIONS. PERMIS D'INSTALLATION ET INSPECTIONS DANS VOTRE RÉGION.
- NE RELIEZ PAS CET APPAREIL À UN CONDUIT DE CHEMINÉE DESSERVANT DÉJÀ UN AUTRE APPAREIL.
- UTILISER UN TUYAU DE RACCORDEMENT DE 6 PO (150 MM) DIAM., HOMOLOGUÉ OU NOIR 24 MSG (MIN.)
- PEUT ÊTRE CONNECTÉ À UNE CHEMINÉE DE MAÇONNERIE GAINÉ PRÊTE À L'EMPLOI AVEC DES COMBUSTIBLES SOLIDES.
- N'OBSTRUEZ PAS L'ESPACE SOUS LE CAISSON DU POÊLE
- CONSULTEZ LE CODE LOCAL DE CONSTRUCTION ET LES INSTRUCTIONS DU FABRICANT QUANT AUX PRÉCAUTIONS À PRENDRE LORSQUE VOUS FAITES PASSER UNE CHEMINÉE À TRAVERS D'UN MUR OU D'UN PLAFOND COMPOSÉS DE MATÉRIEAUX COMBUSTIBLES.
- LE TUYAU DE RACCORDEMENT DE CHEMINÉE NE DOIT PAS TRAVERSER UN MUR OU PLAFOND EN MATÉRIEAUX COMBUSTIBLES.
- DÉGAGEMENT MINIMAL ENTRE UN RACCORDEMENT DE CHEMINÉE À SIMPLE PAROIS ET UN MUR ET TOUT MATÉRIEL COMBUSTIBLE - 18 POUCES / 455 mm. CE DÉGAGEMENT PEUT ÊTRE RÉDUIT EN UTILISANT DES PROTECTEURS DE TUYAUX CLASSÉS, PROTECTEURS DE MUR OU AUTRES MOYENS APPROUVÉS PAR LES OFFICIELS DE LA CONSTRUCTION OU DU SERVICE D'INCENDIE DE VOTRE RÉGION.
- CONNECTEUR HORIZONTAL NON PERMIS DANS MAISONS MOBILES
- PIÈCES REQUISES POUR INSTALLATION EN MAISON MOBILE OU EN ALCOÛVE: PRISE D'AIR EXTÉRIEUR ET L'UN DES RACCORDS SUIVANTS: EN COMBINAISON AVEC L'UN DES SYSTÈMES DE CHEMINÉE COMPATIBLES SUIVANTS:
CANADA-TUYAU DE RACCORDEMENT HOMOLOGUÉ ULC S-641 ET CHEMINÉE HOMOLOGUÉE ULC S-629. ÉTATS-UNIS - TUYAU DE RACCORDEMENT ET CHEMINÉE HOMOLOGUÉS UL-103HT.
- COMPOSANTS OPTIONNELS: VENTILATEUR (WODC.BLOW), ALIMENTATION ÉLECTRIQUE DU VENTILATEUR : 115 V, 60 HZ, 0.5 AMP. LE CORDON D'ALIMENTATION ÉLECTRIQUE NE DOIT PAS ÊTRE PLACÉ SOUS LE POÊLE.
- LE FIL ÉLECTRIQUE NE DOIT PAS ÊTRE PLACÉ SOUS LE POÊLE
- ATTENTION: RISQUE DE TEMPÉRATURES EXCESSIVES - GARDES LE TIROIR DE CENDRES FERMÉ PENDANT L'ALLUMAGE DU POÊLE.
- OPÉREZ SEULEMENT LORSQUE LA PORTE D'ALIMENTATION EST FERMÉE. • OUVREZ SEULEMENT POUR ALIMENTER LE FEU.
- GARDEZ LES MEUBLES ET AUTRES MATÉRIEAUX COMBUSTIBLES BIEN ÉLOIGNÉS DU POÊLE.
- REMPLACES LA VITRE AVEC UNIQUEMENT DE LA VITRE CÉRAMIQUE.
- CONNECTEUR HORIZONTAL NON PERMIS DANS MAISONS MOBILES
- ♦ TEL QUE TESTÉ: UN ISOLANT THERMIQUE POUR TUYAU PEUT ÊTRE EXIGÉ PAR LES AUTORITÉS LOCALES. * DIMENSIONS D'ALCOÛVE EN MATÉRIEAUX COMBUSTIBLES: PROFONDEUR MAX.: 3 PIEDS (0,91 M), HAUTEUR MIN.: 7 PIEDS (2,1 M), LARGEUR MIN.: 43 PO (1,09 M).
- LE PLANCHER COMBUSTIBLE DOIT ÊTRE PROTÉGÉ PAR UN MATÉRIEL NON-COMBUSTIBLE TOUT D'UNE PIÈCE QUI DOIT S'ÉTENDRE DE PAR LE DEVANT, LES CÔTÉS ET L'ARRIÈRE TEL QU'INDIQUÉ.
- POUR UTILISATION AVEC BOIS SOLIDE SEULEMENT. LE POELE CONÇU POUR BRÛLER BOIS DE CORDE SEULEMENT. LA COMBUSTION D'AUTRES MATÉRIELS PEUT.
- CET APPAREIL DE CHAUFFAGE AU BOIS DOIT FAIRE L'OBJET D'ENTRETIENS ET D'INSPECTIONS PÉRIODIQUES POUR UN FONCTIONNEMENT ADÉQUAT. CONSULTEZ LE MANUEL D'UTILISATION POUR PLUS D'INFORMATION.



MANUFACTURED BY/ FABRIQUÉ PAR:
PACIFIC ENERGY FIREPLACE PRODUCTS LTD.
2975 ALLENBY RD., DUNCAN, BC V9L 6V8

MADE IN CANADA/ FABRIQUÉ AU CANADA

U.S. ENVIRONMENTAL PROTECTION AGENCY.
Certified to comply with 2020 crib wood particulate emission standards, using test Method 28R// Certifié conforme aux normes sur les émissions de particules de 2020.

1.4 g/hr

130619

100003042

DATE OF MANUFACTURE



TN10-1

Appendix C –Equipment Calibration Records



Established 1974

QUALITY CONTROL SERVICES

LABORATORY EQUIPMENT • SALES • SERVICE • CALIBRATION • REPAIRS
2340 SE 11TH Ave. Portland, Oregon 97214 • Box 14831 Portland, Oregon 97293
(503) 236-2712 • FAX (503) 235-2535 • www.qc-services.com



Calibration Services
Certificate Number: 1550.01
Laboratory code: 115953

Dirigo Laboratories
11785 SE Hwy 212, Ste 305
Clackamas, OR 97015

Report Number: DIRI01A05026161221

A2LA ACCREDITED **CERTIFICATE OF CALIBRATION WITH DATA**

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Rice Lake	IQ+355E-2A x 1000	A05026	N/A	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	1	QC033	12/21/16	6/27/16	6/2017

FUNCTIONAL CHECKS

SHIFT TEST	LINEARITY	REPEATABILITY	ENVIRONMENTAL CONDITIONS
Test Wt: 250 Tol: 1	Test Wt: HB44 Tol: HB44	Test Wt: 100 Tol: 1	
As-Found: Pass: ☒ Fail: ☐	As-Found: Pass: ☒ Fail: ☐	As-Found: Pass: ☒ Fail: ☐	☐ ☒ ☐ Good Fair Poor
As-Left: Pass: ☒ Fail: ☐	As-Left: Pass: ☒ Fail: ☐	As-Left: Pass: ☒ Fail: ☐	Temperature: 16.9°C

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
1000	999.8	999.8	0.5
700	699.8	699.8	0.5
500	500.0	500.0	0.5
300	300.0	300.0	0.5
100	100.0	100.0	0.5
50	50.0	50.0	0.5

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Avoirdupois Cast W	Rice Lake	25 and 50lb	PWO990-CA	11/4/15	11/2017	20152112

Permanent Information Concerning this Equipment:

2000lbs platform. Has a custom pan.

Comments/Information Concerning this Calibration

Report prepared/reviewed by: N. KILMER Date: 12.21.16

Technician: N. Kilmer

Signature: [Signature]

THIS CERTIFICATE SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE APPROVAL OF QUALITY CONTROL SERVICES, INC.

The uncertainty is calculated according to the ISO Guide to the Expression of Uncertainty in Measurement and includes the uncertainty of standards used combined with the observed standard deviation of the unit under test. The uncertainty is expanded with a k factor of 2 for an approximate 95% level of confidence. Instruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy.

Member: National Conference of Standards Laboratories and Weights & Measures

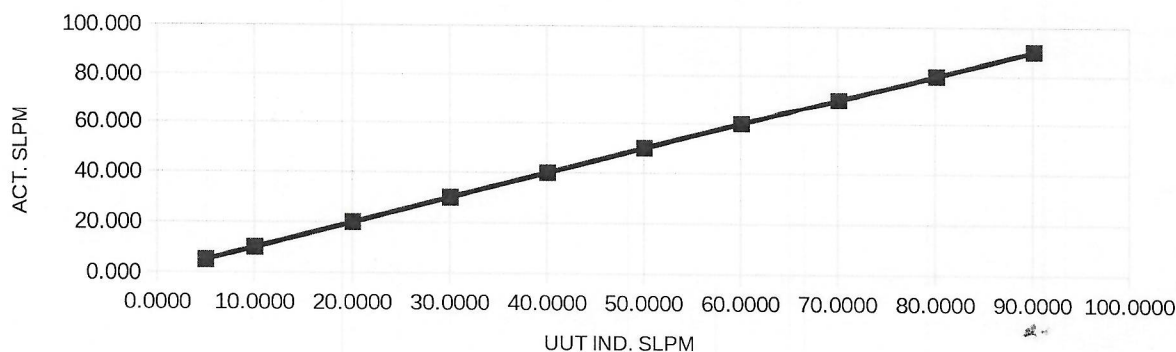
PT ID: DIRI01

CERTIFICATE OF CALIBRATION

CUSTOMER: DIRIGO LABORATORIES INC. CLACKAMAS OR
PO NUMBER: 1009
INST. MANUFACTURER: APEX
INST. DESCRIPTION: DIGITAL DGM STANDARD
MODEL NUMBER: SK25DA
SERIAL NUMBER: 1101001
RATED UNCERTAINTY: +/- .5 % RD.
UNCERTAINTY GIVEN: TOTAL measurement uncertainty: +/- .190 % RD. K=2
NOTES: AS RECEIVED/AS LEFT WITHIN SPECS. REFERENCE CONDITIONS ARE: 760 mm HGA 70 F

CALIBRATION DATE: 02/04/16
CALIBRATION DUE: 02/04/17
PROCEDURE: NAVAIR 17-20MG-02
CALIBRATION FLUID: AIR @ 14.7 PSIA 70 F
STANDARD(S) USED: A4, A24 DUE 06-2016
NIST TRACE #' S: 1331545884, 1390386562, 1424683640
AMBIENT CONDITIONS: 769 mm HGA 34 % RH 68 F
CERTIFICATE FILE #: 449362.16

TEST POINT NUMBER	UUT INDICATED	DM.STD. ACTUAL	CORRECTION	K
	SLPM	SLPM	SLPM	FACTOR
1	5.0128	5.008	0.99905	60.057
2	10.0236	9.997	0.99735	60.159
3	20.0431	20.003	0.99800	60.120
4	30.0586	30.013	0.99848	60.091
5	40.0721	40.009	0.99842	60.095
6	50.0826	49.972	0.99779	60.133
7	60.0911	59.993	0.99837	60.098
8	70.1133	70.012	0.99855	60.087
9	80.1376	80.028	0.99863	60.082
10	90.1653	89.984	0.99799	60.121
AVERAGE (Y)=			0.99826376	



All instruments used in the performance of the shown calibration have traceability to the National Institute of Standards and Technology (NIST). The uncertainty ratio between the calibration standards (DM.STD.) used and the unit under test (UUT) is a minimum of 4:1, unless otherwise noted. Calibration has been performed per the shown procedure number, in accordance with ISO 10012:2003, ISO 17025:2005, ANSI/NCSL-Z-540.3, and/or MIL-STD-45662A. Test methods: API2530-92 & ASME MFC-3M-1989.

Dick Munns Company • 10572 Calle Lee #130 • Los Alamitos, CA 90720
Phone (714) 827-1215 • Fax (714) 827-0823

This Calibration Certificate shall not be reproduced except in full, without approval by DICK MUNNS COMPANY. The data shown applies only to the instrument being calibrated and under the stated conditions of calibration.

Date:

Approved By:

Calibration Technician:

2/4/2016

[Signature]

[Signature]



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Dirigo Laboratories
11785 SE Hwy 212, Ste 305
Clackamas, OR 97015

Report Number: DIRI0128095160627

A2LA ACCREDITED **CERTIFICATE OF CALIBRATION WITH DATA**

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Balance	Sciencetech	ZSA 210	28095	N/A	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
g	0.0001	QC012	6/27/16	12/11/15	12/2016

FUNCTIONAL CHECKS

ECCENTRICITY		LINEARITY		STANDARD DEVIATION			ENVIRONMENTAL CONDITIONS
Test Wt:	Tol:	Test Wt:	Tol:	Test Wt:	Tol:		
100	0.0004	50x4	0.0003	100	0.0002		☐ ☒ ☐
As-Found:		As-Found:		1. 100.0000	5. 100.0000	9. 100.0001	Good Fair Poor
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	2. 100.0003	6. 100.0004	10. 100.0000	Temperature: 19.2°C
As-Left:		As-Left:		3. 99.9997	7. 100.0001	<u>Result</u>	
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	4. 99.9999	8. 100.0002	0.00020	

A2LA ACCREDITED SECTION OF REPORT

Standard	As-Found	As-Left	Expanded Uncertainty
200	200.0129	199.9998	0.00041
100	100.0066	99.9999	0.00041
50	50.0029	50.0000	0.00041
10	10.0003	10.0000	0.00041
1	1.0001	0.9999	0.00041
0.1	0.0995	0.1000	0.00041

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	Rice Lake	20kg to 1mg	7133	4/29/16	4/2017	20160940

Permanent Information Concerning this Equipment:

Comments/Info Concerning this Calibration:

6/16 External span adjustment completed.

Report prepared/reviewed by: M. Murray Date: 4-27-16

Technician: N. Kilmer

Signature: [Signature]

THIS CERTIFICATE SHALL NOT BE REPRODUCED WITHOUT THE APPROVAL OF QUALITY CONTROL SERVICES, INC.

The uncertainty is calculated according to the ISO Guide to the Expression of Uncertainty in Measurement and includes the uncertainty of standards used combined with the observed standard deviation and readability of the unit under test. The uncertainty is expanded with a k factor of 2 for an approximate 95% level of confidence. Instruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy. Calibrations comply with ISO/IEC 17025 and ANSI/Z540-1-1994 quality standards.

Member: National Conference of Standards Laboratories and Weights & Measures



Established 1974

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Calibration Services
Certificate Number: 1550.01
Laboratory code: 115953

Dirigo Laboratories
11785 SE Hwy 212, Ste 305
Clackamas, OR 97015

Report Number: DIRI0182484A0912013i161221

A2LA ACCREDITED **CERTIFICATE OF CALIBRATION WITH DATA**

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Digiweigh	DWP12i 400x.01	82484A0912013i	N/A	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	0.01	QC033	12/21/16	6/27/16	6/2017

FUNCTIONAL CHECKS

SHIFT TEST		LINEARITY		REPEATABILITY		ENVIRONMENTAL CONDITIONS
Test Wt:	Tol:	Test Wt:	Tol:	Test Wt:	Tol:	
50	0.05	HB44	HB44	50	0.01	
As-Found:		As-Found:		As-Found:		
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	
As-Left:		As-Left:		As-Left:		☐ ☒ ☐ Good Fair Poor Temperature: 16.7°C
Pass: ☐	Fail: ☒	Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
400	400.04	400.04	0.058
300	300.03	300.03	0.058
200	200.02	200.02	0.058
100	100.00	100.00	0.012
50	50.00	50.00	0.012
20	20.00	20.00	0.012

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Avoirdupois Cast W	Rice Lake	25 and 50lb	PWO990-CA	11/4/15	11/2017	20152112

Permanent Information Concerning this Equipment:

Comments/Information Concerning this Calibration

Report prepared/reviewed by: N. KILMER Date: 12.21.16

Technician: N. Kilmer

Signature: [Signature]

THIS CERTIFICATE SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE APPROVAL OF QUALITY CONTROL SERVICES, INC.

The uncertainty is calculated according to the ISO Guide to the Expression of Uncertainty in Measurement and includes the uncertainty of standards used combined with the observed standard deviation of the unit under test. The uncertainty is expanded with a k factor of 2 for an approximate 95% level of confidence. Instruments listed above were calibrated using standards traceable to the National Institute of Standards and Technology (NIST). Calibration data reflect results at the time and location of calibration. Calibration data should be reviewed to insure that the instrument is performing to its required accuracy.

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PT ID: DIRI01



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Dirigo Laboratories
11785 SE Hwy 212, Ste 305
Clackamas, OR 97015

Report Number: DIRI0182484A0912013i161221

A2LA ACCREDITED **CERTIFICATE OF CALIBRATION WITH DATA**

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Digiweigh	DWP12i 400x.01	82484A0912013i	N/A	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	0.01	QC033	12/21/16	6/27/16	6/2017

FUNCTIONAL CHECKS

SHIFT TEST	LINEARITY	REPEATABILITY	ENVIRONMENTAL CONDITIONS
Test Wt: 50 Tol: 0.05	Test Wt: HB44 Tol: HB44	Test Wt: 50 Tol: 0.01	
As-Found: Pass: ☒ Fail: ☐	As-Found: Pass: ☒ Fail: ☐	As-Found: Pass: ☒ Fail: ☐	☐ ☒ ☐ Good Fair Poor
As-Left: Pass: ☐ Fail: ☒	As-Left: Pass: ☒ Fail: ☐	As-Left: Pass: ☒ Fail: ☐	Temperature: 16.7°C

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
400	400.04	400.04	0.058
300	300.03	300.03	0.058
200	200.02	200.02	0.058
100	100.00	100.00	0.012
50	50.00	50.00	0.012
20	20.00	20.00	0.012



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Report of Calibration

Firm: Dirigo Laboratories
Address: 11785 SE Hwy 212, Ste 305
City/State/Zip: Clackamas, OR 97015

Test Completed: 01/15/16
Purchase Order: 1001
Traceable Number: 20152489

Test Item: 20lb and 10lb Individual Grip Handle Weights
Serial No.: Listed in Table

Manufacturer: Unknown

<u>Material</u>	<u>Assumed Density</u>	<u>Range</u>	<u>Tolerance Class</u>
Cast Iron	7.2 g/cm ³	20lb to 10lb	NIST HB 105-1 (F)

Method and Traceability

The procedure used for this calibration is NIST IR 6969 SOP 7 Single Substitution Weighing Design. Standards used for comparison are traceable to the National Institute of Standards and Technology (reports on file) and are part of a comprehensive measurement assurance program for ensuring continued accuracy and traceability within the level of uncertainty reported. The Traceable Number listed above is Traceable to National Standards through an unbroken chain of comparison each having stated uncertainties.

Standards Used:

Avoirdupois Working Standards were calibrated: 06/18/2014 Due: 06/18/2016 Standards ID: 34AA
Mass Comparators Used: MET-09, 20 Tested by: D. Thompson

Conventional Mass: "The conventional value of the result of weighing a body in air is equal to the mass of a standard, of conventionally chosen density, at a conventionally chosen temperature, which balances this body at this reference temperature in air of conventionally chosen density. International Recommendation 33 (OIML IR 33 1973, 1979). "Conventional Value of the Result of Weighing in Air" (Previously known as "Apparent Mass vs. 8.0g/cm³).

Uncertainty Statement: The uncertainty conforms to the ISO Guide to the Expressions of Uncertainty in Measurement. Uncertainty as reported is based on a coverage factor K=2 for an approximate 95 percent level of uncertainty. Uncertainty components include the standard deviation of the process, the uncertainty of the standard used, an uncertainty component associated with the potential drift of the standard used, and the estimated uncertainty related to measuring and determining the air buoyancy effect.

Conventional Mass Values are listed on page 2 of this report.

page 1 of 2

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 01/15/16

Signature  David S. Thompson

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Report of Calibration

Firm: Dirigo Laboratories
Address: 11785 SE Hwy 212, Ste 305
City/State/Zip: Clackamas, OR 97015

Test Completed: 01/15/16
Purchase Order: 1001
Traceable Number: 20152489

Test Item: 20lb and 10lb Individual Grip Handle Weights
Serial No.: Listed in Table

Manufacturer: Unknown

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
21.448	760.64	44.58

Conventional Mass Value

Nominal Value	As Found pounds	As Found Correction* (mg)	Uncertainty (mg)	Tolerance (mg)
20lb #098	19.9995450	-206.4	6.4	910
10lb #097	10.0006510	295.3	5.1	450
10lb #051	10.0003421	155.2	5.1	450

*Correction is the difference between the conventional mass value of a weight and its nominal value.

Comments: These weights were received in good condition and were within NIST Handbook 105-1 Class F tolerances As Found. No adjustments or changes were made so As Found values should be considered to be As Left values.

Accredited by the American Association for Laboratory Accreditation (A2LA) under Calibration Laboratory Code 115953 and Certificate Number 1550.01. This laboratory meets the requirements of ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration.

page 2 of 2

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 01/15/16


Signature David S. Thompson



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Report of Calibration

Firm: PFS Teco
Address: 11785 SE Hwy 212, Ste 305
City/State/Zip: Clackamas, OR 97015

Test Completed: 08/27/18
Submitted By: John Steinert
Traceable Number: 20181772

Test Item: 5 lb Individual Grip Handle Weight
Serial No.: 10744

Manufacturer: Rice Lake

<u>Material</u>	<u>Assumed Density</u>	<u>Range</u>	<u>Tolerance Class</u>
Cast Iron	7.2 g/cm ³	5 lb	ASTM Class 7

Method and Traceability

The procedure used for this calibration is NIST IR 6969 SOP 7 Single Substitution Weighing Design. Standards used for comparison are traceable to the National Institute of Standards and Technology (reports on file) and are part of a comprehensive measurement assurance program for ensuring continued accuracy and traceability within the level of uncertainty reported. The Traceable Number listed above is Traceable to National Standards through an unbroken chain of comparison each having stated uncertainties.

Standards Used:

20 kg to 200 g Working Standards Were Calibrated: 03/22/18 Due: 03/31/19 Standards ID: 75388
100 g to 1 mg Working Standards Were Calibrated: 04/04/18 Due: 04/30/19 Standards ID: 723318

Mass Comparators Used: MET-08

Tested by: D. Thompson

Conventional Mass: “The conventional value of the result of weighing a body in air is equal to the mass of a standard, of conventionally chosen density, at a conventionally chosen temperature, which balances this body at this reference temperature in air of conventionally chosen density. International Recommendation 33 (OIML IR 33 1973, 1979). “Conventional Value of the Result of Weighing in Air” (Previously known as “Apparent Mass vs. 8.0 g/cm³).

Uncertainty Statement: The uncertainty conforms to the ISO Guide to the Expressions of Uncertainty in Measurement. Uncertainty as reported is based on a coverage factor k=2 for an approximate 95 percent level of uncertainty. Uncertainty components include the standard deviation of the process, the uncertainty of the standard used, an uncertainty component associated with the potential drift of the standard used, and the estimated uncertainty related to measuring and determining the air buoyancy effect.

Conventional Mass Values are listed on page 2 of this report.

page 1 of 2

Quality Control Services, Inc.
Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 08/28/18


Signature David S. Thompson

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Report of Calibration

Firm: PFS Teco
Address: 11785 SE Hwy 212, Ste 305
City/State/Zip: Clackamas, OR 97015

Test Completed: 08/27/18
Submitted By: John Steinert
Traceable Number: 20181772

Test Item: 5 lb Individual Grip Handle Weight
Serial No.: 10744

Manufacturer: Rice Lake

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
21.838	762.06	52.23

Conventional Mass Value

Nominal Value	As Found pounds	As Found Correction* (mg)	Uncertainty (mg)	Tolerance (mg)
5 lb	5.0006085	276.0	2.0	760

*Correction is the difference between the conventional mass value of a weight and its nominal value.

Comments: This weight was new from the manufacturer and was within ASTM Class 7 tolerances As Found. No adjustments or changes were made so As Found values should be considered to be As Left values.

Accredited by the American Association for Laboratory Accreditation (A2LA) under Calibration Laboratory Code 115953 and Certificate Number 1550.01. This laboratory meets the requirements of ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration.

page 2 of 2

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Metrology Laboratory Manager
E-mail dthompson@qc-services.com

Date: 08/28/18

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EPA Method 5 Dry Gas Meter Calibration for γ and $\Delta H@$

Manufacturer / Model: XC-60-ED
ID: Box-A
Serial Number: 1902130
Equipment No.: Dirigo 053
Calibration Date: 9/7/2016
Next Calibration Due: 3/7/2017
Barometric Pressure: 30.15 inHg
Signature/Date: [Signature] 9/7/16

Average DGM γ factor =

1.007

Average Meter Orifice $\Delta H@$ =

58.571

	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	153.398	157.354	153.013
Standard Ave. Meter Temperature ($^{\circ}$ F), (Tstd)	76.1	77.3	78.3
DGM Initial Volume (cuft)	0.000	0.000	0.000
DGM Final Volume (cuft)	5.433	5.674	5.594
DGM Average Temperature ($^{\circ}$ F), (T _{DGM})	89.0	96.2	100.7
Time (min)	35.0	40.0	45.0
Orifice ΔH ("H ₂ O)	2.49	2.03	1.53
Vacuum ("H ₂ O)	0.00	0.00	0.00
Total Volume for Standard DGM (Vstd) (cuft)	5.417	5.557	5.404
Total Volume for DGM (V _{DGM}) (cuft)	5.433	5.674	5.594

Dry Gas Meter γ Factor	1.013	1.007	1.001
γ Factor Deviation From Average	0.006	0.000	0.006
Meter Orifice $\Delta H@$	58.489	58.554	58.670
Orifice $\Delta H@$ Deviation From Average	0.082	0.017	0.099

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = (V_{std} \times (Std \gamma \text{ factor}) \times (P_{bar}) \times (T_{DGM} + 460)) / (V_{DGM} \times (T_{std} + 460) \times (P_{bar} + (dH / 13.6)))$
- $\Delta H@ = 0.0319 \times \Delta H (((T_{DGM} + 460) \times (Time^2)) / (P_{bar} \times (\gamma \text{ factor}^2) \times (V_{DGM}^2)))$

Measurement of uncertainty = +/- 0.14 cfm

Standard Meter Data

Date	2/4/2016
γ Factor	0.998
Model	SK25DA
Serial Number	1101001

Pre-Calibration Data

Date	3/8/2016
γ Factor	1.002
$\Delta H@$	58.685
Tolerance (5%)	0.050
Deviation	0.005

Pass

DGM Calibration Data

γ Deviation Tolerance	0.020
Maximum γ Deviation	0.006
$\Delta H@$ Deviation Tolerance	0.200
Maximum $\Delta H@$ Deviation	0.099

Pass



EPA Method 5 Dry Gas Meter Calibration for γ and $\Delta H@$

Manufacturer / Model: XC-60-ED
ID: Box B
Serial Number: 1902133
Equipment No.: Dirigo 054
Calibration Date: 9/7/2016
Next Calibration Due: 3/7/2017
Barometric Pressure: 30.15 inHg
Signature/Date: *Ben Abel* 9/8/16

Average DGM γ factor =

1.002

Average Meter Orifice $\Delta H@$ =

59.911

	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	151.554	154.122	150.749
Standard Ave. Meter Temperature (°F), (Tstd)	79.0	75.2	80.0
DGM Initial Volume (cuft)	0.000	0.000	0.000
DGM Final Volume (cuft)	5.464	5.587	5.505
DGM Average Temperature (°F), (T _{DGM})	97.7	93.6	101.6
Time (min)	35.0	40.0	45.0
Orifice ΔH ("H ₂ O)	2.50	2.00	1.51
Vacuum ("H ₂ O)	0.00	0.00	0.00
Total Volume for Standard DGM (Vstd) (cuft)	5.352	5.443	5.324
Total Volume for DGM (V _{DGM}) (cuft)	5.464	5.587	5.505

Dry Gas Meter γ Factor	1.005	1.001	1.000
γ Factor Deviation From Average	0.003	0.001	0.002
Meter Orifice $\Delta H@$	59.869	59.935	59.930
Orifice $\Delta H@$ Deviation From Average	0.043	0.024	0.019

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = (V_{std} \times (Std \gamma \text{ factor}) \times (P_{bar}) \times (T_{DGM} + 460)) / (V_{DGM} \times (T_{std} + 460) \times (P_{bar} + (dH / 13.6)))$
- $\Delta H@ = 0.0319 \times \Delta H (((T_{DGM} + 460) \times (Time^2)) / (P_{bar} \times (\gamma \text{ factor}^2) \times (V_{DGM}^2)))$

Standard Meter Data

Date	2/4/2016
γ Factor	0.998
Model	SK25DA
Serial Number	1101001

Pre-Calibration Data

Date	3/8/2016
γ Factor	1.001
$\Delta H@$	59.917
Tolerance (5%)	0.050
Deviation	0.001

Pass

DGM Calibration Data

γ Deviation Tolerance	0.020
Maximum γ Deviation	0.003
$\Delta H@$ Deviation Tolerance	0.200
Maximum $\Delta H@$ Deviation	0.043

Pass

Measurement of uncertainty = +/- 0.14 cfm



EPA Method 5 Dry Gas Meter Calibration for γ and $\Delta H@$

Manufacturer / Model: Apex-AK-600
ID: Ambient Box
Serial Number: 810016
Equipment No.: Dirigo 055
Calibration Date: 8/5/2016
Next Calibration Due: 2/5/2017
Barometric Pressure: 29.92 inHg
Signature/Date: *[Signature]* 8/5/16

Average DGM γ factor =

1.003

Average Meter Orifice $\Delta H@$ =

32.449

	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	179.160	160.699	149.637
Standard Ave. Meter Temperature (°F), (Tstd)	77.0	78.0	78.5
DGM Initial Volume (cuft)	0.000	0.000	0.000
DGM Final Volume (cuft)	6.354	5.658	5.231
DGM Average Temperature (°F), (T _{DGM})	80.0	81.0	83.5
Time (min)	30.0	30.0	33.0
Orifice ΔH ("H ₂ O)	2.50	2.00	1.45
Vacuum ("H ₂ O)	0.00	0.00	0.00
Total Volume for Standard DGM (Vstd) (cuft)	6.327	5.675	5.284
Total Volume for DGM (V _{DGM}) (cuft)	6.354	5.658	5.231

Dry Gas Meter γ Factor	0.993	1.002	1.014
γ Factor Deviation From Average	0.010	0.001	0.011
Meter Orifice $\Delta H@$	32.516	32.315	32.517
Orifice $\Delta H@$ Deviation From Average	0.067	0.135	0.067

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = (V_{std} \times (Std \gamma \text{ factor}) \times (P_{bar} \times (T_{DGM} + 460)) / (V_{DGM} \times (T_{std} + 460) \times (P_{bar} + (dH / 13.6))))$
- $\Delta H@ = 0.0319 \times \Delta H (((T_{DGM} + 460) \times (Time^2)) / (P_{bar} \times (\gamma \text{ factor}^2) \times (V_{DGM}^2)))$

Measurement of uncertainty = +/- 0.14 cfm

Standard Meter Data

Date	2/4/2016
γ Factor	0.998
Model	SK25DA
Serial Number	1101001

Pre-Calibration Data

Date	1/9/2016
γ Factor	0.999
$\Delta H@$	30.755
Tolerance (5%)	0.050
Deviation	0.004

Pass

DGM Calibration Data

γ Deviation Tolerance	0.020
Maximum γ Deviation	0.011
$\Delta H@$ Deviation Tolerance	0.200
Maximum $\Delta H@$ Deviation	0.135

Pass



Praxair
5700 South Alameda Street
Los Angeles, CA 90058
Tel: (323) 585-2154 Fax: (714) 542-6689
PGVPID: F22016

DocNumber: 000091012

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information:

PRAXAIR WHSE VANCOUVER WA
603 SE VICTORY AVE
VANCOUVER WA 986610

Praxair Order Number: 33855113
Customer P. O. Number: 05949702
Customer Reference Number:

Fill Date: 2/25/2016
Part Number: NI CD10CO33E-AS
Lot Number: 109605601
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure & Volume: 2000 psig 140 cu. ft.

Certified Concentration:

Expiration Date:	3/1/2024	NIST Traceable
Cylinder Number:	CC199294	Analytical Uncertainty:
9.91 %	CARBON DIOXIDE	± 0.5 %
2.51 %	CARBON MONOXIDE	± 0.8 %
10.50 %	OXYGEN	± 0.4 %
Balance	NITROGEN	

Certification Information: Certification Date: 3/1/2016 Term: 96 Months Expiration Date: 3/1/2024

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Do Not Use this Standard if Pressure is less than 100 PSIG.

O2 responses have been corrected for CO2 interference.

Analytical Data: (R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component: CARBON DIOXIDE

Requested Concentration: 10 %
Certified Concentration: 9.91 %
Instrument Used: Horiba VIA-510 S/N 20C194WK
Analytical Method: NDIR
Last Multipoint Calibration: 2/26/2016

Reference Standard Type: GMIS
Ref. Std. Cylinder #: SA17695
Ref. Std. Conc: 9.87%
Ref. Std. Traceable to SRM #: 1674b
SRM Sample #: 7-H-07
SRM Cylinder #: FF10631

First Analysis Data:		Date:	3/1/2016
Z: 0	R: 9.87	C: 9.91	Conc: 9.91
R: 9.87	Z: 0	C: 9.91	Conc: 9.91
Z: 0	C: 9.92	R: 9.87	Conc: 9.92
UOM: %	Mean Test Assay: 9.913 %		

Second Analysis Data:		Date:	
Z: 0	R: 0	C: 0	Conc: 0
R: 0	Z: 0	C: 0	Conc: 0
Z: 0	C: 0	R: 0	Conc: 0
UOM: %	Mean Test Assay: 0 %		

2. Component: CARBON MONOXIDE

Requested Concentration: 2.5 %
Certified Concentration: 2.51 %
Instrument Used: Horiba VIA-510 S/N UB9UCSYX
Analytical Method: NDIR
Last Multipoint Calibration: 2/26/2016

Reference Standard Type: GMIS
Ref. Std. Cylinder #: CC103175
Ref. Std. Conc: 2.017%
Ref. Std. Traceable to SRM #: 2640a
SRM Sample #: 53-C-38
SRM Cylinder #: CAL013925

First Analysis Data:		Date:	3/1/2016
Z: 0	R: 2.01	C: 2.5	Conc: 2.5
R: 2.02	Z: 0	C: 2.51	Conc: 2.51
Z: 0	C: 2.51	R: 2.02	Conc: 2.51
UOM: %	Mean Test Assay: 2.507 %		

Second Analysis Data:		Date:	
Z: 0	R: 0	C: 0	Conc: 0
R: 0	Z: 0	C: 0	Conc: 0
Z: 0	C: 0	R: 0	Conc: 0
UOM: %	Mean Test Assay: 0 %		

DocNumber: 000091012

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3. Component: OXYGEN

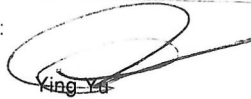
Requested Concentration: 10.5 %
 Certified Concentration: 10.50 %
 Instrument Used: OXYMAT 5E
 Analytical Method: PARAMAGNETIC
 Last Multipoint Calibration: 2/26/2016

Reference Standard Type: GMIS
 Ref. Std. Cylinder #: CC243259
 Ref. Std. Conc: 20.03%
 Ref. Std. Traceable to SRM #: 2659a
 SRM Sample #: 71-E-19
 SRM Cylinder #: FF22331

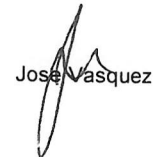
First Analysis Data:				Date:	3/1/2016
Z:	0	R:	20.04	C:	10.51
R:	20.04	Z:	0	C:	10.51
Z:	0	C:	10.51	R:	20.06
UOM: %				Mean Test Assay:	10.501 %

Second Analysis Data:				Date:	
Z:	0	R:	0	C:	0
R:	0	Z:	0	C:	0
Z:	0	C:	0	R:	0
UOM: %				Mean Test Assay:	0 %

Analyzed by:


 King Yd

Certified by:


 Jose Vasquez

**Praxair**

5700 South Alameda Street
Los Angeles, CA 90058
Tel: (323) 585-2154 Fax: (714) 542-6689
PGVPID: F22015

DocNumber: 000085245

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS**Customer & Order Information:**

PRAXAIR WHSE VANCOUVER WA
603 SE VICTORY AVE
VANCOUVER WA 986610

Praxair Order Number: 32589283
Customer P. O. Number: 05749997
Customer Reference Number:

Fill Date: 10/5/2015
Part Number: NI CD17CO8E-AS
Lot Number: 109527801
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure & Volume: 1290 psig 99 cu. ft.

Certified Concentration:

Expiration Date:	10/9/2023	NIST Traceable
Cylinder Number:	CC246162	Analytical Uncertainty:
16.76 %	CARBON DIOXIDE	± 0.2 %
4.26 %	CARBON MONOXIDE	± 0.4 %
17.04 %	OXYGEN	± 0.2 %
Balance	NITROGEN	

Certification Information: Certification Date: 10/9/2015 Term: 96 Months Expiration Date: 10/9/2023

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Do Not Use this Standard if Pressure is less than 100 PSIG.

O2 responses have been corrected for CO2 interference.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component: CARBON DIOXIDE

Requested Concentration: 17 %
Certified Concentration: 16.76 %
Instrument Used: Horiba VIA-510 S/N 2807014
Analytical Method: NDIR
Last Multipoint Calibration: 9/10/2015

First Analysis Data:		Date: 10/9/2015	
Z: 0	R: 19.75	C: 16.71	Conc: 16.738
R: 19.75	Z: 0	C: 16.73	Conc: 16.758
Z: 0	C: 16.75	R: 19.77	Conc: 16.778
UOM: %	Mean Test Assay:		16.758 %

Reference Standard Type: GMIS
Ref. Std. Cylinder #: CC158146
Ref. Std. Conc: 19.79%
Ref. Std. Traceable to SRM #: 2745
SRM Sample #: 9-C-36
SRM Cylinder #: CAL016135

Second Analysis Data:		Date:	
Z: 0	R: 0	C: 0	Conc: 0
R: 0	Z: 0	C: 0	Conc: 0
Z: 0	C: 0	R: 0	Conc: 0
UOM: %	Mean Test Assay:		0 %

2. Component: CARBON MONOXIDE

Requested Concentration: 4.25 %
Certified Concentration: 4.26 %
Instrument Used: Horiba VIA-510 S/N UB9UCSYX
Analytical Method: NDIR
Last Multipoint Calibration: 10/5/2015

First Analysis Data:		Date: 10/9/2015	
Z: 0	R: 3.95	C: 4.26	Conc: 4.264
R: 3.96	Z: 0	C: 4.27	Conc: 4.274
Z: 0	C: 4.25	R: 3.96	Conc: 4.254
UOM: %	Mean Test Assay:		4.264 %

Reference Standard Type: GMIS
Ref. Std. Cylinder #: CC257812
Ref. Std. Conc: 3.96%
Ref. Std. Traceable to SRM #: 2641a
SRM Sample #: 59-C-02
SRM Cylinder #: FF13690

Second Analysis Data:		Date:	
Z: 0	R: 0	C: 0	Conc: 0
R: 0	Z: 0	C: 0	Conc: 0
Z: 0	C: 0	R: 0	Conc: 0
UOM: %	Mean Test Assay:		0 %

DocNumber: 000085245

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Requested Concentration: 17 %
Certified Concentration: 17.04 %
Instrument Used: OXYMAT 5E
Analytical Method: PARAMAGNETIC
Last Multipoint Calibration: 10/8/2015

First Analysis Data: Date: 10/9/2015

Z: 0 R: 20.04 C: 17.05 Conc: 17.036
R: 20.04 Z: 0 C: 17.05 Conc: 17.036
Z: 0 C: 17.05 R: 20.06 Conc: 17.036
UOM: % Mean Test Assay: 17.036 %

Analyzed by:

Jacquelyne Fiero

Reference Standard Type: GMIS
Ref. Std. Cylinder #: CC243259
Ref. Std. Conc: 20.03%
Ref. Std. Traceable to SRM #: 2659a
SRM Sample #: 71-E-19
SRM Cylinder #: FF22331

Second Analysis Data: Date:

Z: 0 R: 0 C: 0 Conc: 0
R: 0 Z: 0 C: 0 Conc: 0
Z: 0 C: 0 R: 0 Conc: 0
UOM: % Mean Test Assay: 0 %

Certified by:

Jack Fu